WATER DISTRIBUTION SYSTEM
BETWEEN OFF-POST SUPPLY WELLS AND DISTRIBUTION POINTS
FORMER FIRE TRAINING AREA AT MARSHALL ARMY AIRFIELD

FORT RILEY, KANSAS

FINAL REVISED SYSTEM DESIGN AND SCOPE OF WORK
MAY 2002

CONTRACT NO. DACW41-95-D-0022

Prepared By

Bay West, Inc.

10620 Widmer Rd.
Lenexa, KS 66215

J970236

FFTA_3_1_001

Bay West

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United States Army Corps of Engineers
Kansas City District
ATTN: CENWK-PM-ED/Mr. Rick Van Saun
601 East 12th Street
Kansas City, MO 64105-2896

May 30, 2002

RE: Redesign Submittal for Contract No. DACW41-95-D-0022, Delivery Order No. 0012. "Water Distribution and Well Installation, Off-Post Near the Former Fire Training Area, Marshall Army Airfield, Ft. Riley, Kansas" and Response to Review Comments.

Dear Mr. Van Saun:

Please find enclosed our responses to USACE review comments on the above referenced project. The 13 copies of the Final Design submitted have been distributed per the approved Document Distribution List. If you require any additional information or have questions regarding this submittal please call me at (913) 663-2915.

Sincerely

Philip C Dula

Philip Dula P.G., CHMM
Kansas City Office Manager

Enclosures:
Responses to Comments

Cc:
Dick Shields/Ft. Riley
Allan Gerth/Ft. Riley
Craig Bernstein/EPA Region VII
Rob Weber/KDHE

Comments received from Ft Riley

<u>Scope of Work</u>

Comment 1: ***Objective,*** The stated objective indicates that two off-post water supply wells will be installed, however, there is no discussion of the procedures necessary to complete installation of the M-1 Replacement Well in the *Description of Work* section, only plugging and abandonment of the existing M-1 well is discussed. Please clarify and/or modify to address M-1.

Response: A discussion pertaining to the planned scope of work with respect to Replacement Well M-1 has been added to the Description of Work as requested and is included as Section 3.9.

Comment 2*:* ***Description of Work, Section 3.3,*** This section mentions the re-designed distribution system will provide water service to the old house structure; it may be useful to indicate that the old house structure was identified as a concession stand [one of three: old house, pit area, and grandstand area] per Mr. Thompson during the December 17, 2001 site visit.

Response: A statement has been added to Section 3.3 as requested providing an explanation as why the old house structure has been added as an additional concession area.

Comment 3: ***Section 3.4,*** In this section, the casing is incorrectly identified as "casting".

Response: The spelling error/typo has been corrected as requested.

Comment 4: This section includes brief mention of equipment removal from well R-4, however, it may be useful to expand the discussion regarding decontamination and disposal procedures for the removed casing and any liquid derived waste.

Response: Bay West's procedure for decontamination of well casings and equipment located in the area of concern/contaminant plume has been added to the text. In addition disposal procedures have been added as well. It is planned to wash the pulled casings and well equipment in a non-phosphate detergent and to triple rinse the pulled well equipment. All decontamination fluids will be containerized and placed in a 55-gallon drums. The drums will be labeled per USACE and EPA requirements. A sample will be collected from the collected decontamination fluids and submitted for VOC analysis. Disposal requirements will be based on analytical results per EPA Method 8260. It is planned to transport the decontamination fluids to the Ft. Riley Environmental Waste Management Center with the casings and well pumps from wells R-1 and R-2.

Comment 5: ***Section 3.6,*** Discussion of the new standpipe is included, however, the section does not mention the utilization of the standpipe as a water truck station nor the location change from the existing station (from the western portion of track to the eastern portion) as identified on the *Site Plan* figure.

Response: The text has been revised to indicate that the existing water truck fill station located at the western end of the racetrack will be removed and a new water truck fill station located 310 feet east of the Pit Area Concession Stand and Restroom buildings will be constructed.

Comment 6: ***Section 3.8,*** This section states that a shelter will be provided, however, there is no further discussion of the shelter nor any detail in the technical drawings and specifications.

Response: Additional text has been added to indicate the general dimensions of the shed. The shed will be a Marco Series Baron Storage Building. Building specifications are included in Appendix 4 and are referenced in Drawing C-3.1 Site Plan.

Comment 7: Indication that the 525-gallon capacity pressure tank will be "newly" installed should be included to avoid confusion with the hydro-pneumatic tank identified as existing on the *Existing Conditions* figure.

Response: The text has been changed to indicate that this is a new tank. It is planned to use a 528-gallon hydro pneumatic tank manufactured by the John Wood Company. The dimensions of this tank are consistent with the cubic feet of storage space of the selected shed. The specifications of the hydro pneumatic tank have been included in Appendix 4 and are included in drawing C-3.1.

Comment 8: ***Section 5 - Project Management,*** The point-of-contact information should be revised. Richard Shields and Oral Saulters are the POCs for the Fort Riley Directorate of Environment and Safety.

Response: The point of contact information for Ft. Riley personnel have been revised as requested.

Comment 9*: Section 6 – Report,* This section indicates that the project completion report will be submitted in twelve (12) copies for the Draft and seventeen (17) for the Final. The number of copies planned for submittal does not match the number identified in Section 4 *Document Distribution* [nine (9) and thirteen (13)], please clarify.

Response: The number of copies per submittal have been revised in the text to be consistent with those stated in the revised scope of work. A total of 9 drafts and 13 final copies will be submitted to the individuals listed in Section 4 of the Scope of Work.

Comment 10: This section does not identify the submittal of a Work plan as identified in section 1.3.2.1 of the Specifications (Section 02521 *Water Well Construction*).

Response: Section 6 has been added to the Scope of Work to address the project requirements for a project Work Plan and Health and Safety Plan. This is consistent with the Work Plan requirements stated in Specifications Section 02521.

Plans and Detail Drawings

Comment 11: The *Existing Conditions* figure (C-1.1) does not identify the following: 1) Well R-4 on the figure, 2) two of the three concession stands (old house structure nor pit area, only the grandstand concession stand is included), 3) the pipelines from well R-1 to the grandstand concession stand and the pipelines from R-1 to the pit area tank.

Response: Drawing C-1.1 has been revised to include 1) Well R-4 the three concession stands (old house structure, pit area, and the grandstand concession stand., 3). Per discussion with the property owner there are no as-built drawings for the racetrack and therefore actual existing subsurface locations of existing water lines or septic tanks and associated lines can not be determined. These lines therefore can not be accurately shown on the drawings.

Comment 12: The *Site Plan* figure (C-3.1) does not include the pipeline from the pit area tank to the grandstand concession stand.

Response: See response to comment 11.

Comment 13: The *Details* technical drawing (C-6.1) does not include any specifications/details for the new tank nor the shelter.

Response: See response to comments 6 and 7.

Comment 14: The *Details* technical drawing (C-6.1) does not include the diameter for either of the replacement wells (specified to be 5-inch inside diameter for M-1 Replacement and 8-inch inside diameter for the Racetrack Replacement) as identified in section 1.3.9.2 *Well Design* (Section 02521 *Water Well Construction*) of the specifications (page 02521-5).

Response: The replacement well inside diameters have been added to Drawing C-6.1. The Racetrack replacement well is specified to utilize a 8-inch inside diameter casing. The M-1 Replacement well is specified to utilize a 5-inch inside diameter casing.

Specifications

Comment 15: Section 01330 *Submittal Procedures*, section 3.5.1 *Procedures* (page 01330-3) indicates that five (5) copies of all submittals shall be submitted for approval.

This does not agree with the number of copies identified in sections 4 *Document Distribution* and 6 *Report* (see comment 9 above).

Response: See response to Comment 9.

Comment 16: Section 02510 *Water Supply Systems*, section 1.3 *Related Equipment*, "related" is misspelled (page 02510-3).

Response: The misspelling has been corrected.

Comment 17: Section 02521 *Water Well Construction*, section 3.9 *Abandonment and Plugging of the Existing Well* (page 02521-11), only three well are identified for plugging and abandonment procedures (M-1, R-1, and R-2), however, procedures for R-3 and R-4 should be incorporated.

Response: Wells R-3 and R-4 are additional wells requiring removal and plugging. These wells were inadvertently overlooked in the description on the referenced page. Wells R-3 and R-4 have been included in the narrative as requested.

Review comments received from USACE KC District/ Dan Wilson EIT

Comment 1: ***Scope of Work, section 3.1:*** Has a hydrogeologic or geologic drilling been done yet?

Response: Test wells have not been completed in support of this project. Pilot holes will be drilled prior to well completion as specified in the Scope of Work. The USACE has based the in-house design on well data from existing site wells and monitoring wells. Several residential wells are located within a one mile radius of the site that indicate that the shallow aquifer will provide an adequate water supply. Discussions with Mike Houck, Director of Environmental Services for Rural Region Local Environmental Protection problem indicated that the shallow aquifer will provide an adequate water supply.

Comment 2: ***Scope of Work, general:*** Have the water rights for the new wells been obtained and the decommissioning papers for the old wells been done by Kansas Water Office?

Response: Well permits and decommissioning approvals will not be obtained from KDHE and Geary County, Kansas Rural Lakes Region until a written Notice to proceed is received from the USACE per the approved contractor cost estimate. Acquisition of required permits will be included as a task in the cost estimate. It is premature at this point to obtain these permits.

Comment 3: ***Site Plan, C 8.1*****:** Need detail on how and where tie in of machine shop will happen.

Response: This project is a construction design project and some components can not be accurately determined until construction activities commence. Bay West's cost estimate will be based on tying into the existing system. Access to the Machine Shop was not possible during Bay West's site visits to the site in an effort to obtain more accurate information.

Comment 4: ***Site Plan, C 8.1*****:** How is water getting to the concession stand north of the track? (Grandstand Area Concession Stand)

Response: Per discussion with the property owner there are no as-built drawings for the racetrack and therefore actual existing subsurface locations of existing water lines or septic tanks and associated lines can not be determined. These lines therefore can not be accurately shown on the drawings. Per discussion with the property owner and from site observations once the new system line is tied into the vault located at the Pit Area Concession Stand this connection will provide service to the line that supplies water to the concession stand north of the track.

Comment 5: ***Site Plan, C 8.1:*** How is water getting to the farmhouse that well R-4 is presently feeding?

Response: There is an existing water line from well R-4 to the old house structure (farmhouse). The new main 4" ID water line installed by Bay West from the replacement Racetrack Well will be tied into via the existing 2" line using a reducer to form the connection at the old house structure.

Comment 6: ***Site Plan, C 8.1*****:** Several notes with tags need to be repositioned to show correct location of tag.

Response: The incorrectly located tags have been correctly positioned as requested.

Comment 7: ***Site Plan, C 8.1:*** The jack under track tag should reference note 5 not note 8.

Response: Correction has been made as requested

Comment 8: ***Site Plan, C 8.1:*** All reference to PVC pipe should be removed and left to the specifications, size of pipe only should be in plans.

Response: All references to PVC pipe have been removed from the drawings.

Comment 9: ***Site Plan, C 8.1, Note 3:*** this needs to be more than just a note it needs to have a detail shown with it.

Response: A detail for the hydro pneumatic tank has been added to Drawing C-3.1 as requested. In addition tank information has been included in Appendix 4. It is planned to use a 528-gallon hydro pneumatic tank manufactured by the John Wood Company.

Comment 10: ***Site Plan, C 8.1:*** Drain back valve vault needs to have details to show exactly what is needed.

Response: A detail for the drain back valve for the water wells has been added to Drawing C-3.1.

Comment 11: ***Site Plan, C 8.1:*** Need detail of well placement and control panel proximity. Detail should also show fencing.

Response: The well control panel details have been included as an additional specification in Appendix 4 of this submittal. The subcontracted drilling company will construct the well with controls at the well per industry standards. A general spec for a Well Controls has been added to drawing C-6-1. Fencing has not been included in the design per discussion during the December 17, 2001 site walk when it was determined that fencing was not to be installed. Well protection was to consist of installing steel posts set in concrete around the well to provide protection from vehicular traffic.

Bay West has been asked to provide an option for the installation of an onsite generator with diesel fuel supply tank and spill protection to supply power to the Racetrack Replacement Well. This option will require the installation of a structure/shed to house the generator and an 6-foot high fence with locking gate to limit access to this structure. This option is included in the cost estimate. If this option is selected specifications and drawing details will be addressed as a change order to the contract.

Comment 12: ***Details, C 6.1:*** Trench detail should have a depth of 6" specified for topsoil.

Response: Top soil depth has been indicated on the drawing as requested

Comment 13: ***Details, C 6.1***: Trench detail shows impervious fill why?

Response: The design for this project was created by the USACE in September 1998. The trench detail as shown was provided in this design. Bay West can not ascertain why impervious fill was specified.

Comments 14: ***Details, C 6.1:*** Need detail of well control panel.

Response: See response to comment 11.

Comments 15: ***Details, C 6.1:*** Fencing detail is needed for going around wells and control panels.

Response: See response to comment 11.

Comments 16: ***Specifications, 02316, section 2.2:*** This section should include 12 gauge tracer wire. Tape is good for warning of digging into plastic pipe but often breaks and is sometimes hard to locate with metal detector.

Response: Text has been revised to specify the use of 12-gauge tracer wire as requested.

Comments 17: ***Specifications, general:*** Need specification section for well pumps.

Response: Specifications have been added for well pumps as requested. Specification 11212

Comment 18: ***Specifications, general:*** Need specification section for well control panels.

Response: Specifications have been added for well control panels as requested.

Comment 19: ***Specifications, general:*** Need specification section for pressure water tanks.

Response: Specifications have been added for pressure tanks as requested.

Comment 20: ***Specifications, general***: Need specification section for underground wire.

Response: Underground wiring will be installed per Junction City building code. A licensed electrician will be subcontracted to perform all electrical work.

WATER DISTRIBUTION SYSTEM
BETWEEN OFF-POST SUPPLY WELLS AND DISTRIBUTION POINTS
FORMER FIRE TRAINING AREA AT MARSHALL ARMY AIRFIELD

FORT RILEY, KANSAS

FINAL REVISED SYSTEM DESIGN AND SCOPE OF WORK
MAY 2002

CONTRACT NO. DACW41-95-D-0022

Prepared By

Bay West, Inc.

Bay West

10620 Widmer Rd.
Lenexa, KS 66215

J970236

TABLE OF CONTENTS

SCOPE OF WORK

Provide Water Distribution System
Between Off-Post Supply Wells and Distribution Points
Former Fire Training Area at Marshall Army Airfield
Fort Riley, Kansas
Contract DACW41-95-D-0022

1. **Objective.** Bay West, Inc. will provide all services necessary to install two off-post water supply wells, distribution piping, and service connections to supply water to four distribution points.

2. **Scope.** General project requirements of this scope of work consist of providing services as necessary to perform the following activities: installation and testing of the domestic water supply wells, installation of distribution piping, installation of service connections, performance of required system testing, preparation of a final report, and restoration of site to previous conditions to include, but not limited to, grading, compaction, and seeding.

3. **Description of Work.** Bay West shall perform and assume all responsibility for the accuracy and completeness of the following work and services in accordance with criteria and instructions specified herein. In addition the following revisions have been incorporated into the scope of work and design of the alternate water supply.

   3.1 The Race Track well location as currently designed in the September 1998 design will be relocated to a point within 45 feet north of utility/electric pole # 6-36 SPPA 45/5-35 and approximately 135 feet southeast of well R-4. The new well will be installed to bedrock, screened in the bottom 30-40 feet depending on depth to bedrock and the vadose zone (water table). The pump will be located ten feet from the top of the bedrock.

   3.2 Electrical power for the race track replacement well as located/described in Section 3.1 will be obtained from the Flint Hills Rural Electric Cooperation. To provide the necessary power for the 15 HP, 3 phase, 480 V pump it will be necessary to install additional utility poles, heavier gauge electrical overhead line, and a larger capacity transformer to this location.

   A second option has been evaluated and included in the project cost estimate for the use of a diesel fuel powered generator to provide power to the Racetrack Replacement Well. This option is not part of the project SOW and if selected will be addressed per a contract modification.

   3.3 The re-designed distribution system will provide water service to the old house structure located approximately 150 feet northwest of the racetrack replacement well location, and a small concession stand and restroom area located in the pit area, and a concession stand in the grandstand area. The existing line running from well R-1 to the grandstand will be capped and abandoned in place. It should be noted that the old house structure was identified as an additional concession stand by Mr. Thompson (property owner) during the December 17, 2001 site visit. The concession area had not been included in the previous design.

3.4 Five existing wells designated R-1, R-2, R-3, R-4,and M-1 shall be plugged and abandoned per State of Kansas well abandonment regulations. These regulations are included as Appendix 2 of this document. A concrete vault at R-4 shall be removed. The existing pumps and piping at well R-4 shall be removed, rinsed and stockpiled on site. An attempt shall be made to pull the existing casings at each well to be removed. If the casing cannot be pulled, it shall be cut 3' feet below ground surface and plugged with grout according to Kansas regulations. The removed casing shall be rinsed on site and properly disposed of. The decontamination process will involve cleaning with a non-phosphate detergent and triple rinsing the removed casing. All fluids used to decontaminate the casing will be contained in 55-gallon drums and appropriately labeled per USACE and Federal requirements. The containerized decontamination fluids and the casings from well R-1 and R-2, shall be disposed of at the Fort Riley Environmental Waste Management Center. The casings from wells R-3, R-4, and M-1 can be disposed of as normal waste. A sample of the decontamination fluids will be collected and submitted for VOC analysis per EPA Method 8260.

3.5 The new water line shall extend from the well along the crest of the slope formed by a former oxbow until it is due south of the point where the new standpipe shall be installed. At the point were the new water line transects the race track, it shall be jacked under the track.

3.6 A new 3" PVC standpipe with outlet height of 10' and a radius of 4' shall be constructed in line with the existing pit area concession stand. This standpipe will be utilized as a water truck fill station. This structure will replace the existing water truck fill station and will be located approximately 310 feet east of the Pit Area restrooms. The distribution system shall be designed to provide a 200-gpm capacity at the standpipe outlet. A new 10'x 20'x 6" concrete pad shall be installed centered at the standpipe at the west- end of the pad. A light fixture similar to existing exterior light fixtures at the racetrack shall be mounted on the standpipe pole and tied into the existing electrical distribution system. The property owner presently has planned to relocate the existing light poles, located along the inside of the track and shorten the track straight aways.

3.7 The existing water truck fill station located at the western loop of the track will be removed and the debris disposed as normal waste. The existing piping will be capped and abandoned in place.

3.8 A shelter shall be provided for a new 525-gallon capacity pressure tank that is to be located at the restroom facility in the pit area. The shelter will be installed on a 10'x 10'x 6"concrete pad. The shelter will have dimensions of 8'x 8'x8' with one access door. The shed supplied will be of pre-fabricated construction. The water distribution system shall be designed so that it can be winterized. At a minimum, a valve vault and drain back valves shall be installed at the truck fill standpipe, the old house and the manhole in the pit area. The pressure tank, well head, and associated piping shall be designed so they can be drained completely.

3.9 Bay West will install a replacement well for the existing well identified as M-1 that supplies water to a mobile home located on property adjacent to the Racetrack. The M-1 Replacement Well will be designed to provide a minimum of 10 GPM. The existing 30-gallon hydro pneumatic tank located in the machine shop adjacent to the trailer will be retained.

3.10 Bay West, Inc. shall propose a schedule to complete construction by August 1, 2002.

3.11 Bay West, Inc shall mobilize and perform fieldwork upon notification by the Contracting Officer.

4. Document Distribution

4.1 Pre-Final (95%) Design- Bay West, Inc. shall provide a 95% design submittal including revised plans and specifications and supporting design computations. These documents shall be distributed as indicated in the attached Document Distribution List.

4.2 Final (100%) Design- Bay West, Inc. shall incorporate all comments received from the government on the 95% design submittal. Bay West, Inc shall provide a 100% design submittal including revised plans and specifications and supporting design computations. These documents shall be distributed as indicated in the attached Document Distribution List.

Document Distribution List
Water Distribution and Well Installation
Fort Riley, Kansas

Addressee	Number of Copies (1) 95%	100%
Commander USACE, Kansas City District ATTN: CENWK-PM-ED (R. Van Saun) 601 East 12th Street Kansas City, Missouri 64106-2896	3	3
Fort Riley Area Office U.S. Army Corps of Engineers P.O. Box 2189 Fort Riley, Kansas 66442-6016	3	3
Directorate of Environmental & Safety ATTN: AFZN-ES-OM Building 407, Main Post Fort Riley, Kansas 66442-6016	3	3
Craig Bernstein, Remedial Project Manager U.S. Environmental Protection Agency, Region VII Removal Enforcement Section, Superfund Division Assessment & Restoration Section, Superfund Unit 901 North 5th Street Kansas City, Kansas 66101		2
Rob Weber Kansas Department of Health and Environment Bureau of Environmental Remediation 1000 Southwest Jackson Suite 410 Topeka, Kansas 66612-1367		2

4.3 Release of Information. Bay West shall not publicize, nor release in any manner, information or data in regard to projects on which they may be working or negotiating with this office, not discuss prior to public release by this office, a project, any future program, or any planning with anyone not directly concerned with the project. Any inquiries in regard to these matters shall be referred to the Contracting Officer or Kansas City District Technical Manager (CENWK-PE-EA).

4.4 Contractor Identification. While on the confines of Fort Riley, Kansas, (and associated off-post areas) all contractor and subcontractor personnel shall carry picture ID card with the persons name, and the name of the company he or she works for clearly visible. These ID cards shall be worn on the outside of the clothing over the right or left breast pocket. (necklace type ID card holders may pose a safety risk to the wearer if machinery is being used.) Furthermore, all contractors and subcontractor owned or leased vehicles must be identified by signage, showing the name of the company that is actually accomplishing the field work. Temporary magnetic signs attached to the exterior of both the right and left side of the vehicle will suffice. The vehicle identification requirement extends to all vehicles, including automobiles leased for administrative purposes.

5. **Project Management.** Bay West shall assign a principal or key employee to serve as the Project Manager. The Project manager shall oversee the coordination of the entire project and shall be capable of administering all instructions from the Contracting Officer and octaining answers to all questions from the Technical Manager during and after the period of the contract. During the execution of the work under the contract, the Contractor shall keep close contacts with Technical Manager. All written and electronic documents shall be annotated and returned to the Technical Manager.

Person	**Representing**
Richard Shields or Oral Saulters	Fort Riley Directorate of Environmental & Safety
Rick Van Saun	Project Manager/Technical Manager, USACE
Trudy Shannon	Contracting Officer's Representative

6. **Report**. Bay West will submit a Work Plan per section 1.3.2.1 of Specifications Section 02521 Water Well Construction of this submittal. The Work Plan will be submitted within 1 week of notice to proceed. A Project Health & Safety Plan per USACE requirements will be submitted at this time as well. Bay West, Inc shall prepare and submit a project report within four weeks of the completion of all field activities. The report shall be submitted in two iterations (Draft and Final) and shall be submitted in nine copies for the Draft and thirteen copies for the final PLANS AND DETAIL DRAWINGS

7. **Special Requirements**.

7.1 **Coordination and Notification Requirements**. Bay West, Inc is responsible to coordinate all logistical details of each stage of the work. Bay West, Inc shall notify the Corps and Fort Riley two (2) weeks prior to commencing fieldwork. In addition, the A-E shall notify the Fort Riley and the Contracting Officers Representative (COR) the day of arrival on site.

During the work, Bay West, Inc will immediately notify the Corps of and significant events that occur. Bay West, Inc will subsequently furnish a written record to describe the events and the proposed or completed resolution actions that were taken.

APPENDIX 1

PLANS AND DETAIL DRAWINGS

1. T-1.1 Cover
2. T-2.1 Index, Legend and General Notes
3. C-1.1 Existing Conditions
4. C-3.1 Site Plan
5. C-6.1 Details

US Army Corps of Engineers

Kansas City District

You Matter – We Care

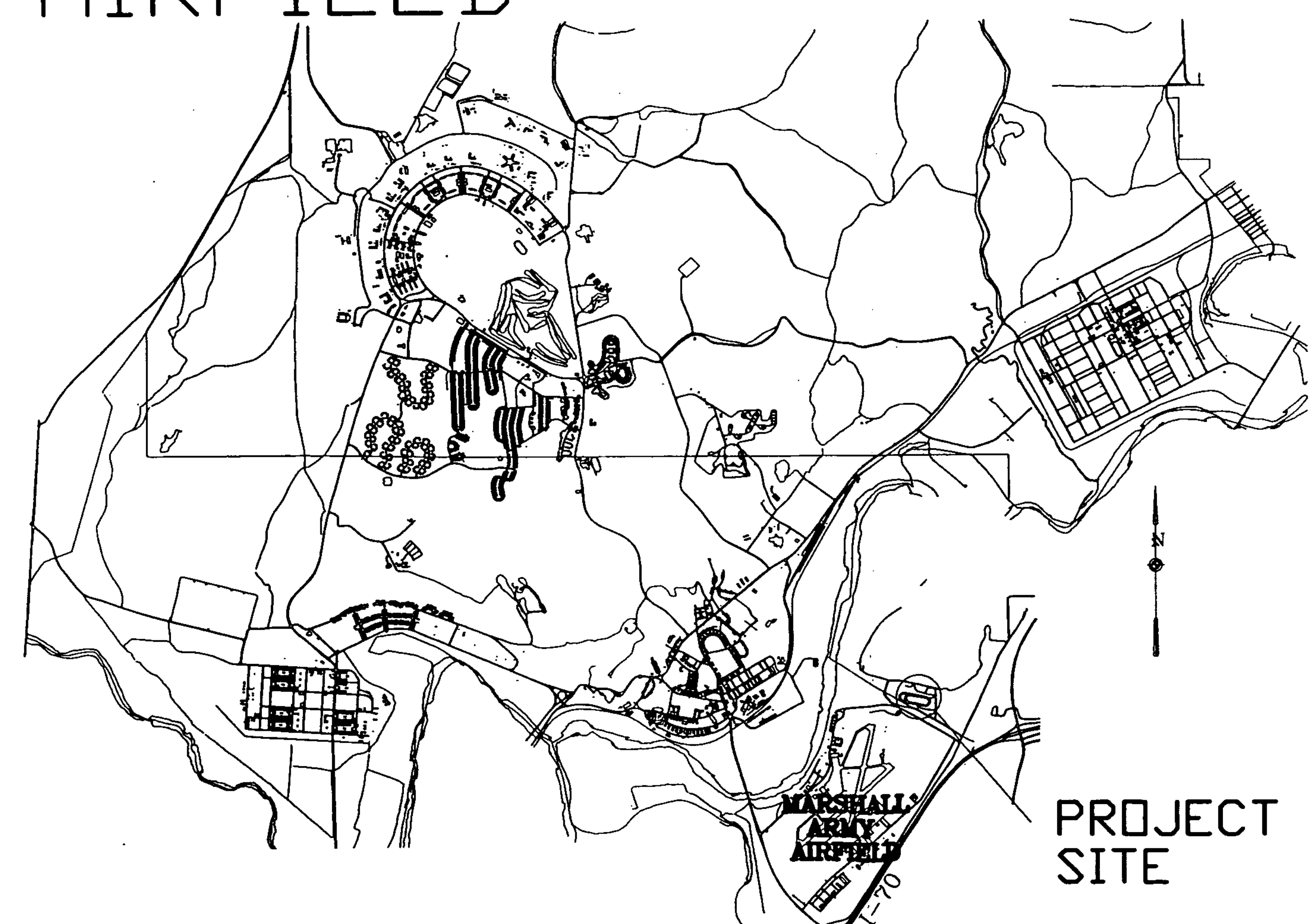
OFF-POST ALTERNATE WATER SUPPLY

FORMER FIRE TRAINING AREA MARSHALL ARMY AIRFIELD

Fort Riley, Kansas

September 1998
(Revised May 2002)

IFB# DACW41-95-D-0022



INDEX OF DRAWINGS

NOTES:

1. LEGENDS ARE COMPOSED OF STANDARD SYMBOLS AND ARE PERTINENT TO THE CONDITIONS OF THIS SET OF DRAWINGS TO THE EXTENT APPLICABLE.

2. ADDITIONAL LEGENDS AND/OR ANOTHER LEGEND SHEET MAY APPEAR IN THIS SET OF DRAWINGS TO INDICATE SPECIFIC CONDITIONS IN LIEU OF SYMBOLS SHOWN ON THIS SHEET.

3.THE INFORMATION SHOWN ON DRAWINGS REFLECTING THE EXISTING CONDITIONS WAS TAKEN FROM AVAILABLE DRAWINGS AND SURVEYS, AND FURNISHED FOR INFORMATION PURPOSES AS RELATED TO THE PROJECT SCOPE OF WORK. THESE DRAWINGS ARE NOT TO BE CONSTRUED AS "AS-BUILT" CONDITIONS.

CIVIL LEGEND

FUTURE EXISTING NEW

- BUILDINGS
- ROADS
- CURB & GUTTER
- WALKS
- CONTOURS (22, 12)
- SPOT GRADE ELEVATIONS (772, 772)
- DIRECTION OF DRAINAGE
- CULVERT
- STORM DRAIN (SD)
- SUBDRAIN
- SUBDRAIN OUTLET LINE
- WATERLINE (W)
- SANITARY SEWER (S)
- WASTE DRAIN (WD)
- SUBDRAIN FLUSHING & OBSERVATION RISER (OR)
- MANHOLE SELF EXPLANATORY DEPENDING ON TYPE OF UTILITY LINE
- CURB INLET
- DROP INLET #2 (DI 2)
- FIRE HYDRANT
- GATE VALUE & VALVE BOX OR SERVICE STOP & BOX
- RAILROAD
- DRILL HOLE
- POST INDICATOR VALVE (PIV)
- PROPERTY LINE MONUMENT (MT)
- UNDERGROUND STEAM SUPPLY (US) GAS METER
- FIRE PROTECTION WATERLINE (FW)
- GAS (G)
- GAS MAIN (GAS MAIN)
- GAS METER (M)
- PROJECT LIMIT
- CROSS WALK
- SIGN
- SIGN

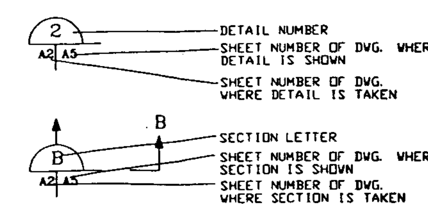
VALVES AND FITTINGS

- GLOBE VALVE
- GATE VALVE
- SWING CHECK VALVE
- HOSE GATE VALVE
- PLUG VALVE
- NEEDLE VALVE
- STRAINER
- RELIEF VALVE
- MOTOR OPERATED VALVE
- TEMPERATURE REGULATING VALVE
- SOLENOID VALVE
- PRESSURE REDUCING VALVE
- FLOAT VALVE
- ANCHOR
- EXPANSION JOINT
- ELBOW DOWN
- ELBOW UP
- TEE DOWN
- TEE UP
- CAP
- UNION
- CALIBRATED BALANCE VALVE
- COMBINATION VALVE (FLOW CONTROL, STRAINER, BALL VALVE AND UNION)
- BALL VALVE
- REDUCING OR INCREASING FITTING
- THERMOMETER AND WELL

FENCES

- X — EXISTING CHAIN LINK SECURITY

SYMBOL IDENTIFICATION



US Army Corps of Engineers
Kansas City District

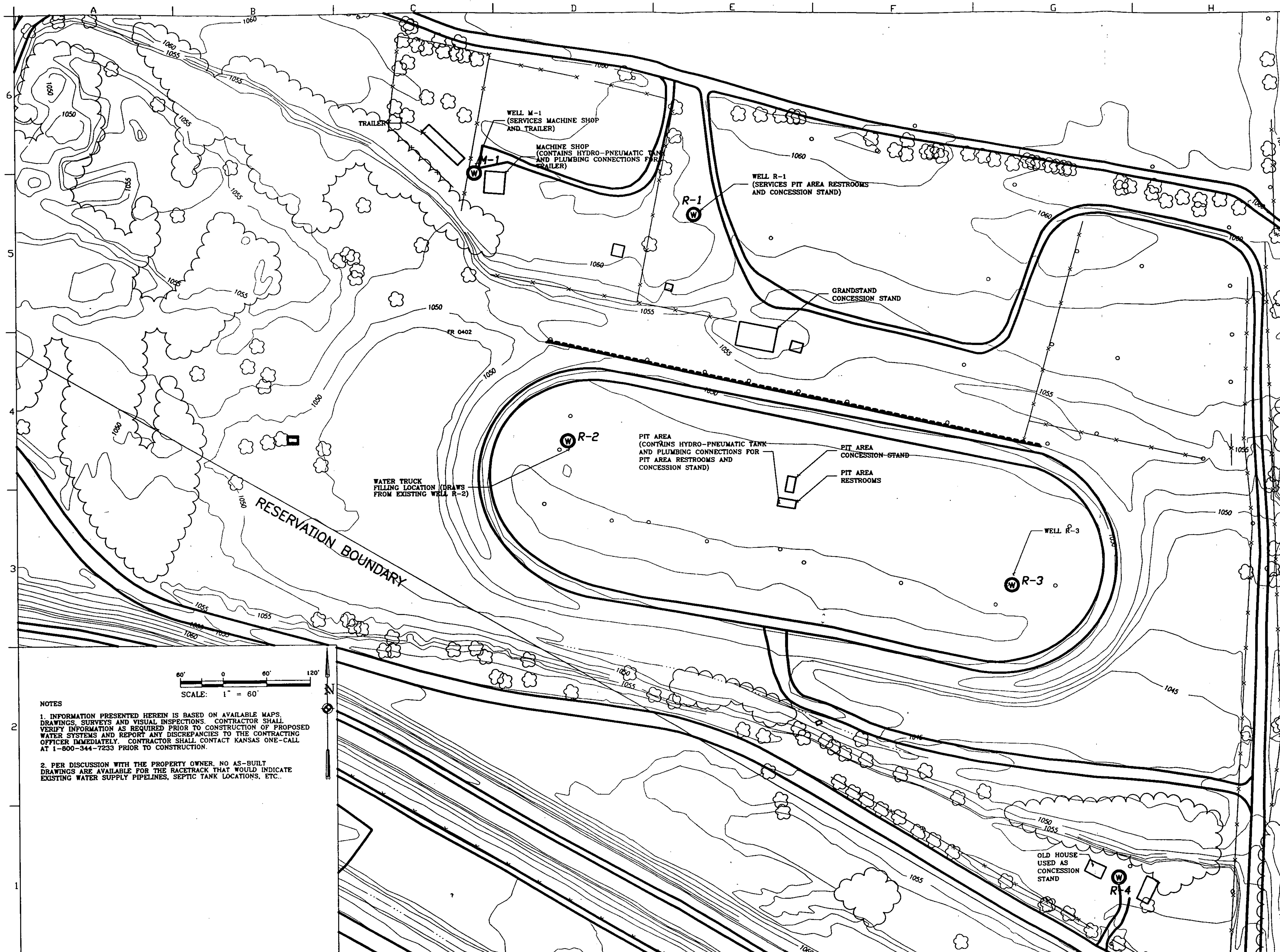
Designed by: RGJ		Date: Sep 1998	Rev. X
Dwn by: RGJ	Ckd by: TEW	Design file no. X	
Reviewed by: ROW		Drawing code: X	
Submitted by: WRK		File name: maaft0201 Plot date: X Plot scale: 1"=8'	

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

FORT RILEY, KANSAS
OFF-POST ALTERNATE WATER SUPPLY
IFB NO. DACW-41-95-D-0022

INDEX, LEGEND AND GENERAL NOTES

Sheet reference number:
T-2.1



NOTES

1. INFORMATION PRESENTED HEREIN IS BASED ON AVAILABLE MAPS, DRAWINGS, SURVEYS AND VISUAL INSPECTIONS. CONTRACTOR SHALL VERIFY INFORMATION AS REQUIRED PRIOR TO CONSTRUCTION OF PROPOSED WATER SYSTEMS AND REPORT ANY DISCREPANCIES TO THE CONTRACTING OFFICER IMMEDIATELY. CONTRACTOR SHALL CONTACT KANSAS ONE-CALL AT 1-800-344-7233 PRIOR TO CONSTRUCTION.

2. PER DISCUSSION WITH THE PROPERTY OWNER, NO AS-BUILT DRAWINGS ARE AVAILABLE FOR THE RACETRACK THAT WOULD INDICATE EXISTING WATER SUPPLY PIPELINES, SEPTIC TANK LOCATIONS, ETC..

US Army Corps of Engineers
Kansas City District

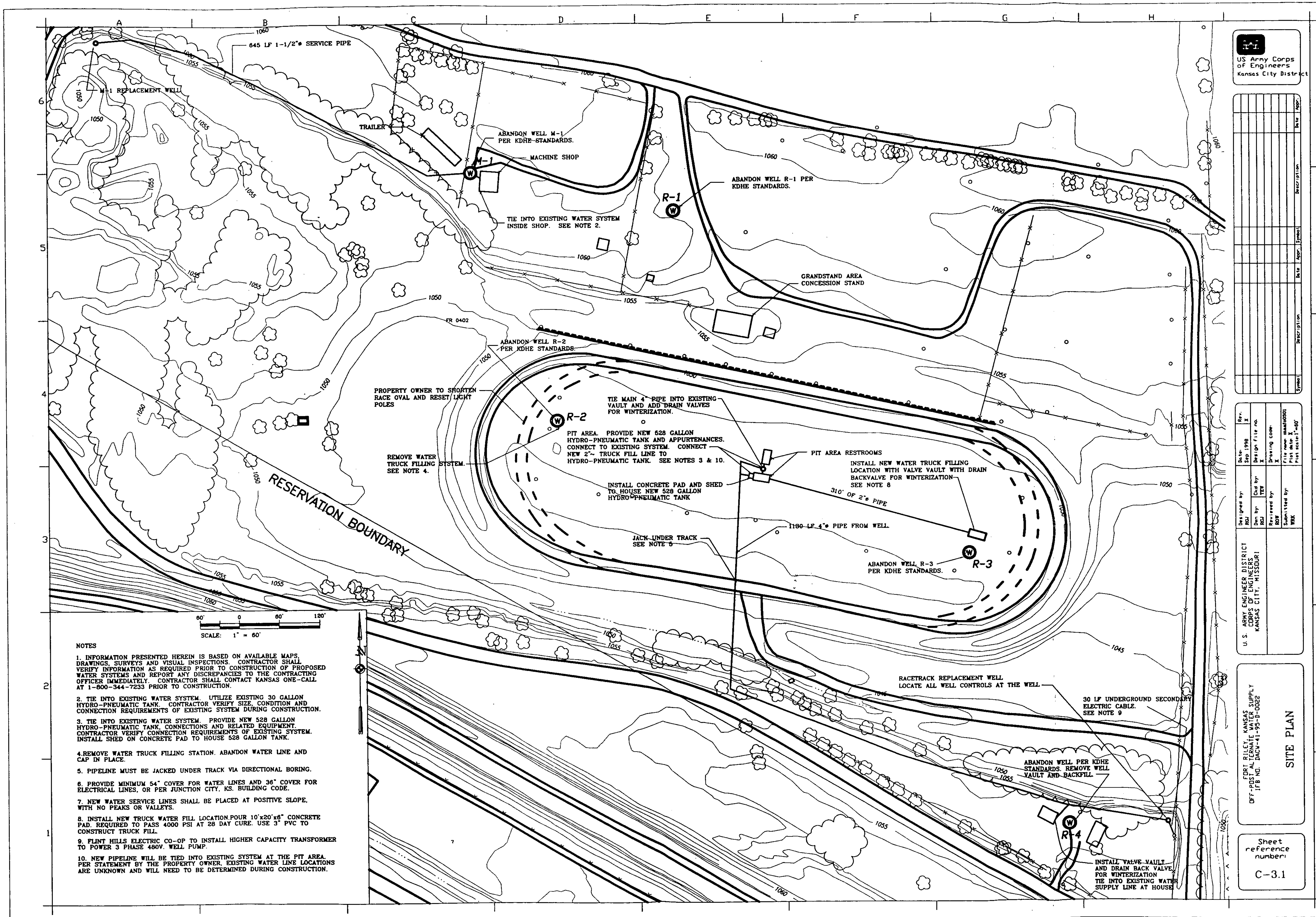
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Date: Sep 1998

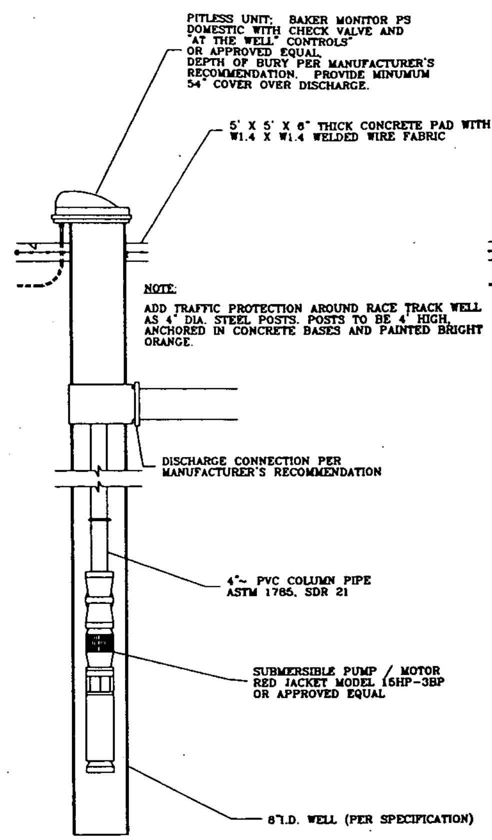
FORT RILEY, KANSAS
OFF-POST ALTERNATE WATER SUPPLY
IFB NO. DACW-41-95-D-0022

EXISTING CONDITIONS

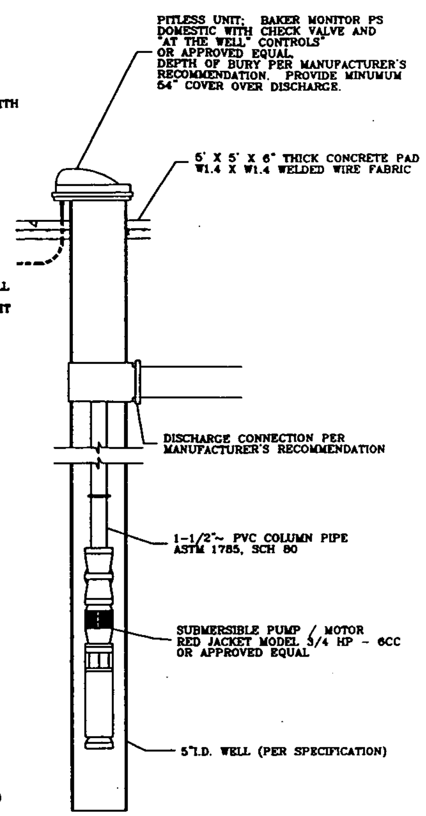
Sheet reference number:
C-1.1



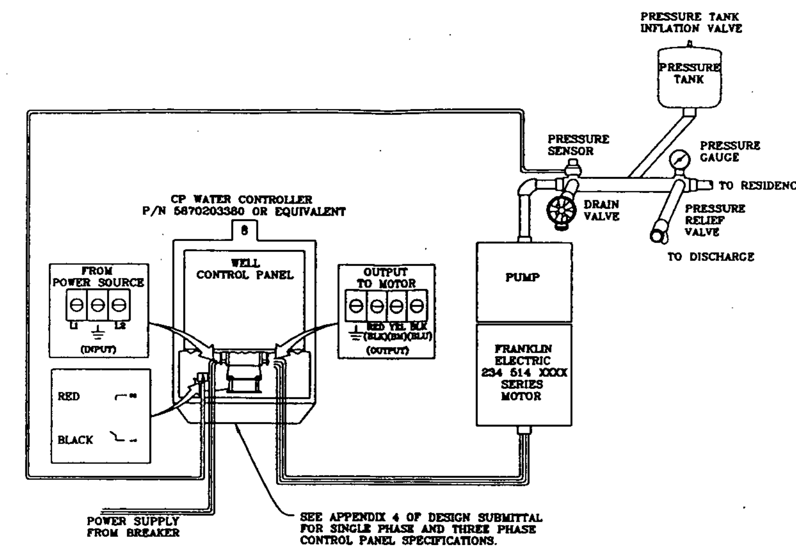
845 LF 1-1/2"ø SERVICE PIPE
M-1 REPLACEMENT WELL
TRAILER
ABANDON WELL M-1 PER KDHE STANDARDS.
MACHINE SHOP
M-1
TIE INTO EXISTING WATER SYSTEM INSIDE SHOP. SEE NOTE 2.
R-1
ABANDON WELL R-1 PER KDHE STANDARDS.
GRANDSTAND AREA CONCESSION STAND
FR 0402
ABANDON WELL R-2 PER KDHE STANDARDS.
PROPERTY OWNER TO SHORTEN RACE OVAL AND RESET LIGHT POLES
R-2
REMOVE WATER TRUCK FILLING SYSTEM. SEE NOTE 4.
TIE MAIN 4" PIPE INTO EXISTING VAULT AND ADD DRAIN VALVES FOR WINTERIZATION.
PIT AREA. PROVIDE NEW 528 GALLON HYDRO-PNEUMATIC TANK AND APPURTENANCES. CONNECT TO EXISTING SYSTEM. CONNECT NEW 2"~ TRUCK FILL LINE TO HYDRO-PNEUMATIC TANK. SEE NOTES 3 & 10.
PIT AREA RESTROOMS
INSTALL NEW WATER TRUCK FILLING LOCATION WITH VALVE VAULT WITH DRAIN BACKVALVE FOR WINTERIZATION. SEE NOTE 8
INSTALL CONCRETE PAD AND SHED TO HOUSE NEW 528 GALLON HYDRO-PNEUMATIC TANK
310' OF 2"ø PIPE
1190 LF 4"ø PIPE FROM WELL.
JACK UNDER TRACK SEE NOTE 5
ABANDON WELL R-3 PER KDHE STANDARDS.
R-3
RESERVATION BOUNDARY
RACETRACK REPLACEMENT WELL LOCATE ALL WELL CONTROLS AT THE WELL
30 LF UNDERGROUND SECONDARY ELECTRIC CABLE. SEE NOTE 9
ABANDON WELL PER KDHE STANDARDS. REMOVE WELL VAULT AND BACKFILL.
R-4
INSTALL VALVE VAULT AND DRAIN BACK VALVE FOR WINTERIZATION TIE INTO EXISTING WATER SUPPLY LINE AT HOUSE
60' 0 60' 120'
SCALE: 1" = 60'
N
NOTES
1. INFORMATION PRESENTED HEREIN IS BASED ON AVAILABLE MAPS, DRAWINGS, SURVEYS AND VISUAL INSPECTIONS. CONTRACTOR SHALL VERIFY INFORMATION AS REQUIRED PRIOR TO CONSTRUCTION OF PROPOSED WATER SYSTEMS AND REPORT ANY DISCREPANCIES TO THE CONTRACTING OFFICER IMMEDIATELY. CONTRACTOR SHALL CONTACT KANSAS ONE-CALL AT 1-800-344-7233 PRIOR TO CONSTRUCTION.
2. TIE INTO EXISTING WATER SYSTEM. UTILIZE EXISTING 30 GALLON HYDRO-PNEUMATIC TANK. CONTRACTOR VERIFY SIZE, CONDITION AND CONNECTION REQUIREMENTS OF EXISTING SYSTEM DURING CONSTRUCTION.
3. TIE INTO EXISTING WATER SYSTEM. PROVIDE NEW 528 GALLON HYDRO-PNEUMATIC TANK, CONNECTIONS AND RELATED EQUIPMENT. CONTRACTOR VERIFY CONNECTION REQUIREMENTS OF EXISTING SYSTEM. INSTALL SHED ON CONCRETE PAD TO HOUSE 528 GALLON TANK.
4.REMOVE WATER TRUCK FILLING STATION. ABANDON WATER LINE AND CAP IN PLACE.
5. PIPELINE MUST BE JACKED UNDER TRACK VIA DIRECTIONAL BORING.
6. PROVIDE MINIMUM 54" COVER FOR WATER LINES AND 36" COVER FOR ELECTRICAL LINES, OR PER JUNCTION CITY, KS. BUILDING CODE.
7. NEW WATER SERVICE LINES SHALL BE PLACED AT POSITIVE SLOPE, WITH NO PEAKS OR VALLEYS.
8. INSTALL NEW TRUCK WATER FILL LOCATION.POUR 10'x20'x6" CONCRETE PAD. REQUIRED TO PASS 4000 PSI AT 28 DAY CURE. USE 3" PVC TO CONSTRUCT TRUCK FILL.
9. FLINT HILLS ELECTRIC CO-OP TO INSTALL HIGHER CAPACITY TRANSFORMER TO POWER 3 PHASE 480V. WELL PUMP.
10. NEW PIPELINE WILL BE TIED INTO EXISTING SYSTEM AT THE PIT AREA. PER STATEMENT BY THE PROPERTY OWNER, EXISTING WATER LINE LOCATIONS ARE UNKNOWN AND WILL NEED TO BE DETERMINED DURING CONSTRUCTION.
US Army Corps of Engineers Kansas City District
Symbol Description Date Appr.
U. S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS KANSAS CITY, MISSOURI
Designed by: RCJ
Dwn by: RCJ
Ckd by: TEW
Reviewed by: ROW
Submitted by: WRK
Date: Sep 1998
Rev. X
Design file no. X
Drawing code: X
File name: maafo0301
Plot date: X
Plot scale: 1"=60'
FORT RILEY, KANSAS
OFF-POST ALTERNATE WATER SUPPLY
IFB NO. DACW-41-95-D-0022
SITE PLAN
Sheet reference number:
C-3.1



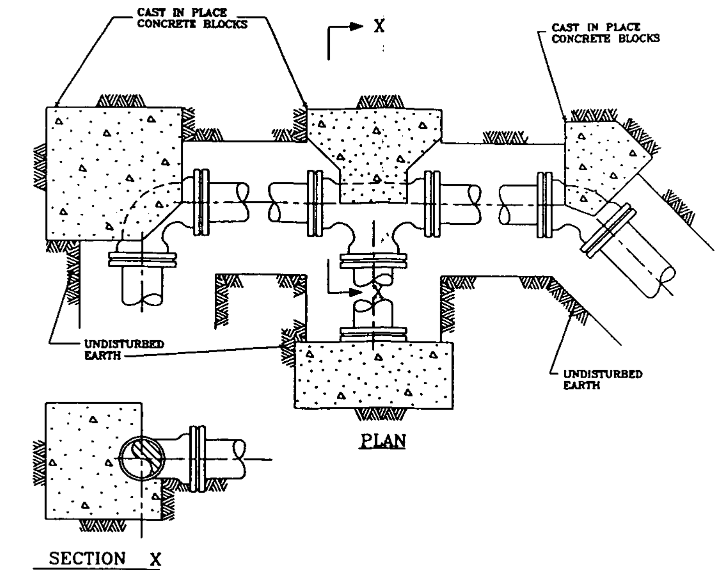
RACETRACK REPLACEMENT WELL DETAIL
NOT TO SCALE



M-1 REPLACEMENT WELL DETAIL
NOT TO SCALE



TYPICAL WELL CONTROL DETAIL
NOT TO SCALE



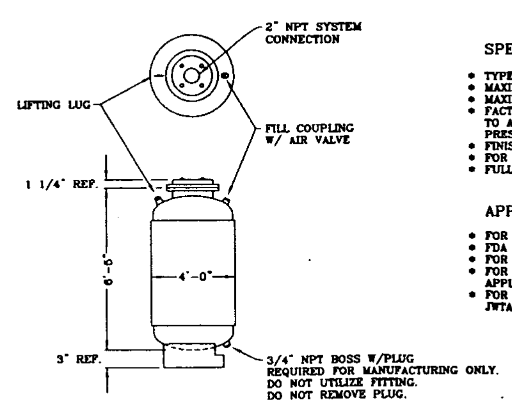
FITTING SIZES	BEARING AREA OF BLOCK IN SQ. FT.				
	TEE, WYE & END	90° BEND	45° BEND	22 1/2° BEND	11 1/4° BEND
4"	1.9	2.7	1.4	.75	.5

NOTE: ABOVE AREAS ARE BASED ON AN ALLOWABLE SOIL BEARING PRESSURES OF 2000 POUNDS PER SQ. FT.

TYPICAL CONCRETE BLOCKING DETAILS
NOT TO SCALE

NOTES:
1. PLACE 4 mil. POLYETHYLENE BETWEEN CONCRETE AND FITTING (CONCRETE SHALL NOT INTERFERE WITH JOINT.)
2. MINIMUM CONCRETE THICKNESS SHALL BE 12"
3. THE HORIZONTAL DIMENSION OF THE BEARING AREA SHALL BE BETWEEN 0.8 AND 1.25 TIMES THE VERTICAL DIMENSION
4. THRUST BLOCK ORIENTATION SHALL BE SUCH THAT THE CENTER OF THE FITTING CORRESPONDS WITH THE CENTER OF THE THRUST BLOCK.
5. THRUST BLOCKS ARE NOT REQUIRED FOR PIPE SIZES SMALLER THAN 4"

TYPE I SERIES
ASME BAG TYPE HYDRO-PNEUMATIC TANK



SPECIFICATIONS

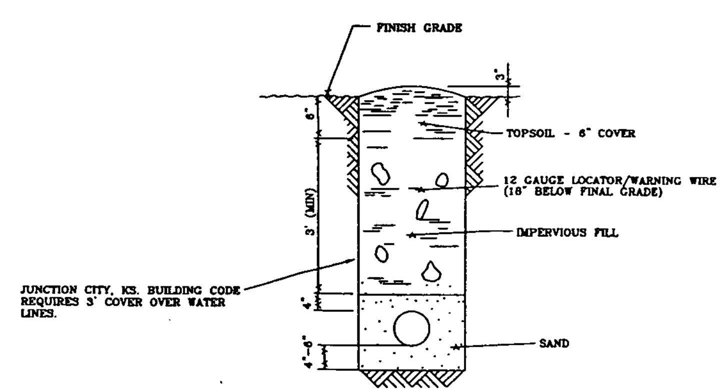
- TYPE DESIGN & CONSTRUCTION: ASME SECTION VIII DIVISION I
- MAXIMUM WORKING PRESSURE: 125 PSI
- MAXIMUM OPERATING TEMPERATURE: 160° F
- FACTORY PRECHARGE: 12 PSI - ADJUSTABLE IN THE FIELD TO A MAXIMUM OF 80 PSI. FOR HIGHER PRECHARGE PRESSURE - CONSULT FACTORY.
- FINISH: GRAY PRIMER
- FOR VERTICAL INSTALLATION ONLY
- FULL COUPLING ADDED TO PROTECT CHARGING VALVE

APPLICATIONS

- FOR USE IN HYDROPNEUMATIC APPLICATIONS
- FDA APPROVED POTABLE MATERIAL
- FOR SIZING TANK - PLEASE REFER TO TECHNICAL BULLETIN 002.
- FOR HYDRONIC EXPANSION AND NON-POTABLE HYDRO-PNEUMATIC APPLICATIONS, USE JBER SERIES - SPECIFICATION SHEET 615.
- FOR HIGHER TEMPERATURE POTABLE HYDRO-PNEUMATIC TANK, USE JWTA SERIES - SPECIFICATION SHEET 699B.

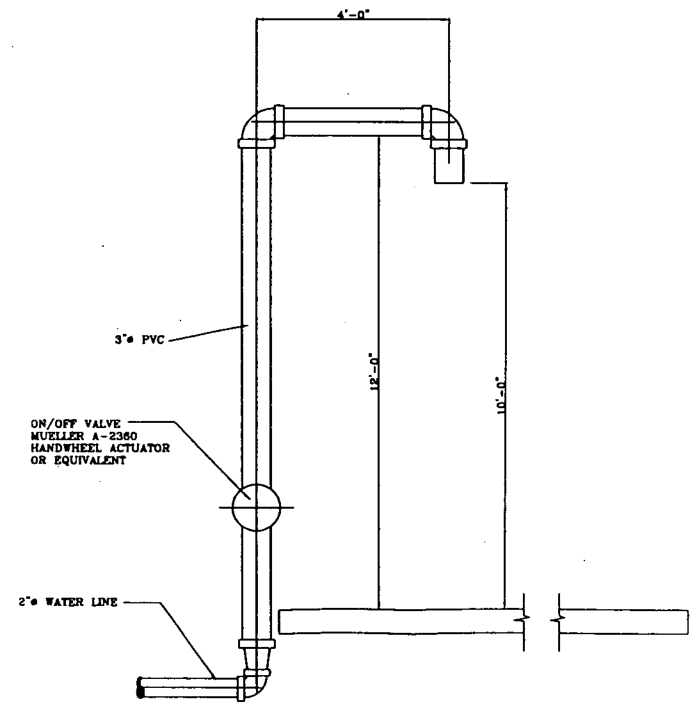
528 GALLON HYDRO-PNEUMATIC TANK DETAIL
NOT TO SCALE

NOTE:
TANK TO BE INSTALLED ON A 10'x10'x6" CONCRETE PAD ADJACENT TO THE WESTERN WALL OF THE PIT AREA RESTROOM BUILDING. AN 8'x8'x8' BARON STORAGE BUILDING WILL BE INSTALLED TO PROTECT THE TANK. BUILDING SPECIFICATIONS ARE INCLUDED IN APPENDIX 4 OF THE DESIGN SUBMITTAL.



TYPICAL TRENCH DETAIL
NOT TO SCALE

NOTE:
MATCH SURROUNDING GRADE AND SURFACING FOR ROAD AND RACETRACK CROSSINGS.



TRUCK FILL STATION
NOT TO SCALE

NOTES:
1. 10' x 20' x 6" CONCRETE PAD 4000 PSI COMPRESSION STRENGTH @ 28 DAYS
2. 12" SPACING/CENTERS ON REBAR
3. MUELLER VALVE, SELF DRAINING FOR FREEZE PROTECTION

US Army Corps of Engineers
Kansas City District

Symbol	Description	Date	Appr.	Symbol	Description	Date	Appr.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Designed by: RGJ	Date: Sep 1998	Rev. X
Dwn by: RGJ / Ckd by: TEW	Design file no. X	
Reviewed by: RDW	Drawing code: X	
Submitted by: WRK	File name: maa0601 / Plot date: X / Plot scale: 1"=8'	

FORT RILEY, KANSAS
OFF-POST ALTERNATE WATER SUPPLY
IFB NO. DACW-41-95-D-0022

DETAILS

Sheet reference number:
C-6.1

30" X 36" Drawings

US Army Corps
of Engineers
Kansas City District
You Matter - We Care

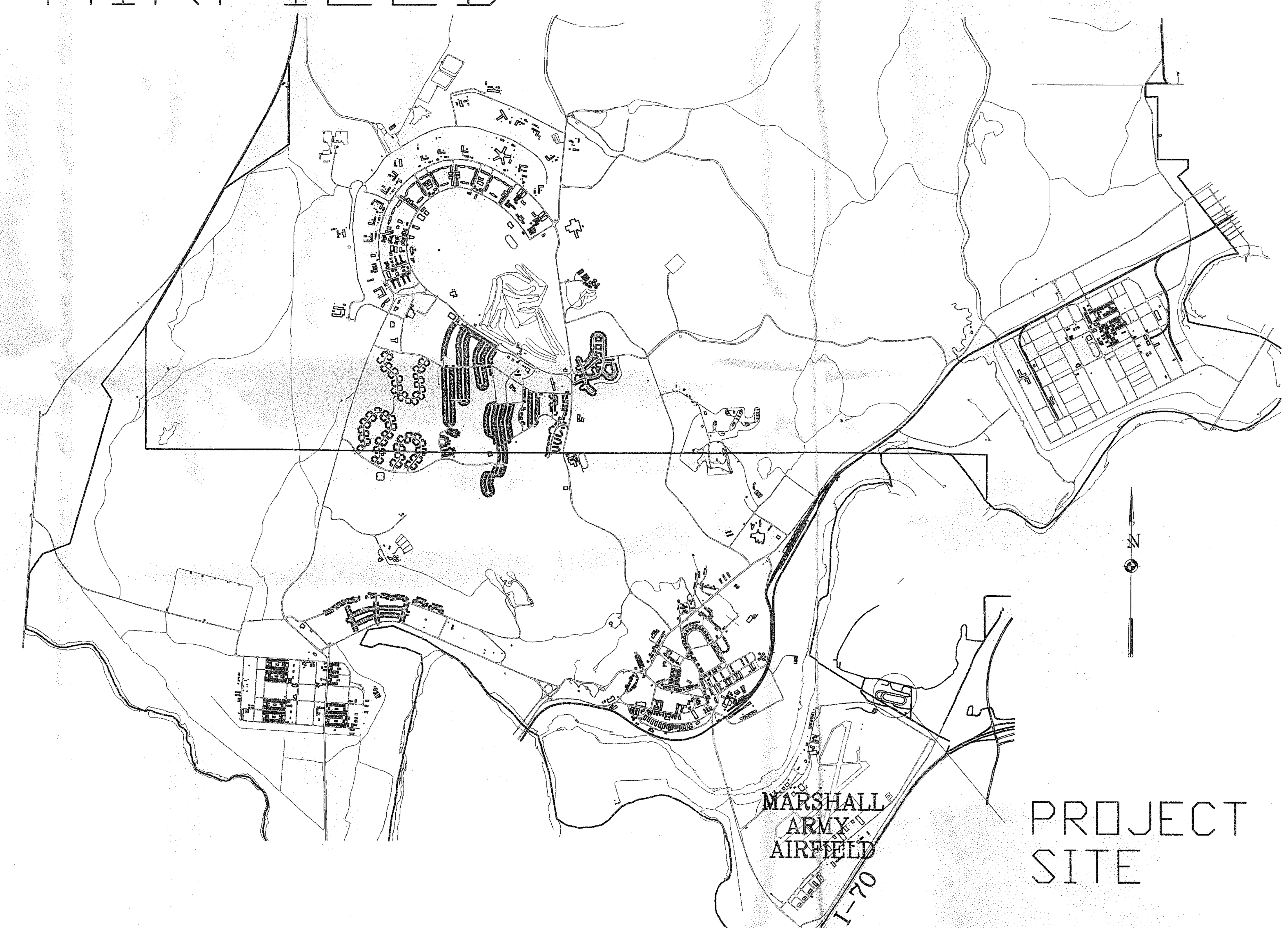
OFF-POST ALTERNATE WATER SUPPLY

FORMER FIRE TRAINING AREA
MARSHALL ARMY AIRFIELD

Fort Riley, Kansas

September 1998
(Revised May 2002)

IFB# DACW41-95-D-0022



INDEX OF DRAWINGS

GENERAL

CIVIL

NOTES:

1. LEGENDS ARE COMPOSED OF STANDARD SYMBOLS AND ARE PERTINENT TO THE CONDITIONS OF THIS SET OF DRAWINGS TO THE EXTENT APPLICABLE.

2. ADDITIONAL LEGENDS AND/OR ANOTHER LEGEND SHEET MAY APPEAR IN THIS SET OF DRAWINGS TO INDICATE SPECIFIC CONDITIONS IN LIEU OF SYMBOLS SHOWN ON THIS SHEET.

3.THE INFORMATION SHOWN ON DRAWINGS REFLECTING THE EXISTING CONDITIONS WAS TAKEN FROM AVAILABLE DRAWINGS AND SURVEYS, AND FURNISHED FOR INFORMATION PURPOSES AS RELATED TO THE PROJECT SCOPE OF WORK. THESE DRAWINGS ARE NOT TO BE CONSTRUED AS "AS-BULT" CONDITIONS.

CIVIL LEGEND

FUTURE EXISTING NEW

- BUILDINGS
- ROADS
- CURB & GUTTER
- WALKS
- CONTOURS (22, 12)
- SPOT GRADE ELEVATIONS (772)
- DIRECTION OF DRAINAGE
- CULVERT
- STORM DRAIN (SD)
- SUBDRAIN
- SUBDRAIN OUTLET LINE
- WATERLINE (W)
- SANITARY SEWER (S)
- WASTE DRAIN (WD)
- SUBDRAIN FLUSHING & OBSERVATION RISER (OR)
- MANHOLE SELF EXPLANATORY DEPENDING ON TYPE OF UTILITY LINE
- CURB INLET
- DROP INLET #2 (DI 2)
- FIRE HYDRANT
- GATE VALUE & VALVE BOX OR SERVICE STOP & BOX
- RAILROAD
- DRILL HOLE
- POST INDICATOR VALVE (PIV)
- PROPERTY LINE MONUMENT (MT)
- UNDERGROUND STEAM SUPPLY (US) GAS METER
- FIRE PROTECTION WATERLINE (FW)
- GAS (G)
- GAS MAIN
- GAS METER (M)
- PROJECT LIMIT
- CROSS WALK
- SIGN
- SIGN

VALVES AND FITTINGS

- GLOBE VALVE
- GATE VALVE
- SWING CHECK VALVE
- HOSE GATE VALVE
- PLUG VALVE
- NEEDLE VALVE
- STRAINER
- RELIEF VALVE
- MOTOR OPERATED VALVE
- TEMPERATURE REGULATING VALVE
- SOLENOID VALVE
- PRESSURE REDUCING VALVE
- FLOAT VALVE
- ANCHOR
- EXPANSION JOINT
- ELBOW DOWN
- ELBOW UP
- TEE DOWN
- TEE UP
- CAP
- UNION
- CALIBRATED BALANCE VALVE
- COMBINATION VALVE (FLOW CONTROL, STRAINER, BALL VALVE AND UNION)
- BALL VALVE
- REDUCING OR INCREASING FITTING
- THERMOMETER AND WELL

FENCES

X EXISTING CHAIN LINK SECURITY

SYMBOL IDENTIFICATION

2 — DETAIL NUMBER

A2 — SHEET NUMBER OF DWG. WHERE DETAIL IS SHOWN

A5 — SHEET NUMBER OF DWG. WHERE DETAIL IS TAKEN

B — SECTION LETTER

A2 — SHEET NUMBER OF DWG. WHERE SECTION IS SHOWN

A5 — SHEET NUMBER OF DWG. WHERE SECTION IS TAKEN

US Army Corps of Engineers Kansas City District

Symbol	Description	Date	Appr.

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Designed by: RGJ		Date: Sep 1998	Rev. X
Dwn by: RGJ	Ckd by: TEW	Design file no. X	
Reviewed by: ROW		Drawing code: X	
Submitted by: WRK		File name: mamf0201 Plot date: X Plot scale: 1"=8'	

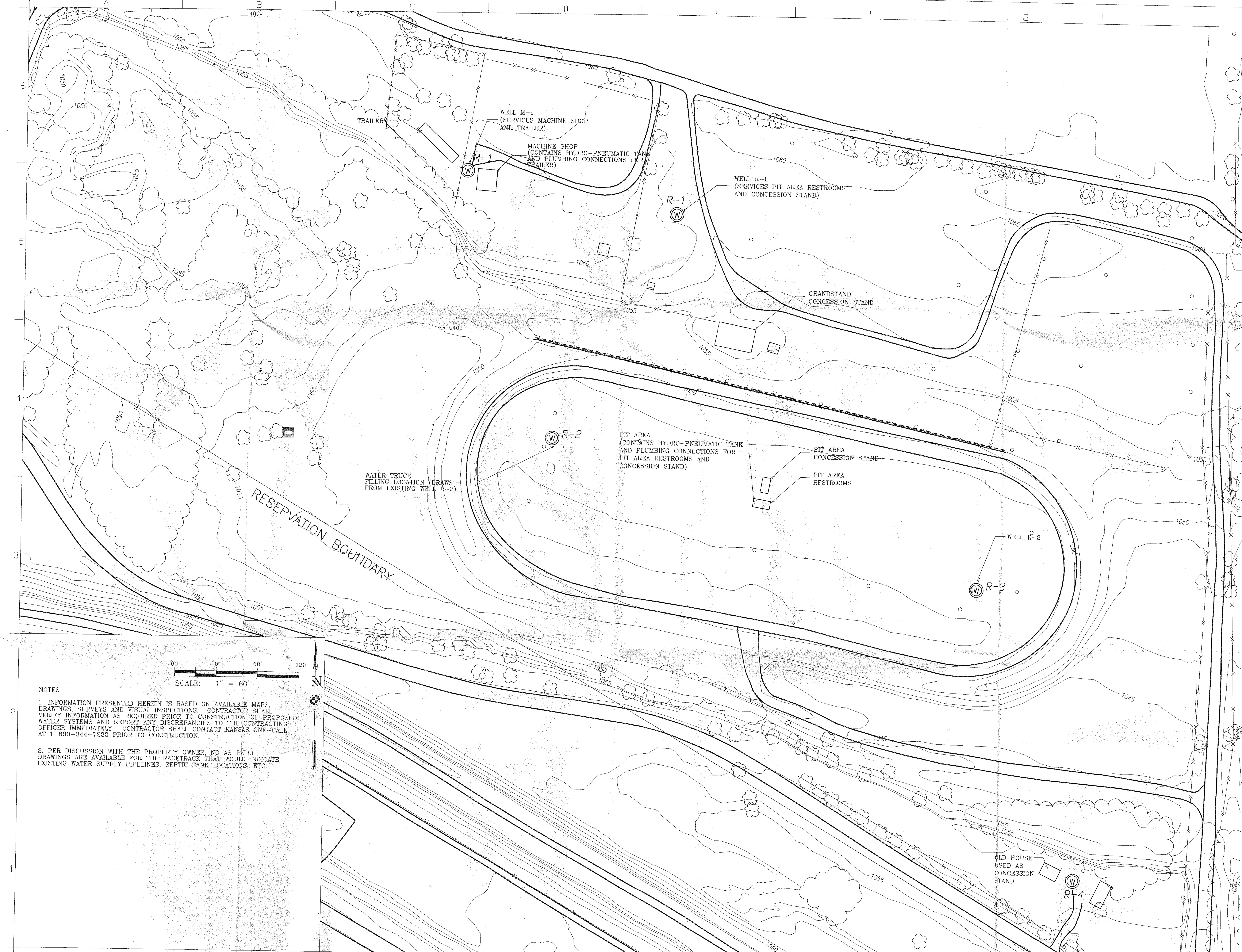
U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

FORT RILEY, KANSAS
OFF-POST ALTERNATE WATER SUPPLY
IFB NO. DACW-41-95-D-0022

INDEX, LEGEND AND GENERAL NOTES

Sheet reference number:

T-2.1



NOTES

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2. PER DISCUSSION WITH THE PROPERTY OWNER, NO AS-BUILT DRAWINGS ARE AVAILABLE FOR THE RACETRACK THAT WOULD INDICATE EXISTING WATER SUPPLY PIPELINES, SEPTIC TANK LOCATIONS, ETC.

US Army Corps of Engineers
Kansas City District

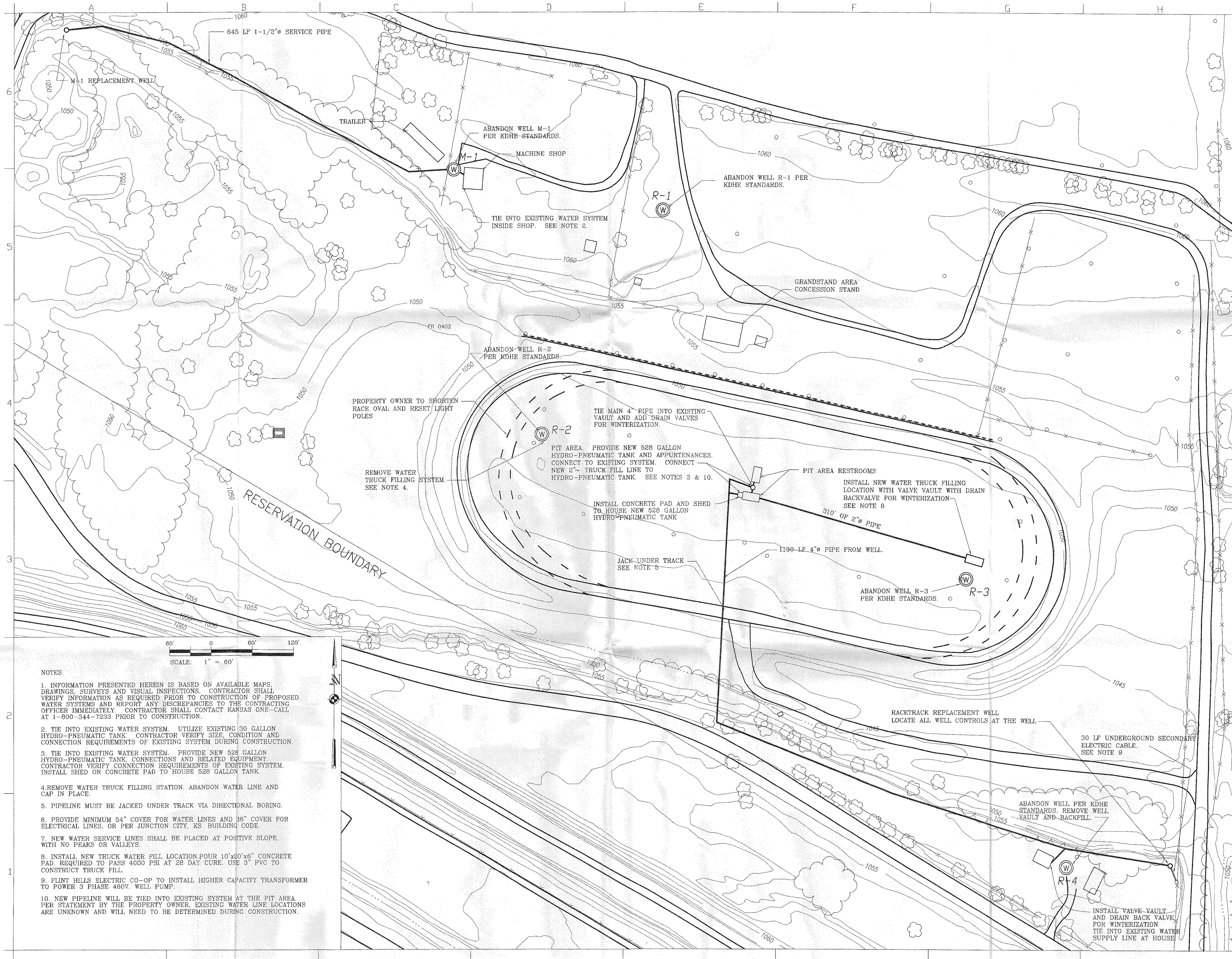
Designed by: RGJ | Date: Sep 1998 | Rev. X
Dwn by: RGJ | Ckd by: TEW | Design file no. X
Reviewed by: ROW | Drawing code: X
Submitted by: WRK | File name: mas1c0101 | Plot date: X | Plot scale: 1"=60'

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

FORT RILEY, KANSAS
OFF-POST ALTERNATE WATER SUPPLY
IFB NO. DACW-41-95-D-0022

EXISTING CONDITIONS

Sheet reference number:
C-1.1



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2. TIE INTO EXISTING WATER SYSTEM. UTILIZE EXISTING 30 GALLON HYDRO-PNEUMATIC TANK. CONTRACTOR VERIFY SIZE, CONDITION AND CONNECTION REQUIREMENTS OF EXISTING SYSTEM DURING CONSTRUCTION.

3. TIE INTO EXISTING WATER SYSTEM. PROVIDE NEW 528 GALLON HYDRO-PNEUMATIC TANK, CONNECTIONS AND RELATED EQUIPMENT. CONTRACTOR VERIFY CONNECTION REQUIREMENTS OF EXISTING SYSTEM. INSTALL SHED ON CONCRETE PAD TO HOUSE 528 GALLON TANK.

4. REMOVE WATER TRUCK FILLING STATION. ABANDON WATER LINE AND CAP IN PLACE.

5. PIPELINE MUST BE JACKED UNDER TRACK VIA DIRECTIONAL BORING.

6. PROVIDE MINIMUM 54" COVER FOR WATER LINES AND 36" COVER FOR ELECTRICAL LINES, OR PER JUNCTION CITY, KS. BUILDING CODE.

7. NEW WATER SERVICE LINES SHALL BE PLACED AT POSITIVE SLOPE, WITH NO PEAKS OR VALLEYS.

8. INSTALL NEW TRUCK WATER FILL LOCATION.POUR 10'x20'x6" CONCRETE PAD. REQUIRED TO PASS 4000 PSI AT 28 DAY CURE. USE 3" PVC TO CONSTRUCT TRUCK FILL.

9. FLINT HILLS ELECTRIC CO-OP TO INSTALL HIGHER CAPACITY TRANSFORMER TO POWER 3 PHASE 480V. WELL PUMP.

10. NEW PIPELINE WILL BE TIED INTO EXISTING SYSTEM AT THE PIT AREA. PER STATEMENT BY THE PROPERTY OWNER, EXISTING WATER LINE LOCATIONS ARE UNKNOWN AND WILL NEED TO BE DETERMINED DURING CONSTRUCTION.

US Army Corps of Engineers
Kansas City District

Symbol	Description	Date	Appr.

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

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Reviewed by: ROW		Drawing code: X	
Submitted by: WRK		File name: maafc0301 Plot date: X Plot scale: 1"=60'	

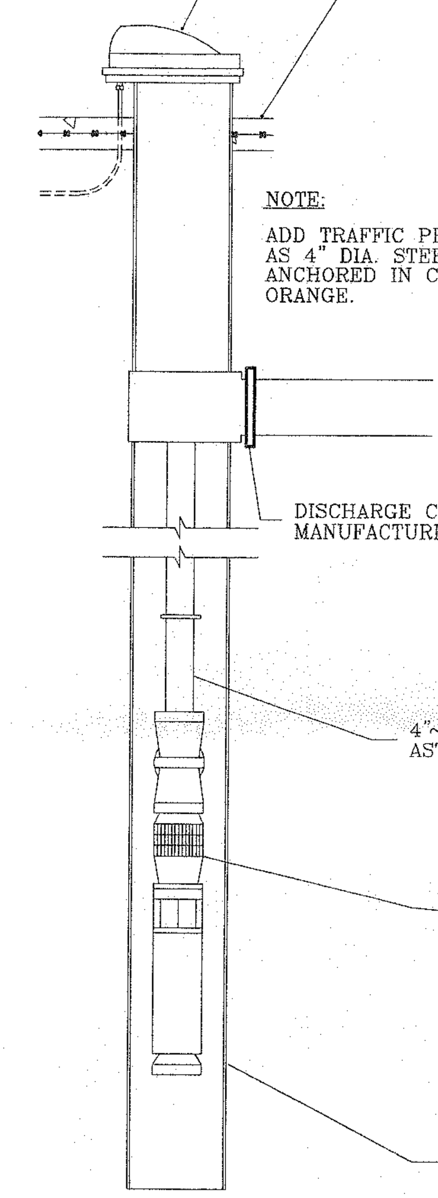
FORT RILEY, KANSAS
OFF-POST ALTERNATE WATER SUPPLY
IFB NO. DACW-41-95-D-0022

SITE PLAN

Sheet reference number:
C-3.1

PITLESS UNIT: BAKER MONITOR PS DOMESTIC WITH CHECK VALVE AND "AT THE WELL" CONTROLS" OR APPROVED EQUAL, DEPTH OF BURY PER MANUFACTURER'S RECOMMENDATION. PROVIDE MINUMUM 54" COVER OVER DISCHARGE.

5' X 5' X 6" THICK CONCRETE PAD WITH W1.4 X W1.4 WELDED WIRE FABRIC



NOTE:
ADD TRAFFIC PROTECTION AROUND RACE TRACK WELL AS 4" DIA. STEEL POSTS. POSTS TO BE 4' HIGH, ANCHORED IN CONCRETE BASES AND PAINTED BRIGHT ORANGE.

DISCHARGE CONNECTION PER MANUFACTURER'S RECOMMENDATION

4"∼ PVC COLUMN PIPE ASTM 1785, SDR 21

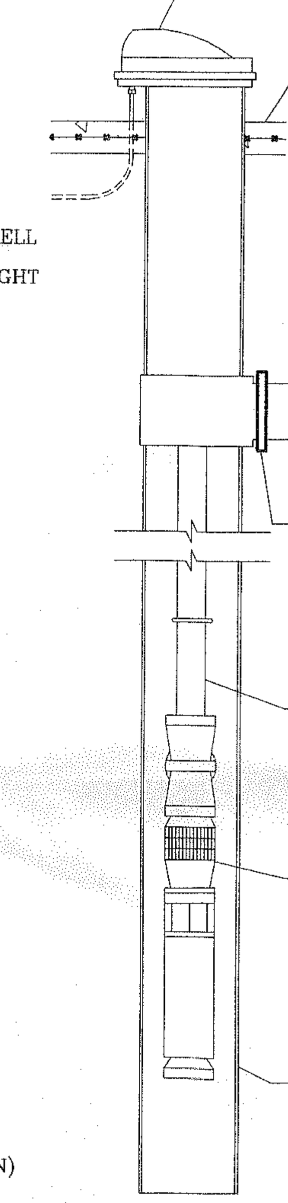
SUBMERSIBLE PUMP / MOTOR RED JACKET MODEL 15HP-3BP OR APPROVED EQUAL

8"I.D. WELL (PER SPECIFICATION)

RACETRACK REPLACEMENT WELL DETAIL
NOT TO SCALE

PITLESS UNIT: BAKER MONITOR PS DOMESTIC WITH CHECK VALVE AND "AT THE WELL" CONTROLS" OR APPROVED EQUAL, DEPTH OF BURY PER MANUFACTURER'S RECOMMENDATION. PROVIDE MINUMUM 54" COVER OVER DISCHARGE.

5' X 5' X 6" THICK CONCRETE PAD WITH W1.4 X W1.4 WELDED WIRE FABRIC



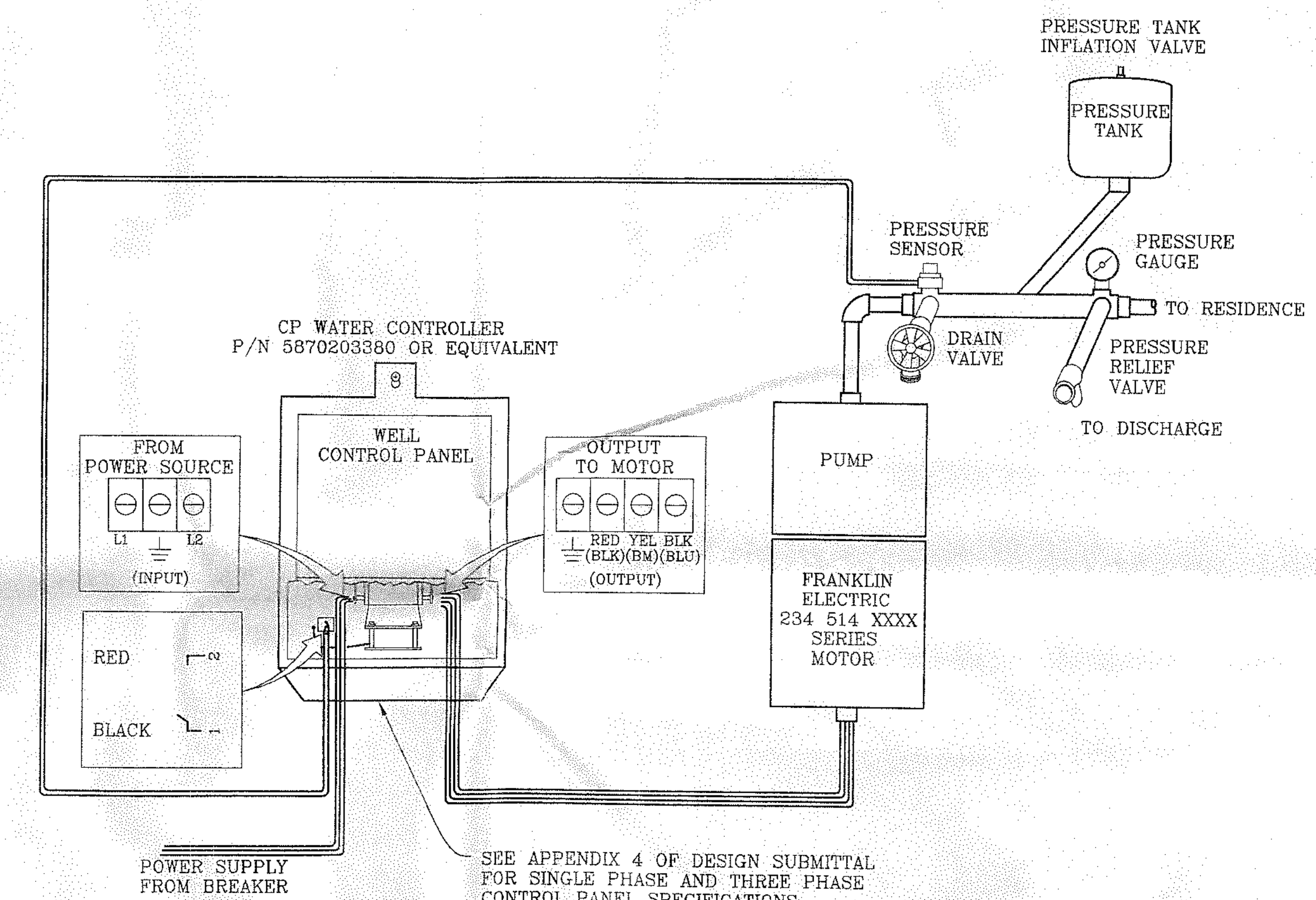
DISCHARGE CONNECTION PER MANUFACTURER'S RECOMMENDATION

1-1/2"∼ PVC COLUMN PIPE ASTM 1785, SCH 80

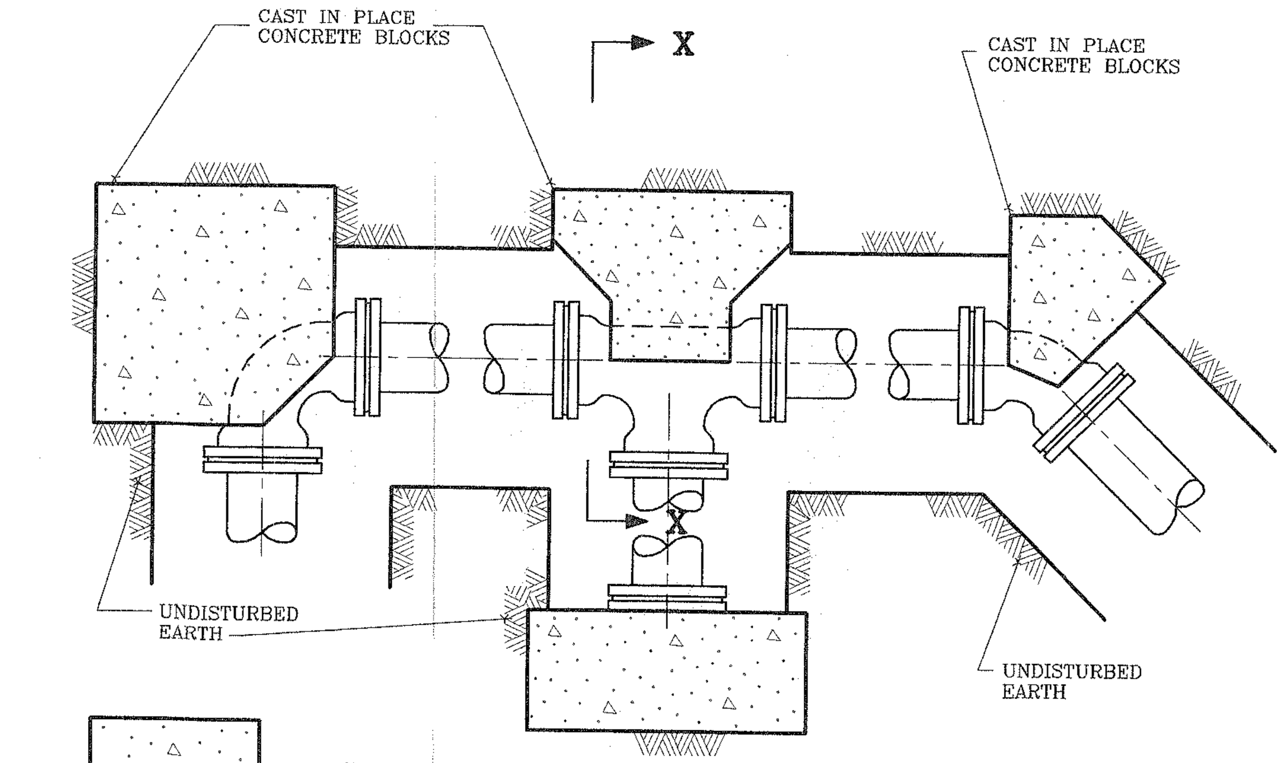
SUBMERSIBLE PUMP / MOTOR RED JACKET MODEL 3/4 HP - 6CC OR APPROVED EQUAL

5"I.D. WELL (PER SPECIFICATION)

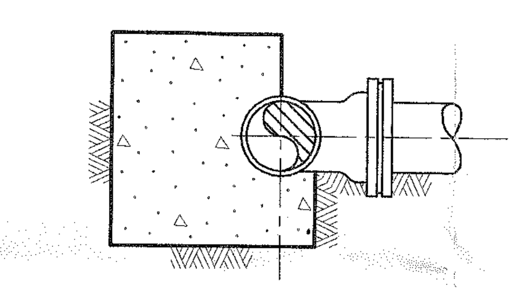
M-1 REPLACEMENT WELL DETAIL
NOT TO SCALE



TYPICAL WELL CONTROL DETAIL
NOT TO SCALE



PLAN



SECTION X

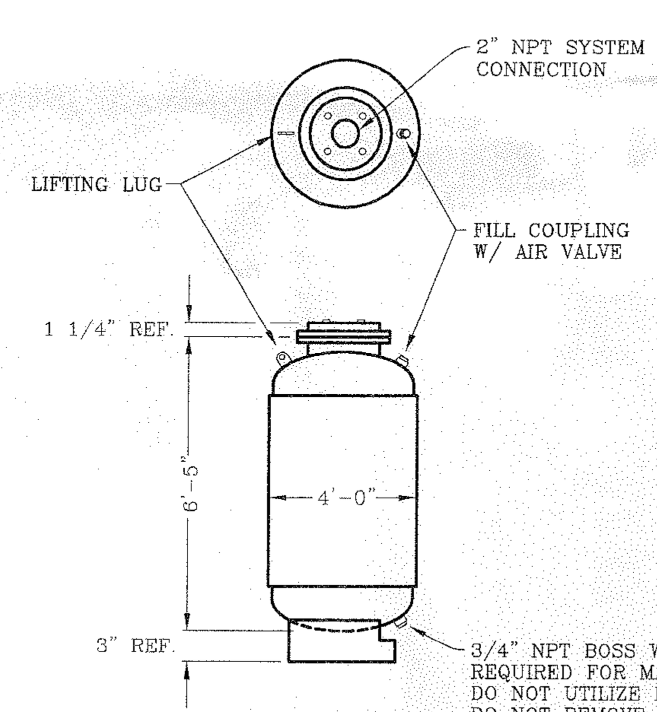
FITTING SIZES	BEARING AREA OF BLOCK IN SQ. FT.				
	TEE, WYE & END	90° BEND	45° BEND	22 1/2° BEND	11 1/4° BEND
4"	1.9	2.7	1.4	.75	.5

NOTE: ABOVE AREAS ARE BASED ON AN ALLOWABLE SOIL BEARING PRESSURES OF 2000 POUNDS PER SQ. FT.

TYPICAL CONCRETE BLOCKING DETAILS
NOT TO SCALE

NOTES:
1. PLACE 4 ml. POLYETHYLENE BETWEEN CONCRETE AND FITTING (CONCRETE SHALL NOT INTERFERE WITH JOINT.)
2. MINIMUM CONCRETE THICKNESS SHALL BE 12"
3. THE HORIZONTAL DIMENSION OF THE BEARING AREA SHALL BE BETWEEN 0.8 AND 1.25 TIMES THE VERTICAL DIMENSION
4. THRUST BLOCK ORIENTATION SHALL BE SUCH THAT THE CENTER OF THE FITTING CORRESPONDS WITH THE CENTER OF THE THRUST BLOCK.
5. THRUST BLOCKS ARE NOT REQUIRED FOR PIPE SIZES SMALLER THAN 4"

TYPE I SERIES
ASME BAG TYPE HYDRO-PNEUMATIC TANK



SPECIFICATIONS

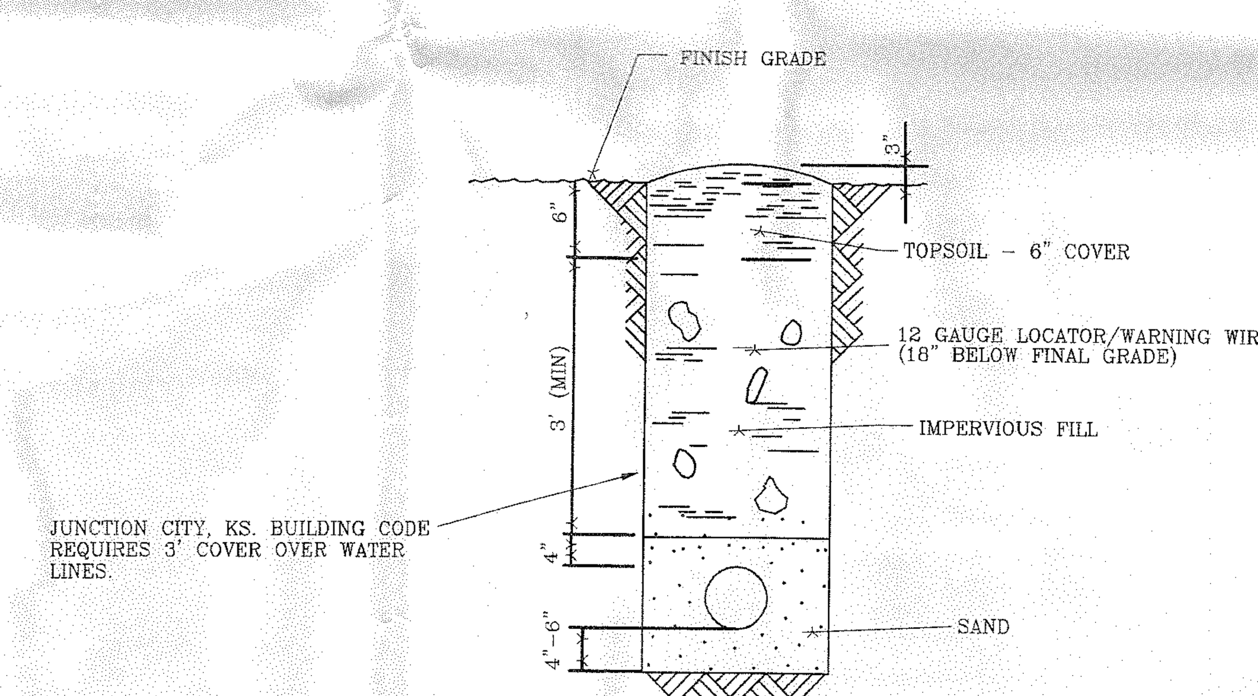
* TYPE DESIGN & CONSTRUCTION: ASME SECTION VIII DIVISION I
* MAXIMUM WORKING PRESSURE: 125 PSI
* MAXIMUM OPERATING TEMPERATURE: 160° F
* FACTORY PRECHARGE: 12 PSI - ADJUSTABLE IN THE FIELD TO A MAXIMUM OF 80 PSI. FOR HIGHER PRECHARGE PRESSURE - CONSULT FACTORY.
* FINISH: GRAY PRIMER
* FOR VERTICAL INSTALLATION ONLY
* FULL COUPLING ADDED TO PROTECT CHARGING VALVE

APPLICATIONS

* FOR USE IN HYDROPNEUMATIC APPLICATIONS
* FDA APPROVED POTABLE MATERIAL
* FOR SIZING TANK - PLEASE REFER TO TECHNICAL BULLETIN 002.
* FOR HYDRONIC EXPANSION AND NON-POTABLE HYDRO-PNEUMATIC APPLICATIONS, USE JBER SERIES - SPECIFICATION SHEET 615.
* FOR HIGHER TEMPERATURE POTABLE HYDRO-PNEUMATIC TANK, USE JWTA SERIES - SPECIFICATION SHEET 699B.

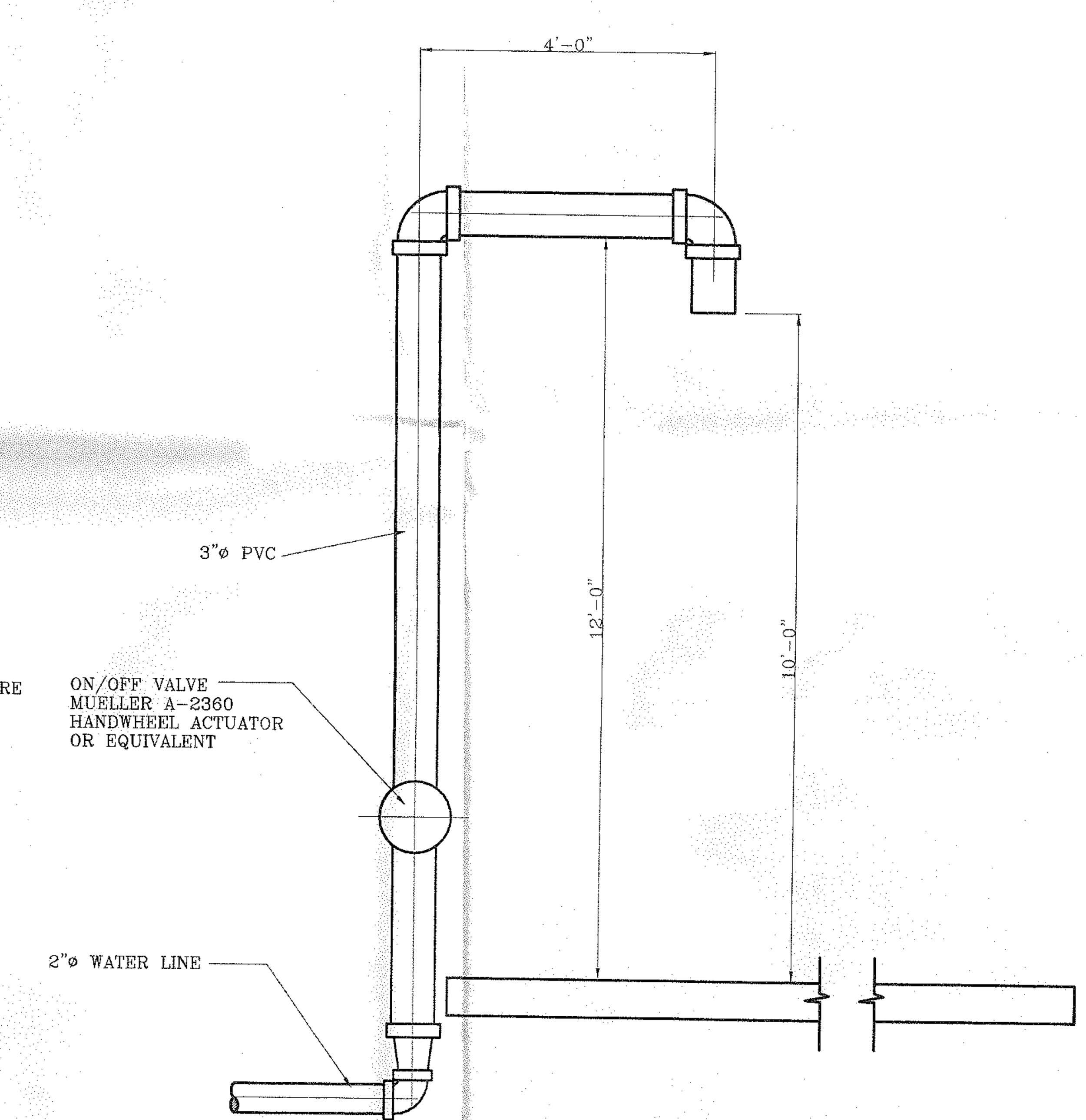
528 GALLON HYDRO-PNEUMATIC TANK DETAIL
NOT TO SCALE

NOTE:
TANK TO BE INSTALLED ON A 10'x10'x6" CONCRETE PAD ADJACENT TO THE WESTERN WALL OF THE PIT AREA RESTROOM BUILDING. AN 8'x8'x8' BARON STORAGE BUILDING WILL BE INSTALLED TO PROTECT THE TANK. BUILDING SPECIFICATIONS ARE INCLUDED IN APPENDIX 4 OF THE DESIGN SUBMITTAL.



TYPICAL TRENCH DETAIL
NOT TO SCALE

NOTE:
MATCH SURROUNDING GRADE AND SURFACING FOR ROAD AND RACETRACK CROSSINGS.



TRUCK FILL STATION
NOT TO SCALE

NOTES:
1. 10' x 20' x 6" CONCRETE PAD 4000 PSI COMPRESSION STRENGTH @ 28 DAYS
2. 12" SPACING/CENTERS ON REBAR
3. MUELLER VALVE, SELF DRAINING FOR FREEZE PROTECTION

US Army Corps of Engineers
Kansas City District

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Designed by: RGJ | Dwn by: RGJ | Ckd by: TEW | Reviewed by: ROW | Submitted by: WRK
Date: Sep 1998 | Rev. X | Design file no. X | Drawing code: X | File name: mmaf00601 | Plot date: X | Plot scale: 1=8'

FORT RILEY, KANSAS
OFF-POST ALTERNATE WATER SUPPLY
IFB NO. DACW-41-95-D-0022

DETAILS

Sheet reference number:
C-6.1

APPENDIX 2

SPECIFICATIONS

1. Section 01330 Submittal Procedures
2. Section 02316 Excavation and Backfill for Utilities Systems
3. Section 02510 Water Supply Systems
4. Section 02521 Water Well Construction
5. Section 11212 Pumps
6. Section 15400 Plumbing General Purpose
7. Section 16415 Electrical Work, Interior

Section 01330
Submittal Procedures
9/97

1. GENERAL

1.1 SUBMITTAL IDENTIFICATION

Submittals required are identified by SD numbers as follows:

SD-01 Data
SD-04 Drawings
SD-06 Instructions
SD-07 Schedules
SD-08 Statements
SD-09 Reports
SD-13 Certifications
SD-14 Samples
SD-18 Records
SD-19 Operations and Maintenance Manuals

1.2 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.2.1 Government Approved

Governmental approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. They are considered to be "shop drawings".

1.2.2 Information Only

All submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings".

1.3 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which can exist, as the Contractor under the CQC requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.4 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the Contracting Officer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change of the contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Contracting Officer.

1.5 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

2. PRODUCTS (NOT APPLICABLE)

3. EXECUTION

3.1 GENERAL

The Contractor shall make submittals as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determinations of compliance with contract requirements. Prior to submittal, all items such as: Contractor's Quality Control (CQC) representative and each item shall be stamped, signed, and dated by the CQC representative indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts lists); certifications; warranties; and other such required submittals. Submittals requiring Government approval shall be scheduled and made prior to the acquisition of the material of equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

3.2 SUBMITTAL REGISTER (ENG FORM 4288)

At the end of this section is one set of ENG FORM 4288 listing items of equipment and materials for which submittals are required by the specifications; this list may be all inclusive and additional submittals may be required. Columns “d” through “r” have been completed by the Government; the Contractor shall complete columns “a” and “s” through “u” and submit the forms to the Contracting Officer for approval register will become the scheduling document and will be used to control submittals throughout the life of the contract. The submittal register and the progress schedule shall be coordinated.

3.3 SCHEDULING

Submittals covering component item forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of 30 calendar days exclusive of mailing time) shall be allowed and shown on the register for review of approval. No delays damages or time extensions will be allowed for time in late submittals.

3.4 TRANSMITTAL FORM (ENG FORM 4025)

The sample transmittal form (ENG FORM 4025) attached to this section shall be used for submitting both Government approved and information only submittals in accordance with the instructions on the reverse side of the form. These forms will be furnished to the Contractor . This form shall be properly completed by filling out all the heading blank spaces and identifying each item submitted. Special care shall be exercised to ensure proper listing of the specifications paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

3.5 SUBMITTAL PROCEDURE

Submittals shall be made as follows:

3.5.1 Procedures

The Contractor shall submit for approval nine (9) copies of all submittals. The mailing address for these submittals shall be obtained at the preconstruction conference. Items not to be submitted as described above are samples and test cylinders, and shall be submitted accompanied by nine (9) copies of ENG FORM 4025. Thirteen (13) copies of all final submittals will be delivered as specified. Items are to be sent to:

Document Distribution List
Water Distribution and Well Installation
Fort Riley, Kansas

Addressee	Number of Copies (1) 95%	100%
Commander USACE, Kansas City District ATTN: CENWK-PM-ED (R. Van Saun) 601 East 12th Street Kansas City, Missouri 64106-2896	3	3
Fort Riley Area Office U.S. Army Corps of Engineers P.O. Box 2189 Fort Riley, Kansas 66442-6016	3	3
Directorate of Environmental & Safety ATTN: AFZN-ES-OM Building 407, Main Post Fort Riley, Kansas 66442-6016	3	3
Craig Bernstein, Remedial Project Manager U.S. Environmental Protection Agency, Region VII Removal Enforcement Section, Superfund Division Assessment & Restoration Section, Superfund Unit 901 North 5th Street Kansas City, Kansas 66101		2
Rob Weber Kansas Department of Health and Environment Bureau of Environmental Remediation 1000 Southwest Jackson Suite 410 Topeka, Kansas 66612-1367		2

3.5.2 Deviations

For submittals which included proposed deviations requested by the Contractor, the column "variation" of ENG FORM 4025 shall be checked. The annotate such deviations on the submittal. The Government reserved the right to rescind inadvertent approval of submittals containing unnoted deviations.

3.6 CONTROL OF SUBMITTALS

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register".

3.7 GOVERNMENT APPROVED SUBMITTALS

Upon completion of review of submittals requiring Government approval, the submittals will be identified as having received approval by being so stamped and dated. Four copies of the submittal will be retained by the Contracting Officer and one copy of the submittal will be returned to the Contractor.

3.8 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirements to furnish samples for testing by the Government laboratory or the check testing by the Government in those instances where the technical specifications so prescribe.

3.9 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

CONTRACTOR:

Bay West, Inc.

CONTRACT NUMBER

TRANSMITTAL NUMBER ______

ITEM NUMBER ______

SPECIFICATION SECTION ______

PARAGRAPH NUMBER ______

______ APPROVED AS SUBMITTED

______ APPROVED WITH CORRECTIONS AS NOTED

SIGNATURE: ______

TITLE: ______

DATE: ______

SUBMITTAL REGISTER	CONTRACT NO. DACW41-95-D-0022

TITLE AND LOCATION	CONTRACTOR	SPECIFICATION SECTION
OFF-POST ALTERNATE WATER SUPPLY, FORMER FIRE TRAINING AREA, FORT RILEY, KANSAS	BayWest	02316

				TYPE OF SUBMITTAL									CLASSIFICATION			CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		
TRANSMITTAL NUMBER	ITEM NUMBER	SPECIFICATION PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	DATA	DRAWINGS	INSTRUCTIONS	SCHEDULES	STATEMENTS	REPORTS	CERTIFICATES	SAMPLES	RECORDS	INFORMATION ONLY	GOVERNMENT APPROVAL	REVIEWER	SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	CODE	DATE	SUBMIT TO GOVERNMENT	CODE	DATE	REMARKS
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p*	q	r	s	t	u	v	w	x	y
		1.3	Field Density Tests						x				FIO		RE									
		1.3	Testing of Backfill Materials						x				FIO		RE									

ENG FORM 4288, (KCD ELECTRONIC VERSION, Feb, 94) *EP=ENG DIV, EP-D GL=ENG DIV, EP-GL RE=RESIDENT ENG AE=ARCHITECT/ENG FIRM

SUBMITTAL REGISTER	CONTRACT NO. DACW41-95-D-0022

TITLE AND LOCATION	CONTRACTOR	SPECIFICATION SECTION
OFF-POST ALTERNATE WATER SUPPLY, FORMER FIRE TRAINING AREA, FORT RILEY, KANSAS	BayWest	02510

				TYPE OF SUBMITTAL									CLASSIFICATION			CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		
TRANSMITTAL NUMBER	ITEM NUMBER	SPECIFICATION PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	DATA	DRAWINGS	INSTRUCTIONS	SCHEDULES	STATEMENTS	REPORTS	CERTIFICATES	SAMPLES	RECORDS	INFORMATION ONLY	GOVERNMENT APPROVAL	REVIEWER	SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	CODE	DATE	SUBMIT TO GOVERNMENT	CODE	DATE	REMARKS
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p*	q	r	s	t	u	v	w	x	y
		1.4	Manufacturer's Data	x										GA	PE									Incomplete submittals will be rejected.
		1.4	Satisfactory Installation					x						FIO	RE									
		1.4	Bacteriological Disinfection						x					FIO	RE									

SUBMITTAL REGISTER

CONTRACT NO.
DACW41-95-D-0022

TITLE AND LOCATION

OFF-POST ALTERNATE WATER SUPPLY, FORMER FIRE TRAINING AREA, FORT RILEY, KANSAS

CONTRACTOR

BayWest

SPECIFICATION SECTION
02521

				TYPE OF SUBMITTAL									CLASSIFICATION			CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		
TRANSMITTAL NUMBER	ITEM NUMBER	SPECIFICATION PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	DATA	DRAWINGS	INSTRUCTIONS	SCHEDULES	STATEMENTS	REPORTS	CERTIFICATES	SAMPLES	RECORDS	INFORMATION ONLY	GOVERNMENT APPROVAL	REVIEWER	SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	CODE	DATE	SUBMIT TO GOVERNMENT	CODE	DATE	REMARKS
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p*	q	r	s	t	u	v	w	x	y
		1.3.2.1	Work Plan	x										GA	PE									
		1.3.2.2	Test Reports						x					GA	PE									
		1.3.2.3	Records									x		GA	PE									

ENG FORM 4288, (KCD ELECTRONIC VERSION, Feb, 94) *EP=ENG DIV, EP-D GL=ENG DIV, EP-GL RE=RESIDENT ENG AE=ARCHITECT/ENG FIRM

Section 02316

Excavation, Trenching, and Backfilling for Utilities Systems
11/97

1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designated only.

American Society for Testing and Materials (ASTM)

ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m))
ASTM D 2487	(1993) Classifications of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1998; R 1993) Water content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.2 DEGREE OF COMPACTION

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 Submittal Procedures:

SD-09 Reports
Field Density Tests, FIO-RE. Testing of Backfill Materials; FIO-RE.

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

2. PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, SP-SM, SP-SC, CL, ML, CL-ML, CH, MH.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include manmade fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 2 inches. The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials shall include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM shall be identified as cohesionless only when the fines are nonplastic.

2.1.4 Rock

Rock shall consist of boulders measuring ½ cubic yard or more and materials that cannot be removed without systematic drilling and blasting such as rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits, and below ground concrete or masonry structures, exceeding ½ cubic yard in volume, except that pavements shall not be considered as rock.

2.1.5 Unyielding Materials

Unyielding material shall consist of rock and gravelly soils with stones greater than 2 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.1.6 Unstable Material

Unstable material shall consist of material too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.1.7 Select Granular Material

Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a No. 200 mesh sieve and no less than 95 percent by weight passing the 1 inch sieve. The maximum allowable aggregate size shall be ¾ inch, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.1.8 Initial Backfill Material

Initial Backfill shall consist of select granular material or satisfactory materials free from rocks 2 inches or larger in any dimension or free from rocks of such size as recommended by the price manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than 2 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

2.2 PLASTIC MARKING TAPE

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6 inches wide with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape/Wire color shall be as specified in Table 1 and shall be marked with a continuous printed inscription describing the specific utility. In addition 12-gauge tracer wire will be used to mark the newly installed water lines.

Table 1. Tape/Wire Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

3. EXECUTION

3.1 EXCAVATION

Excavation shall be preformed to the lines and grades indicated. Rock excavation shall include removal and disposition of material defined as rock in paragraph MATERIALS. Earth excavation shall include removal and disposal of material not classified as rock excavation. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to ½ depth of the excavation, but in no instance closer than 2 feet. Excavated material not required or not satisfactory for backfill shall be removed from the site. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph Backfilling and Compaction at no additional cost to the Government.

3.1.1 Trench Excavation Requirements

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls mot than feet 3 high shall be shored, cut back to a stable slop, or provided with equivalent means of protective for employees who may be exposed to moving ground or cave in. Vertical trench walls more than 3 feet high shall be shored. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes that may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

3.1.1.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 2 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.1.1.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 4 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.1.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Governments.

3.1.1.4 Excavation of Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in a excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.1.1.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.1.2 Stockpiles

Stockpiles of satisfactory and wasted materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well-drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination that may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government. Locations of stockpiles of satisfactory materials shall be subject to prior approval of the Contracting Officer.

3.2 BACKFILLING AND COMPACTION

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for the other hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

3.2.1 Trench Backfill

Trenches shall be backfilled to match surrounding grades. The trench shall be backfilled to two feet above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

3.2.1.1 Replacement of Unyielding Materials

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.2.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

3.2.1.3 Bedding and Initial Backfill

Initial backfill material shall be placed and compacted with approved tampers to a height of at lease one-foot above the utility pipe or conduit. The backfill shall be bought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.2.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways, railroads and airfields, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

a. Roadways, Railroads, and Airfields: Backfill shall be placed up to the elevation at which the requirements in Section 02300 EARTHWORK CONTROL. Water flooding or jetting methods of compaction will not be permitted.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 12 inch loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesiveless soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

3.2.2 Backfill for Appurtenance

After the manhole, catch basin, inlet, or similar structure has been constructed backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be bought up evenly on all sided of the structure to prevent eccentric loading and excessive stress.

3.3 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.3.1 Water Lines

Trenches shall be of a depth to provide a minimum cover of 3 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. This requirement is per Junction City, KS building code.

3.3.2 Plastic Marking Tape

Warning tapes shall be installed directly about the pipe, at a depth of 18 inches below finished grade unless otherwise shown.

3.4 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

3.4.1 Testing Facilities

Tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved by the Contracting Officer. The first inspection shall be at the expense of the Government. Cost incurred for any subsequent inspection required because of failure of the first inspection will be charged to the Contractor.

3.4.2 Testing of Backfill Materials

Characteristics of backfill materials shall be determined in accordance with particle size analysis of soils ASTM D 422 and moisture-density relations of soil ASTM D 1557. A minimum of one particle size analysis and one moisture-density relation test shall be performed on each different type of material used for bedding and backfill.

3.4.3 Field Density Tests

Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 500 feet of installation shall be performed. Two additional tests shall be performed at the racetrack crossing. One moisture density relationship shall be determined for every 1500 cubic yards of material used. Field in-place density shall be determined in accordance with ATSM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using the sand cone method as described in paragraph Calibration of the ASTM publications. ASTM D 2922 results in a wet unit weight of soil and when using the method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contracting Officer. Copies of calibration curves, results of calibration tests, and field and laboratory density test shall be furnished to the Contracting Officer. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at not additional cost to the Government.

Section 02510

Water Supply Systems
04/98

1 General

1.1 References

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

American Society for Testing and Materials (ATSM)

ASTM D 1784	(1996) Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVS) Compounds
ASTM D 1785	(1996a) Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, 120
ASTM D 2241	(1996a) Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR Series)
ASTM D 2464	(1996a) Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1996a) Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1996a) Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1996a) Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe Systems
ASTM D 2774	(1994) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
ASTM F 477	(1995) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

	American Society of Mechanical Engineers (ASME)
ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
	American Water Works Association (AWWA)
AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA ANSI/AWWAC104/A21.4	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA ANSI/AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 1 In. through 48 In. (75 # mm through 1200 # mm), for Water and Other Service Liquids
AWWA ANSI/AWWA C111/A21.11	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA ANSI/AWWA C153/A21.53	(1994; Errata Nov 1996) Ductile-Iron Compact Fittings, 3 In. Through 24 In. (76 mm through 610 mm) and 54 In. through 64 in. (1,400 mm through 1,600 mm) for Water Service Liquids
AWWA C651	(1992) Disinfecting Water Mains
AWWA C900	(1989; C900a) Polyvinyl Chloride (PVC) Pressure Pipes, 4 In. through 12 In., for Water Distribution
AWWA M23	(1980) Manual: PVC Pipe –Design and Installation
NSF International (NSF)	
NFS ANSI/NSF 14	(1996) Plastics Piping Components and Related Materials.

NSF ANSI/NSF 61	(1997a) Drinking Water System Components-Health Effects (Sections 1-9)

1.2 PIPING

This section covers service lines, and connections to building service. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all time.

1.2.1 Service Lines

Piping for water service lines shall be polyvinyl chloride (PVC) plastic, unless otherwise shown or specified.

1.2.2 Potable Water Lines

Piping and components of potable water systems that come in contract with the potable water shall conform to NSF ANSI/NSF 61.

1.2.3 Plastic Piping System

Plastic piping system components intended for transportation of potable water shall comply with NSF ANSI/NSF 14 and be legibly marked with their symbol.

1.2.4 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

1.3 RELATED EQUIPMENT

Pumps, pitless units, pressure tanks, valves, controls, switches and other related equipment shall be as shown on the drawings. Shop drawing submittals shall include information for all related equipment, including equipment required or shown on the drawings but not specifically identified in this specification section, to clearly illustrate how each piece of equipment will function in the system.

1.4 SUBMITTALS

The Contractor shall submit all items designated with a GA-PE, including product literature, calculations, component data, certificates, diagrams and drawings, concurrently as a complete system submittal package. Omission of any required submittal item from the package shall be sufficient cause for disapproval of the entire submittal. Unless otherwise indicated in the submittal review commentary, disapproval of any item within the package shall require a re-submittal of the entire system package, in which all deficiencies shall be corrected.

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURE.

SD-01 Data

Manufacturer's Data; GA-PE.

The manufacturer's cut sheets, engineering data and installation recommendation's for each complete potable water system, including pumps, piping, pressure tanks, pitless units and all related equipment. Pump curves, calculations and applicable drawings or schematic showing equipment layouts shall be included.

SD-08 Statements

Satisfactory Installation; FIO-RE.

A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the correct drawings and specifications, and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

SD-09

Bacteriological Disinfection; FIO-RE.

Test results from commercial laboratory verifying disinfection.

1.5 HANDLING

Pipe and accessories shall be handled to ensure delivery to the trench in sound, undamaged condition, including no injury to the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor in a satisfactory manner, at no additional cost to the Government. No other pipe or material shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

1.5.1 Miscellaneous Plastic Pipe and Fittings

Polyvinyl chloride (PVC pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations.

2. PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 PLASTIC PIPE

2.1.1.1 PVC Plastic Pipe

Pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

a. Pipe less than 4 In. Diameter:

   (1) Screw-Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 80, with joints meeting requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified. Pipe couplings when used, shall be tested as required by ASTM D 2464.

   (2) Elastomeric-Gasket Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 40, with joints meeting requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified, or it may be pipe conforming to requirements ASTM D 2241, elastomeric joint, with the following applications:

SDR	Maximum Working Pressure psi	Minimum Hydrostatic Pressure psi
26	100	133
21	120	160
17	150	200
13.5	200	266

(3) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure.

b. Pipe 4 through 12 inch Diameter: Pipe, couplings and fittings shall conform to AWWA C900, Class 190, CIOD pipe dimensions, elastomeric-gasket joint, unless otherwise shown or specified.

2.2 FITTINGS AND SPECIALS

2.2.1 PVC Pipe System

(a) For pipe less than 4 inches in diameter, fittings for threaded pipe shall conform to requirements of ASTM D 2464, threaded to conform to the requirements of ASME B1.20.1 for use with Schedule 80 pipe and fittings, fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467; and fittings for elastomeric-gasket joint pipe shall be iron conforming to AWWA ANSI/AWWA C110/A21.10 or AWWA ANSI/AWWA C111/A21.11. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA ANSI/AWWA C104/A21.4.

(b) For pipe 4 inches in diameter and larger, fittings and specials shall be iron, bell end in accordance with AWWA ANSI/AWWA C110/A21.10, 150 psi pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or fittings and special dimensions as required by the pipe manufacturer; or fittings and special dimensions as required by the pipe manufacturer; or fittings and specials may be of the same material as the pipe with elastomeric gasket, all in conformance with AWWA C900. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA ANSI/AWWA C104/A21.4. Fittings shall be bell and spigot or plain end pipe, or as applicable. Ductile iron compact fittings shall be in accordance with AWWA ANSI/AWWA C153/A21.53.

2.3 JOINTS

2.3.1 Plastic Pipe Jointing

2.3.1.1 PVC Pipe

Joints, fittings, and couplings shall be as specified for PVC pipe. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendations, and as approved by the Contacting Officer.

2.4 Miscellaneous Items

2.4.1 Disinfection

Chlorinating materials shall conform to all following:

Chlorine, Liquid: AWWA B301

Hypochlorites, Calcium and Sodium: AWWA B300.

3. EXECUTION

3.1 INSTALLATION

3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly dimensionally defined on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from the sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe, for a distance of at least 10 feet each side of the crossing, shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

3.1.3 Joint Deflection

3.1.3.1 Offset for Flexible Plastic Pipe

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contacting Officer, but shall not exceed 5 degrees.

3.1.4 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Water-line materials shall not be dropped or dumped into the trench. Abrasion of the pipe coating shall be avoided. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by and at the Contractor's expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

3.1.4.1 Plastic Pipe Installation

PVC pipe shall be installed in accordance with AWWA M23.

3.1.4.2 Piping Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed using standard methods as approved by the Contracting Officer.

3.1.4.3 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.5 Jointing

a. Pipe less than 4 inch diameter: Threaded joints shall be made by wrapping the male threads with approved thread tape or applying an approved lubricant, then threading the joining members together. The joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with ASTM F 477 and as specified. Pipe ends for push-on joints shall be beveled to facilitate assembly and marked to indicate when the pipe is fully seated. The gasket shall be prelubricated to prevent displacement. The gasket and ring groove in the bell or coupling shall match. The manufacturer of the pipe and fittings shall supply the elastomeric gasket. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall use sockets conforming to ASTM D 2467. The solvent cement used shall meet the requirements of ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specific recommendations.

b. Pipe 4 through 12-inch diameter: Joints shall be elastomeric gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 4-inch diameter with configuration using elastomeric ring gasket.

3.1.5.2 Transition Fittings

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

3.1.6 Installation of Service Lines

Service lines shall be constructed as shown on the drawings.

3.1.7 Thrust Restraint

Plugs, caps, tees and bends deflecting 11.25 degrees or more, either vertically or horizontally, on waterlines 4 inch in diameter or larger, and fire hydrants shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be thrust blocks.

3.1.7.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 1 ½ sand, 5 gravel, and having a compressive strength of not less than 2,000 psi after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed the base and thrust bearing sides of the thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.2 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking for fittings or hydrants, the hydrostatic tests shall not be made until at lease 5 days after installation of the concrete thrust blocking, unless otherwise approved.

3.2.1 Pressure Test

After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Water supply lines designated on the drawings shall be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

a. Wet or unstable soil conditions in the trench.

b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.

c. Maintaining the trench in an open condition would delay completion of the project.

The Contractor may request a waiver, setting forth in writing the reasons for he request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactory completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than 200 psi pressure. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section, necessary to maintain pressure within 5 psi or the specified leakage test pressure after the pipe has been filled with water and the air expelled. Piping installation will not be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

L= 0.0001351ND (P raised to 0.5 power)

L= Allowable leakage in gallons per hour
N= Number of joints in the length of pipeline tested
D= Nominal diameter of the pipe in inches
P= Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

3.2.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

3.2.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be as specified. Replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

a. Pressure test and leakage test may be conducted concurrently.

b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

3.3 DISINFECTION

3.3.1 Bacteriological Disinfection

Before acceptance of potable water operation, the waterline shall be disinfected as prescribed by AWWA C651. Personnel from the Contractor's commercial laboratory shall take at least 3 water samples in proper sterilized containers and perform a bacterial examination in accordance with state's approving authority for examination of potable water. The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

3.3.2 Lead Residual

Following the bacteriological disinfection and testing, the system shall be flushed with a sufficient velocity of water and sufficient tests performed at each hot and cold water discharge point until no more than 15 ppb lead residuals remain in the system. All tests and samples shall be performed in accordance with state and, if applicable, Federal regulations. Sample for testing are to be collected after a 6 hour continuous period of no flushing, and will be considered first draw samples. The commercial laboratory shall be certified by the state's approving authority for examination of potable water. Lead residual test results shall be submitted to the Contracting Officer. The system will not be accepted until satisfactory bacteriological results and lead residual test results have been obtained. All flushing and testing for lead residuals, including all costs, are the responsibility of the Contractor.

3.4 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

Section 02521

Water Well Construction

1. GENERAL

1.1 SCOPE

This section covers pilot holes drilling and sampling, construction of two water wells, abandonment and plugging five existing wells, complete.

1.2 APPLICATION PUBLICATIONS

The following publications of the issues listed below, but referred to hereafter by basic designation only, form a part of this specification to the extent indicated by the referenced thereto:

1.2.1 American Society for Testing and Materials (ASTM)

D422-63	Method for Particle-Size Analysis of Soils.
F480	Specification for Thermoplastic Water Well Casing pipe and Couplings Made in Standard Dimension Ratio (SDR).
D 1785-88	Standard Specification for Poly (VinylChloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
C150	Portland Cement

1.2.2 American Water Works Association (AWWA)

AWWA –1	(1985, 16th Ed.) Standard Method for Examination of Water and Wastewater.
AWWA A100	(1984) Water Wells
AWWA B300	(1987) Hypochlorites

1.2.3 Kansas State Department of Health and Environment (KDHE)

B-1-15	Policies Governing the Design of Public Water Supply System
Article 12	Groundwater Exploration and Protection Act and Plugging Packet

1.3 GENERAL

1.3.1 Contractor Responsibilities

The responsibilities of the Contractor include: Drilling and sampling the pilot holes; testing the samples and final design of the water wells; drilling and installing the water wells; water wells development; and pump testing.

1.3.2 Submittals

The following shall be submitted as submittals:

1.3.2.1 Work Plan

Before beginning work, the Contractor shall submit for review his proposed plan for drilling and constructing water wells and pilot holes. The plan shall include, but not limited to, the proposed method of drilling and sampling, equipment to be used, details of proposed test on soil samples, details of proposed casing, well screen, grouting materials, gravel pack material and method of placing gravel pack, methods and equipment proposed for developing the well, sand content testing, plumbness testing, and for performing pump test. No work shall be performed until the drilling plan has been reviewed and any comments have been answered to the Government satisfaction. No deviation from the drilling plan will be permitted without approval of the Contracting Officer. The work plan shall comply with policies established by the state of Kansas for drilling and constructing domestic drinking water supply wells. The Contractor shall submit details of specific methods to be employed to control potential contamination for pollution arising from well installation activities.

1.3.2.2 Test Reports

Submittals shall be as specified in paragraph 1.3.3.3: Sampling and Testing, paragraph 1.3.8.3: Testing.

1.3.2.3 Records

The Contractor shall be responsible for obtaining all permits, licenses, or other requirements necessary for protection of the work. A copy of all such documents shall be furnished to the Contracting Officer. Before beginning work, appropriate local and state agencies shall be notified. In addition, the Contractor shall notify the appropriate State agency (ies) that wells will be abandoned, and submit the appropriate documentation to the state. A copy of all such correspondence shall be furnished to the Contracting Officer. During the drilling of the well holes an include depths, elevations, and description of all formations encountered, identification of each stratum according to the Unified Soil Classification System, or standard rock nomenclature, as necessary. The Contractor shall prepare a graphic boring log to scale showing the required details. Five prints of the drawings shall be submitted to the Contracting Officer.

1.3.3.1 General

The Contractor shall be licensed as a water well driller in the state of Kansas, with proven ability and skill in water well installation in unconsolidated sand and gravel aquifers. The Contractor shall submit evidence that he has been engaged in the successful completion of a water well contract. The Constructor shall perform all quality control inspection, sampling, and testing of filter pack material. The Contractor shall take any actions necessary to comply with the Technical Provisions of the specification and submit required reports to substantiate his compliance.

1.3.3.2 Inspection

The Contractor's quality control organization shall be responsible for observation and compliance to technical specifications on all water well operations including, but not limited to, the following: Survey for elevations, materials, drilling method, joints, bottom plug, materials storage, well screen, well pipe assembly and installations, backfilling, cleaning, development, pumps, pump testing, control of drilling fluids and wells effluents, restoration of construction area, and safety. Completed wells shall be protected against damage and contamination. The detailed inspection may be assigned to the foreman supervising the work. All contractual work shall be performed in the presence of a Government quality assurance inspector. At least 5 days in advance of the work, the Contractor shall provide the Contracting Officer with a detailed schedule including the dates, shift times, number of shifts and number of sampling rigs to be utilized, to ensure the availability of adequate Government Quality Assurance (QA) Personnel.

1.3.3.3 Sampling and Testing

The Contractor's quality control organization shall verify that the well pipe and screen conform to the specifications before delivery to the project. The particle-size distribution of the filter pack shall be sampled and tested by the Contractor using U.S. Standard Sieves. The filter pack shall be sampled from the material stockpiles at the project, tested, and the results submitted to the Government Inspector a minimum of 48 hours before being used in water well construction. Filter pack stockpiles shall be clearly marked by means of a sign driven into the ground at each stockpile. When additional material is brought on site, care shall be taken to completely isolate each new load from the existing stockpile until each load is tested and accepted. Filter pack that does not meet the appropriate gradation set fourth in paragraph 2.1.3 shall not be used as water well backfill and shall be removed from the work area. There shall be at least one filter-pack particle-size distribution test for each load of each filter pack, where one load is defined as the quantity of filter pack that one truck or one puptrailer contains. If trucks or trailers are used with capabilities larger than 10 cubic yards each, at least one particle size distribution shall be performed on each 10 cubic yards or fraction thereof. The laboratory test procedure shall conform to that presented in ASTM D422. Whenever there is reason to suspect that materials do not meet specified requirements, additional tests shall be performed as directed by the

Contracting Officer. If materials fail to meet the gradation requirements, the Contractor shall remove all in-place materials which are representative of the failing tests, and shall adjust hid operations to produce acceptable materials.

1.3.3.5 Reporting Well Construction

For each well or abandoned borehole, the reports shall include logs of the boring with sample locations and gradation test results, an as-built drawing (showing elevations of the well screen and riser pipe, backfill material, and a development report. The elevations at which changes of materials are encountered shall be shown to the nearest 0.1 foot on the log. The log of filter-pack material shall include the filter-pack particles-size distribution test data, and notes concerning installation and development of the water well. The development report shall include the development method used, elapsed time for each development cycle, pumping rates, amount of material pulled into the well, filter pack elevation changes outside the well, and total development time. Completed reports and logs shall be submitted the day after the work for which the report is made.

1.3.4 Contractor Supervision

The Contractor shall provide for the supervision of all phases of the pilot hole drilling, sampling, water well drilling, installation, development, and testing. All drilling shall be performed by drillers having the experience described in Paragraph 1.3.2.1.

1.3.5 Location

The Contractor shall place each well in coordination with the Corps of Engineers, Fort Riley Directorate of Environment and Safety, and the landowners.

1.3.6 Obstructions

If obstructions are encountered in the foundation which, in the opinion of the Contracting Officer, render it impracticable to complete the well to the directed depth, the Contracting Officer may adjust the depth to conform to that of the obstruction. Alternatively, the Contracting Officer may direct the Contractor to abandon the well, plug the borehole by backfilling with filter pack tremied to 20 feet below the ground surface and grouting the remaining borehole.

1.3.7 Construction Limits

All construction storage and staging areas will be supplied on-post. All efforts shall be made to minimize construction activities at off-post areas to those necessary for well installation, piping installation, and site restoration.

1.3.8 Pilot Holes

1.3.8.1 General

The contractor shall provide all plant, labor and materials to perform the pilot hole drilling and sampling. The driller shall be experienced in obtaining geotechnical samples. The drill rig shall be a percussion tool rig or geotechnical sampling rig capable of taking drive samples in alluvial materials. Samples shall be taken continuously from the ground surface to the top of bedrock (approximately 40=bgs) using drive barrels, split tube samplers, auger tube samplers, or other approved samplers capable of recovering adequate representative sample material for gradation testing. Diameter of samplers shall be between 2 inches and 5 inches. Double wall reverse circulation drilling shall not be used. Standard rotary drilling shall not be used to collect samples, but may be used to clean out borings between drives. Drilling fluid shall be disposed of as directed by the Contracting Officer. Upon completion of the pilot hole, the hole shall be filled with sand.

1.3.8.2 Sampling

Samples shall be taken from each drive interval (at least one per 5 feet for auger tube samples) and at each change of material. Samples shall be labeled, with project name and location, pilot hole number, jar or sack number, depth (from-to), and date. A qualified geologist shall be present during the pilot hole drilling operation and shall log the pilot hole for types of material, depths of contacts, recovery per sample, drilling fluids used, type of drilling and sample method.

1.3.9 Well Design

1.3.9.1 Designer Qualifications

The Contractor shall design the wells based on the Contractor's boring log, soil bearings, and gradation tests of samples. The well shall be designed in accordance with current industry standards. Well design parameters to include depths, screened intervals, screen slot size, referenced used and calculations supporting design shall be submitted for review and approval prior to installation. The wells shall be designed by a qualified geologist or engineer having experience in designing wells.

1.3.9.2

One well (M-1 Replacement) shall be designed for nominal 5-inch inside diameter polyvinyl chloride (PVC) screen and casing riser with a maximum discharge rate of 15 gallons per minute. The anticipated well depth is approximately 40 feet. One water well (Racetrack Replacement) shall be designed for a nominal 8-inch inside diameter polyvinyl chloride (PVC) screen and casing riser with a maximum discharge rate of 200 gallons per minute (or sufficient to meet peak demand). The anticipation well depth is approximately 40-50 feet. The water well designer shall be responsible for determining the actual well depths, casing and screen diameters, and borehole diameters necessary to provide the required quantity of groundwater based on information derived from the pilot holes.

2 PRODUCTS

2.1 MATERIALS

2.1.1 Polyvinyl chloride (PVC) riser and couplings

PVC riser shall be new Schedule 40, 5-inch or 8-inch, as applicable, diameter conforming to ASTM: D 1785-88. Joints shall be flush threaded with O-ring seals and compatible with screen threads.

2.1.2 Well Screen

Bay West, Inc shall furnish new commercially manufactured schedule 40 PVC well screen, having a nonclogging, wirewrapped, continuous-slot strainer. The well screen shall be 5-inch or 8-inch, as applicable, diameter. Joints shall be flush threaded with O-rings seals and compatible with the riser and plug threads. The slot size testing and final well design. The installation Schedule in the drawings is an approximation for bidding purposes only. A Certificate of Compliance shall be submitted. Connecting rings on screens shall be considered screen for measurement purposes.

2.1.2.1 Filter Packing

Filter packing shall be clean, washed, free draining, durable, rounded natural siliceous sand, free of clay balls, and shall be well graded within the limits determined by the well designer. Calcareous and deleterious substances (which includes soft friable or elongated particles, objectionable materials and other foreign matter) is not permitted. Bay West, Inc shall submit documentation in accordance with paragraph 1.3.3.3, Sampling and Testing.

2.1.4 Water Well Outflow

Pumps, piping and appurtenances shall conform to requirements specified in Appendix B.

2.1.5 Cement Grout

Cement grout shall consist of a mixture or water, Portland cement and sand. Portland cement shall conform to ASTM Standard C150, Type I or II low alkali. Mix water shall be potable. Accelerators meeting the requirements of ASTM C494 type C or E may be used with prior approval. Cement grout shall be proportioned not to exceed 6 gallons of water per cubic foot of cement, with a mixture of such consistency that well can be properly grouted. No more than 3 percent of weight of bentonite powder may be added to reduce shrinkage.

3 EXECUTIVE

3.1 DRILLING WELLS

Wells shall be drilled by the standard mud-rotary or conventional reverse rotary method, using equipment and procedures which will ensure verticality and proper placement and depth of well screen, riser pipe, and gravel pack. The method of drill shall conform to all state and local standards for water well construction. Wells shall be drilled over the pilot holes. Boreholes shall be not less than 12 inches nor greater than 18 inches in diameter and may be drilled deeper than the final design depth of the well to allow for cutting settlement, at Bay West, Inc. discretion and expense. Boreholes shall be cleaned of drill cuttings to at least 1.5 feet below the bottom well assembly shown in the construction drawings.

3.2 INSTALLATION OF RISER PIPE AND SCREEN

3.2.1 Assembly

All riser pipe and screen shall be in good condition before installation and all couplings and other accessory parts shall be securely fastened in place. Any dents, bends, cracks, or other damage to well screens and riser pipes shall be grounds for rejection by the Contracting Officer. Centering devices shall be attached to the assembly riser pipe and screen in such numbers, and shall be of a type that will satisfactorily center the riser pipe and screen in the borehole, and will hold it securely in position until the filter pack is in place. Centering devices shall be installed on blank riser pipe or on well screen connection collars. Bay West, Inc. shall take care to align centering devices so that they will not inhibit the placement of tremie pipes on any side of the well.

3.2.2 Joints

Sections of water well pipe and screen shall be joined as specified in subparagraph 2.1. Joints shall be designed and constructed to have the strength of the pipe and shall be capable of supporting the weight of the water well assembly as it is lowered into the borehole. Joints shall be made so that the well is straight and will allow passage of the test dummy.

3.2.3 Installation

The riser pipe and well screen shall be lowered into the borehole to the design depth, in a manner that will avoid jarred impacts and ensure that the assembly is centered and not damaged or disconnected. "Bumping" the assembly by raising and dropping, will not be permitted. If insufficient borehole depth is available, the well assembly shall be removed and the borehole shall be cleaned. The top of the riser pipe shall be secured at the specified elevation during placement of the primary filter pack.

3.2.4 Alignment

Each well shall be installed and maintained straight and plumb and at the design elevation. Alignment shall be tested immediately after filter pack placement by using a 20-foot long cylindrical dummy with a maximum outside diameter of the screen. The dummy shall be lowered through the well casing and screen to the bottom of the well. Alternate well alignment survey methods may be used with approval by the Contracting Officer, If the well does not meet the alignment check, the well assembly shall be removed, corrected and returned to the borehole prior to development.

3.3 PLACEMENT OF FILTER PACK

3.3.1 General

After the well screen and riser pipe have been installed, the primary filter pack material shall be placed by a tremie pipe having a minimum inside diameter of 1.5 inches and slots to assist in the prevention of bridging in the pipe. The filter pack shall have a nominal thickness of 2 to 6 inches between the outside of the well screen and the natural formation and shall be placed to the depths shown on the Installation Schedule. The tremie pipe shall then be raised from the bottom in increments not to exceed 2 feet, allowing the filter material to flow out the bottom. After the backfilling has started, a continuous supply of primary filter pack material shall be placed in the top of the tremie. Filter pack shall not be placed on top of any sediment.

3.4 DEVELOPMENT OF WELL

3.4.1 General

Bay West, Inc shall be responsible for developing the well in accordance with his plan submitted per paragraph 1.3.2.1. Development will not be considered complete until there are no visible fines in water that has been allowed to stand for 10 minutes.

3.4.1.1

Bay West shall be responsible for maintaining at the well the needed access and work area and the clearance in the well area necessary to accomplish development. Bay West shall construct the necessary discharge lines to dispose effluent as described in Paragraph 5.2.

3.4.2.1

As development proceeds, filter pack material shall be added to the annular space around the riser, to maintain the top of the filter pack at the specified elevation. If, at any time during the development process, the filter pack becomes contaminated with any silt or other foreign material, the material shall be removed and the pack restored to the specified tolerance. Bay West, Inc shall provide an approved means for accurately measuring the water level, depth in well and depth to pack at all times and under all conditions. If, at any time during the development process, it becomes apparent, in the opinion of the Contracting Officer, that the well may be damaged, development operations shall immediately cease. The Contacting Officer may require a change in method if the desired results are not achieved. Wells which, in the opinion of the Contracting Officer, continue to produce excessive amounts of fines after 12 hours, may be ordered to be abandoned, plugged, and backfilled, and may require Bay West, Inc to construct new well nearby.

3.4.2.3

Intermittent pumping may be used to aid in development; however, it shall not be used as the primary means of development.

3.5 PLACEMENT OF GROUT

The grout shall be placed through a tremie pipe. The bottom end of the tremie pipe shall have a plug or tee fitting, and the lower portion of the tremie pipe shall have horizontal discharge ports to prevent jetting into the filter pack. The tremie pipe shall be lowered to 0.5 foot above the top of the secondary filter pack for well, and 0.5 foot about bottom of hole for pilot hole, prior to starting grout placement and the discharge end of the pipe shall be submerged in the emplaced grout at all times all grouting is completed.

3.6 PUMPING TESTS

Upon completion, but before acceptance, each well shall be pump tested for well efficiency. While pump test is being conducted, no drilling, excavation, development (other than chemical agitation with a bubbler operation), or other pumping will be allowed. The Contractor shall furnish a pump capable of pumping at constant rates as specified herein. The Contractor shall provide an electrical tape, bubbler tube, or other approved means for accurately determining the water level in the well under all conditions. The Contractor shall furnish and install an orifice meter, or turbine flow meter or approved design for the purpose of accurately measuring the discharge rate from the well at all times during the pump tests. The Contractor shall furnish, install, or construct the necessary pipe and discharge lines to dispose of the pumping test discharge. An approved centrifugal sand sampler shall be installed in the discharge pipe, to determine sand content of the discharge. The Contractor shall record all pump test data. Prior to starting the pump test, the water level shall be allowed to reach static level. The well will be considered to be at "static" when the water level fluctuates less than 0.1 foot in 30 minutes. The Contractor shall test each well by pumping at a constant rate of discharge until the drawdown has stabilized. The drawdown will be considered stable when the water level fluctuates less than 0.1 foot in 30 minutes. After the draw down has stabilized at the initial pumping rate, the Contractor shall use an increased pumping rate, and the test shall be repeated. A minimum of four such steps shall be run. Pumping rates in excess of 250 gpm will not be required. It is anticipated that pumping tests will range between 2 ½ to 6 hours and not exceed 6 hours. If the test is interrupted prior to completion, other than by direction of the Contracting Officer, the test shall be rerun at no additional cost to the Government. If the pump test indicate incomplete well development by either drawing excessive fines into the well during the tests or by exhibiting an increasing specific capacity will increase in pump rate, the Contraction Officer may direct removal of sand or sediment from the well, additional development, and additional pump testing. At the completion of the pumping test, ground water samples will be taken and analyzed for Target Compound List (TCL) Volatiles using EPA Method 8260. One record sample will be taken from each well. A duplicate sample will also be taken from each well. QA/QC samples shall include field blanks for non-dedicated sampling equipment, trip blanks for sample shipment to the laboratory, and a MS/MSD. The laboratory used shall be certified by the US Army Corps of Engineers.

3.7 WELL COMPLETION

The wells shall be sterilized, capped, and sealed in accordance with KDHE Requirements.

3.8 RESTORATION OF WORK AREA

3.8.1 Drilling Fluid and Cutting

The Contractor shall provide a means of remove drilling fluids from the site. Drilling Fluid and cutting shall be disposed of on-post. Drill Cuttings will be used for all daily cover at the post construction debris landfill. Drilling fluids shall be dumped 100 feet west of the Marshall Army Airfield SVE building/fenceline (on-post) after coordination with USACE and Fort Riley DES.

3.8.2 Earthwork

The Contractor shall remove all very soft, saturated material from the bottom and sides of ruts and any other depressions created by the well installation. These depressions shall then be backfilled with silt/clay to the adjacent existing natural ground surface. Backfill material shall be placed in 12-inch maximum, traffic-compacted lifts. Grassed areas that are disturbed shall be reseeded by the Contractor. Borrow material for restoration of the work area and for backfill around outlet pipes is available and shall be obtained under the direction of the Contracting Officer.

3.8.3 Backfill Around Outlet Pipes

Trenches excavated in clay or silt for the installation of outfall pipes shall be backfilled to preexisting grades, using clays or silts. Backfill material shall be placed in 6-inch maximum lifts and each life shall be compacted with a hand-held mechanical tamper. Care shall be taken to preserve the integrity of the watertight connection at the well. No excavation for outlet pipes shall be left unattended.

3.8.4 Wells

All new well risers and cover shall be cleaned of debris and prepared for painting.

3.8.5 Cleaning

All material resulting for well construction and resultant surface erosion, shall be removed. Pre-existing debris shall also be removed at the same time. Material removed from the work area shall be deposited at the disposal area.

3.9 ABANDONMENT AND PLUGGING OF THE EXISTING WELL

3.9.1 The location of the existing wells (M-1, R-1, R-3, R-4 and R-2) are shown on the attached drawings. The five wells scheduled for abandonment are approximately 40 feet deep, no more than 8-inch nominal inside diameter, are of PVC construction, and are assumed to be screened across the lower 20 feet of the well.

3.9.2 The abandonment of the wells shall conform to "Article 30. Water Well Contractor's License; Water Well Construction and Abandonment" State of Kansas, Department of Health & Environment, Bureau of Water, Industrial Program Section, dated May 1, 1987, Paragraph 28-30-7. The article is attached at the end of this section.

3.9.3 Plugging of the existing well shall conform to "Plugging Packet", State of Kansas, Department of Health & Environment, Bureau of Water, Industrial Program Section. The article is attached at the end of this section.

STATE OF KANSAS
DEPARTMENT OF HEALTH & ENVIROMENT

ARTICLE 30
WATER WELL CONTRACTOR'S LICENSE
WATER WELL CONSTRUCTION
AND ABANDONMENT

28-30

Kansas Administrative Regulations
Kansas Department of Health and Environment

Notice to Reader

The following regulations represent an electronic facsimile of Kansas Administrative Regulations, promulgated by the Kansas Department of Health and Environment and published by the Kansas Secretary of State. While every effort has been made to assure the accuracy, these electronic copies do not represent the official regulations of the state. The official regulations are the bound copies printed by the Secretary of State.

Where possible KDHE will append changed regulations to the appropriate article. Once again, the lack of any attachments should not be construed as meaning there are no revisions.

Nothing contained herein should be construed as legal advice by KDHE. If you are not an attorney, you should secure competent counsel to interpret the regulations and advise you.

Office of Public Information
Kansas Department of Health & Environment

Notes

The *Kansas Register* notes the following changes:

ment system, or the function of the monitoring systems unless necessary to comply with the requirements in this regulation.

(ii) If the owner or operator demonstrates that disturbance of the final cover, liner or other component of the containment system, including any removal of waste, will not increase the potential threat to human health or the environment, the disturbance may be approved by the director.

(4) The owner or operator shall prepare a post-closure plan not later than the effective date of this regulation, or by the initial receipt of waste, whichever is later, and submit it to the director.

(5) Following completion of the post-closure care period for each MSWLF unit, the owner or operator shall submit a certification to the director. The certification shall be signed by an independent registered professional engineer, or approved by the director, and must verify that post-closure care has been completed in accordance with the post-closure plan. (Authorized by K.S.A. 1993 Supp. 65-3406; implementing K.S.A. 65-3401; effective Oct. 24, 1994.)

Article 30.—WATER WELL CONTRACTOR'S LICENSE; WATER WELL CONSTRUCTION AND ABANDONMENT

28-30-1. (Authorized by K.S.A. 1979 Supp. 82a-1202, 82a-1205; effective, E-74-34, July 2, 1974; modified, L. 1975, ch. 481, May 1, 1975; revoked May 1, 1980.)

28-30-2. Definitions. (a) "License" means a document issued by the Kansas department of health and environment to qualified persons making application therefore, authorizing such persons to engage in the business of water well contracting.

(b) "Department" means the Kansas department of health and environment.

(c) "Abandoned water well" means a water well determined by the department to be a well:

(1) whose use has been permanently discontinued;

(2) in which pumping equipment has been permanently removed;

(3) which is either in such a state of disrepair that it cannot be used to supply water, or has the potential for transmitting surface contaminants into the aquifer, or both;

(4) which poses potential health and safety hazards; or

(5) which is in such a condition that it cannot be placed in active or inactive status.

(d) "Water well contractor" or "contractor" means any individual, firm, partnership, association, or corporation who constructs, reconstructs, or treats a water well. The term shall not include:

(1) an individual constructing, reconstructing or treating a water well located on land owned by the individual, when the well is used by the individual for farming, ranching, or agricultural purposes or for domestic purposes at the individual's place of abode; or

(2) an individual who performs labor or services for a licensed water well contractor at the contractor's direction and under the contractor's supervision.

(e) "Aquifer" means an underground formation that contains and is capable of transmitting groundwater.

(f) "Confined aquifer" is an aquifer overlain and underlain by impermeable layers. Groundwater in a confined aquifer is under pressure greater than atmospheric pressure and will rise in a well above the point at which it is first encountered.

(g) "Unconfined aquifer" is an aquifer containing groundwater at atmospheric pressure. The upper surface of the groundwater in an unconfined aquifer is the water table.

(h) "Domestic uses" means the use of water by any person or family unit or household for household purposes, or for the watering of livestock, poultry, farm and domestic animals used in operating a farm, or for the irrigation of lands not exceeding a total of two acres in area for the growing of gardens, orchards and lawns.

(i) "Public water-supply well" means a well that:

(1) provides groundwater to the public for human consumption; and

(2) has at least 10 service connections or serves an average of at least 25 individuals daily at least 60 days out of the year.

(j) "Groundwater" means the part of the subsurface water which is in the zone of saturation.

(k) "Grout" means cement grout, neat cement grout, bentonite clay grout or other material approved by the department used to create a permanent impervious watertight bond between the casing and the undisturbed formation surrounding the casing or between two or more strings of casing.

(1) "Neat cement grout" means a mixture consisting of one 94 pound bag of portland cement to five to six gallons of clean water.

(2) "Cement grout" means a mixture consisting of one 94 pound bag of portland cement to an equal volume of sand having a diameter no larger than 0.080 inches (2 millimeters) to five to six gallons of clean water.

(3) "Bentonite clay grout" means a mixture consisting of water and commercial grouting or plugging sodium bentonite clay containing high solids such as that manufactured under the trade name of "volclay grout," or an equivalent as approved by the department.

(A) The mixture shall be as per the manufacturer's recommendations to achieve a weight of not less than 9.4 pounds per gallon of mix. Weighting agents may be added as per the manufacturer's recommendations.

(B) Sodium bentonite pellets, tablets or granular sodium bentonite may also be used if they meet the specifications listed in paragraph (k)(3) of this regulation.

(C) Sodium bentonite products that contain low solids, are designed for drilling purposes, or that contain organic polymers shall not be used.

(l) "Pitless well adapter or unit" means an assembly of parts installed below the frost line which will permit pumped groundwater to pass through the wall of the casing or extension thereof and prevent entrance of contaminants.

(m) "Test hole" or "hole" means any excavation constructed for the purpose of determining the geologic, hydrologic and water quality characteristics of underground formations.

(n) "Static water level" means the highest point below or above ground level which the groundwater in the well reaches naturally.

(o) "Annular space" means the space between the well casing and the well bore or the space between two or more strings of well casing.

(p) "Sanitary well seal" is a manufactured seal installed at the top of the well casing which, when installed, creates an airtight and watertight seal to prevent contaminated or polluted water from gaining access to the groundwater supply.

(q) "Treatment" means the stimulation of production of groundwater from a water well, through the use of hydrochloric acid, muriatic acid, sulfamic acid, calcium or sodium hypochlorite, polyphosphates or other chemicals and mechanical means, for the purpose of reducing or removing iron and manganese hydroxide and oxide deposits, calcium and magnesium carbonate deposits and slime deposits associated with iron or manganese bacterial growths which inhibit the movement of groundwater into the well.

(r) "Reconstructed water well" means an existing well that has been deepened or has had the casing replaced, repaired, added to or modified in any way for the purpose of obtaining groundwater.

(s) "Pump pit" means a watertight structure which:

(1) is constructed at least two feet away from the water well and below ground level to prevent freezing of pumped groundwater; and

(2) houses the pump or pressure tank, distribution lines, electrical controls, or other appurtenances.

(t) "Grout tremie pipe" or "grout pipe" means a steel or galvanized steel pipe or similar pipe having equivalent structural soundness that is used to pump grout to a point of selected emplacement during the grouting of a well casing or plugging of an abandoned well or test hole.

(u) "Uncased test hole" means any test hole in which casing has been removed or in which casing has not been installed.

(v) "Drilling rig registration license number" means a number assigned by the department which is affixed to each drilling rig operated by or for a licensed water well contractor.

(w) "Active well" means a water well which is an operating well used to withdraw water, or to monitor or observe groundwater conditions.

(x) "Inactive status" means a water well which is not presently operating but is maintained in such a way that it can be put back in operation with a minimum of effort.

(y) "Heat pump hole" means a hole drilled to install piping for an earth coupled water source heat pump system, also known as a vertical closed loop system. (Authorized by K.S.A. 1992 Supp. 82a-1205 and implementing K.S.A. 82a-1202, K.S.A. 1992 Supp. 82a-1205, 82a-1213; effective, E-74-34, July 2, 1974; modified, L. 1975, ch. 481, May 1, 1975; amended May 1, 1980; amended May 1, 1987; amended Nov. 22, 1993.)

28-30-3. Licensing. (a) Eligibility. To be eligible for a water well contractor's license an applicant shall:

(1) pass an examination conducted by the department; or

(2) meet the conditions contained in subsection (c).

(b) Application and fees.

(1) Each application shall be accompanied by an application fee of $10.00.

(2) Before issuance of a water well contractor's license, each contractor shall pay a license fee of $100.00 plus $25.00 for each drill rig operated by or for the contractor. These fees shall accompany the application and shall be by bank draft, check or money order payable to the Kansas department of health and environment—water well licensure.

(c) Reciprocity.

(1) Upon receipt of an application and payment of the required fees from a nonresident, the secretary may issue a license, providing the nonresident holds a valid license from another state and meets the minimum requirements for licensing as prescribed in K.S.A. 82a-1207, and any amendments thereto.

(2) If the nonresident applicant is incorporated, evidence shall be submitted to the department of health and environment showing that the applicant meets the registration requirements of the Kansas secretary of state.

(3) Nonresident fees for a license shall be equal to the fee charged a Kansas contractor by the applicant's state of residence but shall not be less than $100.00. The application fee and drill rig license fee shall be the same as the Kansas resident fees.

(d) License renewal.

(1) Each licensee shall make application for renewal of license and rig registrations before July 1 of each year by filing the proper renewal forms provided by the department and fulfilling the following requirements:

(A) payment of the annual license fee and a rig registration fee for each drill rig to be operated in the state;

(B) filing of all well records for each water well constructed, reconstructed or plugged by the licensee in accordance with K.S.A. 28-30-4 during the previous licensure period;

(C) filing a report, on a form provided by the department, of all approved continuing education units earned by the licensee during the previous licensure period;

(D) satisfying the continuing education requirements set forth in subsection (g); and

(E) providing any remaining outstanding information or records requested that existed prior to the issuance of revocation of a license.

(2) Failure to comply with paragraphs (A), (B), (C), (D) and (E) above shall be grounds to revoke the existing license and terminate the license renewal process.

(e) Water well construction fee. A fee of $5.00 shall be paid to the Kansas department of health and environment, either by bank draft, check or money order, for each water well constructed by a licensed water well contractor. The construction fee shall be paid when the contractor requests the water well record form WWC-5 from the department, or shall accompany the water well records submitted on form WWC-5 as required under K.A.R. 28-30-4. No fee shall be required for reconstructed or plugged water wells.

(f) License number. Each drill rig operated by or for a licensed water well contractor shall have prominently displayed thereon the drill rig license number, as assigned by the department, in letters at least two inches in height. Decals, paint, or other permanent marking materials shall be used.

(g) Continuing education requirements. Licensed water well contractors shall earn at least eight units of approved continuing education per year beginning with the first full year of licensure or the renewal period. One unit of continuing education shall equal 50 minutes of approved instruction except for trade shows and exhibitions which shall be counted as one unit per approved trade show and exhibition attended. (Authorized by K.S.A. 1992 Supp. 82a-1205; implementing K.S.A. 82a-1202, K.S.A. 1992 Supp. 82a-1205, 82a-1206, 82a-1207, 82a-1209; effective, E-74-34, July 2, 1974; effective May 1, 1975; amended May 1, 1980; amended May 1, 1983; amended May 1, 1987; amended Nov. 22, 1993.)

28-30-4. General operating requirements. (a) *Water well record.* Within 30 days after construction or reconstruction of a water well, the water well contractor shall submit a report of such work, to the Kansas department of health and environment and to the landowner, on the water well record form, form WWC-5, provided by the department. The contractor shall report to the department and to the landowner on the water well record or attachments made thereto any polluted or other noncompliant conditions which the contractor was able to correct and any conditions which the contractor was unable to correct. The contractor shall report to the department and the landowner the plugging of any abandoned water well. The report shall include the location, landowner's name, method, type of plug material, its placement and amount used to plug the abandoned water well.

A landowner who constructs, reconstructs, or plugs a water well, which will be or was, used by the landowner for farming, ranching or agricultural purposes or is located at the landowner's place of abode, shall submit a water well record, on form WWC-5, of such work to the department within 30 days after the construction, reconstruction or plugging of the water well. No fee shall be required from the landowner for the record.

(b) *Artificial recharge and return.* The construction of artificial recharge wells and freshwater return wells shall comply with all applicable rules and regulations of the department.

(c) *Well tests.* When a pumping test is run on a well, results of the test shall be reported on the water well record, form WWC-5, or a copy of the contractor's record of the pumping test shall be attached to the water well record.

(d) *Water samples.* Within 30 days after receipt of the water well record, form WWC-5, the department may request the contractor, or landowner who constructs or reconstructs his or her own water well, to submit a sample of water from the well for chemical analysis. Insofar as is possible, the department will define in advance areas from which well water samples are required. (Authorized by K.S.A. 82a-1205 and implementing K.S.A. 82a-1202, 82a-1205, 82a-1212, 82a-1213; effective, E-74-34, July 2, 1974; modified, L. 1975, ch. 481, May 1, 1975; amended May 1, 1980; amended May 1, 1987.)

28-30-5. Construction regulations for public water supply and reservoir sanitation zone wells. All activities involving public water supply wells and wells located in reservoir sanitation zones shall conform to existing statutes, and rules and regulations, of the Kansas department of health and environment, including K.A.R. 28-10-100, 28-10-101, and 28-15-16. (Authorized by K.S.A. 82a-1205; implementing K.S.A. 82a-1202, 82a-1205; effective, E-74-34, July 2, 1974; effective May 1, 1975; amended May 1, 1980; amended May 1, 1983; amended May 1, 1987.)

28-30-6. Construction regulations for all wells not included under section 28-30-5. (a) Each water well shall be so located as to minimize the potential for contamination of the delivered or obtained groundwater and to protect groundwater aquifers from pollution and contamination.

(b) Grouting.

(1) Constructed or reconstructed wells shall be sealed by grouting the annular space between the casing and the well bore from ground level to a minimum of 20 feet or to a minimum of five feet into the first clay or shale layer if one is present, whichever is greater. If a pitless well adapter or unit is being installed, the grouting shall start below the point at which the pitless well adapter or unit attaches to the well casing and shall continue a minimum of 20 feet below this point, or to a minimum of five feet into the first clay or shale layer, whichever is greater.

(2) To facilitate grouting, the grouted interval of the well bore shall be drilled to a minimum diameter at least three inches greater than the maximum outside diameter of the well casing. If a pitless well adapter or unit is being installed on the well's casing, the well bore shall be a minimum diameter of at least three inches greater than the outside maximum diameter of the well casing through the grouted interval below the point where the pitless well adapter or unit attaches to the well casing.

(c) If groundwater is encountered at a depth less than the minimum grouting requirement, the grouting requirement may be modified to meet local conditions if approved by the department.

(d) Waters from two or more separate aquifers shall be separated from each other in the bore hole by sealing the bore hole between the aquifers with grout.

(e) The well casing shall terminate not less than one foot above the finished ground surface. No casing shall be cut off below the ground surface except to install a pitless well adapter unit, which shall extend at least 12 inches above the ground surface. No opening shall be made through the well casing except for the installation of a pitless well adapter designed and fabricated to prevent soil, subsurface and surface water from entering the well.

(f) Well vents shall be used and shall terminate not less than one foot above the ground surface and shall be screened with brass, bronze, copper screen or other screen materials approved by the department which are 16-mesh or greater and turned down in a full 180 degree return bend so as to prevent the entrance of contaminating materials.

(g) Prior to completion of a constructed or reconstructed well, the well shall be cleaned of mud, drill cuttings and other foreign matter so as to make it suitable for pump installations.

(h) Casing. All wells shall have durable watertight casing from at least one foot above the finished ground surface to the top of the producing zone of the aquifer. The watertight casing shall extend not less than 20 feet below the ground level. Exceptions to either of the above requirements may be granted by the department if warranted by local conditions. The casing shall be clean and serviceable and of a type to guarantee reasonable life so as to insure adequate protection to the aquifer or aquifers supplying the groundwaters. Used, reclaimed, rejected, or contaminated pipe shall not be used for casing any well. All water well casing shall be approved by the department.

(i) All wells, when unattached during construction, reconstruction, treatment or repair, or during use as cased test holes, observation or monitoring wells, shall have the top of the well casing securely capped in a watertight manner to prevent contaminating or polluting materials from gaining access to the groundwater aquifer.

(j) During construction, reconstruction, treatment or repair and prior to its first use, all wells producing water for human consumption or food processing shall be disinfected according to K.A.R. 28-30-10.

(k) The top of the well casing shall be sealed by installing a sanitary well seal.

(l) All groundwater producing zones that are known or suspected to contain natural or manmade pollutants shall be adequately cased and grouted off during construction of the well to prevent the movement of polluted groundwater to either overlying or underlying fresh groundwater zones.

(m) Toxic materials shall not be used in the construction, reconstruction, treatment or plugging of a water well unless those materials are thoroughly flushed from the well prior to use.

(n) Any pump pit shall be constructed at least two feet away from the water well. The pipe from the pump or pressure tank in the pump pit to the water well shall be sealed in a watertight manner where it passes through the wall of the pump pit.

(o) Water wells shall not be constructed in pits, basements, garages or crawl spaces. Existing water wells which are reconstructed, abandoned and plugged in basements shall conform to these rules and regulations except that the finished grade of the basement floor shall be considered ground level.

(p) All drilling waters used during the construction or reconstruction of any water well shall be initially disinfected by mixing with the water enough sodium hypochlorite to produce at least 100 milligrams per liter, mg/1, of available chlorine.

(q) Natural organic or nutrient producing material shall not be used during the construction, reconstruction, or treatment of a well unless it is thoroughly flushed from the well and the groundwater aquifer or aquifers before the well is completed. Natural organic or nutrient producing material shall not be added to a grout mix used to grout the well's annular space.

(r) Pump mounting.

(1) All pumps installed directly over the well casing shall be so installed that an airtight and watertight seal is made between the top of the well casing and the gear or pump head, pump foundation or pump stand.

(2) When the pump is not mounted directly over the well casing and the pump column pipe or pump suction pipe emerges from the top of the well casing, a sanitary well seal shall be installed between the pump column pipe or pump suction pipe and the well casing. An airtight and watertight seal shall be provided for the cable conduit when submersible pumps are used.

(s) Construction of sand point or well point water wells. Sand point or well point water wells shall be constructed by drilling or boring a pilot hole to a minimum depth of three feet below ground surface. The pilot hole shall be a minimum of three inches greater in diameter than the drive pipe or blank casing if the casing method is used. Sand point wells shall only be completed by using the casing method or the drive pipe method as described in paragraphs (1) and (2) below or other methods as described in paragraph (3) below. Sand point wells constructed prior to the effective date of this regulation shall not be required to meet these requirements. All sand point wells that are replaced, constructed, reconstructed or plugged after the effective date of this regulation shall meet these regulations.

(1) Casing method. Approved, durable, watertight well casing shall be set from a minimum of three feet below the ground surface to at least one foot above the ground surface. The casing shall be sealed between the casing and the pilot hole with

approved grouting material from the bottom of the casing to ground surface. The drive pipe shall be considered the pump drop pipe. For underground discharge completions, a "T" joint shall be used. The drive pipe shall be capped with a solid cap at the "T" joint when the casing method is used. An approved sanitary well seal and a well vent shall be installed on the top of the well casing in accordance with K.A.R. 28-30-6 (f) and (k).

(2) Drive pipe method. Sand point wells may be installed without a casing for above ground discharge completions only. In such completions, the drive pipe shall terminate at least one foot above finished ground level. The annular space between the drive pipe and the pilot hole shall be sealed with approved grouting material from the bottom of the pilot hole to ground surface. The top of the drive pipe shall be sealed airtight and watertight with a solid cap of the same material as the drive pipe. A well vent shall not be required for the drive pipe method.

(3) Other methods. Other methods may be specfically approved by the department on a case-by-case basis by using the appeal procedure included in K.A.R. 28-30-9.

(4) Abandonment of sand point wells. Upon abandonment of a sand point well, the contractor or landowner shall either pull the drive pipe or leave it in place. If the drive pipe is left in place, the sand point well shall be plugged from the bottom of the well to three feet below the ground surface with approved grouting material. The drive pipe well shall be cut off three feet below the ground surface and the remaining three foot deep hole shall be backfilled with surface soil.

If the drive pipe is completely pulled, the remaining hole shall be plugged with approved grouting material from the bottom of the remaining hole to three feet below the ground surface. The hole shall be backfilled with surface soil from 3 feet to ground surface. (Authorized by K.S.A. 1991 Supp. 82a-1205; implementing K.S.A. 82a-1202, K.S.A. 1991 Supp. 82a-1205; effective, E-74-34, July 2, 1974; modified, L. 1975, ch. 481, May 1, 1975; amended May 1, 1980; amended May 1, 1983; amended May 1, 1987; amended June 21, 1993.)

28-30-7. Plugging of abandoned wells, cased and uncased test holes. (a) All water wells abandoned by the landowner on or after July 1, 1979, and all water wells that were abandoned prior to July 1, 1979 which pose a threat to groundwater supplies, shall be plugged or caused to be plugged by the landowner. In all cases, the landowner shall perform the following as minimum requirements for plugging abandoned wells.

(1) The casing shall be cut off three feet below ground surface and removed.

(2) All wells shall be plugged from bottom to top using volumes of material equaling at least the inside volume of the well.

(3) Plugging top of well:

(A) For cased wells a grout plug shall be placed from six to three feet below ground surface.

(B) For dug wells, the lining material shall be removed to at least five feet below ground surface, and then sealed at five feet with a minimum of six inches of concrete or other materials approved by the department. Compacted surface silts and clays shall be placed over the concrete seal to ground surface.

(4) Any groundwater displaced upward inside the well casing during the plugging operation shall be removed before additional plugging materials are added.

(5) From three feet below ground level to ground level, the plugged well shall be covered over with compacted surface silts or clays.

(6) Compacted clays or grout shall be used to plug all wells from the static water level to six feet below surface.

(7) All sand and gravel used in plugging abandoned domestic or public water supply wells shall be chlorinated prior to placement into a well.

(b) Abandoned wells formerly producing groundwater from an unconfined aquifer shall be plugged in accordance with the foregoing and in addition shall have washed sand, and gravel or other material approved by the department placed from the bottom of the well to the static water level.

(c) Abandoned wells, formerly producing groundwater from confined and unconfined aquifers or in confined aquifers only, shall be plugged according to K.A.R. 28-30-7(a) and by using one of the following additional procedures:

(1) The entire well column shall be filled with grout, or other material approved by the department, by use of a grout tremie pipe.

(2) A 10 foot grout plug shall be placed opposite the impervious formation or confining layer above each confined aquifer or aquifers by use of a grout tremie pipe; and

(A) The space between plugs shall be filled with clays, silts, sand and gravel or grout and shall be placed inside the well so as to prevent bridging.

(B) A grout plug at least 20 feet in length shall be placed with a grout pipe so at least 10 feet of the plug extends below the base of the well casing and at least 10 feet of the plug extends upward inside the bottom of the well casing.

(C) A grout plug at least 10 feet in length shall be placed from at least 13 feet below ground level to the top of the cut off casing.

(3) Wells that have an open bore hole below the well casing, and where the casing was not grouted into the well bore when the well was constructed, shall be plugged by (1) or (2) above except that the top 20 feet of well casing shall be removed or perforated with a casing ripper or similar device prior to plugging. If the well is plugged according to part (2) of this subsection, the screened or perforated intervals below the well casing shall be grouted the entire length by use of a grout tremie pipe.

(d) Plugging of abandoned holes. If the hole penetrates an aquifer containing water with more than 1,000 milligrams per liter, mg/l, total dissolved solids or is in an area determined by the department to be contaminated, the entire hole shall be plugged with an approved grouting material from the bottom of the hole, up to within three feet of the ground surface using a grout tremie pipe or similar method. From three feet below ground surface to ground surface the plugged hole shall be covered over with compacted surface silts or clays; otherwise, the hole shall be plugged in accordance with the following paragraphs.

(1) Plugging of abandoned cased test holes. The casing shall be removed if possible and the abandoned test hole shall be plugged with an approved grouting material from the bottom of the hole, up to within three feet of the ground surface, using a grout tremie pipe or similar method. From three feet below ground surface to ground surface the plugged hole shall be covered over with compacted surface silts or clays. If the casing cannot be removed, in addition to plugging the hole with an approved grouting material the annular space shall also be grouted as described in K.A.R. 28-30-6 or as approved by the department.

(2) Abandoned uncased test holes, exploratory holes or any bore holes except seismic or oil field related exploratory and service holes regulated by the Kansas corporation commission under K.A.R. 82-3-115 through 82-3-117. A test hole or bore hole drilled, bored, cored or augered shall be considered an abandoned hole immediately after the completion of all testing, sampling or other operations for which the hole was originally intended. The agency or contractor in charge of the exploratory or other operations for which the hole was originally intended is responsible for plugging the abandoned hole using the following applicable method, within three calendar days after the termination of testing or other operations.

(A) The entire hole shall be plugged with an approved grouting material from bottom of the hole, up to within three feet of the ground surface, using a grout tremie pipe or similar method.

(B) From three feet below ground surface to ground surface the plugged hole shall be covered over with compacted surface silts or clays.

(C) For bore holes of 25 feet or less, drill cuttings from the original hole may be used to plug the hole in lieu of grouting material, provided that an aquifer is not penetrated or the bore hole is not drilled in an area determined by the department to be a contaminated area.

(3) Plugging of heat pump holes drilled for closed loop heat pump systems. The entire hole shall be plugged with an approved grouting material from bottom of the hole, to the bottom of the horizontal trench, using a grout tremie pipe or similar method approved by the department.

(e) Abandoned oil field water supply wells. A water well drilled at an oil or gas drilling site to supply water for drilling activities shall be considered an abandoned well immediately after the termination of the oil or gas drilling operations. The company in charge of the drilling of the oil or gas well shall be responsible for plugging the abandoned water well, in accordance with K.A.R. 28-30-7(a), (b), and (c), within 30 calendar days after the termination of oil or gas drilling operations.

Responsibility for the water well may be conveyed back to the landowner in lieu of abandoning and plugging the well but the well must conform to the requirements for active or inactive status. The transfer must be made through a legal document, approved by the department, advising the landowner of the landowner's responsibilities and obligations to properly maintain the well, including the proper plugging of the well when it is abandoned and no longer needed for water production activities. If a transfer is to be made, the oil or gas drilling company shall provide the department with a copy of the transfer document within 30 calendar days after the termination of oil or gas drilling operations. Within 30 calendar days of the effective date of the transfer of the well the landowner shall notify the department of the intended use and whether the well is in active status or inactive status in accordance with K.A.R. 28-30-7(f).

(f) Inactive status. Landowners may obtain the department's written approval to maintain wells in an inactive status rather than being plugged if the landowner can present evidence to the department as to the condition of the well and as to the landowner's intentions to use the well in the future. As evidence of intentions, the owner shall be responsible for properly maintaining the well in such a way that:

(1) The well and the annular space between the hole and the casing shall have no defects that will permit the entrance of surface water or vertical movement of subsurface water into the well;

(2) the well is clearly marked and is not a safety hazard;

(3) the top of the well is securely capped in a watertight manner and is adequately maintained in such a manner as to prevent easy entry by other than the landowner;

(4) the area surrounding the well shall be protected from any potential sources of contamination within a 50 foot radius;

(5) if the pump, motor or both, have been removed for repair, replacement, etc., the well shall be maintained to prevent injury to people and to prevent the entrance of any contaminant or other foreign material;

(6) the well shall not be used for disposal or injection of trash, garbage, sewage, wastewater or storm runoff; and

(7) the well shall be easily accessible to routine maintenance and periodic inspection.

The landowner shall notify the department of any change in the status of the well. All inactive wells found not to be in accordance with the criteria listed in lines one through seven above shall be considered to be abandoned and shall be plugged by the landowner in accordance with K.A.R. 28-30-7(a) through (c). (Authorized by K.S.A. 82a-1205; implementing K.S.A. 82a-1202, 82a-1205, 82a-1212, 82a-1213; effective, E-74-34, July 2, 1974; modified, L. 1975, ch. 481, May 1, 1975; amended May 1, 1980; amended May 1, 1983; amended May 1, 1987.)

28-30-8. Pollution sources. Well locations shall be approved by municipal and county governments with respect to distances from pollution sources and compliance with local regulations. The following minimum standard shall be observed.

(a) The horizontal distances between the well and the potential source of pollution or contamination such as sewer lines, pressure sewer lines, septic tanks, lateral fields, pit privy, seepage pits, fuel or fertilizer storage, pesticide storage, feed lots or barn yards shall be 50 feet or more as determined by the department.

(b) Proper drainage in the vicinity of the well shall be provided so as to prevent the accumulation and ponding of surface water within 50 feet of the well. The well shall not be located in a ravine or any other drainage area where surface water may flow into the well.

(c) When sewer lines are constructed of cast iron, plastic or other equally tight materials, the separation distance shall be 10 feet or more as determined by the department.

(d) All wells shall be 25 feet or more from the nearest property line, allowing public right-of-ways to be counted; however, a well used only for irrigation or cooling purposes may be located closer than 25 feet to an adjoining property where:

(1) such adjoining property is served by a sanitary sewer and does not contain a septic tank system, disposal well or other source of contamination or pollution; and

(2) the property to be provided with the proposed well is served by both a sanitary sewer and a public water supply. (Authorized by and implementing K.S.A. 82a-1202, 82a-1205; effective, E-74-34, July 2, 1974; modified, L. 1975, ch. 481, May 1, 1975; amended May 1, 1980; amended May 1, 1987.)

28-30-9. Appeals. (a) Requests for exception to any of the foregoing rules and regulations shall be submitted to the department in writing and shall contain all information relevant to the request.

(1) Those requests shall specifically set forth why such exception should be considered.

(2) The department may grant exceptions when geologic or hydrologic conditions warrant an exception and when such an exception is in keeping with the purposes of the Kansas groundwater exploration and protection act.

(b) Appeals from the decision of the department shall be made to the secretary, who after due consideration may affirm, reverse or modify the decision of the department. (Authorized by K.S.A. 82a-1205; implementing K.S.A. 82a-1202, 82a-1205; effective, E-74-34, July 2, 1974; effective May 1, 1975; amended May 1, 1980; amended May 1, 1983; amended May 1, 1987.)

28-30-10. Water well disinfection for wells constructed or reconstructed for human consumption or food processing. (a) Gravel for gravel-packed wells shall be disinfected by immersing the gravel in a chlorine solution containing not less than 200 milligrams per liter, mg/l, of available chlorine before it is placed in the wells annular space.

(b) Constructed or reconstructed wells shall be disinfected by adding sufficient hypochlorite solution to them to produce a concentration of not less than 100 mg/l of available chlorine when mixed with the water in the well.

(c) The pump, casing, screen and pump column shall be washed down with a 200 mg/l available chlorine solution.

(d) All persons constructing, reconstructing or treating a water well and removing the pump or pump column, replacing a pump, or otherwise performing an activity which has potential for contaminating or polluting the groundwater supply shall be responsible for adequate disinfection of the well, well system and appurtenances thereto. (Authorized by and implementing K.S.A. 82a-1202, 82a-1205; effective, E-74-34, July 2, 1974; modified, L. 1975, ch. 481, May 1, 1975; amended May 1, 1980; amended May 1, 1987.)

Article 31.—HAZARDOUS WASTE MANAGEMENT STANDARDS AND REGULATIONS

28-31-1. General provisions. (a) Any reference in these rules and regulations to standards, procedures, or requirements of 40 CFR Parts 124, 260, 261, 262, 263, 264, 265, 266, 268, or 270, as in effect on July 1, 1992, and 49 CFR Parts 172, 173, 178 or 179, as in effect on October 1, 1992, inclusive shall constitute a full adoption by reference of the part, subpart, and paragraph so referenced, including any notes and appendices associated therewith, unless otherwise specifically stated in these rules and regulations.

(b) When used in any provision adopted from 40 CFR Parts 124, 260, 261, 262, 263, 264, 265, 266, 268, or 270, as in effect on July 1, 1992, inclusive, references to "the United States" shall be replaced with "the state of Kansas," "environmental protection agency" shall be replaced with the "Kansas department of health and environment," "administrator" or "regional administrator" shall be replaced with the "secretary" and "Federal Register" shall be replaced with the "Kansas Register." (Authorized by and implementing K.S.A. 65-3431; effective, E-82-20, Nov. 4, 1981; effective May 1, 1982; amended, T-86-32, Sept. 24, 1985; amended May 1, 1986; amended May 1, 1987; amended May 1, 1988; amended Feb. 5, 1990; amended April 25, 1994.)

28-31-2. Definitions. (a) Incorporation. 40 CFR 260 subpart B, as in effect on July 1, 1992, is adopted by reference.

(b) "Disposal authorization" means approval from the secretary to dispose of hazardous waste in Kansas.

(c) "EPA generator" means any person who meets any of the following conditions:

(1) Generates in any single calendar month or accumulates at any time 1,000 kilograms (2,200 pounds) or more of hazardous waste;

(2) generates in any single calendar month or accumulates at any time 1 kilogram (2.2 pounds) of acutely hazardous waste; or

(3) generates or accumulates at any time 25 kilograms (55 pounds) or more of debris and contaminated materials from the clean up of spillage of acutely hazardous waste.

(d) "Kansas generator" means any person who meets all of the following conditions:

(1) Generates 25 kilograms (55 pounds) or more of hazardous waste and less than 1,000 kilograms (2,200 pounds) in any single calendar month;

(2) accumulates at any time no more than 1,000 kilograms (2,200 pounds) of hazardous waste or 1 kilogram (2.2 pounds) of acutely hazardous waste; and

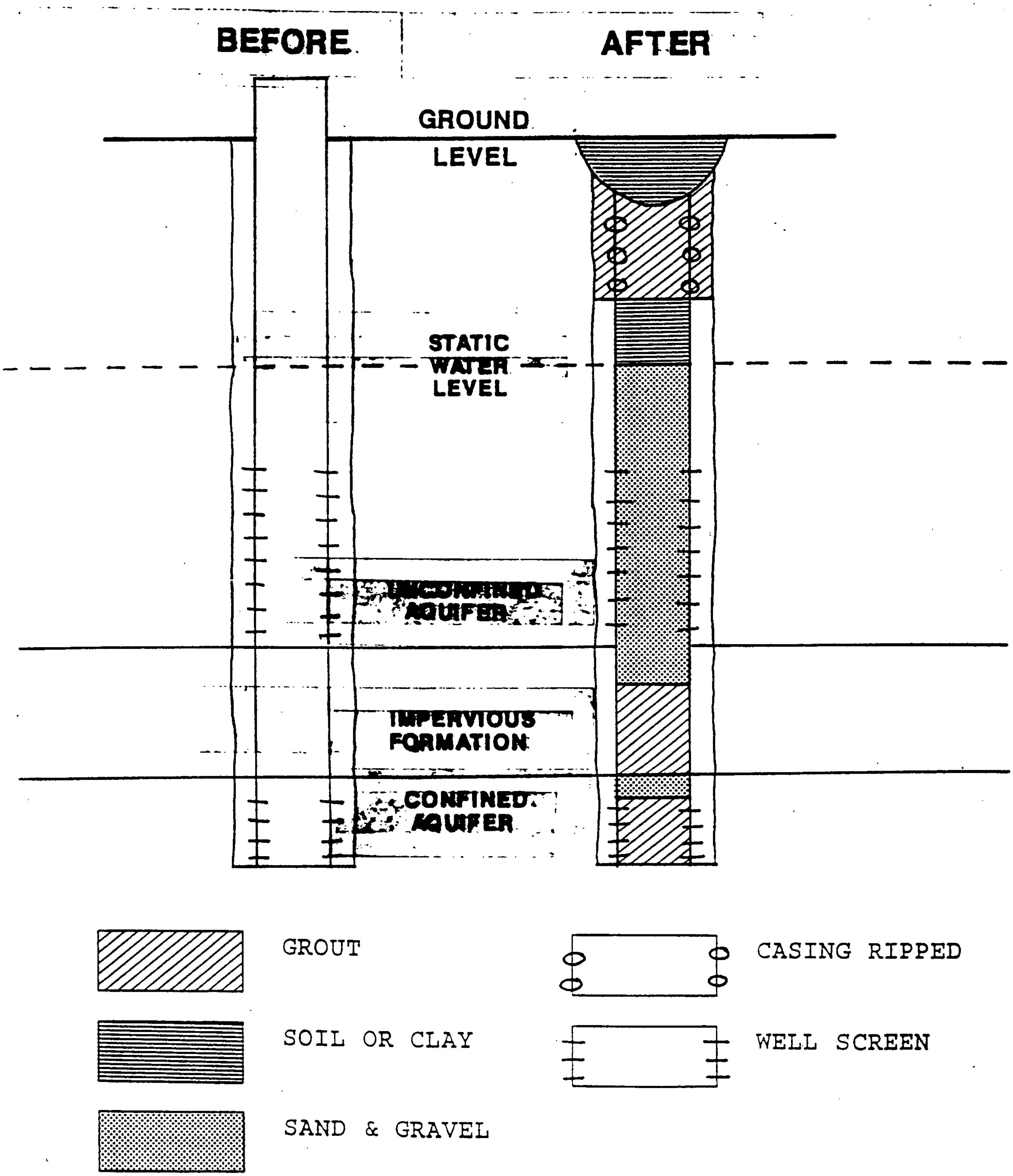
(3) generates or accumulates at any time no more than 25 kilograms (55 pounds) of debris and contaminated materials from the clean up of spillage of acutely hazardous waste.

(e) "Small quantity generator" means any person who meets all of the following conditions:

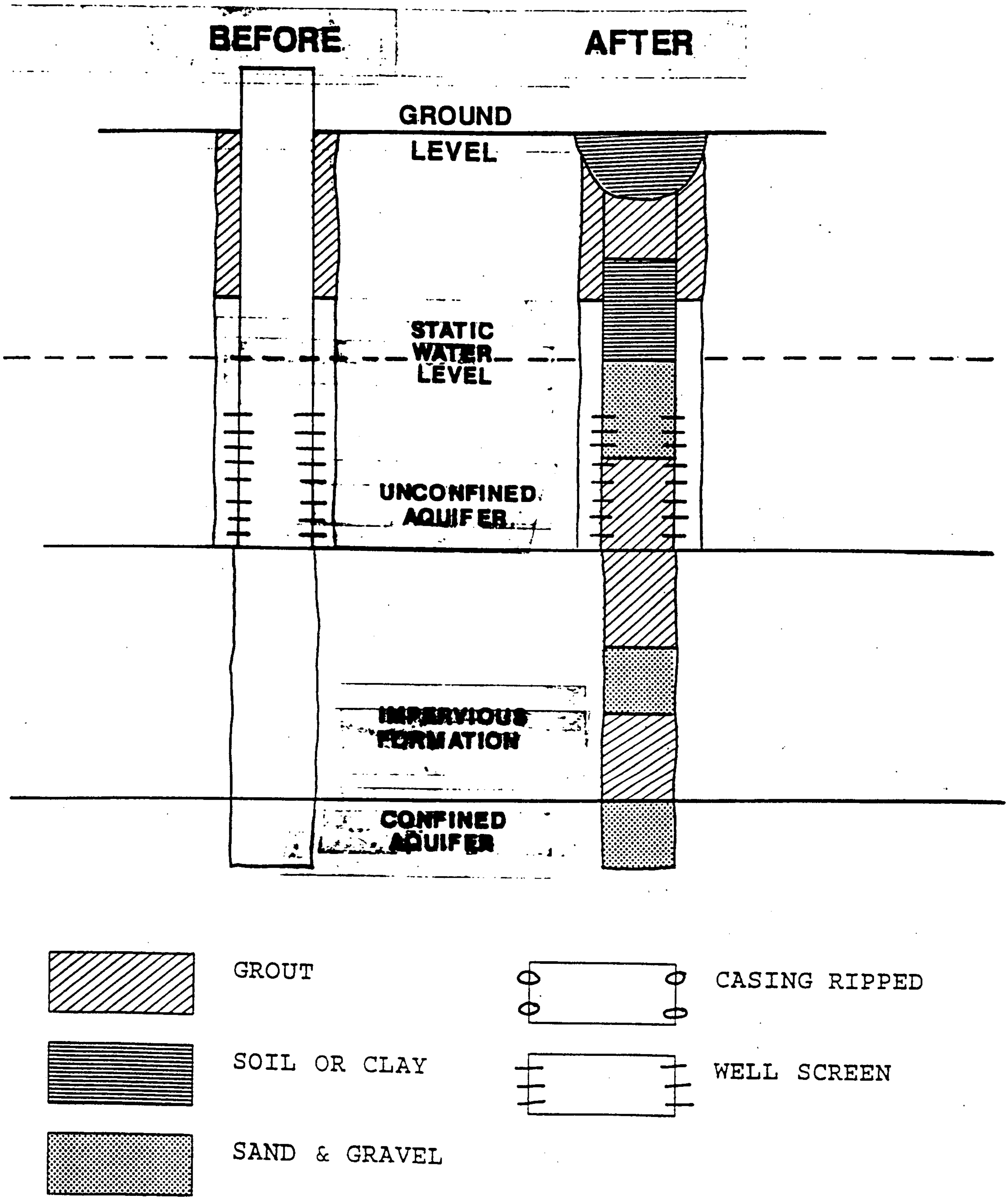
(1) Generates less than 25 kilograms (55 pounds) of hazardous waste, or less than 1 kilogram (2.2 pounds) of acutely hazardous waste in any single calendar month; and

(2) accumulates at any time less than 1,000 kilograms (2,200 pounds) of hazardous waste or 1

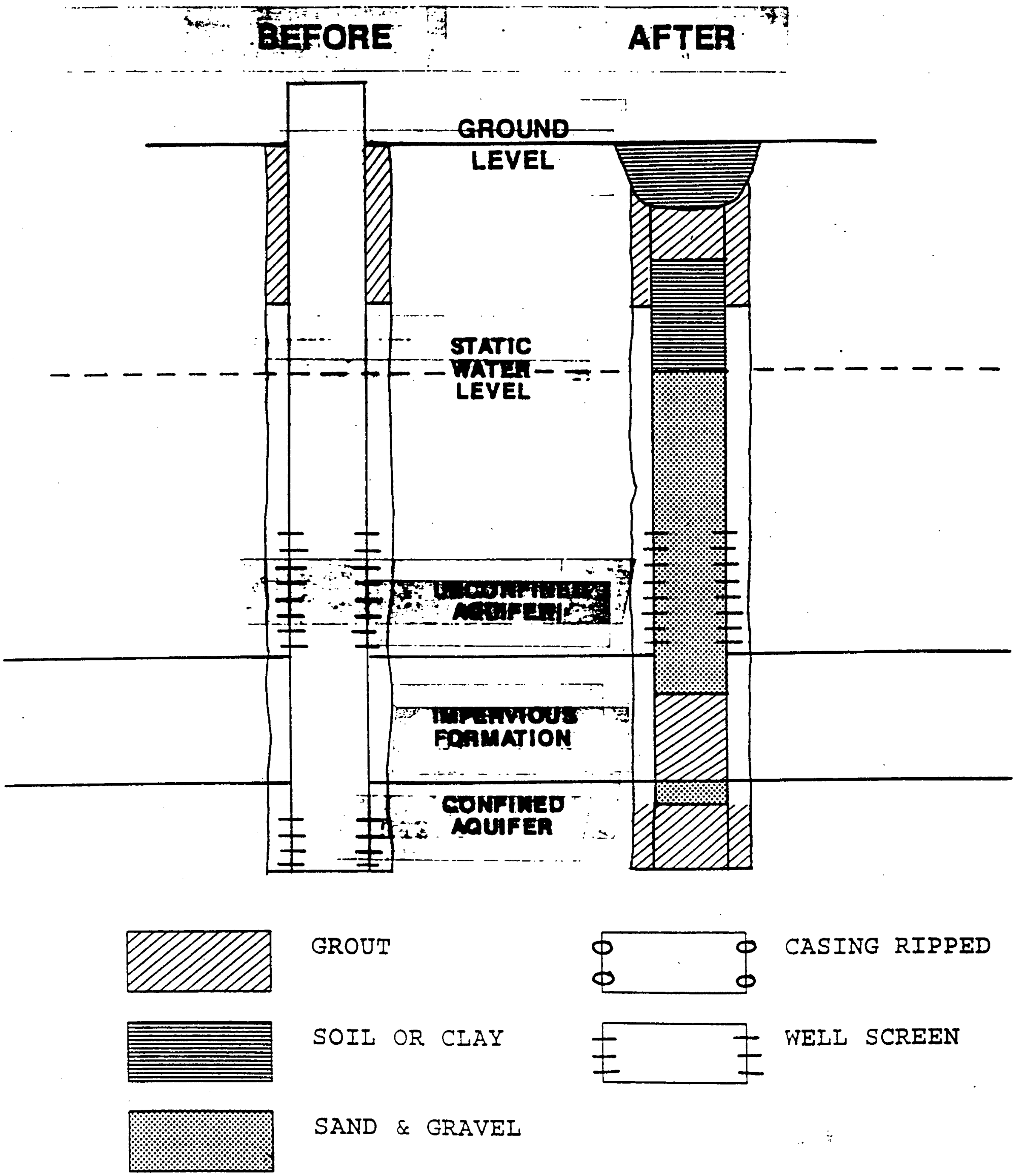
PLUGGING of an UNCONFINED, CONFINED WELL
(not grouted)



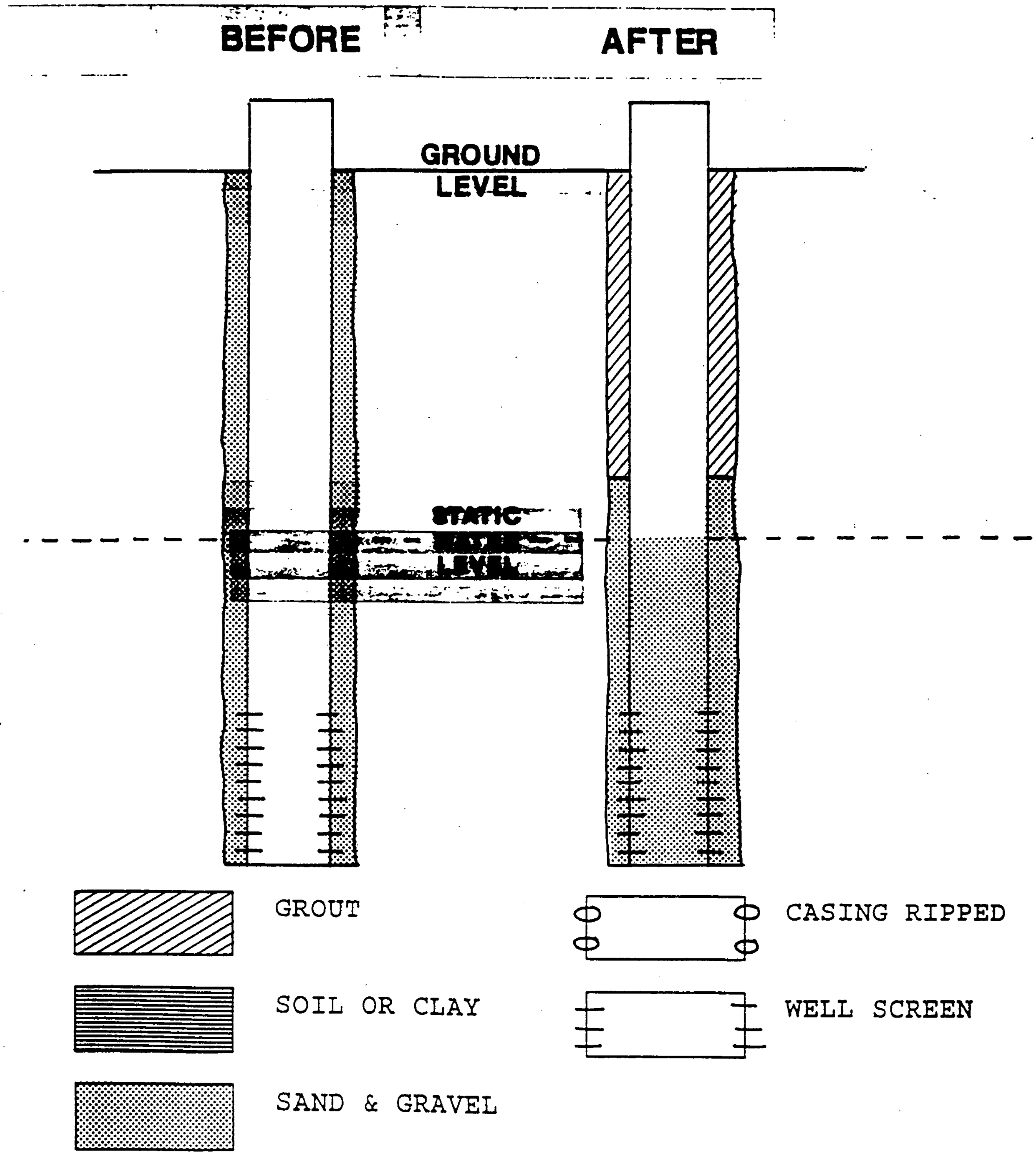
PLUGGING of an UNCONFINED, CONFINED WELL
(open hole, grouted)



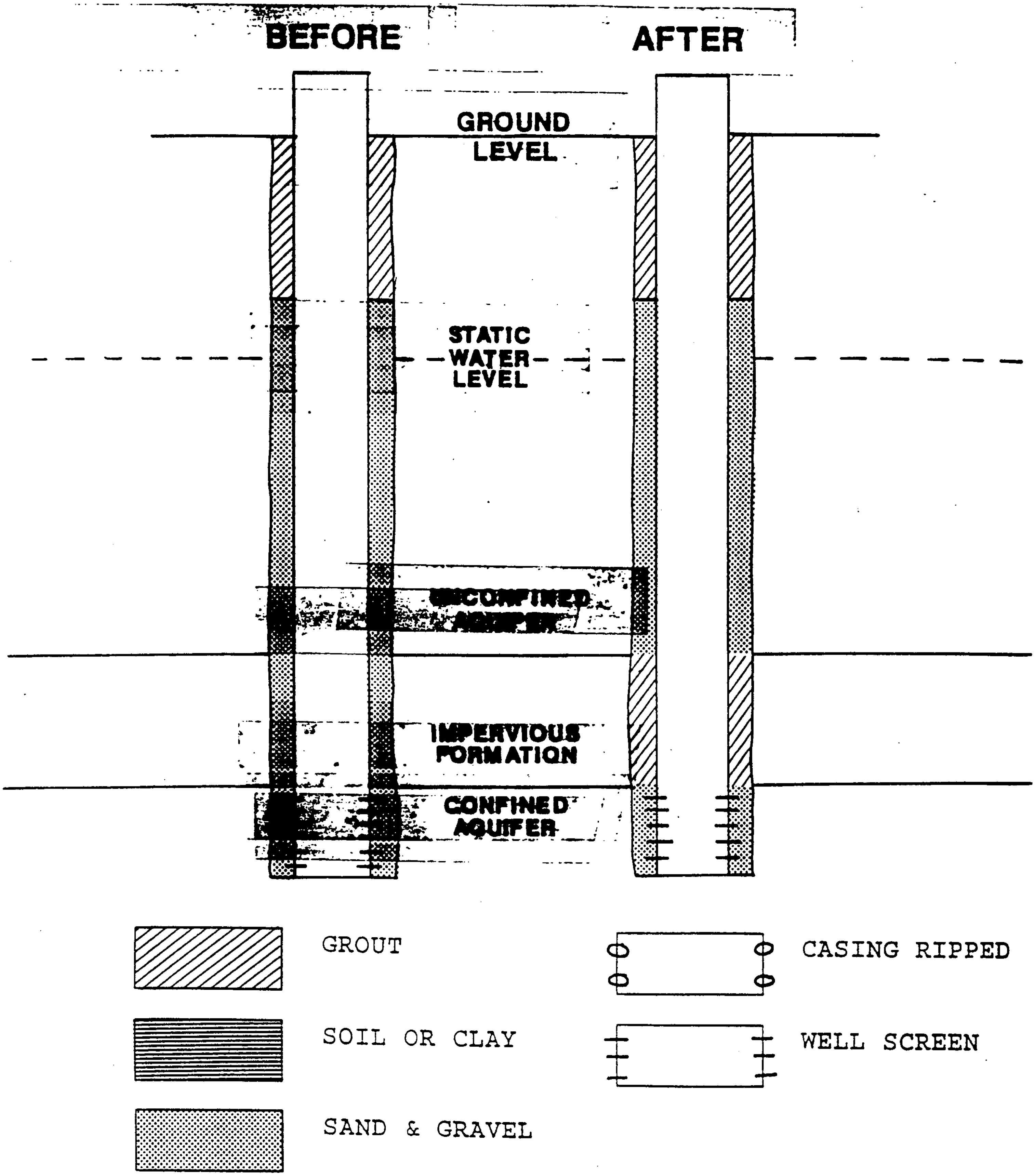
PLUGGING of an UNCONFINED, CONFINED WELL
(grouted)



GROUTING an UNCONFINED WELL

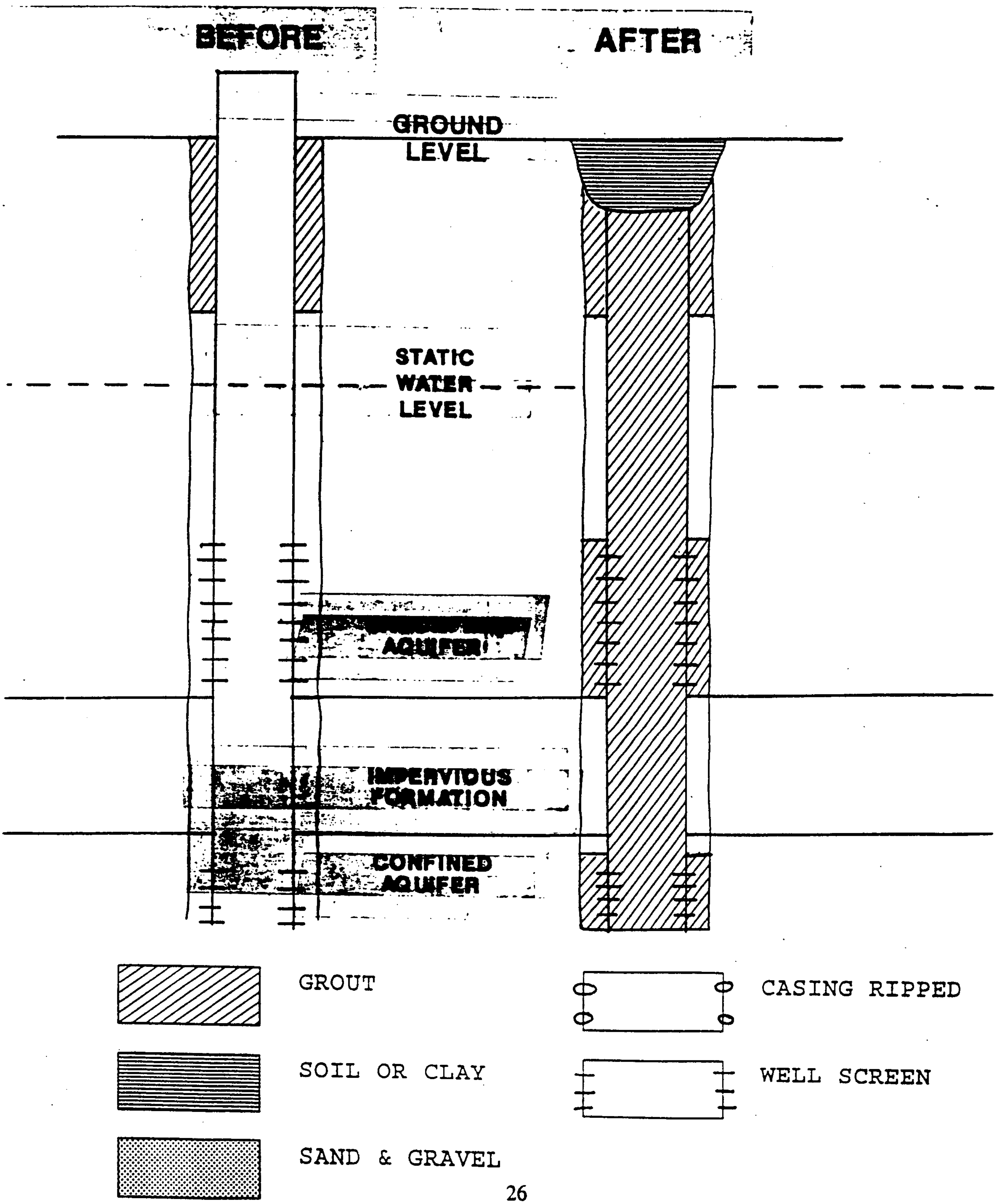


GROUTING a CONFINED WELL



PLUGGING of a WELL by FILLING with GROUT (grouted)

ii



State of Kansas
Mike Hayden, Governor

Department of Health and Environment
Division of Environment

Stanley C. Grant, Ph.D., Secretary
Forbes Field, Bldg. 740, Topeka, KS 66620-0002
(913) 296-
FAX (913) 296-

Policy Memorandum 87-3
March 1987

FROM: Gyula F. Kovach, P.E.

SUBJECT: KDHE REQUIREMENTS FOR PLUGGING ABANDONED WATER WELLS

PURPOSE:

To establish the Bureau of Water Protection's policy regarding plugging requirements for abandoned water wells. This policy is to assure the intent of the requirements of the Kansas Groundwater Exploration and Protection Act, K.S.A. 82a-1201, et seq. and implementing regulations, K.A.R. 28-30-1 thru 10, are met when plugging abandoned water wells. This policy applies to public water wells, private water wells and monitoring wells.

BACKGROUND:

The Kansas Groundwater Exploration and Protection Act was established by the 1973 Kansas Legislature to provide ". . . for the exploration and protection of groundwater through the licensing and regulation of water well contractors in Kansas, . . . by requiring proper description of the location, drilling and well construction, and proper plugging of abandoned water wells and test holes . . . ." K.S.A. 82a-1213 requires all holes drilled and abandoned in search of a water supply to be properly plugged by a licensed drilling contractor in accordance with Department rules and regulations. Any unplugged water well shall be plugged or caused to be plugged by the landowner in accordance with Department rules and regulations. Department requirements for plugging abandoned wells and test holes are found at K.A.R. 28-30-7. THis regulation sets forth specific details and procedures which must be followed by water well contractors and landowners when plugging abandoned wells or exploratory test holes. Neither the Kansas Groundwater Protection and Exploration Act nor the implementing Kansas administrative regulations require a landowner who drills a water well on his own property and which will be used by the individual for farming, ranching or agricultural purposes or at the individual's abode, or who plugs a test hole or a water well, to be a licensed water well contractor. However, the individual landowner must follow the specific detailed requirements found in the Act and the regulations when drilling or plugging a well.

This policy memorandum does not apply to underground injection wells. Those wells are covered by more stringent plugging requirements.

POLICY:

Abandoned water wells and test holes, whether cased or uncased, shall be plugged in accordance with the requirements of K.A.R. 28-30-7. Landowners are not required to be licensed water well contractors to either drill and construct a water supply well, or to plug abandoned water wells if constructed or plugged by a licensed water well contractor. Any individual or firm not licensed as a water well contractor, who plugs a water well when the water well is not on the individual's premises, is in violation of the Kansas Groundwater Exploration and Protection Act. A report, filed on form WWC-5 (copy attached), shall be completed and submitted for each water well constructed, reconstructed, or plugged.

Questions concerning this policy statement should be referred to the Kansas Department of Health & Environment, Bureau of Water, (913) 296-5522

Charles Konigsberg, Jr., M.D., M.P.H., Director of Health (913) 296-1343

James Power, P.E., Director of Environment (913) 296-1535

Lorne Phillips, Ph.D., Director of Information Systems (913) 296-1415

Roger Carlson, Ph.D., Director of the Kansas Hea and Environmental Labora (913) 296-1619

Example

WATER WELL RECORD Form WWC-5 KSA 82a-1212 Plugging Report

1 LOCATION OF WATER WELL. County: Gray | Fraction SW ¼ NE ¼ NW ¼ | Section Number 13 | Township Number T 26 S | Range Number R 29 E

Distance and direction from nearest town or city street address of well if located within city? 225 S & 0.25 E. of Ingalls

WATER WELL OWNER: John Doe

RR#, St. Address, Box #: RR 2

City, State, ZIP Code: Ingalls, KS 67858

Board of Agriculture, Division of Water Resources Application Number 18651

3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:

NW x	NE
SW	SE

N, S, E, W; 1 Mile

4 DEPTH OF COMPLETED WELL 241 ft. ELEVATION

Depth(s) Groundwater Encountered 1 ... ft. 2 ... ft. 3 ...

WELL'S STATIC WATER LEVEL 65 ft. below land surface measured on mo/day/yr 2-16-81

Pump test data: Well water was ... ft. after ... hours pumping ... gpm

Est. Yield ... gpm: Well water was ... ft. after ... hours pumping ... gpm

Bore Hole Diameter ... in. to ... ft., and ... in. to ...

WELL WATER ~~TO BE~~ was USED AS: 1 Domestic; 2 Irrigation; 3 Feedlot; 4 Industrial; 5 Public water supply; 6 Oil field water supply; 7 Lawn and garden only; 8 Air conditioning; 9 Dewatering; 10 Monitoring well; 11 Injection well; 12 Other (Specify below)

Was a chemical/bacteriological sample submitted to Department? Yes ... No ... If yes, mo/day/yr sample was submitted ... Water Well Disinfected? Yes No

5 TYPE OF BLANK CASING USED: 1 Steel; 2 PVC; 3 RMP (SR); 4 ABS; 5 Wrought iron; 6 Asbestos-Cement; 7 Fiberglass; 8 Concrete tile; 9 Other (specify below)

CASING JOINTS: Glued ... Clamped ... Welded ... Threaded ...

Blank casing diameter 16 in. to ... ft., Dia ... in. to ... ft., Dia ... in. to ...

Casing height above land surface 3 ft. below in., weight ... lbs. ft. Wall thickness or gauge No. ...

TYPE OF SCREEN OR PERFORATION MATERIAL: 1 Steel; 2 Brass; 3 Stainless steel; 4 Galvanized steel; 5 Fiberglass; 6 Concrete tile; 7 PVC; 8 RMP (SR); 9 ABS; 10 Asbestos-cement; 11 Other (specify); 12 None used (open hole)

SCREEN OR PERFORATION OPENINGS ARE: 1 Continuous slot; 2 Louvered shutter; 3 Mill slot; 4 Key punched; 5 Gauzed wrapped; 6 Wire wrapped; 7 Torch cut; 8 Saw cut; 9 Drilled holes; 10 Other (specify); 11 None (open hole)

SCREEN-PERFORATED INTERVALS: From ... ft. to ... ft., From ... ft. to ...
From ... ft. to ... ft., From ... ft. to ...

GRAVEL PACK INTERVALS: From ... ft. to ... ft., From ... ft. to ...
From ... ft. to ... ft., From ... ft. to ...

6 GROUT MATERIAL: 1 Neat cement; 2 Cement grout; 3 Bentonite; 4 Other ...

Grout Intervals: From 6 ft. to 3 ft., From ... ft. to ... ft., From ... ft. to ...

What is the nearest source of possible contamination: 1 Septic tank; 2 Sewer lines; 3 Watertight sewer lines; 4 Lateral lines; 5 Cess pool; 6 Seepage pit; 7 Pit privy; 8 Sewage lagoon; 9 Feedyard; 10 Livestock pens; 11 Fuel storage; 12 Fertilizer storage; 13 Insecticide storage; 14 Abandoned water well; 15 Oil well/Gas well; 16 Other (specify below)

Direction from well? Southeast How many feet? 150 ft.

FROM	TO	LITHOLOGIC LOG	FROM	TO	PLUGGING INTERVALS
241	65	sand + gravel (248.8 cubic ft.)			
65	6	Clays (83.4 cubic ft.)			
6	3	Cement grout (4.2 cubic ft.)			

7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) 2-16-81 and this record is true to the best of my knowledge and belief. Water Well Contractor's License No. ... This Water Well Record was completed on (mo/day/yr) 2-20-81 under the business name of — by (signature) John Doe

INSTRUCTIONS: Use typewriter or ball point pen. PLEASE PRESS FIRMLY and PRINT clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66620-7320. Telephone 913-296-5545. Send one to WATER WELL OWNER and retain one for your records.

SIGNIFICANCE OF WATER MINERALIZATION

Total Dissolved Solids: The total dissolved solids is a measure in weight (mg/l) of the mineral matter dissolved in the water. This figure multiplied by 8.34 gives pounds of mineral matter per million gallons of water. The U.S. Public Health Service Drinking Water Standards recommend less than 500 mg/l total solids for drinking or culinary uses. If such water is not available 1000 mg/l will be considered satisfactory. The specific conductance (micromhos per centimeter) is a measure of the water's ability to conduct an electric current and is therefore an indication of the ionic strength, or mineralization, of the water.

Total Hardness: The calcium ion and the magnesium ion cause the hardness of water and the sum of the two, both expressed as $CaCO_3$, is termed the total hardness. Hardness is undesirable in water in that it produces an insoluble sticky curd with soap and produces scaling in teakettles and hot water tanks. A total hardness above 400 mg/l as $CaCO_3$ is considered excessive for public water supplies in Kansas. Hardness can be removed readily by the softening process.

Sodium: Sodium is not particularly significant physiologically except to those persons having an abnormal sodium metabolism and who are thus on a restricted sodium diet. It is important in irrigation waters because a high sodium to calcium-magnesium ratio tends to decrease the permeability of the soil and thus will have a harmful effect on soil structure. The base exchange or zeolite process of softening increases the sodium content of the water being softened. Limit 100 mg/l

Iron and Manganese: Iron and manganese have little significance physiologically but they are undesirable in a public water supply because both will produce staining of laundered fabrics and porcelain plumbing fixtures and create consumer complaint. If present in an appreciable amount iron gives the water a rusty turbid appearance and an unpleasant taste. Both substances create problems in the chlorination of water. The U.S.P.H.S. Drinking Water Standards recommend that iron be less than 0.3 mg/l and manganese less than 0.05 mg/l. Iron and manganese can be readily removed by treatment, particularly if lime-soda softening is also being practiced.

Sulfate: Sulfate is one of the principal mineralizing characteristics of water in Kansas and if present in large amounts it will impart a bitter taste to the water and it may act as a laxative to people who are not accustomed to drinking the water. The drinking water standards recommend that sulfate be less than 250 mg/l. Sulfate cannot be removed economically.

Chloride: Chloride is one of the principal mineralizing substances present in water in Kansas. When present in sufficient amount, chloride imparts a salty taste to the water but otherwise has little or no physiological significance when present in concentrations not offensive to taste. The drinking water standards recommend that chloride be less than 250 mg/l. Chloride cannot be removed economically.

Nitrate: Nitrate is important in drinking water because high concentrations may produce cyanosis or methemoglobinemia in infants. The recommended limit for public water supplies in Kansas is 10 mg/l nitrate (as N) when used for infants under one year of age. Older children and adults are not affected. Nitrate is also important in water to be used for livestock watering because excessive amounts may be harmful, particularly to young animals. Nitrate cannot be removed economically.

Fluoride: Fluoride is important in drinking water because in high concentration it may produce a mottling or discoloration of the tooth enamel of children and in low concentration it does not afford sufficient protection for the prevention of dental decay in children. A concentration of 1.0 mg/l fluoride is considered optimum for public water supplies in Kansas and a concentration of 1.5 mg/l fluoride is the recommended limit. It is recommended that fluoride be added to public water supplies when the concentration is substantially less than the optimum.

Phosphate: Total phosphate represents all forms of phosphate in water including polyphosphates used in the treatment of water. Phosphate in water has little physiological significance but it does stimulate the growth of algae and thus may cause water treatment problems. If a poly-phosphate is being fed to stabilize iron it is recommended that the feed rate be limited to 3 mg/l phosphate per 1 mg/l iron.

* * * * *

- mg/l = milligrams per liter
- One gallon weighs 8.34 pounds
- 1 mg/l = 8.34 lbs. per million gallons
- 17.1 mg/l = 1 grain per gallon
- To obtain results in grains per gallon divide results in milligrams per liter by 17.1.
- Reacting values are in terms of milligram equivalents per liter

KANSAS STATE DEPARTMENT OF HEALTH AND ENVIRONMENT

DIVISION OF ENVIRONMENT
(March 1975)

DISINFECTION TABLE TO DISINFECT THE WELL WATER

(Produces a 100 mg/liter chlorine solution per-foot of casing size)

CASING SIZE Nominal diameter (INCHES)	GALLONS OF WATER PER ONE FOOT OF CASING SIZE (GAL/FT/CA. SIZE)	OUNCES OF PRODUCT ADDED TO DISINFECT ONE (1) FOOT OF WATER PER CASING SIZE		
		5.25% to 6.0% Chlorine	10% Chlorine	70% Chlorine
		<u>PRODUCT</u>: Clorox, Purex, Sno-White, Kandu, Topco, Action, White Magic, Surefine and MC_2 or other brand names. (sodium hypochlorite) (FLUID OUNCES)	<u>PRODUCT</u>: Liquid Bleach. Purchased from a chemical supply company. (sodium hypochlorite) (FLUID OUNCES)	<u>PRODUCT</u>: High test Calcium Hypochlorite. Purchased from a chemical supply company. (calcium hypochlorite) (DRY OUNCES)
1.25	0.06	0.015	0.008	0.0011
1.50	0.09	0.023	0.012	0.0017
2	0.16	0.041	0.021	0.0031
2.5	0.25	0.064	0.033	0.0048
3	0.37	0.094	0.049	0.0071
3.5	0.50	0.127	0.067	0.0095
4	0.65	0.165	0.087	0.0124
5	1.02	0.259	0.136	0.0194
6	1.50	0.381	0.200	0.0286
8	2.60	0.660	0.347	0.0495
10	4.08	1.036	0.544	0.0777
12	5.87	1.490	0.782	0.1118
14	8.00	2.031	1.066	0.1523
16	10.44	2.650	1.391	0.1988
18	13.21	3.354	1.761	0.2515
24	23.50	5.966	3.132	0.4474
30	36.70	9.317	4.891	0.6988

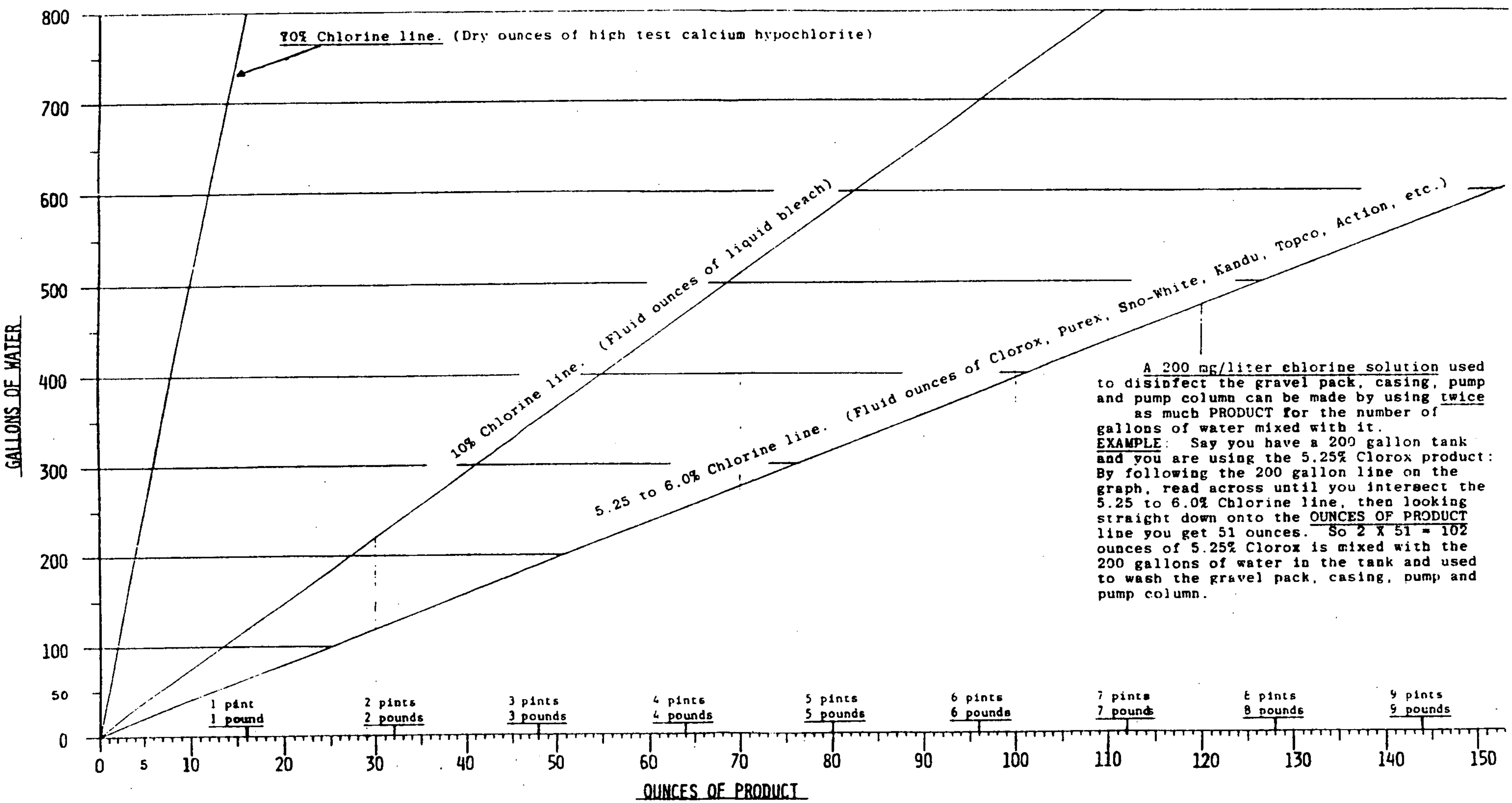
1. <u>FORMULA TO FIND HEIGHT OF WATER COLUMN</u>: (total depth of water well) - (measured static water level) = (height of water column)
   <u>EXAMPLE</u>: (216 feet depth of well) - (37 feet static water level) = (179 feet of water column)

2. <u>FORMULA TO FIND NUMBER OF OUNCES USED TO DISINFECT THE WELL WATER</u>: (height of water column) X (ounces of <u>PRODUCT</u> added to disinfect one (1) foot of water per casing size) = (ounces of <u>PRODUCT</u> needed to be placed and mixed with the water in the well) <u>EXAMPLE</u>: For a 5 inch casing using 5.25% Clorox Product: (179 feet) X (0.259) = (46.36 fluid ounces) Which is approximately 3 pints of Clorox placed down the well and mixed with the well water by surging and left standing in the well for 8-10 hours to properly disinfect the well water.

3. FORMULA TO FIND NUMBER OF GALLONS INSIDE THE CASING: (gallons of water per one (1) foot of casing size) X (height of water

DISINFECTION GRAPH TO DISINFECT THE WELL WATER

(PRODUCES A 100 MG/LITER CHLORINE SOLUTION WHEN MIXED WITH THE NUMBER OF GALLONS OF WATER)



NOTE: 1 PINT = 16 FLUID OUNCES
1 POUND = 16 DRY OUNCES

METHODS FOR CHLORINATING PRIVATE WATER SUPPLIES

1. The well cover should be removed so that fluid can be dumped or poured into the well, if possible the pumping system should remain functional. Caution must be taken to avoid electrical shock.

2. The volume of water contained in the system should be estimated so that the appropriate amount of chlorine bleach can be added. The volume of water in the well, piping, pressure tank, and water heater must be totaled.

   a. The volume of the well should be estimated by subtracting the depth to the water inside the well from the total depth of the well. This will tell you how many feet of water are in the well. The attached chart shows how many gallons of water per foot are contained in each different size (diameter) wells.

   b. The volume of the water heater and the pressure tank (if used) should be readily available.

   c. The piping from the well to the point of use can be estimated at between 20 and 100 gallons depending on the length and size of piping to the house and the number of sinks, toilets, showers or other dispensers. If the well is a long distance from the house (over 200 ft.) some additional volume should be added.

   d. Total the volume of water contained in the entire system.

      a. The amount of water contained in the well __________

      b. Capacity of the water heater __________
         Capacity of the pressure tank __________

      c. Estimated volume contained in the piping __________

      d. Total: Add the four numbers above to obtain the total volume of water in the system. __________

   One ounce of chlorine bleach should be added for every 2 gallons of water in the system. More chlorine may be required for heavy concentrations of bacteria to insure that the disinfection of the system is complete. In most cases 1/2 to 1 gallon of chlorine laundry bleach is an ample amount to obtain complete disinfection of the system even with heavy bacteria concentrations. The chlorine bleach should be diluted before it is added to the well to minimize any corrosion of metal casing or pump parts from concentrated chlorine.

3. Obtain a tank or enough clean buckets or containers which can be filled with chlorinated water to equal at least the volume of water contained in the well. The chlorine solution can be mixed up by adding 1 oz. of chlorine bleach to every 2 gallons of water in the containers. These containers should be placed near the well before the chlorine solution is mixed since they will be poured into the well once step 4 has been completed.

4. Add the required amount of chlorine to the well. Run the hose from the nearest faucet to the well and circulate the chlorine mixture through the hose and back into the well. By circulating the water in the well an even mixture of chlorine solution can be obtained. While mixing the chlorine solution with the hose the sides of the casing and the drop pipe for the pump can be washed with the chlorinated mixture.

   A strong odor of chlorine smell should be present after the mixing process has been completed. If the chlorine smell is not strong more chlorine should be added.

5. Pour the mixture of chlorinated water into the well and allow the well to set for 2 or more hours before proceeding with step 6.

6. Run water from each faucet in the distribution system until a chlorine odor is present in the water. This should be done for hot and cold water. The hot water should take longer than the cold because the hot water tank holds a large volume of water. Chlorinated water should be allowed to enter all of the lines in the distribution system including lines to bathtubs, showers, toilets, and outside hydrants so complete disinfection can be achieved. Carbon filters should be removed or bypassed. The air pressure should be released from the pressure tank (except those with a permanent air cushion) so that the entire tank may be filled with chlorinated water.

   Caution: Some pressure tanks may be damaged by strong chlorine solutions. The manufacturer should be contacted to provide needed information about disinfection of the pressure tank.

It may be necessary to repeat steps 4 and 5 if the chlorine smell reaching the faucets is weak. The chlorinated water should be allowed to remain in the well and piping for 12 to 24 hours if possible.

The chlorinated water contained in the system should be pumped to waste when the allotted time has passed. The water having a strong chlorine smell should not be discharged to a septic tank as it may kill the needed microorganisms in the septic system. This water should be discharged onto a driveway or area where damage will not be done to vegetation or other property. The chlorinated water contained in the plumbing system should be discharged until the chlorine odor is absent from all water sources. A small amount of chlorinated water contained in the plumbing of the house should not affect the septic tank. If bacteria problems persist the chlorination process may need to be repeated.

After the well has been chlorinated the well must be sealed to prevent surface water, small animals and insects from entering the well. A screened vent should be provided in the casing or well seal so air may enter the well but water and insects cannot.

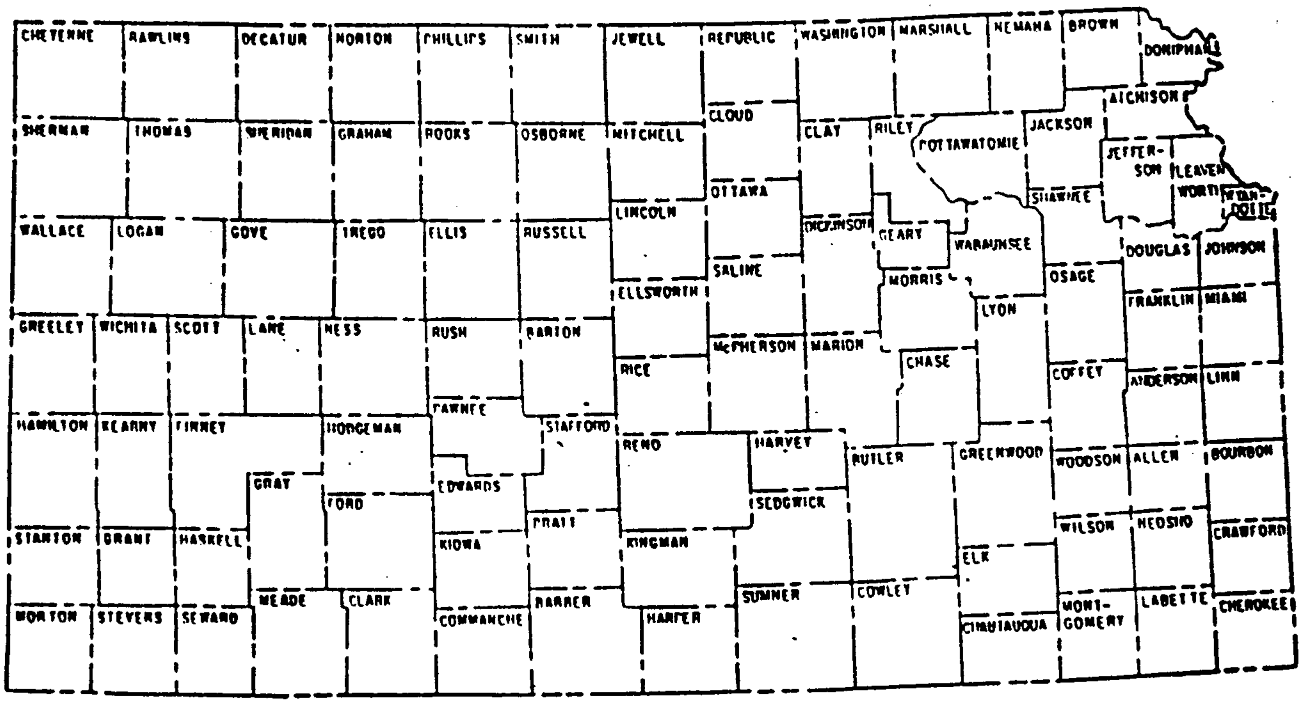
Some wells are constructed so that it is not possible to install a positive well seal such as a dug well. These wells can be reconstructed and cased or a continuous chlorination system can be installed which will kill the unwanted bacteria.

If after reading this publication you are unsure of this procedure for chlorination you may contact the Bureau of Water within the Department of Health and Environment located in Topeka (913) 296-5523 or one of the six district offices at the locations shown below.

Dodge City -(316) 225-0596
Wichita -(316) 838-1071
Chanute -(316) 431-2390
Lawrence -(913) 842-4600
Salina -(913) 827-9639
Hays -(913) 625-5664

dg

Pipe Or Well Diameter (Inches)	Gallons Of Water Per Foot Of Length
1/2	.010
3/4	.023
1	.041
1 1/4	.067
1 1/2	.092
2	.163
2 1/2	.255
3	.37
3 1/2	.50
4	.65
5	1.02
6	1.50
8	2.60
10	4.08
12	5.87
14	8.00
16	10.44
18	13.21
24	23.50
30	36.70



1. <u>SOUTHWEST DISTRICT OFFICE</u> - 302 W. McArtor Rd., Dodge City 67801 - 316/225-0596

   Ubel, Don C. - Env. Geol. II - North Star Route - Dodge City - 225-1697

2. <u>SOUTH CENTRAL DISTRICT OFFICE</u> - 1919 Amidon, Ste. 130, Wichita 67203 - 316/838-1071

   O'Connor, Ralph E. - Env. Geol. II - 2257 S. Ridgewood, Wichita - 686-9175
   Parker, Kyle - Env. Geol. I - 1956 N. Gow, Wichita - 945-8452
   Marcotte, Stanley - Env. Tech. IV - 1939 N. Gow, Wichita - 945-2807

3. <u>SOUTHEAST DISTRICT OFFICE</u> - 1500 W. 7th, P.O. Box 888, Chanute 66720 - 316/431-2390

   Thornton, William - Env. Geol. II - 913 W. 4th, Chanute - 431-6438
   McKee, Norman L. - Env. Tech. IV - 1503 W. 14th, Chanute - 431-0359

4. <u>NORTHEAST DISTRICT OFFICE</u> - 808 W. 24th St., Lawrence 66046 - 913/842-4600

   Glotzbach, Marvin W. - Env. Geol. II - 3640 SE Howard Dr., Topeka - 235-8942
   Roth, Meredith - Env. Tech. IV - 2710 SE 32nd, Topeka - 266-2987

5. <u>NORTH CENTRAL DISTRICT OFFICE</u> - 2501 Market Pl., Ste. D & E, Salina 67401 - 913/825-6

   Robl, Dale A. - Env. Geol. I - 2204 Huntington Rd., Salina - 825-6507

6. <u>NORTHWEST DISTRICT OFFICE</u> - 2301 E. 13th, Hays 67601 - 913/625-5663

   Larson, Michael K. - Env. Geol. II - 501 W. 37th #5, P.O. Box 1193, Hays - 625-4110

WATER WELL PLUGGING RECORD Form WWC-5P KSA 82a-1212

1 LOCATION OF WATER WELL: County:	Fraction 1/4 1/4 1/4	Section Number	Township Number	Range Number

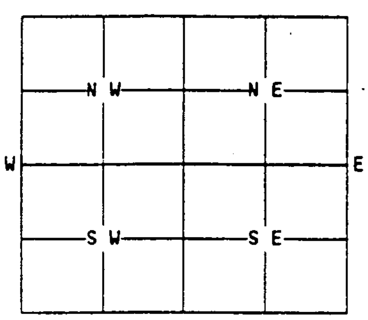
Distance and direction from nearest town or city street address of well if located within city?

2 WATER WELL OWNER:

RR#, St. Address, Box #:
City, State, ZIP Code :

Board of Agriculture, Division of Water Resources
Application Number:

3 MARK WELL'S LOCATION WITH AN "X" IN SECTION BOX:



4 DEPTH OF WELL..........................ft.

WELL'S STATIC WATER LEVEL.............ft.

WELL WAS USED AS:

1 Domestic
2 Irrigation
3 Feedlot
4 Industrial
5 Public Water Supply
6 Oil Field Water Supply
7 Lawn and Garden Only
8 Air Conditioning
9 Dewatering
10 Monitoring Well
11 Injection Well
12 Other...................

Was a chemical/bacteriological sample submitted to Department? Yes....No....
If yes, mo/day/yr sample was submitted....................

Water Well Disinfected: Yes...... No......

5 TYPE OF BLANK CASING USED:

1 Steel
2 PVC
3 RMP (SR)
4 ABS
5 Wrought
6 Asbestos-Cement
7 Fiberglass
8 Concrete Tile
9 Other (specify below)
....

Blank casing diameter...........in. Was casing pulled? Yes...... No...... If yes, how much............
Casing height above or below land surface....................in.

6 GROUT PLUG MATERIAL: 1 Neat cement 2 Cement grout 3 Bentonite 4 Other.............................

Grout Plug Intervals: From......ft. to.......ft., From......ft. to ......ft., From...... to......ft.

What is the nearest source of possible contamination:

1 Septic tank
2 Sewer lines
3 Watertight sewer lines
4 Lateral lines
5 Cess Pool
6 Seepage pit
7 Pit privy
8 Sewage lagoon
9 Feedyard
10 Livestock pens
11 Fuel storage
12 Fertilizer storage
13 Insecticide storage
14 Abandoned water well
15 Oil well/Gas well
16 Other (specify below)
....

Direction from well? .... How many feet? ....

FROM	TO	PLUGGING MATERIALS

7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION:This water well was plugged under my jurisdiction and was completed on (mo/day/year)...................... and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. .... This Water Well Record was completed on (mo/day/year) .... under the business name of ....
by (signature) ....

INSTRUCTIONS: Use typewriter or ball point pen. <u>Please press firmly</u> and <u>print</u> clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66620-0001. Telephone: 913/296-3565. Send one to Water Well Owner and retain one for your records.

~~REC~~ REC'D
OCT 95

STATE OF KANSAS
DEPARTMENT OF HEALTH AND ENVIRONMENT

ARTICLE 12

GROUNDWATER EXPLORATION AND PROTECTION ACT

KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT
1885

Bureau of Water
Industrial Program Section
Forbes Field, Building 283
Topeka, Kansas 66620
913/296-5524

ARTICLE 12

Groundwater Exploration and Protection Act

82a-1201. Title. This act shall be known as the "Kansas groundwater exploration and protection act:.

History: L. 1973, ch. 417, § 1; July 1.

82a-1202. Declaration of purpose. It is the purpose of this act to provide for the exploration and protection of groundwater through the licensing and regulation of water well contractors in Kansas to protect the health and general welfare of the citizens of this state; to protect groundwater resources from waste and potential pollution by requiring proper description of the location, drilling and well construction, and proper plugging of abandoned water wells and test holes; and to provide data on potential water supplies through well logs, well pumping tests and water quality tests which will permit the economic and efficient utilization and management of the water resources of this state.

In order to achieve these objectives, this act requires licensing of water well contractors; provides for the establishment of standards for well construction, reconstruction, treatment and plugging; requires each licensed water well contractor to keep and transmit to the state, upon request, a copy of the log of the well, pump test data if available, and water quality samples; and maintains within the state geological survey of Kansas a record system of well logs and water quality data which will be available to the public.

History: L. 1973, ch. 417, § 2; L. 1979, ch. 334, § 1; July 1.

82a-1203. Definitions. As used in this act, unless the context otherwise requires:

(a) "Construction of water wells" means all acts necessary to obtaining groundwater by any method for any use including, without limitation, the location of and excavation for the well.

(b) "Person" means any individual, association, firm, partnership, corporation or governmental entity.

(c) "Sand point" or "well point" means any driven well which is 25 feet or less in depth and is constructed by manually driving into the ground a drive point fitted to the lower end of tightly connected sections of pipe that are 2 inches or less in diameter.

(d) "Domestic uses" means the use of water by any person, family unit or household or household purposes, the watering of livestock, poultry, farm and domestic animals used in operating a farm or the irrigation of lands not exceeding a total of two acres of area for the growing of gardens, orchards or lawns.

(e) "Secretary" means the secretary of health and environment

(f) "Water well" means any excavation that is drilled, cored, bored, washed, driven, dug, jetted, or otherwise constructed, when the intended use of such excavation is for the location, diversion, artificial recharge, or acquisition of groundwater.

(g) "Water well contractor" or "contractor" means any person who constructs, reconstructs or treats a water well. The tern shall not include:

(1) An individual while in the act of constructing a water well on land which is owned by such individual and is used by such individual for domestic purposes at such individual's place of abode, but only when the well is constructed in compliance with prescribed minimum well standards as provided in this act; or

(2) an individual who performs labor or services for a licensed water well contractor at such contractor's direction and under such contractor's supervision.

History: L. 1973, ch. 417, § 3; L. 1974, ch. 352, § 172; L. 1989, ch 311, § 1; July 1.

82a-1205. Administration and enforcement of act; license fees; licenses; inspection; personnel; report. (a) The secretary shall be responsible for the administration and enforcement of the provisions of this act and any rules and regulations adopted pursuant thereto.

(b) The secretary shall fix by rules and regulations reasonable license fees annually for each contractor and for each drill rig operated by or for such contractor. The secretary shall fix by rules and regulations an additional fee for each well drilled except as provided in paragraphs (1) and (2) of subsection (c) of K.S.A. 82a-1203 and amendments thereto. Such fees shall be in an amount, which, together with any other funds available therefor, will produce an amount, which will properly administer the provisions of this act. Any nonresident may secure a water well contractor's license in Kansas upon approval of an application therefor by the secretary and the payment of the fee equal to the fee charged for a similar nonresident license by the state in which the applicant is a resident, but in no case shall the fee be less than that charged a Kansas resident.

(c) The secretary shall have the power and authority and may cause to be inspected water wells in all phases of construction, reconstruction, treatment or plugging, and shall have access to such wells at all reasonable times. The secretary shall have general supervision and authority over the construction, reconstruction and treatment of all water wells and the plugging of holes drilled and abandoned in search of a groundwater supply or hydrogeological information.

(d) The secretary may employ within funds available such engineering, geological, legal, clerical and other personnel as may be necessary for the proper performance of responsibilities under this act. Such employees shall be within the classified service under the Kansas civil service act.

(e) The secretary is authorized and directed to cause examination to be made of applicants for licensing; to renew such licenses; to adopt rules and regulations necessary to establish continuing education requirements for persons licensed under this act; to issue licenses to qualified water well contractors in this state; to revoke or suspend licenses after their issuance is hereafter determined, after notice to the person affected and an opportunity for hearing; and to reinstate licenses previously revoked when justification therefor is shown.

(f) The secretary shall prepare, in the form and manner prescribed by law, a report on the administration of this act.

History: L. 1973, ch. 417, § 5; L. 1974, ch. 352, § 173; L. 1979, ch. 334, § 2; L. 1983, ch. 286, § 8; L. 1991, ch 293 § 1; July 1.

82a-1206. Licensure of water well contractors; application fee; disposition of moneys; water well contractors licensing fund abolished; standards for grating license. (a) Each well contractor desiring to engage in the business of constructing, reconstructing or treating water wells in this state shall make initial application for a license to the secretary. Every contractor making such application shall set out such information as may be required upon forms to be adopted and furnished by the secretary. The secretary shall charge an application fee as established by regulation for the filing of such initial application by a contractor, and the secretary shall not act upon any application until such application fee has been paid.

(b) All application fees and license fees collected hereunder shall be remitted to the state treasurer at least monthly. Upon receipt of any such remittance, the state treasurer shall deposit the entire amount thereof in the state treasury and the same shall be credited to the state general fund. On July 1, 1983, the director of accounts and reports shall transfer all moneys in the water well contractors licensing fund to the state general fund. All liabilities of the water well contractors licensing fund are hereby transferred to and imposed upon the state general fund. The water well contractors licensing fund is hereby abolished.

(c) A license to construct water wells shall be issued to any applicant if, under the standards set forth in K.S.A. 82a-1207 and amendments thereto, the secretary shall determine such applicant is qualified to conduct water well construction operations. In the granting of such licenses due regard shall be given to the interest of the state of Kansas in the protection of its underground water resources. Application fees paid hereunder shall be retained by the secretary whether such initial license is issued or denied, but if denied, the license fee shall be refunded.

(d) Applicants for licenses hereunder who are engaged in business as water well contractors in this state, if incorporated, shall submit evidence of current good standing with the registration requirements for corporations of the secretary of state.

History: L. 1973, ch. 417, § 6; L. 1974, ch. 352, § 174; L. 1979, ch. 334, § 3; L. 1983, ch. 286, § 14; July 1.

82a-1207. Investigation of qualifications: examination. Under such reasonable rules and regulations as the secretary may adopt pertaining to the business of water well contracting and construction of water wells, the secretary shall investigate by examination or otherwise, the qualifications of all applicants for initial licenses as water well contractors to construct, reconstruct or treat wells for production of underground waters in this state. Where an examination is required, such examination may be oral or written or both. The qualifications required of each candidate for such an examination are as follows:

(a) Familiarity with Kansas water laws, sanitary standards for water well drilling and construction of water wells and rules and regulations relating to water well construction, reconstruction, treatment and plugging as adopted by the secretary;

(b) Knowledge of groundwater and subsurface geology in its relation to well construction.

The examinations conducted by the secretary shall be held at such times and places as he may determine. Failure of an applicant to pass such examination shall disqualify him from making further application for a period of one (1) month. The secretary shall act within a reasonable time upon all applications for licenses hereunder.

History: L. 1973, ch. 417, § 7; L. 1974, ch. 352, § 175; L. 1979, ch. 334, § 4; July 1.

82a-1209. Terms of license; renewal; fees; revocation, when. The term of all licenses issued under the provisions of this act shall be July 1 of each year through the following June 30.

Any contractor licensed under the provisions of this act may, on or before July 1, each year, renew such license by paying the annual fee as determined by the secretary and complying with continuing education requirements established by the secretary. If the licensee has not met the requirements for renewal of the license on or before July 1, the license shall be revoked by the secretary. Prior to such revocation, however, the secretary shall notify the applicant of the secretary's intention to revoke at least 10 days prior to the time set for action to be taken, by notice to the applicant at the address appearing on such license in the records and files of the secretary and compliance with the provision of the Kansas administrative procedure act. A license, once revoked, may not be reinstated unless the revocation resulted because of an error of the secretary or other reason not the fault of the licensee. A person whose license has been revoked and who desires to continue to engage in the business of water well construction in this state, must make application as provided for in K.S.A. 82a-1207, and amendments thereto. Such applicant may be required to retake the examination.

History: L. 1973, ch. 417, § 9; L. 1974, ch. 352, § 177; L. 1979, ch. 334, § 5; L. 1984, ch. 313, § 147; L. 1991, ch. 293, § 2; July 1.

82a-1210. Revocation of license, when; complaints against licensee; notice and hearing. Any license issued under this act may be revoked by the secretary (1) when the licensee has practiced fraud or deceit in obtaining a license or otherwise engaging in activities regulated by this act; (2) for negligence or incompetence; or (3) for violating any requirement of this act. Any person, in addition to the secretary, may make complaint against any licensee. Notice shall be given to the licensee of the specific charges, in accordance with the notice provisions of the Kansas administrative procedure act. Prior to revocation or suspension of a license, the water well contractor shall be afforded the opportunity promptly to bring the well up to standard or to correct the error resulting in the complaint. Compliance must be acceptable to the secretary. The secretary shall not revoke any license pursuant to this section without giving the licensee an opportunity for hearing in accordance with the provisions of the Kansas administrative procedure act.

History: L. 1973, ch. 417, § 10; L. 1974, ch. 352, § 178; L. 1979, ch. 334, sec 6; L. 1984, ch. 313, § 148; July 1, 1985.

82a-1211. Appeal from decisions of secretary. Appeals from decisions of the secretary may be taken in accordance with the provisions of the act for judicial review and civil enforcement of agency actions.

History: L. 1973, ch. 417, § 11; L. 1974, ch. 352, § 179; L. 1984, ch. 313, § 149; July 1, 1985.

82a-1212. Log of drilling, boring or digging; contents; filed with state geological survey. Any water well contractor licensed under this act who constructs, reconstructs or plugs a water well shall keep a careful and accurate log of the construction, reconstruction or plugging of such well and shall furnish a record of said well log to the secretary within thirty (30) days after completion of such well in such form as the secretary might require. The log shall show:

(a) The name and address of the landowner and the legal description of the location of the well;

(b) The character and depth of the formation passed through or encountered;

(c) The depth at which water is encountered;

(d) The static water level of the completed well;

(e) A copy of the record of pumping test, if any; and

(f) The construction or reconstruction details of the completed water well including lengths and sizes of casing, length and size of perforations or screens, and length and size of gravel packing; [and]

(g) The amount, type and placement of plug materials used in plugging a water well.

A water sample shall be furnished to the secretary, upon request, within thirty (30) days after completion of such well unless an extension of time is granted by the secretary, in which case, the sample shall be furnished to the secretary within such extended period of time. The well logs and a copy of the water quality analysis shall be transmitted by the secretary to the state geological survey and kept on file by the survey and be available to the public.

History: L. 1973, ch. 417, § 12; L. 1974, ch. 352, § 180; L. 1979, ch. 334, § 7, July 1.

82a-1213. Abandoned holes; plugging; failure to properly seal. All holes drilled in search of a water supply and abandoned, shall be properly plugged by the drilling contractor in accordance with rules and regulations established by the secretary in order to assure adequate and proper plugging of abandoned wells to prevent pollution of existing groundwater. Any contractor who fails to properly seal any exploratory wells drilled in search of a water supply and abandoned by him or her shall be subject to the penalties set out in this act. All unplugged abandoned water wells shall be plugged or caused to be plugged by the landowner in accordance with rules and regulations established by the secretary in order to assure adequate and proper plugging of abandoned water wells to prevent pollution to existing groundwater supplies, except that no unplugged abandoned water well existing on the effective date of this act which is not polluting or threatening to pollute a groundwater supply shall be required to be plugged.

History: L. 1973, ch. 417, § 13; L. 1974, ch. 352, § 181; L. 1979, ch. 334, § 8; July 1.

82a-1214. Penalty for violations of act; enforcement of act. Any person who shall willfully violate any lawful rule or regulation of the secretary relating to water well contracting, or who shall engage in the business of constructing, reconstructing or treating water wells without first having obtained a license as in this act required, or who shall knowingly violate any provisions of this act, shall be guilty of a class B misdemeanor and subject to the penalties therefor as provided by law. In addition the secretary of health and environment is hereby authorized to apply to the district court for enforcement of this act or rules and regulations adopted under this act in accordance with the provisions of the act for judicial review and civil enforcement of agency actions.

History: L. 1973, ch. 417, § 14; L. 1974, ch. 352, § 182; L. 1979,ch. 335, § 1; L. 1984, ch. 313, § 150; July 1, 1985.

82a-1215. Severability. If any word, phrase, sentence or provision of this act is determined to be invalid, such invalidity shall not affect the other provisions of this act and they shall be given effect without the invalid provision, and to this end the provisions of this act are declared to be severable.

History: L. 1973, ch. 417, § 15; July 1.

82a-1216. Civil penalties and orders; appeals; disposition of penalties. (a) Any person who violates any provision of the Kansas groundwater exploration and protection act, any rules or regulations adopted thereunder or any order issued by the secretary thereunder shall incur in addition to other penalties provided by law, a civil penalty not to exceed $5,000 for each violation. In the case of a continuing violation every day such violation continues shall be deemed a separate violation.

(b) The secretary of the department of health and environment or the director of the division of environment, if designated by the secretary, upon a finding that a person has violated any provision of Kansas groundwater exploration and protection act, or any order issued or rule or regulation adopted thereunder, may: (1) Issue a written order requiring that necessary remedial or preventive action be taken within a reasonable time period; (2) assess a civil penalty for each violation within the limits provided in this section which shall constitute an actual and substantial economic deterrent to the violation for which is assessed; or (3) both issue such order and assess such penalty. The order shall specify the provisions of the act or rules or regulations alleged to be violated and the facts constituting each violation. Said order shall include the right to a hearing. Any such order shall become final unless, within 15 days after service of the order, the person named therein shall request in writing a hearing by the secretary. If a hearing is requested, the secretary shall notify the alleged violator or violators of the date, place and time of the hearing.

(c) No civil penalty shall be imposed under this section except after notification by issuance and service of the written order and hearing, if a hearing is requested, in accordance with the provisions of the Kansas administrative procedure act.

(d) Any person aggrieved by an order of the secretary made under this section may appeal such order to the district court in the manner provided by the act for judicial review and civil enforcement of agency actions.

(e) Any penalty recovered pursuant to the provisions of this section shall be remitted to the state treasurer, deposited in the state treasury and credited to the state general fund.

(f) Nothing in this act shall be construed to abridge, limit or otherwise impair the right of any person to damages or other relief on account of injury to persons or property and to maintain any action or other appropriate proceeding therefor.

History: L. 1989, ch. 311, § 2; July 1.

82a-1217. Restraining orders and injunctions; proof required. (a) Notwithstanding the existence or pursuit of any other remedy, the secretary may maintain, in the manner provided by the act for judicial review and civil enforcement of agency actions, an action in the name of the state of Kansas for injunction or other process against any person to restrain or prevent any violation of the provision of the Kansas groundwater exploration and protection act or of any rules and regulations adopted thereunder.

(b) In any civil action brought pursuant to this section in which a temporary restraining order, preliminary injunction or permanent injunction is sought, it shall be sufficient to show that a violation of the provisions of this act or the rules and regulations adopted thereunder has occurred or is imminent. It shall not be necessary to allege or prove at any stage of the proceeding that irreparable damage will occur should the temporary restraining order, preliminary injunction or permanent injunction not be issued or that the remedy at law is inadequate.

History: L. 1989, ch. 311, § 3; July 1.

82a-1218. Application of penalties to sand and well point wells, exception. (a) The provisions of K.S.A. 82a-1216 and 82a-1217 shall not apply with respect to any sand point or well point which is used for domestic purposes, or the reconstruction, replacement or treatment thereof, and which has not been abandoned, until the secretary adopts minimum standards for the construction, reconstruction, treatment or plugging of sand points or well points, except that a temporary restraining order, preliminary injunction or permanent injunction may be obtained pursuant to K.S.A. 82a-1217 if a health hazard is shown to exist or to be imminent.

History: L. 1989, ch. 311, § 4; July 1.

82a-1219. Act supplemental to Kansas groundwater exploration and protection act. K.S.A. 82a-1216, 82a-1217 and 82a-1218 shall be part of and supplemental to the Kansas groundwater exploration and protection act.

History: L. 1989, ch. 311, § 5; July 1.

SECTION 11212

PUMPS: WATER

03/89

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA E101	(1988) Vertical Turbine Pumps - Line Shaft and Submersible Types

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1993; Rev 1; Rev 2; Rev 3) Motors and Generators

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years. Pumps of the same type shall be the product of one manufacturer.

1.2.2 Nameplates

Each major item of equipment shall have the manufacturer's name, address, type or style, model, serial number, and catalog number on a plate secured to the item of equipment. Submersible pumps and motors shall also have identical nameplates affixed in a conspicuous place to the pumphouse wall or discharge piping. In addition, the nameplate for each pump shall show the capacity in gallons per minute at rated head in feet and speed in revolutions per minute. [Nameplate for each electric motor shall show the horsepower, speed in revolutions per minute, full load current, voltage, frequency, phases, time rating, maximum ambient temperature, insulation class code letter, and service factor.] [Nameplate for each [gasoline] [diesel] engine shall show the horsepower and speed in revolutions per minute.]

1.2.3 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions.

SD-19 Operation and Maintenance Manuals

Vertical Turbine Pump System; [_____].

[Nine] [_9_] complete copies of operating manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. The manuals shall include simplified wiring, layout, and control diagrams of the system as installed.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 PRODUCTS

2.1 PUMP AND DRIVER REQUIREMENTS

2.1.1 Type of Installation

The work shall include furnishing, installing, and testing [line shaft] [and] [submersible] vertical turbine pumping units and their appurtenances as indicated. Pumps shall be [utilized for a potable water supply and] installed in a [well].

2.2 PUMP PERFORMANCE

Pumps shall be capable of discharging quantities of water at maximum pump speed and total pump head with the minimum efficiency noted in the approved design. Total pump head in feet shall consist of the pumping level below datum and the static and friction head above datum at design capacity.

2.4 SUBMERSIBLE VERTICAL PUMPS

Unless otherwise specified, submersible vertical pumps shall be constructed in accordance with AWWA E101, driven by a 3/4 hp electric motor for the Well M-1 and 15 HP electric motor for the Racetrack Replacement well. Pumps shall be designed for connection to piping as indicated.

2.4.1 Pump Head Assembly

Pump head assembly shall consist of the surface plate from which the vertical discharge pipe is suspended and an elbow or fitting as required for connecting to the piping system. Head assembly shall be provided with eyebolts, lugs, or other means for securing slings to facilitate setting and lifting.

2.4.2 Pump Bowl Assembly

Pump bowl assembly shall include the pump bowls, impellers, shaft, and bearings and may be of single stage or multistage configuration.

2.4.2.1 Pump Bowls

Pump bowls shall have integrally-cast vanes with smooth, streamlined water passageways, and shall be constructed of close-grained cast-iron, [and shall be lined with porcelain enamel]. [Pump bowls shall be equipped with replaceable seal rings on the suction side for pumps with enclosed impellers.]

2.4.2.2 Impellers

Impellers shall be carefully finished with smooth water passageways and shall not load the prime mover beyond the nameplate rating over the entire performance range of the pump. Impellers shall be of the enclosed type and shall be constructed of Noryl.

2.4.2.3 Pump Shafts

Pump shafts shall be stainless steel and the pump-motor coupling shall be stainless steel capable of transmitting the required thrust in either direction.

2.4.2.4 Bearings

Intermediate bowl bearings shall be water-lubricated bronze or fluted rubber. Top bowl bearings and suction interconnecting bearings shall be grease packed bronze or water-lubricated bronze or fluted rubber. Grease in grease-packed bearings shall be nonwater-soluble hydraulic type permanently sealed against loss. Grease-packed bearings shall be provided with sand caps to prevent intrusion of abrasive particles. Thrust bearings shall be located in the pump motor.

2.4.2.5 Strainer

A [bronze] [or] [stainless steel] strainer shall be furnished at the pump suction.

2.4.3 Discharge Pipe

Discharge pipe shall be sized as shown. [Discharge column retainers or spiders shall be utilized to maintain the discharge pipe centered in the well casing. A minimum of one retainer shall be provided for each 50 feet of discharge pipe. Provisions shall be made for fastening the retainer spiders to prevent them from sliding on the pipe and damaging the power cable when the pump is installed in the well.]

2.4.4 Check Valves

Check valves shall be provided in the column pipe located at a pipe joint [where indicated] [or] [as recommended by the pump manufacturer]. Check valves shall be vertical type, of the same size as the column pipe in which they are installed. Check valves shall be designed to hold the column full of water, or provide bleed-back through the valve, as recommended by the pump manufacturer. Pumps with bleed-back check valves shall be provided with a positive time-delay relay that will not permit the pump to start until bleed-back is complete.

2.5 PUMP ACCESSORIES

2.5.1 Water-Level Indicator Assembly

A water-level indicator assembly shall be provided for each pump installation. Indicator shall be [the electrode type].

2.6 ELECTRICAL EQUIPMENT

2.6.1 General

Electrical motor-driven equipment specified shall be provided complete with motors, motor starters, and controls.

2.6.3 Submersible Vertical Turbine Pumps

2.6.3.1 Electric Motors

Submersible motors shall be designed and manufactured expressly for the intended use. Motors shall be rated [480] volts, [3] phase, [60] Hz and such rating shall be stamped on the nameplate. Submersible motors may be the wet-stator type, dry-stator type, or oil-filled stator type. Wet-stator motors shall be filled at the factory with water treated to minimize corrosion, and shall be provided with a seal to keep interchange of cooling water and water being pumped to a minimum. Windings shall be insulated with a waterproof material. Dry-stator motors shall have rotor bearings immersed in a coolant lubricant of water-oil or water-glycol mixture, or a water-grease emulsion. When the coolant is water, it may be sealed in the motor or allowed to flow through the motor, depending upon design. Stator case shall be hermetically sealed and may be filled with a solid plastic material to help dissipate heat. Oil-filled stator motors shall be completely filled with high-dielectric constant oil. A mechanical seal shall be provided between the shaft and the motor housing and shall be designed to minimize the loss of oil. An oil reservoir shall be provided to replenish the oil loss for the life of the motor. Wet-stator motors and oil-filled stator motors shall employ a system to automatically balance the liquid pressure in the motor at any depth of submergence up to the maximum allowable. Motor bearings shall provide smooth operations under the conditions encountered for the life of the motor. Adequate thrust bearings shall be provided in the motor to carry the weight of all rotating parts plus the hydraulic thrust, and shall be capable of withstanding the upthrust imposed during pump starting.

2.6.3.2 Control Equipment

[Manually controlled pumps shall have START-STOP pushbutton in cover.] [Automatically controlled pumps shall have three-position MANUAL-OFF-AUTOMATIC selector switch in cover.] [A pump low-water cutoff shall be installed in the well and shall shut the pump off when the water level in the well reaches the level shown.] [Additional controls or protective devices shall be as indicated.]

2.6.3.3 Power Cables

Submersible power cables shall be specifically designed for use with submersible pumps, and shall be as recommended by the manufacturer of the motors with which the cables are used. Each cable shall be not less than No. 12 AWG stranded copper and shall have an ampacity of not less than 125 percent of the motor full load current. Each conductor shall be insulated with a heat resistant, moisture resistant synthetic rubber or thermosetting plastic jacket. A separate stranded, green insulated, grounding conductor shall be provided for each circuit. Single- and multiple-conductor cables shall be jacketed with a watertight synthetic rubber, plastic, or metal jacket impervious to oil or water. Metal jackets shall have a polychloroprene covering. Submersible cables shall be suitable for continuous immersion in water at the maximum depth encountered. Multiple-conductor cables may be used for ampacities up to and including 200 amperes; for greater ampacities single-conductor cables or two multiple-conductor cables shall be used. Cables shall be securely supported from the pump column at intervals not to exceed 15 feet by corrosion-resistant bands or clamps designed to prevent damage to the cable jacket. Single-conductor cables shall be laced, cabled together, or clamped at intervals to prevent spreading apart. Except where cables are connected to the motor terminal wiring, cables shall contain no splices in the length from the junction box or motor starter to the motor. Cables shall be terminated at the junction box or motor starter with a watertight cable connector. Splices in cables will be allowed only at the connection to the motor, and may be made at that point only if there is sufficient room in the well casing without interfering with proper pump setting and operation. A waterproof plug and connector or other type of fitting may be provided for connection of the cable at the motor. Such connection shall be suitable for continuous immersion at the maximum water depth encountered. Splices shall use pressure connectors and shall be cast in an epoxy resin, providing a homogeneous waterproof bond to the outer jacket of the cables. Splices shall be factory fabricated and tested and shall be waterproof and suitable for continuous immersion at the maximum depth encountered. For each 50 feet of setting depth, 1 foot of extra cable length shall be provided to compensate for possible twist or sag of the cable during installation. Where cables pass the pump bowl assembly, cables shall be flat or protected against damage by a corrosion-resistant shield forming a smooth rounded surface. Sharp bends in the cables at the shield or at the connection to the motor will not be allowed.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

Each pump [and engine] shall be installed in accordance with the written instruction of the manufacturer [and under the direct supervision of the manufacturer's representative] [and the impellers shall be set by the manufacturer's representative]. Engine fuel supply system shall be installed as indicated and in conformance with NFPA 30 and NFPA 37.

3.3 TESTING

3.3.1 Factory Pump TestFactory Pump Test

Factory pump performance test shall be made in conformance with AWWA E101 for the following:

a. Running test.

b. Witnessed running test.

c. Sample calculation from test readings.

d. Shop inspection.

e. Hydrostatic test of bowl assembly.

f. Hydrostatic test of discharge head.

3.3.3 Field Equipment TestField Equipment Test

After installation of the pumping units and appurtenances is complete, operating tests shall be carried out to assure that the pumping installation operates properly. Each pumping unit shall be given a running field test in the presence of the Contracting Officer for a minimum of 2 hours [with each combination of electric motor and engine drive]. Each pumping unit shall be operated at its rated capacity or such other point on its head-capacity curve selected by the Contracting Officer. [For submersible pumping units, an insulation resistance test of the cable and the motor shall be conducted prior to installation of the pump, during installation of the pump, and after installation is complete. The resistance readings shall be not less than 10 megohms.]

3.3.3.1 Correct Installation of Appurtenances

Tests shall assure that the units and appurtenances have been installed correctly, that there is no objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly.

3.3.3.2 Deficiencies

If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be reconducted.

-- End Of Section --

SECTION 15400

PLUMBING, GENERAL PURPOSE

08/94

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM D 638	(1996) Tensile Properties of Plastics
ASTM D 638M	(1996) Tensile Properties of Plastics (Metric)
ASTM D 1785	(1996a) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2235	(1996a) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2239	(1996a) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D 2241	(1996a) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2447	(1995) Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
ASTM D 2464	(1996a) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1996a) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1996a) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2657	(1996) Heat Fusing Joining Polyolefin Pipe and Fittings
ASTM D 2661	(1996) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2665	(1996) Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2672	(1996a) Joints for IPS PVC Pipe Using Solvent Cement
ASTM D 2683	(1995) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D 2737	(1996a) Polyethylene (PE) Plastic Tubing
ASTM D 2846	(1996) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3035	(1995) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D 3122	(1995) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings
ASTM D 3138	(1995) Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components
ASTM D 3139	(1996a) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3261	(1996) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

ASTM D 3308	(1991a) PTFE Resin Skived Tape
ASTM D 3311	(1994) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM D 4060	(1995) Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D 4101	(1996a) Propylene Plastic Injection and Extrusion Materials
ASTM F 437	(1993) Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 438	(1993) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F 439	(1993a) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 441	(1995) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F 442	(1994) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM F 477	(1995) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 493	(1993a) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
ASTM F 628	(1995) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core
ASTM F 1290	(1993) Electrofusion Joining Polyolefin Pipe and Fittings
ASTM F 1760	(1996) Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content.

ASME INTERNATIONAL (ASME)

ASME A112.1.2	(1991) Air Gaps in Plumbing Systems
ASME A112.6.1M	(1997) Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.14.1	(1975; R 1990) Backwater Valves
ASME A112.18.1M	(1996) Plumbing Fixture Fittings
ASME A112.19.1M	(1994) Enameled Cast Iron Plumbing Fixtures
ASME A112.19.2M	(1995; Errata) Vitreous China Plumbing Fixtures
ASME A112.19.3M	(1987; R 1996) Stainless Steel Plumbing Fixtures (Designed for Residential Use)
ASME A112.19.4M	(1994; Errata Nov 1996) Porcelain Enameled Formed Steel Plumbing Fixtures
ASME A112.21.1M	(1991) Floor Drains
ASME A112.21.2M	(1983) Roof Drains
ASME A112.36.2M	(1991) Cleanouts
ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.4	(1992) Gray Iron Threaded Fittings
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.12	(1991) Cast Iron Threaded Drainage Fittings
ASME B16.15	(1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASME B16.23	(1992; Errata Jan 1994) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.24	(1991; Errata) Cast Copper Alloy Pipe Flanges, Class 150, 300, 400, 600, 900, 1500, and 2500, and Flanged Fittings, Class 150 and 300
ASME B16.29	(1994) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.34	(1996) Valves - Flanged, Threaded, and Welding End
ASME B16.39	(1986; R 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B31.1	(1995; B31.1a; B31.1b; B31.1c) Power Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE ANSI/ASSE 1001	(1990) Pipe Applied Atmospheric Type Vacuum Breakers
ASSE ANSI/ASSE 1003	(1995) Water Pressure Reducing Valves for Domestic Water Supply Systems
ASSE ANSI/ASSE 1012	(1995) Backflow Preventers with Intermediate Atmospheric Vent
ASSE 1013	(1993) Reduced Pressure Principle Backflow Preventers
ASSE 1018	(1986) Trap Seal Primer Valves Water Supply Fed

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA-01	(1995) Standard Methods for the Examination of Water and Wastewater
AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine

AWWA D100	(1996) Welded Steel Tanks for Water Storage
AWWA M20	(1973) Manual: Water Chlorination Principles and Practices

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS B2.2	(1991) Brazing Procedure and Performance Qualification
CABO A117.1	(1992; Errata Jun 1993) Accessible and Usable Buildings and Facilities

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANCIAL OFFICIALS

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-67	(1995) Butterfly Valves
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1990) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Cast Iron Swing Check Valves, Flanges and Threaded Ends
MSS SP-72	(1992) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-73	(1991; R 1996) Brazing Joints for Copper and Copper Alloy Pressure Fittings
MSS SP-78	(1987; R 1992) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	(1995) Class 3000 Steel Pipe Unions Socket-Welding and Threaded

MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS (NAPHCC)

NAPHCC-01	(1996) National Standard Plumbing Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)

NSF INTERNATIONAL (NSF)

NSF ANSI/NSF 14	(1996) Plastics Piping Components and Related Materials

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA-01	(1991) Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI G-101	(1996) Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data
PDI WH 201	(1992) Water Hammer Arresters

1.2 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening.

1.3 PERFORMANCE REQUIREMENTS

1.4 ELECTRICAL WORK

Motors, motor controllers and motor efficiencies shall conform to the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor-driven equipment specified herein shall be provided complete with motors. Equipment shall be rated at 60 Hz, single phase, ac unless otherwise indicated. Where a motor controller is not provided in a motor-control center on the electrical drawings, a motor controller shall be as indicated. Motor controllers shall be provided complete with properly sized thermal-overload protection in each ungrounded conductor, auxiliary contact, and other equipment, at the specified capacity, and including an allowable service factor.

1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Plumbing System; [_____].

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operations of each system. Detail drawings for the complete plumbing system ; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

Electrical Schematics; [_____].

Complete electrical schematic lineless or full line interconnection and connection diagram for each piece of mechanical equipment having more than one automatic or manual electrical control device.

D-09 Reports

Tests, Flushing and Disinfection ; [_____].

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-13 Certificates

Materials and Equipment; [_____].

Where materials or equipment are specified to comply with requirements of AGA, or ASME, proof of such compliance. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency. Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

SD-19 Operation and Maintenance Manuals

Plumbing System; [_____].

[Nine] [_9_] copies of the operation manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features.

1.6 REGULATORY REQUIREMENTS Plumbing work shall be in accordance with NAPHCC-01.

1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. . Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70

Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85

3.5 WATER METER REMOTE READOUT REGISTER

3.6.3 Color Coding Scheme for Locating Hidden Utility Components

3.8 PAINTING

3.9 TESTS, FLUSHING AND DISINFECTION

3.9.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated.

3.9.4 Operational TestOperational Test

Upon completion of and prior to acceptance of the installation, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

d. Operation of each valve, hydrant, and faucet.

3.9.5 Disinfection

After operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. System shall be flushed as specified, before introducing chlorinating material. . A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator., shall be used. The chlorine residual shall be checked at intervals to ensure that the proper level is maintained. Chlorine application shall continue until the entire main is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system being disinfected shall be opened and closed several times during the contact period to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. Water tanks shall be disinfected by the addition of chlorine directly to the filling water. Following a 6 hour period, no less than 50 ppm chlorine residual shall remain in the tank. The system including the tanks shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. From several points in the system the Contracting Officer will take samples of water in proper disinfection containers for bacterial examination. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA-01. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. The sterilizing shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.11 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

-- End Of Section --

SECTION 16415

ELECTRICAL WORK, INTERIOR

08/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(1995) Code for Electricity Metering
ANSI C12.4	(1984; R 1996) Mechanical Demand Registers
ANSI C12.10	(1987) Electromechanical Watthour Meters
ANSI C12.11	(1987; R 1993) Instrument Transformers for Revenue Metering, 10 kV BIL Through 350 kV BIL (0.6 kV NSV Through 69 kV NSV)
ANSI C37.16	(1988; C37.16a; R 1995) Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C39.1	(1981; R 1992) Requirements for Electrical Analog Indicating Instruments
ANSI C57.12.10	(1987) Safety Requirements for Transformers 230 kV and Below 833/958 Through 8333/10417 kVA, Single-Phase, and 750/862 Through 60 000/80 000/100 000 kVA, Three-Phase Without Load Tap Charging; and 3750/4687 Through 60 000/80 000/100 000 kVA With Load Tap Charging
ANSI C57.12.13	(1982) Conformance Requirements for Liquid-Filled Transformers Used in Unit Installations, Including Unit Substations
ANSI C57.12.27	(1982) Conformance Requirements for Liquid-Filled Distribution Transformers Used in Pad-Mounted Installations, Including Unit Substations

ANSI C57.12.50	(1981; R 1989) Ventilated Dry-type Distribution Transformers 1 to 500 kVA, Single-Phase; and 15 to 500 kVA, Three-Phase with High-Voltage 601 to 34 500 Volts, Low-Voltage 120 to 600 Volts
ANSI C57.12.51	(1981; R 1989) Ventilated Dry-Type Power Transformers, 501 kVA and Larger, Three-Phase, with High-Voltage 601 to 34 500 Volts, Low-Voltage 208Y/120 to 4160 Volts
ANSI C57.12.52	(1981; R 1989) Sealed Dry-Type Power Transformers, 501 kVA and Larger, Three-Phase with High-Voltage 601 to 34 500 Volts, Low-Voltage 208Y/120 to 4160 Volts
ANSI C57.12.70	(1978; R 1993) Terminal Markings and Connections for Distribution and Power Transformers
ANSI C80.5	(1995) Rigid Aluminum Conduit
ANSI C82.1	(1985; C82.1a; C82.1b; C82.1c; C82.1d; C82.1e; R 1992) Specifications for Fluorescent Lamp Ballasts
ANSI C82.4	(1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1995) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 709	(1992; R 1997) Laminated Thermosetting Materials
ASTM D 4059	(1996) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 18	Industrial, Scientific, and Medical Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE ANSI/IEEE C37.13	(1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE ANSI/IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE ANSI/IEEE C57.12.00	(1993) IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE ANSI/IEEE C57.12.80	(1978; R 1992) Terminology for Power and Distribution Transformers
IEEE ANSI/IEEE C57.12.90	(1993) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
IEEE ANSI/IEEE C57.13	(1993) Instrument Transformers
IEEE ANSI/IEEE C57.98	(1993) Guide for Transformer Impulse Tests
IEEE ANSI/IEEE C57.100	(1986; R 1992) Test Procedure for Thermal Evaluation of Oil-Immersed Distribution Transformers
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 242	(1986; R 1991) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE Std 399	(1990) Recommended Practice for Industrial and Commercial Power Systems Analysis

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA BU 1	(1994) Busways
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 3	(1993) Industrial Control and Systems Factory Built Assemblies
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA LE 4	(1987) Recessed Luminaires, Ceiling Compatibility
NEMA MG 1	(1993; Rev 1; Rev 2; Rev 3) Motors and Generators
NEMA MG 10	(1994) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA OS 1	(1989) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA OS 2	(1986; Errata Aug 1986; R 1991) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
NEMA PB 1	(1990) Panelboards
NEMA PB 2	(1995) Deadfront Distribution Switchboards
NEMA PE 5	(1985; R 1991) Utility Type Battery Chargers
NEMA RN 1	(1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA SG 3	(1995) Power Switching Equipment

NEMA ST 20	(1992) Dry-Type Transformers for General Applications
NEMA TC 2	(1990) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA TC 13	(1993) Electrical Nonmetallic Tubing (ENT)
NEMA VE 1	(1996) Metal Cable Tray Systems
NEMA WD 1	(1983; R 1989) General Requirements for Wiring Devices
NEMA WD 6	(1988) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata 96-4) National Electrical Code
NFPA 101	(1997; Errata 97-1) Life Safety Code

UNDERWRITERS LABORATORIES (UL)

UL 1	(1993; Rev thru Jan 1995) Flexible Metal Conduit
UL 4	(1996) Armored Cable
UL 5	(1996) Surface Metal Raceways and Fittings
UL 6	(1997) Rigid Metal Conduit
UL 20	(1995; Rev thru Jan 1998) General-Use Snap Switches
UL 44	(1997; Rev Aug 1997) Thermoset-Insulated Wires and Cables
UL 50	(1995; Rev thru Oct 1997) Enclosures for Electrical Equipment
UL 67	(1993; Rev thru Nov 1995) Panelboards
UL 83	(1996; Rev Sep 1997) Thermoplastic-Insulated Wires and Cables
UL 98	(1994; R thru Oct 1995) Enclosed and Dead-Front Switches

UL 198B	(1995) Class H Fuses
UL 198C	(1986; Rev thru Feb 1998) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198D	(1995) Class K Fuses
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 198G	(1988; Rev May 1988) Fuses for Supplementary Overcurrent Protection
UL 198H	(1988; Rev thru Nov 1993) Class T Fuses
UL 198L	(1995; Rev May 1995) D-C Fuses for Industrial Use
UL 360	(1996; Rev thru Oct 1997) Liquid-Tight Flexible Steel Conduit
UL 467	(1993; Rev thru Aug 1996) Grounding and Bonding Equipment
UL 486A	(1997) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors
UL 486C	(1997) Splicing Wire Connectors
UL 486E	(1994; Rev thru Feb 1997) Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
UL 489	(1996; Rev thru Nov 1997) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	(1996; Rev thru Nov 1997) Attachment Plugs and Receptacles
UL 506	(1994; Rev Oct 1997) Specialty Transformers
UL 508	(1993; Rev thru Oct 1997) Industrial Control Equipment
UL 510	(1994; Rev thru Nov 1997) Insulating Tape

UL 512	(1993; R Dec 1995) Fuseholders
UL 514A	(1996) Metallic Outlet Boxes
UL 514B	(1997) Fittings for Conduit and Outlet Boxes
UL 514C	(1996) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 542	(1994; Rev May 1997) Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 651	(1995; Rev thru Apr 1997) Schedule 40 and 80 Rigid PVC Conduit
UL 651A	(1995; Rev Sep 1996) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 674	(1994; Rev thru Feb 1997) Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 698	(1995; Rev thru Dec 1996) Industrial Control Equipment for Use in Hazardous (Classified) Locations
UL 719	(1996) Nonmetallic-Sheathed Cables
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 817	(1994; Rev thru Aug 1997) Cord Sets and Power-Supply Cords
UL 844	(1995; Rev thru Aug 1997) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 845	(1995; Rev Feb 1996) Motor Control Centers
UL 854	(1996) Service-Entrance Cables
UL 857	(1994; Rev thru Nov 1996) Busways and Associated Fittings
UL 869A	(1993; Rev thru Apr 1996) Reference Standard for Service Equipment

UL 877	(1993; Rev thru May 1997) Circuit Breakers and Circuit-Breaker Enclosures for Use in Hazardous (Classified) Locations
UL 886	(1994; Rev thru Jan 1997) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 891	(1994; Rev thru Jan 1995) Dead-Front Switchboards
UL 924	(1995; Rev thru Oct 97) Emergency Lighting and Power Equipment
UL 935	(1995; Rev thru Apr 1997)Fluorescent-Lamp Ballasts
UL 943	(1993; Rev thru Mar 1997)Ground-Fault Circuit-Interrupters
UL 1004	(1994; Rev thru Feb 1997) Electric Motors
UL 1010	(1995; Rev thru Dec 1996)Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations
UL 1022	(1994) Line Isolation Monitors
UL 1029	(1994; Rev thru Sep 1995) High-Intensity-Discharge Lamp Ballasts
UL 1047	(1995; Rev May 1996) Isolated Power Systems Equipment
UL 1236	(1994; Rev thru Dec 1997) Battery Chargers for Charging Engine-Starter Batteries
UL 1242	(1996; Rev Apr 1997) Intermediate Metal Conduit
UL 1449	(1985; Errata Apr 1986; Rev May 1995) Transient Voltage Surge Suppressors
UL 1564	(1993; Rev Apr 1994) Industrial Battery Chargers
UL 1569	(1995; Rev thru Oct 1997) Metal-Clad Cables
UL 1570	(1995; Rev thru Jun 1997) Fluorescent Lighting Fixtures

UL 1571	(1995; Rev thru Jun 97) Incandescent Lighting Fixtures
UL 1572	(1995; Rev thru Jun 97) High Intensity Discharge Lighting Fixtures
UL 1660	(1994; Rev Jan 1996) Liquid-Tight Flexible Nonmetallic Conduit
UL Elec Const Dir	(1997) Electrical Construction Equipment Directory

1.2 GENERAL

1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated or shown.

1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible. Lighting fixtures, outlets, and other equipment and materials shall be located to avoid interference with mechanical or structural features; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Contractor shall coordinate electrical work with the HVAC and electrical drawings and specifications and provide power related wiring.

1.2.3 Special Environments

1.2.3.1 Weatherproof Locations

Wiring, Fixtures, and equipment in designated locations shall conform to NFPA 70 requirements for installation in damp or wet locations.

1.2.3.2 Hazardous Locations

[Wiring in locations indicated shall conform to the NFPA 70 for Class [I] [II] [III], Division [1] [2] hazardous locations. Equipment shall be suitable for [Group [_____]] [operating temperature of [_____]degrees F].] [Wiring and equipment in locations indicated shall be of the classes, groups, divisions, and suitable for the operating temperature; as indicated.]

1.2.3.3 Ducts, Plenums and Other Air-Handling Spaces

Wiring and equipment in ducts, plenums and other air-handling spaces shall be installed using materials and methods in conformance with NFPA 70unless more stringent requirements are indicated in this specification or on the contract drawings.

1.2.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.2.5 NAMEPLATES

1.2.5.1 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, identification nameplates shall be made of laminated plastic in accordance with ASTM D 709 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws, except motors, or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The front of each panelboard, motor control center, switchgear, and switchboard shall have a nameplate to indicate the phase letter, corresponding color and arrangement of the phase conductors. The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 1/4 inch High Letters	Minimum 1/8 inch High Letters
Panelboards	Control Power Transformers

Starters
Safety Switches
Motor Control Centers
Transformers
Equipment Enclosures
Switchgear
Switchboards
Motors
Control Devices
Instrument Transformers

Each panel, section, or unit in motor control centers, switchgear or similar assemblies shall be provided with a nameplate in addition to nameplates listed above, which shall be provided for individual compartments in the respective assembly, including nameplates which identify "future," "spare," and "dedicated" or "equipped spaces."

1.2.5.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with Nameplate C information in accordance with IEEE ANSI/IEEE C57.12.00. Nameplates shall indicate percent impedance, voltage, kVA, frequency, number of phases, cooling class, insulation class, temperature rise, the number of gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. The Contractor shall furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than [50] [2] ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the [50] [2] ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

1.2.6 As-Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish 2 sets of as-built drawings to the Contracting Officer.

1.2.7 Recessed Light Fixtures (RLF) Option

The Contractor has the option to substitute inch-pound (I-P) RLF to metric RLF. This option shall be coordinated with Section \=09510=\ ACOUSTICAL CEILINGS.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Fault Current and Protective Device Coordination Study; [_____].

The study shall be submitted along with protective device equipment submittals. No time extensions or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study, The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Manufacturer's Catalog; [_____].

Data composed of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists; [_____].

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each item.

Installation Procedures; [_____].

Installation procedures for rotating equipment, transformers, switchgear, battery systems, voltage regulators, and grounding resistors. Procedures shall include diagrams, instructions, and precautions required to install, adjust, calibrate, and test devices and equipment.

SD-04 Drawings

Interior Electrical Equipment; [_____].

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, and other information necessary to define the installation. Detail drawings shall show the rating of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall show physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded. Detail drawings shall as a minimum include:

a. Transformers.

b. Switchgear.

c. Battery system including calculations for the battery and charger.

d. Voltage regulators.

e. Grounding resistors.

f. Motors and rotating machinery.

g. Motor control centers.

h. Busway systems.

i. Single line electrical diagrams including primary, metering, sensing and relaying, control wiring, and control logic.

j. Sway bracing for suspended luminaires.

Structural drawings showing the structural or physical features of major equipment items, components, assemblies, and structures, including foundations or other types of supports for equipment and conductors. These drawings shall include accurately scaled or dimensioned outline and arrangement or layout drawings to show the physical size of equipment and components and the relative arrangement and physical connection of related components. Weights of equipment, components and assemblies shall be provided when required to verify the adequacy of design and proposed construction of foundations or other types of supports. Dynamic forces shall be stated for switching devices when such forces must be considered in the design of support structures. The appropriate detail drawings shall show the provisions for leveling, anchoring, and connecting all items during installation, and shall include any recommendations made by the manufacturer.

Electrical drawings including single-line and three-line diagrams, and schematics or elementary diagrams of each electrical system; internal wiring and field connection diagrams of each electrical device when published by the manufacturer; wiring diagrams of cabinets, panels, units, or separate mountings; interconnection diagrams that show the wiring between separate components of assemblies; field connection diagrams that show the termination of wiring routed between separate items of equipment; internal wiring diagrams of equipment showing wiring as actually provided for this project. Field wiring connections shall be clearly identified.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons why, shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

As-Built Drawings; [_____].

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on the contract drawings, deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full-sized set of prints marked to reflect all deviations, changes, and modifications. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

SD-08 Statements

Onsite Test; GA.

A detailed description of the Contractor's proposed procedures for on-site tests.

SD-09 Reports

Factory Test Reports; GA.

[Six] [_____] copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

Field Test Plan; GA.

A detailed description of the Contractor's proposed procedures for onsite test submitted [20] [30] [_____] days prior to testing the installed system. No field test will be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Field Test Reports; GA.

[Six] [_____] copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

h. Final position of controls and device settings.

SD-13 Certificates

Materials and Equipment; [_____].

The label or listing of the Underwriters Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer. Items which are required to be listed and labeled in accordance with Underwriters Laboratories must be affixed with a UL label that states that it is UL listed. No exceptions or waivers will be granted to this requirement. Materials and equipment will be approved based on the manufacturer's published data.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with NFPA 70, recommendations of the manufacturer, and as shown.

PART 2 PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.1 BUSWAYS

UL 857. Busses shall be [copper] [or] [aluminum]. Enclosures shall be [steel] [aluminum]. Short-circuit ratings, except as indicated, shall be in accordance with NEMA BU 1.

2.1.1 Feeder Busways

Feeder busways shall be [ventilated, except that vertical busways within 6 feet of floors shall be unventilated] [unventilated] low-impedance busway.

2.1.2 Plug-In Busways

Plug-in busways shall be unventilated. [A hook stick of suitable length shall be provided for operating plug-in units from the floor.] [Plug-in units shall be of the circuit-breaker type.] [Plug-in units shall be of the handle-operated switch type equipped with high-interrupting-capacity current-limiting fuses.]

2.2 CABLES AND WIRES

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. [All conductors shall be copper.] [Conductors indicated to be No. 6 AWG or smaller diameter shall be copper. Conductors indicated to be No. 4 AWG and larger diameter shall be either copper or aluminum, unless otherwise indicated or required by manufacturer.]

2.2.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to meet manufacturer's requirements.

2.2.2 Aluminum Conductors

[Aluminum conductors shall not be used.] [Aluminum conductors shall be AA-8000 series electrical grade aluminum alloy conductors. Type EC-1350 aluminum is unacceptable.]

2.2.3 Insulation

Unless indicated otherwise, or required by NFPA 70, power and lighting wires shall be 600-volt, [Type THWN, THHN, or THW conforming to UL 83] [or] [RHW conforming to UL 44], except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW, THW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.2.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.2.5 Service Entrance Cables

Service entrance (SE) and underground service entrance (USE) cables, UL 854.

2.2.6 Non-metallic Sheathed Cable

UL 719, type NM or NMC.

2.2.7 Metal-Clad Cable

UL 1569; NFPA 70, Type MC cable.

2.2.8 Armored Cable

UL 4; NFPA 70, Type AC cable.

2.2.9 Mineral-Insulated, Metal-Sheathed Cable

UL listed NFPA 70, type MI cable. Sheathing containing asbestos fibers shall not be used.

2.2.10 Flat Conductor Cable

UL listed NFPA 70, type FCC.

2.2.11 Tray Cable or Power Limited Tray Cable

UL listed; Type TC or PLTC.

2.2.12 Cord Sets and Power-Supply Cords

UL 817.

2.3 CABLE TRAYS

NEMA VE 1 cable trays shall form a wireway system, and shall be of nominal [3] [4] [6] inch depth. Cable trays shall be constructed of [aluminum] [copper-free aluminum] [zinc-coated steel]. Trays shall include splice and end plates, dropouts, and miscellaneous hardware. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than the load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius. [Radius of bends shall be [12] [24] [36] inches.] [Radius of bends shall be as shown.]

2.3.1 Trough

Trough-type cable trays shall be of a nominal [6] [12] [18] [24] inch width.

2.3.2 Ladder

Ladder-type cable trays shall be of nominal [6] [12] [18] [24] inch width. Rung spacing shall be on [6] [9] [12] [18] inch maximum centers.

2.3.3 Channel

Channel-type cable trays shall be [3] [4] inch width. Trays shall be one-piece construction having slots spaced not more than 4-1/2 inches on centers.

2.3.4 Cantilever

Cantilever-type, center-hung cable trays may be provided at the Contractor's option in lieu of other cable tray types specified.

2.4 TRANSIENT VOLTAGE SURGE PROTECTION

Transient voltage surge suppressors shall be provided as indicated. Surge suppressors shall meet the requirements of IEEE C62.41 and be UL listed and labeled as having been tested in accordance with UL 1449. Surge suppressor ratings shall be [as indicated] [[_____] volts rms, operating voltage; [50] [60] Hz; [1-phase] [3-phase]; [2] [3] [4] wire with ground; transient suppression voltage (peak let-through voltage) of [_____] volts]. Fuses shall not be used as surge suppression.

2.5 CHARGERS, BATTERY

[NEMA PE 5] [UL 1236] [UL 1564]. Battery chargers shall be general purpose, continuous current output, with solid state rectifiers. Means shall be provided to regulate and to adjust the dc output voltage. Chargers shall have continuous current ratings of 10 to 15 percent higher than battery current outputs based upon an 8-hour discharge.

2.6 CIRCUIT BREAKERS

2.6.1 MOLDED-CASE CIRCUIT BREAKERS

Molded-case circuit breakers shall conform to NEMA AB 1 and UL 489and UL 877for circuit breakers and circuit breaker enclosures located in hazardous (classified) locations. Circuit breakers may be installed in panelboards, switchboards, enclosures, motor control centers, or combination motor controllers.

2.6.1.1 Construction

Circuit breakers shall be suitable for mounting and operating in any position. Lug shall be listed for [copper conductors only] [copper and aluminum conductors] in accordance with UL 486E. Single-pole circuit breakers shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically. All ratings shall be clearly visible.

2.6.1.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with NEMA AB 1. Ratings shall be coordinated with system X/R ratio.

2.6.1.3 Cascade System Ratings

Circuit breakers used in series combinations shall be in accordance with UL 489. Equipment, such as switchboards and panelboards, which house series-connected circuit breakers shall be clearly marked accordingly. Series combinations shall be listed in the UL Recognized Component Directory under "Circuit Breakers-Series Connected."

2.6.1.4 Thermal-Magnetic Trip Elements

Thermal magnetic circuit breakers shall be provided as shown. Automatic operation shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes above [150] [_____] amperes.

2.6.2 Solid-State Trip Elements

Solid-state circuit breakers shall be provided as shown. All electronics shall be self-contained and require no external relaying, power supply, or accessories. Printed circuit cards shall be treated to resist moisture absorption, fungus growth, and signal leakage. All electronics shall be housed in an enclosure which provides protection against arcs, magnetic interference, dust, and other contaminants. Solid-state sensing shall measure true RMS current with error less than one percent on systems with distortions through the 13th harmonic. Peak or average actuating devices are not acceptable. Current sensors shall be torodial construction, encased in a plastic housing filled with epoxy to protect against damage and moisture and shall be integrally mounted on the breaker. Where indicated on the drawings, circuit breaker frames shall be rated for 100 percent continuous duty. Circuit breakers shall have tripping features as shown on the drawings and as described below:

a. Long-time current pick-up, adjustable from 50 percent to 100 percent of continuous current rating.

b. [Fixed] [Adjustable] long-time delay.

c. Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.

d. [Fixed] [Adjustable] short-time delay.

e. [Short-time I square times t switch.]

f. Instantaneous current pick-up, adjustable from 1.5 to 9 times long-time current setting.

g. Ground-fault pick-up, adjustable from 20 percent to 60 percent of sensor rating, but not greater than 1200 amperes. Sensing of ground-fault current at the main bonding jumper or ground strap will not be permitted. Zone-selective interlocking shall be provided as shown.

h. [Fixed] [Adjustable] ground-fault delay.

i. Ground-fault I square times t switch.

j. [Overload] [and] [short-time] [and] [ground-fault] trip indicators shall be provided.

2.6.3 Current-Limiting Circuit Breakers

Current-limiting circuit breakers shall be provided as shown. Current-limiting circuit breakers shall limit the let-through I square times t to a value less than the I square times t of one-half cycle of the symmetrical short-circuit current waveform. On fault currents below the threshold of limitation, breakers shall provide conventional overload and short-circuit protection. Integrally-fused circuit breakers shall not be used.

2.6.4 SWD Circuit Breakers

Circuit breakers rated 15 amperes and intended to switch 277 volts or less fluorescent lighting loads shall be marked "SWD."

2.6.5 HACR Circuit Breakers

Circuit breakers 60 amperes or below, 240 volts, 1-pole or 2-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be marked "Listed HACR Type."

2.6.6 Low-Voltage Power

a. Construction:

Low-voltage power circuit breakers shall conform to IEEE ANSI/IEEE C37.13, ANSI C37.16, and NEMA SG 3 and shall be three-pole, single-throw, stored energy, [manually] [electrically] operated, with drawout mounting. Solid-state trip elements which require no external power connections shall be provided. Circuit breakers shall have an open/close contact position indicator, charged/discharged stored energy indicator, primary disconnect devices, and a mechanical interlock to prevent making or breaking contact of the primary disconnects when the circuit breaker is closed. Control voltage shall be [24 V dc] [48 V dc] [125 V dc] [120 V dc] [as indicated]. The circuit breaker enclosure shall be suitable for its intended location.

b. Ratings:

Voltage ratings shall be not less than the applicable circuit voltage. Circuit breakers shall be rated for 100 percent continuous duty and shall have trip current ratings and frame sizes as shown. Nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings shall be in accordance with ANSI C37.16. Tripping features shall be as follows:

1. Long-time current pick-up, adjustable from 50 percent to 100 percent of sensor current rating.

2. Adjustable long-time delay.

3. Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.

4. Adjustable short-time delay.

5. [Short-time I square times t switch.]

6. Instantaneous current pick-up, adjustable from 1.5 to 9 times long-time current setting.

7. Ground-fault pick-up, adjustable from 20 percent to 60 percent of sensor rating, but in no case greater than 1200 amperes. Sensing of ground-fault current at the main bonding jumper or ground strap shall not be permitted. Zone-selective interlocking shall be provided as shown.

8. [Fixed] [Adjustable] ground-fault delay.

9. [Ground-fault I square times t switch.]

10. [Overload] [and] [short-circuit] [and] [ground-fault] trip indicators shall be provided.

2.6.7 Medium-Voltage Circuit Breakers

Medium-voltage circuit breakers shall conform to the requirements specified in Section 16311; MAIN ELECTRIC SUPPLY STATION AND SUBSTATION.

2.6.8 Ground Fault Circuit Interrupters

UL 943. Breakers equipped with ground fault circuit interrupters shall have ground fault class, interrupting capacity, and voltage and current ratings as indicated.

2.7 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

Motor short-circuit protectors shall conform to UL 508 and shall be provided as shown. Protectors shall be used only as part of a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection, and shall be rated in accordance with the requirements of NFPA 70.

2.7.1 Construction

Motor short-circuit protector bodies shall be constructed of high temperature, dimensionally stable, long life, nonhygroscopic materials. Protectors shall fit special MSCP mounting clips and shall not be interchangeable with any commercially available fuses. Protectors shall have 100 percent one-way interchangeability within the A-Y letter designations. All ratings shall be clearly visible.

2.7.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Letter designations shall be A through Y for motor controller Sizes 0, 1, 2, 3, 4, and 5, with 100,000 amperes interrupting capacity rating. Letter designations shall correspond to controller sizes as follows:

CONTROLLER SIZE	MSCP DESIGNATION
NEMA O	A-N
NEMA 1	A-P
NEMA 2	A-S
NEMA 3	A-U
NEMA 4	A-W
NEMA 5	A-Y

2.8 CONDUIT AND TUBING

2.8.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797

2.8.2 Electrical Nonmetallic Tubing (ENT)

NEMA TC 13.

2.8.3 Electrical Plastic Tubing and Conduit

NEMA TC 2.

2.8.4 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660.

2.8.5 Intermediate Metal Conduit

UL 1242.

2.8.6 PVC Coated Rigid Steel Conduit

NEMA RN 1.

2.8.7 Rigid Aluminum Conduit

ANSI C80.5 and UL 6.

2.8.8 Rigid Metal Conduit

UL 6.

2.8.9 Rigid Plastic

NEMA TC 2, UL 651 and UL 651A.

2.8.10 Surface Metal Electrical Raceways and Fittings

UL 5.

2.9 CONDUIT AND DEVICE BOXES AND FITTINGS

2.9.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514C.

2.9.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

2.9.3 Boxes, Outlet for Use in Hazardous (Classified) Locations

UL 886.

2.9.4 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.9.5 Fittings for Conduit and Outlet Boxes

UL 514B.

2.9.6 Fittings For Use in Hazardous (Classified) Locations

UL 886.

2.9.7 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.10 CONDUIT COATINGS PLASTIC RESIN SYSTEM

NEMA RN 1, Type A-40.

2.11 CONNECTORS, WIRE PRESSURE

2.11.1 For Use With Copper Conductors

UL 486A.

2.11.2 For Use With Aluminum Conductors

UL 486B.

2.12 ELECTRICAL GROUNDING AND BONDING EQUIPMENT

UL 467.

2.12.1 Ground Rods

Ground rods shall be of [copper-clad steel conforming to UL 467] [zinc-coated steel conforming to ANSI C135.30] [solid stainless steel] not less than [5/8] [3/4] inch in diameter by [8] [10] feet in length of the sectional type driven full length into the earth.

2.12.2 Ground Bus

The ground bus shall be bare conductor or flat copper in one piece, if practicable.

2.13 ENCLOSURES

NEMA ICS 6 [or NEMA 250] [or UL 698 for use in hazardous (classified) locations,] unless otherwise specified.

2.13.1 Cabinets and Boxes

Cabinets and boxes with volume greater than 100 cubic inches shall be in accordance with UL 50, hot-dip, zinc-coated, if sheet steel.

2.13.2 Circuit Breaker Enclosures

UL 489.

2.13.3 Circuit Breaker Enclosures for Use in Hazardous (Classified) Locations

UL 877.

2.14 FIXTURES, LIGHTING AND FIXTURE ACCESSORIES/COMPONENTS

Standard Drawing 40-06-04 sheets referenced hereinafter and enclosed as an integral part of these specifications, additional fixtures shown on contract drawings, if any, and UL 844 for fixtures to be installed in hazardous (classified) locations. Fixtures, accessories and components, including ballasts, lampholders, lamps, starters and starter holders, shall conform to industry standards specified below.

2.14.1 Fixture, Auxiliary or Emergency

UL 924.

2.14.2 Incandescent Fixture

NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1571.

2.14.3 Fluorescent

a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1570. Fixtures shall be plainly marked for proper lamp and ballast type to identify lamp diameter, wattage, color and start type. Marking shall be readily visible to service personnel, but not visible from normal viewing angles.

b. Ballasts:

(1) Magnetic ballast, energy-saving, high power factor, Class P, automatic-resetting Type, approved for the application by the Certified Ballast Manufacturers: ANSI C82.1 and UL 935. Two-lamp ballasts shall be used for each pair of lamps within a fixture or within continuous mounted fixtures. Single-lamp ballasts shall be used for individually mounted single-lamp

fixtures and where an odd single-lamp fixture occurs at the end of a continuous group. Magnetic fluorescent lamp ballasts shall have a Ballast Efficacy Factor (BEF) not less than shown in the following table:

MAGNETIC FLUORESCENT BALLAST EFFICACY FACTORS*

Design starting temperature above 40 degrees F with 60 Hz input frequency

NUMBER OF LAMPS	LAMP TYPE	NOMINAL OPERATIONAL INPUT VOLTAGE	MAX. LAMP OPERATING CURRENT	MIN. BALLAST EFFICACY FACTOR
1	4 ft rapid start	120 or 277	less than 1000 m amp	1.805
2	4 ft rapid start	120	less than 1000 m amp	1.060
2	4 ft rapid start	277	less than 1000 m amp	1.050
2	8 ft slim-line	120 - 277	less than 1000 m amp	0.570
2	8 ft high output, rapid start	120 - 277	less than 1000 m amp	0.390

* For ballasts not specifically designed for use with dimming controls

The BEF is calculated using the formula:

BEF = Ballast Factor, (in percent) / Power Input

Where Power Input = Total Wattage of Combined Lamps and Ballasts.

(2) Electronic Ballast. Electronic ballasts shall consist of a rectifier, high frequency inverter, and power control and regulation circuitry. The ballasts shall be UL listed, Class P, with a Class A sound rating and shall contain no PCBs. Ballasts shall meet 47 CFR 18 for electromagnetic interference and shall not interfere with the operation of other electrical equipment. Design shall withstand line transients per IEEE C62.41, Category A. Unless otherwise indicated, the minimum number of ballasts shall be used to serve each individual fixture, using one, two, three or four lamp ballasts. A single ballast may be used to serve multiple fixtures if they are continuous mounted, factory manufactured for

that installation with an integral wireway, and are identically controlled.

(a) Light output regulation shall be +/- 10%.

(b) Voltage input regulation shall be +/- 10%.

(c) Lamp current crest factor shall be no more than 1.6.

(d) Ballast factor shall be not less than 85% nor more than 100%, unless otherwise indicated.

(e) A 60 Hz filter shall be provided. Flicker shall be no more than 10% with any lamp suitable for the ballast.

(f) Ballast case temperature shall not exceed 25 degree Celsius rise above 40 degree Celsius ambient, when tested in accordance with UL 935.

(g) Total harmonic distortion shall be in the range of 10-20%.

(h) Power factor shall not be less than 0.95.

(i) Ballasts shall operate at a frequency of 20 kHz or more.

(j) Operating filament voltage shall be 2.5 to 4.5 volts.

(k) Warranty. Three year full warranty including a $10 labor allowance.

(l) Ballast Efficacy Factor (BEF) shall be in accordance with the following table. Ballasts and lamps shall be matching rapid start or instant start as indicated on the following table. If 32W-F32-T8 lamps and ballasts are used, they must be either all rapid start or all instant start.

ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS*

LAMP TYPE	TYPE OF STARTER & LAMP	NOMINAL OPERATIONAL INPUT VOLTAGE	NUMBER OF LAMPS	MIN. BALLAST EFFICACY FACTOR
40W F40 T12	rapid start	120 or 277 V	1	2.3
			2	1.2
			3	0.8
			4	0.6
34W F40 T12	rapid start	120 or 277 V	1	2.6
			2	1.3
			3	1.0
			4	0.7
40W F40 T10	rapid start	120 or 277 V	1	2.2

			2	1.1
			3	0.8
32W F32 T8	rapid or instant start	120 or 277 V	1	2.4
			2	1.4
			3	1.0
			4	0.8

*For ballasts not specifically designed for use with dimming controls

The BEF is calculated using the formula:

BEF = Ballast Factor (in percent) / Power Input

Where Power Input = Total Wattage of Combined Lamps and Ballasts.

c. Lampholders, Starters, and Starter Holders: UL 542.

2.14.4 High-Intensity-Discharge

a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1572.

b. Ballasts: ANSI C82.4 for multiple supply types and UL 1029.

2.15 LOW-VOLTAGE FUSES AND FUSEHOLDERS

2.15.1 Fuses, Low Voltage Cartridge Type

NEMA FU 1.

2.15.2 Fuses, High-Interrupting-Capacity, Current-Limiting Type

Fuses, Class G, J, L and CC shall be in accordance with UL 198C.

2.15.3 Fuses, Class K, High-Interrupting-Capacity Type

UL 198D.

2.15.4 Fuses, Class H

UL 198B.

2.15.5 Fuses, Class R

UL 198E.

2.15.6 Fuses, Class T

UL 198H.

2.15.7 Fuses for Supplementary Overcurrent Protection

UL 198G.

2.15.8 Fuses, D-C for Industrial Use

UL 198L.

2.15.9 Fuseholders

UL 512.

2.16 INSTRUMENTS, ELECTRICAL INDICATING

ANSI C39.1.

2.17 MOTORS, AC, FRACTIONAL AND INTEGRAL

Motors, ac, fractional and integral horsepower, 500 hp and smaller shall conform to NEMA MG 1 and UL 1004for motors; NEMA MG 10 for energy management selection of polyphase motors; and UL 674 for use of motors in hazardous (classified) locations.

2.17.1 Rating

The horsepower rating of motors should be limited to no more than 125 percent of the maximum load being served unless a NEMA standard size does not fall within this range. In this case, the next larger NEMA standard motor size should be used.

2.17.2 Motor Efficiencies

All permanently wired polyphase motors of 1 hp or more shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. Motors of 1 hp or more with open, drip proof or totally enclosed fan cooled enclosures shall be high efficiency type, unless otherwise indicated. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

Minimum Motor Efficiencies

HP	Std. Efficiency	High Efficiency
1	77.0	85.5
1.5	78.5	85.5
2	78.5	85.5
3	78.5	88.5
5	82.5	88.5
7.5	84.0	90.0
10	85.5	90.0
15	85.5	91.0
20	87.5	92.0
25	88.5	92.0
30	88.5	92.0
40	88.5	92.0
50	89.0	92.5
60	89.0	92.5
75	89.0	95.5
100	90.0	93.5
125	91.0	94.5
150	91.0	94.5
200	91.0	94.5
250	91.0	94.5
300	91.0	94.5
350	91.0	94.5
400	91.0	94.5
500	91.0	94.5

2.18 MOTOR CONTROLS AND MOTOR CONTROL CENTERS

2.18.1 General

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Panelboards supplying non-linear loads shall have neutrals sized for 200 percent of rated current.

2.18.2 Motor Starters

Combination starters shall be provided with [circuit breakers,] [and] [fusible switches,] [and] [switches equipped with high-interrupting-capacity current-limiting fuses] [as indicated].

2.18.2.1 Reduced-Voltage Starters

Reduced-voltage starters shall be provided for polyphase motors [_____] hp or larger. Reduced-voltage starters shall be of the single-step autotransformer, reactor, or resistor type having an adjustable time interval between application of reduced and full voltages to the motors. Wye-delta reduced voltage starter or part winding increment starter having an adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced voltage starters specified above for starting of motor-generator sets, centrifugally operated equipment or reciprocating compressors provided with automatic unloaders.

2.18.3 Thermal-Overload Protection

Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

2.18.4 Low-Voltage Motor Overload Relays

2.18.4.1 General

[Thermal] [and] [magnetic current] overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or motor controller, and shall be rated in accordance with the requirements of NFPA 70. [Standard units shall be used for motor starting times up to 7 seconds.] [Slow units shall be used for motor starting times from 8 to 12 seconds.] [Quick trip units shall be used on hermetically sealed, submersible pumps, and similar motors.]

2.18.4.2 Construction

Manual reset type thermal relay shall be [melting alloy] [bimetallic] construction. Automatic reset type thermal relays shall be bimetallic construction. Magnetic current relays shall consist of a contact mechanism and a dash pot mounted on a common frame.

2.18.4.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Trip current ratings shall be established by selection of the replaceable overload device and shall not be adjustable. Where the controller is remotely-located or difficult to reach, an automatic reset, non-compensated overload relay shall be provided. Manual reset overload relays shall be provided otherwise, and at all locations where automatic starting is provided. Where the motor is located in a constant ambient temperature, and the thermal device is located in an ambient temperature that regularly varies by more than minus 18 degrees F, an ambient temperature-compensated overload relay shall be provided.

2.18.5 Automatic Control Devices

2.18.5.1 Direct Control

Automatic control devices (such as thermostats, float or pressure switches) which control the starting and stopping of motors directly shall be designed for that purpose and have an adequate horsepower rating.

2.18.5.2 Pilot-Relay Control

Where the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit.

2.18.5.3 Manual/Automatic Selection

a. Where combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch (marked MANUAL-OFF-AUTOMATIC) shall be provided for the manual control.

b. Where combination manual and automatic control is specified and the automatic-control device actuates the pilot control circuit of a magnetic starter, the magnetic starter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC.

c. Connections to the selector switch shall be such that; only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low-or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

2.18.6 Motor Control Centers

Control centers shall conform to the requirements of NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Control centers shall be indoor type and shall contain combination starters and other equipment as indicated. Control centers shall be NEMA ICS 2, Class [_____], Type [_____]. Each control center shall be mounted on floor sills or mounting channels. Each circuit shall have a suitable metal or laminated plastic nameplate with white cut letters. Motor control centers shall be provided with a full-length ground bus bar.

2.19 PANELBOARDS

Dead-front construction, NEMA PB 1 and UL 67.

2.20 RECEPTACLES

2.20.1 Hospital Grade

UL 498.

2.20.2 Heavy Duty Grade

NEMA WD 1. Devices shall conform to all requirements for heavy duty receptacles.

2.20.3 Standard Grade

UL 498.

2.20.4 Ground Fault Interrupters

UL 943, Class A or B.

2.20.5 Hazardous (Classified) Locations

UL 1010.

2.20.6 NEMA Standard Receptacle Configurations

NEMA WD 6.

a. Single and Duplex, 15-Ampere and 20-Ampere, 125 Volt

15-ampere, non-locking: NEMA type 5-15R, locking: NEMA type L5-15R, 20-ampere, non-locking: NEMA type 5-20R, locking: NEMA type L5-20R.

b. 15-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-15R, locking: NEMA type L6-15R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-15R, locking: NEMA type L15-15R.

c. 20-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-20R, locking: NEMA type L6-20R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-20R, locking: NEMA type L15-20R.

d. 30-Ampere, 125/250 Volt

Three-pole, 3-wire, non-locking: NEMA type 10-30R, locking: NEMA type L10-30R. Three-pole, 4-wire grounding, non-locking: NEMA type 14-30R, locking: NEMA type L14-30R.

e. 30-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-30R, locking: NEMA type L6-30R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-30R, locking: NEMA type L15-30R.

f. 50-Ampere, 125/250 Volt

Three-pole, 3-wire: NEMA type 10-50R. Three-pole, 4-wire grounding: NEMA type 14-50R.

g. 50-Ampere, 250 Volt

Two-pole, 3-wire grounding: NEMA type 6-50R. Three-pole, 4-wire grounding: NEMA type 15-50R.

2.21 Service Entrance Equipment

UL 869A.

2.22 SPLICE, CONDUCTOR

UL 486C.

2.23 POWER-SWITCHGEAR ASSEMBLIES INCLUDING SWITCHBOARDS

Assemblies shall be metal-enclosed, freestanding general-purpose [type] [ventilated type] in accordance with NEMA PB 2, UL 891, and IEEE ANSI/IEEE C37.20.1 and shall be installed to provide front and rear access. Busses shall be [copper] [aluminum]. Assembly shall be approximately 90 inches high; arrangement of circuit breakers and other items specified shall be as indicated. The withstand rating and interrupting capacity of the [switchgear] [switchboards] and [circuit breakers] [fuses] shall be based on the maximum fault current available.

2.23.1 Circuit Breakers

Circuit breakers shall be [stationary] [drawout] [medium-voltage power circuit breakers] [low-voltage power circuit breakers] [molded-case circuit breakers] [molded-case circuit breakers coordinated with current-limiting fuses] [insulated-case, systems type circuit breakers] [4-position drawout type circuit breaker compartments with cell switches for connected, test; disconnected and withdrawn positions].

2.23.2 Auxiliary Equipment

2.23.2.1 Instruments

Instruments shall be long scale, 6.8 inches minimum, semiflush rectangular, indicating or digital switchboard type, mounted at eye level.

a. Ammeter, range 0 to [_____] amperes, complete with selector switch having off position and positions to read each phase current.

b. Voltmeter, range 0 to [_____] volts, complete with selector switch having off position and positions to read each phase [to phase] [to neutral] voltage.

2.23.2.2 Control Switch

A control switch with indicating lights shall be provided for each electrically operated breaker.

2.23.2.3 Control Power Sources

Control buses and control power transformers shall conform to the requirements of Section 16311 MAIN ELECTRIC SUPPLY STATION AND SUBSTATION, where required. Control power shall be [125-volt DC] [48-volt DC] [120-volt AC] [_____].

2.24 SNAP SWITCHES

UL 20.

2.25 TAPES

2.25.1 Plastic Tape

UL 510.

2.25.2 Rubber Tape

UL 510.

2.26 TRANSFORMERS

Single- and three-phase transformers shall have two windings per phase. Full-capacity standard NEMA taps shall be provided in the primary windings of transformers unless otherwise indicated. Three-phase transformers shall be configured with [delta-wye] [wye-delta] windings, except as indicated. "T" connections may be used for transformers rated 15 kVA or below. Transformers supplying non-linear loads shall be UL listed as suitable for supplying such loads with a total K-factor not to exceed K-[9] [13] [_____] and have neutrals sized for 200 percent of rated current.

2.26.1 Transformers, Dry-Type

Transformers shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation system for transformers rated 10 kVA and less, with temperature rise not exceeding [150] [115] [80] degrees C under full-rated load in maximum ambient temperature of 40 degrees C. [Transformer of 150 degrees C temperature rise shall be capable of carrying continuously 100 percent of nameplate kVA without exceeding insulation rating.] [Transformer of 115 degrees C temperature rise shall be capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating.] [Transformer of 80 degrees C temperature rise shall be capable of carrying continuously 130 percent of nameplate kVA without exceeding insulation rating.]

a. 600 Volt or Less Primary:

NEMA ST 20, UL 506, general purpose, dry-type, self-cooled, [ventilated] [unventilated] [sealed] [epoxy-resin cast coil,]. Transformers shall be provided in NEMA [1] [3R] [_____] enclosure. Transformers shall be quiet type with maximum sound level at least 3 decibels less than NEMA standard level for transformer ratings indicated.

b. 601 to 34,500 Volt Primary:

(1) Distribution: Ventilated, [epoxy-resin cast coil,] 1 to 500 kVA, single phase, and 15 to 500 kVA, three-phase, low-voltage 120-600 volts: ANSI C57.12.50.

(2) Power: Ventilated, [epoxy-resin cast coil,] 501 kVA and larger, three-phase, low-voltage 208Y/120 to 4160 volts: ANSI C57.12.51.

(3) Power: Sealed, [epoxy-resin cast coil,] 501 kVA and larger, three-phase, low-voltage 208Y/120 to 4160 volts: ANSI C57.12.52.

2.26.2 Liquid-Insulated Transformers

IEEE ANSI/IEEE C57.12.00, ANSI C57.12.10, ANSI C57.12.13, ANSI C57.12.27, ANSI C57.12.70, IEEE ANSI/IEEE C57.12.80, IEEE ANSI/IEEE C57.12.90, IEEE ANSI/IEEE C57.98, and IEEE ANSI/IEEE C57.100. Transformers may be the mineral-oil insulated, silicone, or the high-molecular weight hydrocarbon (HMWH) type. Voltage and KVA ratings shall be as indicated. Pressure relief valves and relays required for safe operation in an interior location or vault shall be provided. [Single kVA ratings shown are based on self-cooled operation.] [Dual kVA ratings require that transformers be equipped for forced air cooling. Forced air cooling shall include the fans and controls necessary to operate the fans when the self-cooling temperature rating is attained.] [Transformers rated above 300 kVA shall be equipped with features to permit the future addition of cooling fans, controls, and wiring.] Temperature rise shall not exceed [55/65] [_____] degrees C under full load operation in an ambient temperature of 40 degrees C. Percent voltage impedance shall be [_____] [manufacturer's standard] [as required to limit the available fault current to less than the withstand rating of the equipment fed by the transformer]. The basic impulse insulation level (BIL) rating shall be not less than [95] [110] [125] [_____] kV for the distribution voltage shown. Nameplates shall be provided in accordance with IEEE ANSI/IEEE C57.12.00.

2.26.3 Average Sound Level

The average sound level in decibels (dB) of transformers shall not exceed the following dB level at 12 inches for the applicable kVA rating range listed unless otherwise indicated:

-0.33

1-50	50
51-150	55
151-300	58
301-500	60
501-700	62
701-1000	64
1001-1500	65
1501 & above	70

2.27 ISOLATED POWER SYSTEM EQUIPMENT

UL 1047, with monitor UL 1022.

2.28 WATTHOUR METERS, UTILITY REVENUE

Watthour meters shall conform to ANSI C12.1 and ANSI C12.10, except numbered terminal wiring sequence and case size may be the manufacturer's standard. Watthour meters shall be of the [drawout switchboard type] [socket-mounted [outdoor] [indoor] type] having a 15-minute, cumulative form, demand register meeting ANSI C12.4 and provided with not less than two and one-half stators. Watthour demand meters shall have factory-installed electronic pulse initiators meeting the requirements of ANSI C12.1. Pulse initiators shall be solid-state devices incorporating light-emitting diodes, phototransistors, and power transistors, except that mercury-wetted output contacts are acceptable. Initiators shall be totally contained within watthour demand meter enclosures, shall be capable of operating up to speeds of 500 pulses per minute with no false pulses, and shall require no field adjustments. Initiators shall be calibrated for a pulse rate output of one pulse per 1/4 disc revolution of the associated meter and shall be compatible with the indicated equipment.

2.29 WATTHOUR/DEMAND METERS, CHECK

ANSI C12.10 for self-contained [watthour] [watthour-demand] meter with pulse-initiators for remote monitoring of watt-hour usage [and instantaneous demand]. [Meter shall be drawout switchboard type.] [Meter shall be socket-mounted [outdoor] [indoor] type.] Meter shall be Class [100] [200] [as indicated].

2.30 INSTRUMENT TRANSFORMERS

2.30.1 General

Instrument transformers shall comply with ANSI C12.11 and IEEE ANSI/IEEE C57.13. Instrument transformers shall be configured for mounting in/on the device to which they are applied. Polarity marks on instrument transformers shall be visually evident and shown on drawings.

2.30.2 Current Transformers

Unless otherwise indicated, bar, wound, or window-type transformers are acceptable; and except for window-type units installed over insulated buses, transformers shall have a BIL rating consistent with the rated BIL of the associated switchgear or electric power apparatus bushings, buses or conductors. Current transformers shall have the indicated ratios. The continuous thermal-current rating factor shall be not less than [1.0] [1.2] [1.5] [2.0] [3.0] [4.0]. Other thermal and mechanical ratings of current transformer and their primary leads shall be coordinated with the design of the circuit breaker and shall be not less than the momentary rating of the associated circuit breaker. Circuit protectors shall be provided across secondary leads of the current transformers to prevent the accidental open-circuiting of the transformers while energized. Each terminal of each current transformer shall be connected to a short-circuiting terminal block in the circuit interrupting mechanism cabinet, power transformer terminal cabinet, and in the associated instrument and relay cabinets.

2.30.2.1 Current Transformers for Power Transformers

[Single-ratio] [Multi-ratio] bushing type current transformers shall be provided internally around power transformer bushings as shown. [Single-ratio units shall have a minimum metering accuracy class of [0.6B-0.5] [0.3B-0.5].] [Multi-ratio units shall have a minimum relaying accuracy voltage class of [_____] for either a C or T classification.]

2.30.2.2 Current Transformers for Metal-Enclosed Switchgear

Single-ratio units, used for metering and relaying, shall have a metering accuracy class rating of [_____] [B._____]. Single-ratio units, used only for relaying, shall have a relaying accuracy class rating of [_____] for [either] a C [or T] classification.

2.30.2.3 Current Transformers for Metal-Clad Switchgear

Single-ratio units, used for metering and relaying, shall have a metering accuracy class rating of [_____] [B._____]. Single-ratio units, used only for relaying, shall have a relaying accuracy class rating of [_____] for [either] a C [or T] classification.

2.30.2.4 Current Transformers for kWH and Demand Metering (Low Voltage)

Current transformers shall conform to IEEE ANSI/IEEE C57.13. Provide current transformers with a metering accuracy Class of 0.3 through [_____], with a minimum RF of [_____] at 30 degrees C, with 600-volt insulation, and 10 kV BIL. Provide butyl-molded, window-type current transformers mounted [on the transformer low-voltage bushings. Route current transformer leads in a location as remote as possible from the power transformer secondary cables to permit current measurements to be taken with hook-on-ammeters.] [in the current transformer cabinet.]

2.30.2.5 Voltage Transformers

Voltage transformers shall have indicated ratios. Units shall have an accuracy class rating of [_____]. Voltage transformers shall be of the drawout type having current-limiting fuses in both primary and secondary circuits. Mechanical interlocks shall prevent removal of fuses, unless the associated voltage transformer is in a drawout position. Voltage transformer compartments shall have hinged doors.

2.31 WIRING DEVICES

NEMA WD 1 for wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

2.32 Liquid-Dielectrics

Liquid dielectrics for transformers, capacitors, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral oil or less flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall be certified by the manufacturer as having less than [50] [2] parts per million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding [50] [2] ppm shall be replaced.

2.33 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment and system constructed meet the specified requirements for equipment ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, and protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. The Contractor shall provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

2.33.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: [the source bus and extend down to system buses where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses] [the source bus and extended through the secondary side of transformers for medium voltage distribution feeders.] [the source bus and extend through [outgoing breakers] [outgoing medium voltage feeders, down to the individual protective devices for medium voltage radial taps] [outgoing medium voltage feeders, through the secondary side of transformers] [as indicated] for main electric supply substations.] [the nearest upstream device in the existing source system and extend through the downstream devices at the load end.]

2.33.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. [The Contractor shall coordinate with the [commercial power company] [_____] for fault current availability at the site.] [The Contractor shall utilize the fault current availability indicated as a basis for fault current studies.]

2.33.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provide, impedance data shall be shown. Locations of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.33.4 Fault Current Analysis

2.33.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE Std 242, and IEEE Std 399.

2.33.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedances shall be those proposed. Data shall be documented in the report.

2.33.4.3 Fault Current Availability

Balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values shall be provided at each voltage transformation point and at each power distribution bus. The maximum and minimum values of fault available at each location shall be shown in tabular form on the diagram or in the report.

2.33.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. Provide a written narrative that describes: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situation where system coordination is not achievable due to device limitations (an analysis of any device curves which order overlap); coordination between upstream and downstream devices; and relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost changes (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

2.33.6 Study Report

a. The report shall include a narrative: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.

b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.

c. The report shall document utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device curves and protective device ratings and settings.

d. The report shall contain fully coordinated composite time-current characteristic curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.

e. The report shall provide the calculations performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

PART 3 EXECUTION

3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following specifications.

3.1.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, [_____] additional rods not less than 6 feet on centers, or if sectional type rods are used, [_____] additional sections may be coupled and driven with the first rod. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.1.2 Ground Bus

Ground bus shall be provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of [transformer neutrals and other electrical] [electrical] equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment. For raised floor equipment rooms in computer and data processing centers, a minimum of 4, one at each corner, multiple grounding systems shall be furnished. Connections shall be bolted type in lieu of thermoweld, so they can be changed as required by additions and/or alterations.

3.1.3 Grounding Conductors

[A green equipment grounding conductor, sized in accordance with NFPA 70 shall be provided, regardless of the type of conduit. Equipment grounding bars shall be provided in all panelboards. The equipment grounding conductor shall be carried back to the service entrance grounding connection or separately derived grounding connection.] All equipment grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. [When boxes for receptacles, switches, or other utilization devices are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.]

3.2 WIRING METHODS

Wiring shall conform to NFPA 70, the contract drawings, and the following specifications. Unless otherwise indicated, wiring shall consist of insulated conductors installed in [rigid aluminum conduit] [rigid zinc-coated steel conduit] [rigid plastic conduit] [electrical metallic tubing] [electrical nonmetallic tubing] [intermediate metal conduit] [[_____] conduit]. Where cables and wires are installed in cable trays, they shall be of the type permitted by NFPA 70 for use in such applications. [Nonmetallic-sheathed cables or metallic-armored cables may be installed in areas permitted by NFPA 70.] Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified. Wire fill in conduits located in Class I or II hazardous areas shall be limited to 25 percent of the cross sectional area of the conduit.

3.2.1 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 1/2 inch. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. Nonmetallic conduit and tubing may be used in damp, wet or corrosive locations when permitted by NFPA 70 and the conduit or tubing system is provided with appropriate boxes, covers, clamps, screws or other appropriate type of fittings. Electrical metallic tubing (EMT) may be installed only within buildings. EMT may be installed in concrete and grout in dry locations. EMT installed in concrete or grout shall be provided with concrete tight fittings. EMT shall not be installed in damp or wet locations, or the air space of exterior masonry cavity walls. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Aluminum conduit may be used only where installed exposed in dry locations. Nonaluminum sleeves shall be used where aluminum conduit passes through concrete floors and firewalls. Penetrations of above grade floor slabs, time-rated partitions and fire walls shall be firestopped in accordance with Section 07270 FIRESTOPPING. Except as otherwise specified, IMC may be used as an option for rigid steel conduit in areas as permitted by NFPA 70. Raceways shall not be installed under the firepits of boilers and furnaces and shall be kept 6 inches away from parallel runs of flues, steam pipes and hot-water pipes. Raceways shall be concealed within finished walls, ceilings, and floors unless otherwise shown. Raceways crossing structural expansion joints or seismic joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding. Wiring installed in [underfloor duct system] [underfloor raceway system] shall be suitable for installation in wet locations.

3.2.1.1 Pull Wires

A pull wire shall be inserted in each empty raceway in which wiring is to be installed if the raceway is more than 50 feet in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 150 feet in length. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 200 pounds per square inch tensile strength. Not less than 10 inches of slack shall be left at each end of the pull wire.

3.2.1.2 Conduit Stub-Ups

Where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 6 inches above the floor. Empty or spare conduit stub-ups shall be plugged flush with the finished floor with a threaded, recessed plug.

3.2.1.3 Below Slab-on-Grade or in the Ground

Electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing vertically through slabs-on-grade shall be rigid steel or IMC. Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system.

3.2.1.4 Installing in Slabs Including Slabs on Grade

Conduit installed in slabs-on-grade shall be rigid steel or IMC. Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Contracting Officer. Where conduit is run parallel to reinforcing steel, the conduit shall be spaced a minimum of one conduit diameter away but not less than one inch from the reinforcing steel.

3.2.1.5 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment shall be prevented during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

3.2.1.6 Supports

Metallic conduits and tubing,and the support system to which they are attached, shall be securely and rigidly fastened in place to prevent vertical and horizontal movement at intervals of not more than 10 feet and within 3 feet of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, beam clamps, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structure. Loads shall not be applied to joist bridging. Attachment shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Cutting the main reinforcing bars in reinforced concrete beams or joists shall be avoided when drilling holes for support anchors. Holes drilled for support anchors, but not used, shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Raceways shall not be supported using wire or nylon ties. Raceways shall be independently supported from the structure. Upper raceways shall not be used as a means of support for lower raceways. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Cables and raceways shall not be supported by ceiling grids. Except where permitted by NFPA 70, wiring shall not be supported by ceiling support systems. Conduits shall be fastened to sheet-metal boxes and cabinets with two locknuts where required by NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

3.2.1.7 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

3.2.1.8 Exposed Risers

Exposed risers in wire shafts of multistory buildings shall be supported by U-clamp hangers at each floor level, and at intervals not to exceed 10 feet.

3.2.1.9 Exposed Lengths of Conduit, Over 600 Volts

Exposed lengths of conduit containing power conductors operating at more than 600 volts shall have two red bands 2 inches wide spaced 8 inches apart painted near each coupling; the intervening space between the red bands shall be painted white, and on the white space the voltage shall be stenciled in black: [_____] volts.

3.2.1.10 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirements for conduit and tubing and with the additional requirement that no length of run shall exceed 50 feet for 1/2 inch and 3/4 inch sizes, and 100 feet for 1 inch or larger sizes, and shall not contain more than two 90-degree bends or the equivalent. Additional pull or junction boxes shall be installed to comply with these limitations whether or not indicated. Inside radii of bends in conduits of 1 inch size or larger shall not be less than ten times the nominal diameter.

3.2.2 Busway Systems

Busway systems shall be of the voltage, capacity, and phase characteristics indicated. Vertical runs of busways within 6 feet of the floor shall have solid enclosures. Busways shall be supported at intervals not exceeding 5 feet, and shall be braced properly to prevent lateral movement. Busways penetrating walls or floors shall be provided with flanges to completely close wall or floor openings.

3.2.3 Cable Trays

Cable trays shall be supported in accordance with the recommendations of the manufacturer but at no more than 6 foot intervals. Contact surfaces of aluminum connections shall be coated with an antioxidant compound prior to assembly. Adjacent cable tray sections shall be bonded together by connector plates of an identical type as the cable tray sections. The Contractor shall submit the manufacturer's certification that the cable tray system meets all requirements of Article 318 of NFPA 70. The cable tray shall be installed and grounded in accordance with the provisions of Article 318 of NFPA 70. Data submitted by the Contractor shall demonstrate that the completed cable tray systems will comply with the specified requirements. Cable trays shall terminate 10 inches from both sides of smoke and fire partitions. Conductors run through smoke and fire partitions shall be installed in 4 inch rigid steel conduits with grounding bushings, extending 12 inches beyond each side of the partitions. The installation shall be sealed to preserve the smoke and fire rating of the partitions. Penetrations shall be firestopped in accordance with Section 07270 FIRESTOPPING.

3.2.4 Cables and Conductors

Installation shall conform to the requirements of NFPA 70. Covered, bare or insulated conductors of circuits rated over 600 volts shall not occupy the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 volts or less.

3.2.4.1 Sizing

Unless otherwise noted, all sizes are based on copper conductors and the insulation types indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 100 feet long and of 277 volts more than 230 feet long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG. Class 3 low-energy, remote-control and signal circuits shall be not less than No. 22 AWG.

3.2.4.2 Use of Aluminum Conductors in Lieu of Copper

[Aluminum conductors shall not be used.] [Unless otherwise indicated, the Contractor may substitute aluminum conductors in lieu of copper conductors for copper sizes No. 4 AWG and larger. Should the Contractor choose to provide aluminum for conductors, the Contractor shall be responsible for increasing conductor size to have same ampacity as copper size indicated; increasing conduit and pull box sizes to accommodate larger size aluminum conductors in accordance with NFPA 70; ensuring that pulling tension rating of aluminum conductors is sufficient; providing panelboards [and motor control centers] that are UL listed for use with aluminum, and so labelled; relocating equipment, modifying equipment terminations, resizing equipment; and resolving problems that are a direct result of providing aluminum conductors in lieu of copper.]

3.2.4.3 Cable Systems

Cable systems shall be installed where indicated. Cables shall be installed concealed behind ceiling or wall finish where practicable. Cables shall be threaded through holes bored on the approximate centerline of wood members; notching of surfaces will not be permitted. Sleeves shall be provided through bond beams of masonry-block walls for threading cables through hollow spaces. Exposed cables shall be installed parallel or at right angles to walls or structural members. In rooms or areas not provided with ceiling or wall finish, cables and outlets shall be installed so that a room finish may be applied in the future without disturbing the cables or resetting the boxes. Exposed nonmetallic-sheathed cables less than 4 feet above floors shall be protected from mechanical injury by installation in conduit or tubing.

3.2.4.4 Mineral-Insulated Cable

Mineral-insulated, metal-sheathed cable system, Type MI, may be used in lieu of exposed conduit and wiring. Conductor sizes shall be not less than those indicated for the conduit installation. Cables shall be fastened within 12 inches of each turn or offset and at intervals of not more than 6 feet. Cable terminations shall be made in accordance with manufacturer's recommendations.

3.2.4.5 Cable Splicing

Splices shall be made in an accessible location. Crimping tools and dies shall be approved by the connector manufacturer for use with the type of connector and conductor.

a. Copper Conductors, 600 Volt and Under: Splices in conductors No. 10 AWG and smaller diameter shall be made with an insulated, pressure-type connector. Splices in conductors No. 8 AWG and larger diameter shall be made with a solderless connector and insulated with tape or heat-shrink type insulating material equivalent to the conductor insulation.

b. Aluminum Conductors, 600 Volt and Under: Splices of aluminum conductors shall be made with a UL listed, solderless, compression-type, aluminum bodied connector, stamped for AL or AL/CU. Aluminum contact surfaces of conductors shall be cleaned with a wire brush and covered with anti-oxidant joint compound prior to making of connections. Any excess joint compound shall be wiped away after installing the connector. Insulate the connection with tape or heat-shrink type insulating material equivalent to the conductor insulation.

c. Greater Than 600 Volt: Cable splices shall be made in accordance with the cable manufacturer's recommendations and Section 16375ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.2.4.6 Conductor Identification and Tagging

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

a. Color coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for 3-phase and single-phase low voltage systems shall be as follows:

120/208-volt, 3-phase: Black(A), red(B), and blue(C).277/480-volt, 3-phase: Brown(A), orange(B), and yellow(C).120/240-volt, 1-phase: Black and red.

b. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 3 inches of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer.

c. Control and signal circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems where required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors. Switch and outlet boxes located on opposite sides of fire rated walls shall be separated by a minimum horizontal distance of 24 inches. The total combined area of all box openings in fire rated walls shall not exceed 100 square inches per 100 square feet. Maximum box areas for individual boxes in fire rated walls vary with the manufacturer and shall not exceed the maximum specified for that box in UL Elec Const Dir. Only boxes listed in UL Elec Const Dir shall be used in fire rated walls.

3.3.1 Box Applications

Each box shall have not less than the volume required by NFPA 70 for number of conductors enclosed in box. Boxes for metallic raceways, 4 by 4 inch nominal size and smaller, shall be of the cast-metal hub type when located in normally wet locations, when flush and surface mounted on outside of exterior surfaces, or when located in hazardous areas. Cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Boxes for mounting lighting fixtures shall be not less than 4 inches square, or octagonal, except smaller boxes may be installed as required by fixture configuration, as approved. Cast-metal boxes with 3/32 inch wall thickness are acceptable. Large size boxes shall be NEMA [1] [2] [3R] [4] [_____] [7] [12] or as shown. Boxes in other locations shall be sheet steel except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit and tubing or nonmetallic sheathed cable system, when permitted by NFPA 70. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers.

3.3.2 Brackets and Fasteners

Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screw or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. Penetration of more than 1-1/2 inches into reinforced-concrete beams or more than 3/4 inch into reinforced-concrete joists shall avoid cutting any main reinforcing steel. The use of brackets which depend on gypsum wallboard or plasterboard for primary support will not be permitted. In partitions of light steel construction, bar hangers with 1 inch long studs, mounted between metal wall studs or metal box mounting brackets shall be used to secure boxes to the building structure. When metal box mounting brackets are used, additional box support shall be provided on the side of the box opposite the brackets. This additional box support shall consist of a minimum 12 inch long section of wall stud, bracketed to the opposite side of the box and secured by two screws through the wallboard on each side of the stud. Metal screws may be used in lieu of the metal box mounting brackets.

3.3.3 Mounting in Walls, Ceilings, or Recessed Locations

In walls or ceilings of concrete, tile, or other non-combustible material, boxes shall be installed so that the edge of the box is not recessed more than 1/4 inch from the finished surface. Boxes mounted in combustible walls or ceiling material shall be mounted flush with the finished surface. The use of gypsum or plasterboard as a means of supporting boxes will not be permitted. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The bottom of boxes installed in masonry-block walls for concealed wiring shall be mounted flush with the top of a block to minimize cutting of the blocks, and boxes shall be located horizontally to avoid cutting webs of block. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided.

3.3.4 Installation in Overhead Spaces

In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 24 inches from the box.

3.4 DEVICE PLATES

One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel, cast-metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be of [steel with baked enamel finish or impact-resistant plastic and shall be [ivory] [as indicated]] [satin finish corrosion resistant steel or satin finish chromium plated brass]. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed and provided with a hinged, gasketed cover, unless otherwise specified.

3.5 RECEPTACLES

3.5.1 Single and Duplex, 15 or 20-ampere, 125 volt

Single and duplex receptacles shall be rated [15] [20] amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of [ivory] [as indicated] [_____] to match color of switch handles in the same room or to harmonize with the color of the respective wall, and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Switched receptacles shall be the same as other receptacles specified except that the ungrounded pole of each suitable receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application. Receptacles with ground fault circuit interrupters shall have the current rating as indicated, and shall be UL Class A type unless otherwise shown. Ground fault circuit protection shall be provided as required by NFPA 70 and as indicated on the drawings.

3.5.2 Clock Outlet

Clock outlet, for use in other than a wired clock system, shall consist of an outlet box, a plaster cover where required, and a single receptacle with clock-outlet plate. The receptacle shall be recessed sufficiently within the box to allow the complete insertion of a standard cap, flush with the plate. A suitable clip or support for hanging the clock shall be secured to the top of the plate. Material and finish of the plate shall be as specified in paragraph DEVICE PLATES.

3.5.3 Floor Outlets

Floor outlets shall be [adjustable] [nonadjustable] and each outlet shall consist of a cast-metal body with threaded openings for conduits, [adjustable ring] [flange ring], and cover plate with 1/2 inch or 3/4 inch threaded flush plug. Each telephone outlet shall consist of a horizontal cast housing with a receptacle as specified. Gaskets shall be used where necessary to ensure a watertight installation. Plugs with installation instructions shall be delivered to the Contracting Officer at the job site for capping outlets upon removal of service fittings.

3.5.4 Weatherproof Applications

Weatherproof receptacles shall be suitable for the environment, damp or wet as applicable, and the housings shall be labeled to identify the allowable use. Receptacles shall be marked in accordance with UL 514A for the type of use indicated; "Damp locations", "Wet Locations", "Wet Location Only When Cover Closed". Assemblies shall be installed in accordance with the manufacturer's recommendations.

3.5.4.1 Damp Locations

Receptacles in damp locations shall be mounted in an outlet box with a gasketed, weatherproof, cast-metal cover plate (device plate, box cover) and a gasketed cap (hood, receptacle cover) over each receptacle opening. The cap shall be either a screw-on type permanently attached to the cover plate by a short length of bead chain or shall be a flap type attached to the cover with a spring loaded hinge.

3.5.4.2 Wet Locations

Receptacles in wet locations shall be installed in an assembly rated for such use whether the plug is inserted or withdrawn, unless otherwise indicated. In a duplex installation, the receptacle cover shall be configured to shield the connections whether one or both receptacles are in use. [Assemblies which utilize a self-sealing boot or gasket to maintain wet location rating shall be furnished with a compatible plug at each receptacle location and a sign notifying the user that only plugs intended for use with the sealing boot shall be connected during wet conditions].

3.5.5 Receptacles, 15-Ampere, 250-Volt

Receptacles, 15-ampere, 250-volt, shall be [single] [duplex] two-pole, three-wire, grounding type with bodies of [ivory] [as indicated] [_____] phenolic compound supported by mounting yoke having plaster ears. The third grounding pole shall be connected to the metal yoke. Each receptacle shall be provided with a mating cord-grip plug.

3.5.6 Receptacles, 20-Ampere, 250-Volt

Receptacles, single, 20-ampere, 250-volt, shall be [ivory] [as indicated] [_____] molded plastic, two-pole, three-wire or three-pole, four-wire, grounding type complete with appropriate mating cord-grip plug.

3.5.7 Receptacles, 30-Ampere, 125/250-Volt

Receptacles, single, 30-ampere, 125/250-volt, shall be molded-plastic, three-pole, [three-wire, non-grounding type] [four-wire, grounding type], complete with appropriate mating cord-grip type attachment plug. Each dryer receptacle shall be furnished with a non-detachable power supply cord for connection to the electric clothes dryer. The cord shall be an angle-type 36 inch length of Type [SRD] [SRDE] [SRDT] range and dryer cable with three No. 10 AWG conductors.

3.5.8 Receptacles, 30-Ampere, 250-Volt

Receptacles, single, 30-ampere, 250-volt, shall be molded-plastic, three-pole, three-wire type, complete with appropriate mating cord-grip plug.

3.5.9 Receptacles, 50-Ampere, 125/250-Volt

Receptacles, single 50-ampere, 125/250-volt, shall be flush, molded plastic, three-pole, [three-wire, non-grounding] [four-wire, grounding] type. Each range receptacle shall be furnished with a nondetachable power supply cord for connection to the electric range. The cord shall be an angle-type 36 inch length of [SRD] [SRDE] [SRDT] range and dryer cable with one No. 8 and two No. 6 AWG conductors.

3.5.10 Receptacles, 50-Ampere, 250-Volt

Receptacles, single, 50-ampere, 250-volt, shall be flush molded plastic, three-pole, three-wire type, complete with appropriate mating cord-grip plug.

3.5.11 Special-Purpose or Heavy-Duty Receptacles

Special-purpose or heavy-duty receptacles shall be of the type and of ratings and number of poles indicated or required for the anticipated purpose. Contact surfaces may be either round or rectangular. One appropriate straight or angle-type plug shall be furnished with each receptacle. Locking type receptacles, rated 30 amperes or less, shall be locked by rotating the plug. Locking type receptacles, rated more than 50 amperes, shall utilize a locking ring.

3.6 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle and switch plate color shall be [ivory] [as indicated] [_____]. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than [one switch] [two switches] shall be installed in a single-gang position. Switches shall be rated [15-ampere] [20-ampere] [120] [277]-volt for use on alternating current only. Pilot lights indicated shall consist of yoke-mounted candelabra-base sockets rated at 75 watts, 125 volts, and fitted with glass or plastic jewels. A clear 6-watt lamp shall be furnished and installed in each pilot switch. Jewels for use with switches controlling motors shall be green, and jewels for other purposes shall be red. Dimming switches shall be solid-state flush mounted, sized for the loads.

3.7 SERVICE EQUIPMENT

Service-disconnecting means shall be of the [enclosed molded-case circuit breaker type] [fusible safety switch type] [type indicated] [type indicated in paragraph [PANELBOARDS AND LOADCENTERS] [POWER SWITCHGEAR ASSEMBLIES INCLUDING SWITCHBOARDS]] with an external handle for manual operation. When service disconnecting means is a part of an assembly, the assembly shall be listed as suitable for service entrance equipment. Enclosures shall be sheet metal with hinged cover for surface mounting unless otherwise indicated.

3.8 PANELBOARDS AND LOADCENTERS

Circuit breakers and switches used as a motor disconnecting means shall be capable of being locked in the open position. Door locks shall be keyed alike. Nameplates shall be as approved. Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering. Busses shall be [copper] [aluminum].

3.8.1 Loadcenters

Loadcenters shall be circuit breaker equipped.

3.8.2 Panelboards

Panelboards shall be circuit breaker or fusible switch equipped as indicated on the drawings. [Fusible panelboards of the multipole type may have doors over individual circuits and trim over the wiring gutter only, provided each circuit is arranged for locking in the open and closed positions and each branch circuit has an individual identification card in a cardholder with a clear plastic covering.] [Multipole fusible switches shall be of the hinged-door type; single pole fusible switches shall be of the tumbler switch and fuse type. Switches serving as a motor disconnect means shall be of the tumbler switch and fuse type. Switches serving as motor disconnect means shall be horsepower rated in conformance with UL 98.]

3.9 FUSES

Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilize fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics required for effective power system coordination. Time-delay and non-time-delay options shall be as [shown] [specified].

3.9.1 Cartridge Fuses; Noncurrent-Limiting Type

Cartridge fuses of the noncurrent-limiting type shall be Class H, nonrenewable, dual element, time lag type and shall have interrupting capacity of 10,000 amperes. At 500 percent current, cartridge fuses shall not blow in less than 10 seconds.

3.9.2 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, Class [G] [J] [K] [L] [RK1] [RK5] [RK9] [T] [CC] shall have tested interrupting capacity not less than [100,000] [200,000] amperes. Fuse holders shall be the type that will reject all Class H fuses.

3.9.3 Continuous Current Ratings (600 Amperes and Smaller)

Service entrance and feeder circuit fuses (600 amperes and smaller) shall be Class [RK1] [RK5] [J], current-limiting, [nontime-delay] [time-delay] with 200,000 amperes interrupting capacity.

3.9.4 Continuous Current Ratings (Greater than 600 Amperes)

Service entrance and feeder circuit fuses (greater than 600 amperes) shall be Class L, current-limiting, [nontime-delay] [time-delay] with 200,000 amperes interrupting capacity.

3.9.5 Motor and Transformer Circuit Fuses

Motor, motor controller, transformer, and inductive circuit fuses shall be Class RK1 or RK5, current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.10 UNDERGROUND SERVICE

Unless otherwise indicated, interior conduit systems shall be stubbed out 5 feet beyond the building wall and 2 feet below finished grade, for interface with the exterior service lateral conduits [and exterior communications conduits]. Outside conduit ends shall be bushed when used for direct burial service lateral conductors. Outside conduit ends shall be capped or plugged until connected to exterior conduit systems. Underground service lateral conductors will be extended to building service entrance and terminated in accordance with the requirements of Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and NFPA 70.

3.11 AERIAL SERVICE

Services shall conform to the requirements of Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL, IEEE C2, and NFPA 70. The service drop conductors shall be continuous from the point of connection on the last pole to the service mast or structural support, connected to the service entrance conductors, and shall be routed to a weatherhead, or weatherproof conduit fitting, before entry into an enclosing conduit. A drip loop shall be formed in each service conductor below the entrance to the weatherhead or the weatherproof conduit fitting. The weatherhead or weatherproof service entrance conduit fitting shall be securely fastened to a rigid galvanized steel (RGS) conduit that shall be terminated in the [meter enclosure] [service entrance equipment] which penetrates the [exterior wall] [roof]. [Penetration of the conduit through an exterior wall shall be sealed to prevent the entrance of moisture and the escape of conditioned air.] [A roof penetration fitting shall be provided for the conduit to prevent the entrance of rain.] Service entrance conductors shall be routed in [RGS] [intermediate metal conduit (IMC)] in the exterior wall, or in the interior of the building or facility that contains the [meter enclosure] [service entrance equipment]. Aerial service drop conductors will be extended to building service entrance and terminated.

3.12 MOTORS

Each motor shall conform to the hp and voltage ratings indicated, and shall have a service factor and other characteristics that are essential to the proper application and performance of the motors under conditions shown or specified. Three-phase motors for use on 3-phase 208-volt systems shall have a nameplate rating of 200 volts. Unless otherwise specified, all motors shall have open frames, and continuous-duty classification based on a 40 degree C ambient temperature reference. Polyphase motors shall be squirrel-cage type, having normal-starting-torque and low-starting-current characteristics, unless other characteristics are specified in other sections of these specifications or shown on contract drawings. The Contractor shall be responsible for selecting the actual horsepower ratings and other motor requirements necessary for the applications indicated. When electrically driven equipment furnished under other sections of these specifications materially differs from the design, the Contractor shall make the necessary adjustments to the wiring, disconnect devices and branch-circuit protection to accommodate the equipment actually installed.

3.13 MOTOR CONTROL

Each motor or group of motors requiring a single control [and not controlled from a motor-control center] shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit. When combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual control; when the automatic-control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

3.13.1 Reduced-Voltage Controllers

Reduced-voltage controllers shall be provided for polyphase motors [_____][_____] hp or larger. Reduced-voltage starters shall be of the single-step autotransformer, reactor, or resistor type having an adjustable time interval between application of reduced and full voltages to the motors. Wye-delta reduced voltage starters or part winding increment starters having an adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced voltage starters specified above for starting of motor-generator sets, centrifugally operated equipment or reciprocating compressors provided with automatic unloaders.

3.13.2 Motor Control Centers

Control centers shall be indoor type and shall contain combination starters and other equipment as indicated. Control centers shall be NEMA ICS 2, Class [_____], Type [_____]. Each control center shall be mounted on floor sills or mounting channels. Each circuit shall have a suitable metal or laminated plastic nameplate with white cut letters. Combination starters shall be provided with [circuit breakers.] [fusible switches.] [switches equipped with high-interrupting-capacity current-limiting fuses.] Motor control centers shall be provided with a full-length ground bus bar.

3.13.3 Contacts

Unless otherwise indicated, contacts in miscellaneous control devices such as float switches, pressure switches, and auxiliary relays shall have current and voltage ratings in accordance with NEMA ICS 2 for rating designation B300.

3.13.4 Safety Controls

Safety controls for boilers shall be connected to a 2-wire, 120 volt grounded circuit supplied from the associated boiler-equipment circuit. Where the boiler circuit is more than 120 volts to ground, safety controls shall be energized through a two-winding transformer having its 120 volt secondary winding grounded. Overcurrent protection shall be provided in the ungrounded secondary conductor and shall be sized for the load encountered.

3.14 MOTOR-DISCONNECT MEANS

Each motor shall be provided with a disconnecting means when required by NFPA 70 even though not indicated. For single-phase motors, a single or double pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors.

3.15 TRANSFORMER INSTALLATION

Three-phase transformers shall be connected only in a delta-wye or wye-delta configuration as indicated [except isolation transformers having a one-to-one turns ratio]. "T" connections may be used for transformers rated at 15 kVA or below. Dry-type transformers shown located within 5 feet of the exterior wall shall be provided in a weatherproof enclosure. Transformers to be located within the [building] [building and vault] may be provided in the manufacturer's standard, ventilated indoor enclosure designed for use in 40 degrees C ambient temperature, unless otherwise indicated.

3.16 LAMPS AND LIGHTING FIXTURES

Ballasted fixtures shall have ballasts which are compatible with the specific type and rating of lamps indicated and shall comply with the applicable provisions of the publications referenced.

3.16.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed in the fixtures just prior to the completion of the project.

3.16.1.1 Incandescent

Incandescent lamps shall be for 125-volt operation unless otherwise indicated.

3.16.1.2 Fluorescent

Fluorescent lamps for magnetic ballasts shall be as indicated and shall be of a type that will not require starter switches. Lamps shall be of the rapid-start type unless otherwise shown or approved. Fluorescent lamps for electronic ballasts shall be as indicated.

3.16.1.3 High-Intensity-Discharge

High-intensity-discharge lamps shall be the high-pressure sodium type unless otherwise indicated, shown, or approved.

3.16.2 Fixtures

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed on Standard Drawing No. 40-06-04, Sheet Nos. [_____], which accompany and form a part of this specification for the types indicated. Illustrations shown on these sheets are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent energy efficiency, light distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved. In suspended acoustical ceilings with fluorescent fixtures, the fluorescent emergency light fixtures shall be furnished with self-contained battery packs.

3.16.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation. Open type fluorescent fixtures with exposed lamps shall have a wire-basket type guard.

3.16.2.2 Suspended Fixtures

Suspended fixtures shall be provided with swivel hangers in order to ensure a plumb installation. Pendants, rods, or chains 4 feet or longer excluding fixture, shall be braced to limit swinging. Bracing shall be 3 directional, 120 degrees apart. Single unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple unit or continuous-row fluorescent units shall have a tubing or stem for wiring at one point, and a tubing or rod suspension provided for each length of chassis including one at each end. Maximum distance between adjacent tubing or stems shall be 10 feet. Rods shall be of not less than 3/16 inch diameter. Flexible raceway shall be installed to each fixture from an overhead junction box. Fixture to fixture wiring installation is allowed only when fixtures are installed end to end in a continuous run.

3.16.2.3 Ceiling Fixtures

Ceiling fixtures shall be coordinated with and suitable for installation in, on, or from the suspended ceiling provided under other sections of these specifications. Installation and support of fixtures shall be in accordance with the NFPA 70 and manufacturer's recommendations. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels. Recessed fixtures installed in fire-resistive type of suspended ceiling construction shall have the same fire rating as the ceiling or shall be provided with fireproofing boxes having materials of the same fire rating as the ceiling panels, in conformance with UL Elec Const Dir. Surface-mounted fixtures shall be suitable for fastening to the structural support for ceiling panels.

3.16.2.4 Sockets

Sockets of industrial, strip, and other open type fluorescent fixtures shall be of the type requiring a forced movement along the longitudinal axis of the lamp for insertion and removal of the lamp.

3.16.3 Emergency Light Sets

Emergency light sets shall conform to UL 924 with the number of heads as indicated. Sets shall be permanently connected to the wiring system by conductors installed in short lengths of flexible conduit.

3.17 BATTERY CHARGERS

Battery chargers shall be installed in conformance with NFPA 70.

3.18 EQUIPMENT CONNECTIONS

Wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 6 feet or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in damp or wet locations.

3.18.1 Motors and Motor Control

Motors, motor controls, and motor control centers shall be installed in accordance with NFPA 70, the manufacturer's recommendations, and as indicated. Wiring shall be extended to motors, motor controls, and motor control centers and terminated.

3.18.2 Installation of Government-Furnished Equipment

Wiring shall be extended to the equipment and terminated.

3.18.3 Food Service Equipment Provided Under Other Sections

Wiring shall be extended to the equipment and terminated.

3.19 CIRCUIT PROTECTIVE DEVICES

The Contractor shall calibrate, adjust, set and test each new adjustable circuit protective device to ensure that they will function properly prior to the initial energization of the new power system under actual operating conditions.

3.20 PAINTING AND FINISHING

Field-applied paint on exposed surfaces shall be provided under Section 09900 PAINTING, GENERAL.

3.21 REPAIR OF EXISTING WORK

The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceiling, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Government.

3.22 FIELD TESTINGFIELD TESTING

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer [_____] days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspection recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports will be signed and dated by the Contractor.

3.22.1 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.22.2 Ground-Resistance TestsGround-Resistance Tests

The resistance of [each grounding electrode] [each grounding electrode system] [the grounding grid] shall be measured using the fall-of-potential method defined in IEEE Std 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - [25 ohms] [_____].

b. Grid electrode - [_____] ohms.

3.22.3 Ground-Grid Connection Inspection

All below-grade ground-grid connections will be visually inspected by the Contracting Officer before backfilling. The Contractor shall notify the Contracting Officer [_____] hours before the site is ready for inspection.

3.22.4 Cable TestsCable Tests

The Contractor shall be responsible for identifying all equipment and devices that could be damaged by application of the test voltage and ensuring that they have been properly disconnected prior to performing insulation resistance testing. An insulation resistance test shall be performed on all low and medium voltage cables after the cables are installed in their final configuration and prior to energization. The test voltage shall be 500 volts DC applied for one minute between each conductor and ground and between all possible combinations of conductors. The minimum value of resistance shall be:

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

Each cable failing this test shall be repaired or replaced. The repaired cable system shall then be retested until failures have been eliminated.

3.22.4.1 Medium Voltage Cable Tests

a. Continuity test.

b. Insulation resistance test.

c. DC high-potential test.

3.22.4.2 Low Voltage Cable Tests

a. Continuity test.

b. Insulation resistance test.

3.22.5 Metal Enclosed Bus Duct TestsMetal Enclosed Bus Duct Tests

a. Insulation Resistance phase-to-phase, all combinations.

b. Insulation resistance phase-to-ground, each phase.

c. AC or DC high-potential test.

d. Phase rotation test.

3.22.6 Motor TestsMotor Tests

a. Phase rotation test to ensure proper directions.

b. Operation and sequence of reduced voltage starters.

c. High potential test on each winding to ground.

d. Insulation resistance of each winding to ground.

e. Vibration test.

f. Dielectric absorption test on motor [and starter].

3.22.7 Liquid-Filled Transformer TestsLiquid-Filled Transformer Tests

The following field tests shall be performed on all liquid-filled transformers [[_____] kVA and above]

a. Insulation resistance test phase-to-ground, each phase.

b. Turns ratio test.

c. Correct phase sequence.

d. Correct operation of tap changer.

e. [_____]

3.22.8 Dry-Type Transformer TestsDry-Type Transformer Tests

The following field tests shall be performed on all dry-type transformers [[_____] kVA and above].

a. Insulation resistance test phase-to-ground, each phase.

b. Turns ratio test.

c. [_____]

3.22.9 Circuit Breaker TestsCircuit Breaker Tests

The following field tests shall be performed on circuit breakers.

3.22.9.1 Circuit Breaker Tests, Medium Voltage

a. Insulation resistance test phase-to-phase, all combinations.

b. Insulation resistance tests phase-to-ground, each phase.

c. Closed breaker contact resistance test.

d. Power factor test.

e. High-potential test.

f. Manual and electrical operation of the breaker.

3.22.9.2 Circuit Breakers, Low Voltage

a. Insulation resistance test phase-to-phase, all combinations.

b. Insulation resistance test phase-to-ground, each phase.

c. Closed breaker contact resistance test.

d. Manual and electrical operation of the breaker.

3.22.9.3 Circuit Breakers, Molded Case

a. Insulation resistance test phase-to-phase, all combinations.

b. Insulation resistance test phase-to-ground, each phase.

c. Closed breaker contact resistance test.

d. Manual operation of the breaker.

3.22.10 Motor Control Centers

a. Insulation resistance test phase-to-phase, all combinations.

b. Insulation resistance test phase-to-ground, each phase.

c. Manual and electrical operational tests.

3.22.11 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. These tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to insure proper calibration and operation. Relay settings shall be implemented in accordance with the coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE ANSI/IEEE C57.13.

3.23 OPERATING TESTSOPERATING TESTS

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with paragraph FIELD TEST REPORTS.

3.24 FIELD SERVICE

3.24.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of [_____] hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A [VHS] [_____] format video tape of the entire training shall be submitted.

3.24.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of equipment, assist in the performance of the onsite tests, oversee initial operations, and instruct personnel as to the operational and maintenance features of the equipment.

3.25 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End Of Section --

APPENDIX 3

COMPUTATIONS

NOTE: CALCULATIONS FOR THIS PROJECT WERE REVISED USING CALCULATIONS PERFORMED BY RGJ OF THE USACE AND DATED 8-24-98

SYSTEM 1 - RACE TRACK AREA

DEMANDS - SYSTEM DESIGN BASED ON REQUIREMENT OF PROVIDING 200 GPM AT NEW TRUCK FILL STATION PLUS CAPACITY FOR SEVERAL REST-ROOM AND CONCESSION STAND AREAS. SYSTEM WILL SUPPLY:

2 TOILETS / 2 SINKS	ENTRANCE AREA TO RACETRACK
2 TOILETS / 2 SINKS	PIT AREA
4 TOILETS / 4 SINKS	GRANDSTAND AREA
4 URINALS	GRANDSTAND AREA

MAXIMUM USAGE ESTIMATED: 30 TIMES/HOUR
TYPICAL ASSUMED WATER USAGE.
PER USACE DESIGN SPECS
ASSUMPTION MINIMUM SYSTEM PRESSURE = 50 PSI

- 3 GALLONS/TOILET FLUSH
- 1 GALLON/URINAL FLUSH
- 0.5 GALLON/SINK USE

TOTAL ESTIMATED USAGE/HOUR:

(8 TOILETS)(3 GAL/FLUSH)(30 FLUSHES/HR) + (4 URINALS)(1 GALLON/FLUSH)(30/HR) + (8 SINKS)(0.5 GAL/WASH)(30/HR) = 720 GALLONS/HR + 120 GALLONS/HR + 120 GALLONS/HR
= 960 GALLONS/HR

USACE DESIGN ASSUMED ADDITIONAL 100 GALLONS/HR FOR TRUCK FILL

+ 100 GALLONS/HR FOR ADDITIONAL PIT AREA USE
TOTAL USAGE/HOUR = 1,060 GALLONS

MAXIMUM USE: (8 TOILETS)(3 GAL) + (4 URINALS)(1 GAL) + (8 SINKS)(.5 GAL)

= 32 GPM
4 GPM
36 GPM

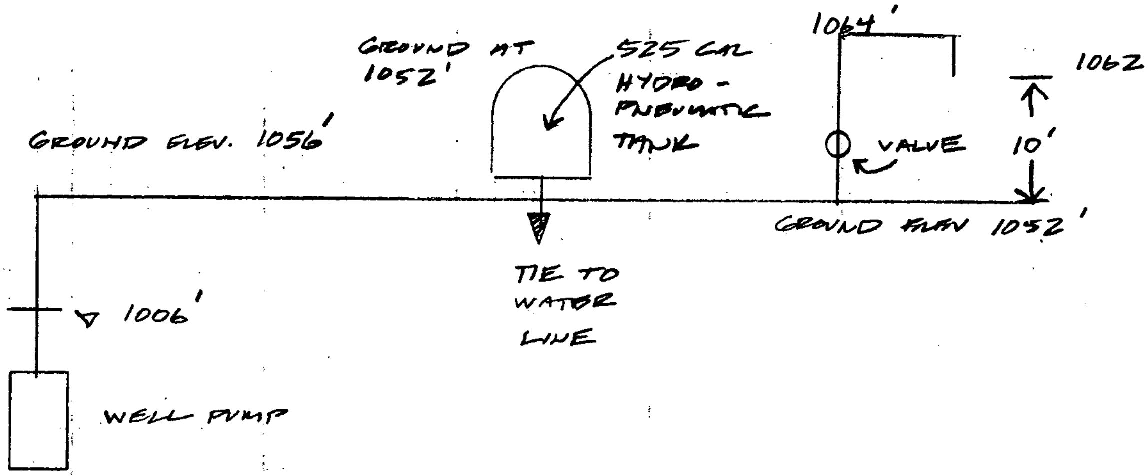
ADD 4 GPM PER ESTIMATED ADDITIONAL PIT AREA USE.

∴ SIZE RACE TRACK SYSTEM FOR ±36 GPM

PER PLUMBING TECHNOLOGY HANDBOOK - COMPARISON INDICATES USACE SYSTEM DESIGN IS MORE THAN ADEQUATE. ASSUMES MINIMUM SYSTEM AT 50 PSI
THE APPROXIMATE PEAK USAGE = GPH = # OF FIXTURES × 60
GPH = 20 × 60
GPH = 1200 OR 20 GPM

IN ADDITION NEW TRUCK FILL STATION WILL BE CONSTRUCTED TO REPLACE TRUCK FILL STATION THAT WILL BE REMOVED. THIS FILL STATION WILL BE REQUIRED TO PROVIDE 200 GPM. PER THE USACE DESIGN THIS WILL BE ACCOMPLISHED BY:

PROVIDING OVER-SIZED HYDROPNEUMATIC TANK TO ALLOW TRUCK FILL TO RUN THROUGH TANK. TANK WILL PROVIDE ON/OFF OPERATION. GENERAL SCHEMATIC OF SYSTEM



50' WELL T.D. ASSUME 50' GROUND SURFACE TO WATER TABLE

SET TANK PRESSURES : P_h = 70 PSIg = 84.7 PSIa = 161.5' HEAD
P_l = 40 PSIg = 54.7 PSIa = 92.3' HEAD

PIPING LENGTHS : WELL PUMP TO HYDROPNEUMATIC TANK = 850'
WELL DEPTH 50' ±
TOTAL (NEGLECT MINOR LOSSES) 900'

HYDROPNEUMATIC TANK TO TRUCK FILL STATION = 310 LF UTILIZING 2" ϕ
PIPING & EQUIPMENT FOR TRUCK FILL 16 LF
TOTAL PIPING 326 LF

NEED TO PROVIDE 200 GPM AT TRUCK FILL STATION WITHOUT DRAINING TANK

P_h = 70 PSIg ∴ APPLY BERNOULLI EQUATION TO CALCULATE ENERGY LOSS

$$Z_1 + P_1/\rho g + V_1^2/2g = Z_2 + P_2/\rho g + V_2^2/2g + h_L$$

WHERE: ρ = DENSITY
Z_1 = UPSTREAM ELEVATION
Z_2 = DOWNSTREAM ELEVATION
P_1 = UPSTREAM PRESSURE
P_2 = DOWNSTREAM PRESSURE
V_1 = UPSTREAM VELOCITY
V_2 = DOWNSTREAM VELOCITY
h_L = ENERGY (HEAD) LOSS
g = ACCELERATION DUE TO GRAVITY 32.174 FT/s^2

SIMPLIFIED PER USACE COMPUTATIONS TO:

$$\frac{P_2}{\gamma} + \cancel{\frac{V_1^2}{2g}} + Z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + Z_2 + H_L$$

$$\frac{P_2}{\gamma} + \overset{\cong}{\phi} + Z_1 = \frac{P_2}{\gamma} + \phi + Z_2 + H_L$$

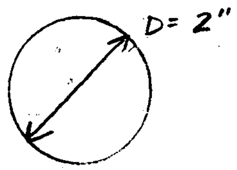
$$\frac{70(144)}{62.4} + 1052 = 1062 + H_L$$

$$151.5' = H_L$$

FIND Q FOR $H_L = 151.5'$ (USE HAZEN-WILLIAMS EQUATION)
FOR $2''\phi$ PVC $C = 140$ $L = 326'$

$V = k\,C R_h S$ WITH $S = h_f / L$, $Q = AV$ AND $R_h = D/4$
FOR CIRCULAR PIPES.

IN THIS EQUATION:



- V = VELOCITY (ft/s)
- k = UNIT CONVERSION FACTOR : $k = 1.318$ ft/s
- C = HAZEN-WILLIAMS COEFFICIENT
- R_h = HYDRAULIC RADIUS $= D/4$ FOR CIRCULAR PIPE
- S = ENERGY SLOPE
- L = LENGTH OF PIPE.
- Q = DISCHARGE FT^3/s
- A = AREA (FT^2)
- D = PIPE DIAMETER (FT)

$Q|_P = 161$ GPM

@ $P_\ell = 40$ PSIg : $\frac{40(144)}{62.4} + 1052' = 1062' + H_L$

$$\frac{5760}{62.4} + 1052' = 1062' + H_L$$

$$92.31' + 1052' = 1062' + H_L$$

$$1144.31 = 1062' + H_L$$

$$82.31' = H_L$$

$Q|_{P\ell} = 116$ GPM

$\Rightarrow$ USE $2''\phi$ PVC FROM HYDROPNEUMATIC TANK TO TRUCK FILL
WELL PUMP TO BE SIZED TO SUPPLY MINIMUM OF 116 GPM

HYDROPNEUMATIC TANK PER MANUFACTURERS SPECIFICATIONS

PUMP CAPACITY IS MINIMALLY 120% OF DEMAND. IN THIS SYSTEM DESIGN WELL PUMP IS TO BE SIZED BASED ON TRUCK FILL STATION REQUIREMENTS : 116 GPM – 161 GPM

ASSUME C = 10 (10 STARTS / HOUR FOR PUMP)

$$W\% = 100 \frac{Ph - Pl}{Ph} = \frac{100\,(84.7 - 54.7)}{84.7} = 35.4\%$$

PER USACE DESIGN APPROXIMATION OF HYDROPNEUMATIC TANK VOLUME IS ABOUT 8 TIMES PUMP CAPACITY. THAT IS IF NON TRUCK FILL STATION DEMAND IS CONSIDERED THEN :

HYPOTHETICAL "X" = 120% (36 GPM) [FROM PAGE 1] = 43 GPM
THEN $V_1 \approx 8(43\ \text{GPM}) = 345$ GPM FOR VOLUME OF TANK
PER MANUFACTURER'S SPECIFICATIONS SELECT 525 GALLON CAPACITY HYDROPNEUMATIC TANK. SEE ATTACHED SHEET.

2" Φ OUTLET, NON-BAFFLED (℄ @ 7" + 6" = 13" FROM TANK BOTTOM, PER EXISTING USACE DESIGN THEN:

$$\frac{2v^2}{2g} + d = \frac{2(16)}{2(32.2)} + \frac{2}{12} = 8''$$

THEN DEPTH FOR TANK WATER SEAL IS 13" + 8" = 21"

$$V| \approx 26\ \text{GAL} \quad (;\ V|_{21''} = 26 \left[\pi\left(\frac{3^2}{4}\right)\left(\frac{21-7}{12}\right)\right]$$

$$7.481 \approx 88\ \text{GAL} = S$$

CHECK TANK SIZE $V_t = \frac{CX}{4W} + S = \frac{6(43)}{4(35.4\%)} + 88$

$$= 270\ \text{GALLONS}$$

PER USACE DESIGN – KEEP 525 GALLON TANK AS THIS WILL PROVIDE A BUFFER SO THAT THE PUMP DOES NOT START AND STOP EXCESSIVELY DURING TRUCK FILL EPISODES.

EVALUATE CONDITIONS FOR HIGHER CAPACITY / OUTPUT PUMP - USE HIGH END ORIGINALLY CALCULATED 116 GPM - 161 GPM THEREFORE 161 GPM ASSUMPTION MADE IN USACE DESIGN IS THAT 15 WELL PUMP STARTS PER HOUR. IF C = 4 THEN $V_t = \frac{(4)(161)}{(4)(35.4\%)}$

$= 454$ GAL

BASED ON 161 GPM REQUIREMENT A 525 GALLON HYDROPNEUMATIC TANK IS SUFFICIENT FOR GREATER WELL OUTPUT

SOLVE FOR MAXIMUM PUMP OUTPUT : 525 GALLONS = $\frac{4x}{4(35.4\%)}$

525 GALLONS = $\frac{X}{35.4\%}$

185.85 GALLONS = X

PER USACE DESIGN 15 PUMP STARTS IS NOT IDEAL BUT WAS EVALUATED AS IT REPRESENTS WORST CASE SCENERIO. EXAMPLE ILLUSTRATES THAT FOR THE EXPECTED INFREQUENT USE OF THE TRUCK FILL THAT THE SYSTEM WILL FUNCTION WITHOUT UNDUE WEAR.

PUMP SELECTION / EVALUATION
- IGNORE MINOR SYSTEM LOSS
- ASSUME 4" Φ PVC
- C = 140 FOR PLASTIC PIPE.

CHECK - 1130 LINEAR FEET PIPE

RECALL - TRUCK WATER FILL STATION REQUIRES 161 GPM

THEREFORE : $Q \cong 161$ GPM @ $TH = EH + P_h + H_f$

WHERE $EH = 1052\text{ FT} - 1006^{.67}$
$= 45.3$

$P_h = 70\text{ PSI} \frac{(144)}{62.4}$
$= 161.5'$

$H_f = 18'$ FOR 161 GPM

→ 161 GPM @ 225 FT TH

SELECT PUMP ON PERFORMANCE CURVES — RED JACKET

= 15 HP

SYSTEM PLOT

Q (GPM)	EH (FT)	Ph (FT)	Hf (FT)	TH@Ph (FT)	Pe (FT)	TH@Pe (FT)
75	45.3	161.5	4.4	211	92.3	142
100	45.3	161.5	7.4	214	92.3	145
125	45.3	161.5	11.3	218	92.3	149
150	45.3	161.5	15.8	223	92.3	153
175	45.3	161.5	21.0	228	92.3	159
200	45.3	161.5	26.7	234	92.3	165
225	45.3	161.5	33.4	240	92.3	171

TO MAINTAIN PRESSURE IN TANK PUMP WILL OPERATE BETWEEN 150 GPM @ 223 TH AND 235 GPM @ 175 TH

SUMMARY

PIPING – 50 FT 4" φ PVC IN WELL
1080 FT 4" φ PVC FROM WELL TO HYDROPNEUMATIC TANK
310 FT 2" φ PVC FROM HYDROPNEUMATIC TANK TO TRUCK WATER FILL STATION

PUMP – RED JACKET 15 HP – 3PB, 3450 RPM

HYDROPNEUMATIC TANK – 525 GALLON NSF CERTIFIED FOR POTABLE WATER. 75 PSI MINIMUM WORKING PRESSURE. BAKER MODEL Q 525C

TRUCK FILL STATION – 3" φ PVC WITH MUELLER A-2360 GATE VALVE. HAND OPERATED.

WATER SYSTEM 2 TRAILER AND MACHINE SHOP

PER EXISTING USACE DESIGN SYSTEM IS BASED ON:

TOILET: 3 GALLONS / FLUSH
SINK: .5 GALLONS / WASH
SHOWER: 10 GALLONS / SHOWER
MAXIMUM USAGE: 4 TIMES / HOUR
OTHER CONSUMPTION: 10 GALLONS / HOUR

THEREFORE ESTIMATED CONSUMPTION IS:

(TOILET 3 GALLONS)(4 TIMES/HOUR) + (SINK .5 GALLONS)(4)(2 SINKS) + (SHOWER 10 GALLONS)(4 TIMES/HOUR) + MSC USE 10 GALLONS

TOILET: 12 GALLONS/HR + SINKS: 4 GALLONS/HR + SHOWER: 40 GALLONS /HOUR + 10 GALLONS MSC = <u>66 GALLONS / HOUR</u>

OR USE PER CONNECTION INSTANTANEOUS DEMAND

3 GALLONS / TOILET + .5 GALLONS / SINK (2) + 10 GALLONS / SHOWER = 14 GPM

ADD 1 GALLON FOR MSC USE = <u>15 GPM</u>

NOTE: THIS IS VERY CONSERVATIVE ESTIMATE AS STATED IN USACE DESIGN AS SHOWER USE ESTIMATE IS HIGH

SYSTEM PER USACE DESIGN WILL UTILIZE:

INSTALL REPLACEMENT WELL TO AN APPROXIMATE DEPTH OF 40 FEET. PROVIDE PUMP AND SYSTEM PIPING AS REQUIRED. TIE INTO EXISTING 30 GALLON HYDROPNEUMATIC TANK. (CONTRACTOR WILL VERIFY SIZE AND CONDITION OF EXISTING SYSTEM.

WELL PUMP SIZE: ASSUME MINIMUM CYCLE TIME $C = 4$ MINUTES
SET $P_h = 60$ PSIg

$= 74.7$ PSIg $= 139$ FT HEAD

$P_l = 40$ PSIg $= 54.7$ PSIg $= 92.3$ FT HEAD

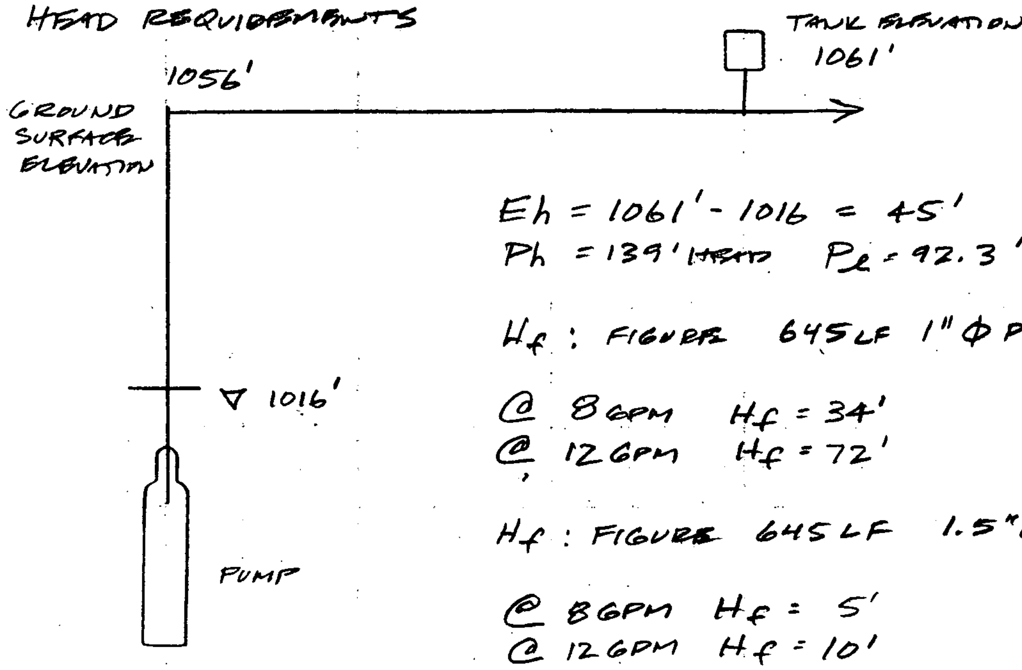
PER USACE: USE $P_c - P_l - 20$ PSI AGAIN AS THERE WILL BE UNUSUAL DEMAND ON THE SYSTEM. THIS WILL PROVIDE A MORE STABLE SYSTEM – CONSTANT PRESSURE.

$$W\% = 100\left(\frac{74.7 - 54.7}{74.7}\right) = 26.8\%$$

FOR 30 GALLON TANK $V_t = 30 = \dfrac{4x}{4(26.8\%)}$ $x = 8$ GPM

FOR 10 PUMP STARTS PER HOUR $X = 12$ GPM

HEAD REQUIREMENTS



$Eh = 1061' - 1016 = 45'$

$Ph = 139'$ HEAD $P_\ell = 92.3'$

H_f : FIGURE 645 LF 1" ϕ PVC C = 140

@ 8 GPM $H_f = 34'$

@ 12 GPM $H_f = 72'$

H_f : FIGURE 645 LF 1.5" ϕ PVC C = 140

@ 8 GPM $H_f = 5'$

@ 12 GPM $H_f = 10'$ SELECT 1.5" ϕ

THEN: TOTAL HEAD IS $\simeq$ $45' + 139 + 10 = 194'$

$\Rightarrow$ SELECT A PUMP TO DELIVER APPROXIMATELY 12 GPM @ 194 FT TH

PUMP SELECTED : RED JACKET 3/4 HP – 6CC OAE 3450 RPM.

PLOT SYSTEM OPERATING CURVE.

Q	EH	Ph	H_f	TH @ PH	P_ℓ	TH @ P_ℓ
5	45	139	2	186	92.3	139
10	45	139	7	191	92.3	144
15	45	139	15	199	92.3	152
20	45	139	26	210	92.3	163

OPERATES WITHIN ACCEPTABLE RANGE – SELECT PUMP AS STATED ABOVE.

APPENDIX 4

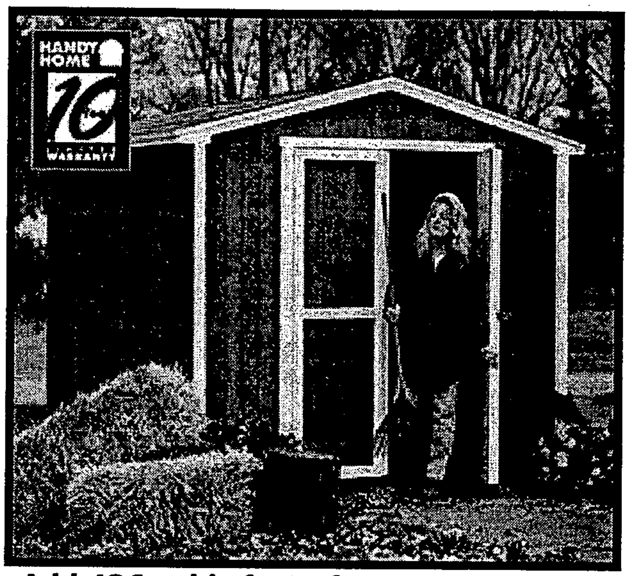
POTENTIAL EQUIPMENT AND SPECIFICATIONS

Marco Series

Baron Storage Building

HANDY HOME PRODUCTS
It's Easy... It's Hardy

- 4'w x 6'h double doors with continuous hinges
- 6' high side walls
- 8' high peak
- 4" o.c. deep groove **EZ**Panel siding



Add 436 cubic feet of storage with this affordable gable style building.

Baron Storage Building SPECIFICATIONS	Standard building
NOMINAL SIZES	8'w x 8'd x 8'h
CUBIC FEET STORAGE	436
WEIGHT	542
ACTUAL FLOOR SIZE	8'w x 7' 8-5/8"d
DOOR SIZE	4'w x 6'h
SIDING	4" o.c. deep groove EZPanel™
TRIM EXTERIOR PAINT OR STAIN	1 qt.
SIDES EXTERIOR PAINT OR STAIN	1-1/2 gal.
DRIP EDGE (linear feet)	40'
ROOF SHINGLES	4 bundles

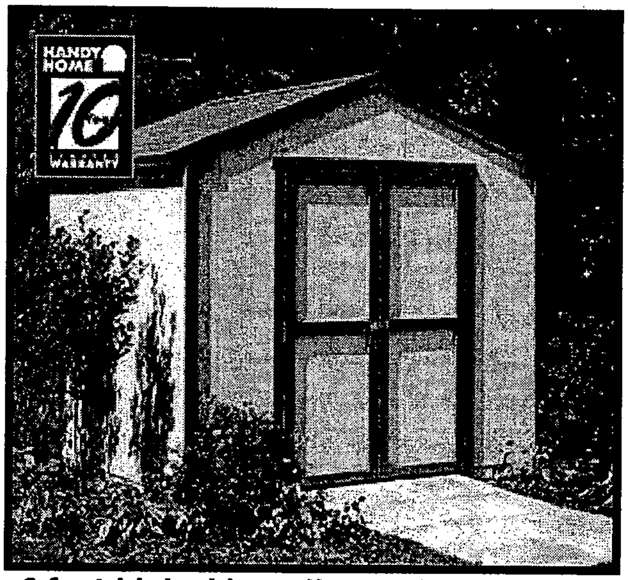
Items furnished by homeowner: Paint, Stain, Drip Edge, and Shingles

MAIN

Marco Series

Regent Storage Building

- 4'w x 6'h double doors with continuous hinges
- 6' high side walls
- 8' high peak
- 8" o.c. deep groove **EZ**Panel siding



6 foot high side walls provide plenty of wall space for long-handled tools or shelving.

Regent Storage Building SPECIFICATIONS	Standard building
NOMINAL SIZES	8'w x 8'd x 8'h
CUBIC FEET STORAGE	436
WEIGHT	542
ACTUAL FLOOR SIZE	8'w x 7' 8-5/8"d
DOOR SIZE	4'w x 6'h
SIDING	Deep groove EZPanel™
TRIM EXTERIOR PAINT OR STAIN	1 qt.
SIDES EXTERIOR PAINT OR STAIN	1 1/2 gal.
DRIP EDGE (linear feet)	40'
ROOF SHINGLES	4 bundles

Items furnished by homeowner: Paint, Stain, Drip Edge, and Shingles

MAIN

THE JOHN WOOD COMPANY

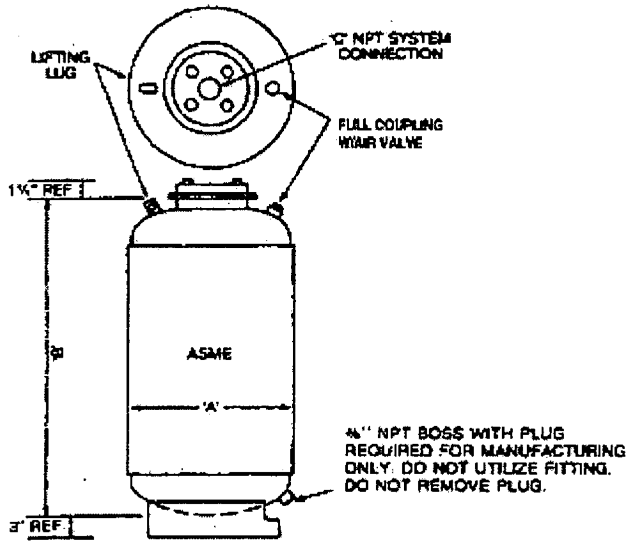
HOME
OUR MISSION
HISTORY
ENGINEERING EXPERTISE
OUR PEOPLE
TANKS & PRESSURE VESSELS
MODULAR SYSTEMS
CONTACT US

ASME Hydro-pneumatic Tanks (158 – 528 gallon)

FORM NO. 616

June 1, 1999

Type I Series
ASME Bag Type Hydro-Pneumatic Tank



Specifications

- Type Design & Construction: ASME Section VIII Division I
- Maximum Working Pressure: 125 PSI
- Maximum Operating Temperature: 160º F
- **Factory Precharge: 12 PSI - Adjustable in the field to a maximum of 80 PSI. For higher precharge pressure - consult factory.**
- Finish: Gray Primer
- For Vertical Installation Only
- Full Coupling Added to Protect Charging Valve

Applications

- For use in hydropneumatic applications
- FDA approved potable material
- For sizing tank - please refer to Technical Bulletin 002.
- For hydronic expansion and non-potable hydro-pneumatic applications, use JBER Series - Specification Sheet 615.
- For higher temperature potable hydro-pneumatic tank, use JWTA Series - Specification Sheet 699B.

Part Number	Tank Capacity		Diameter A	Height B	NPT C	Est. Ship Wt.
	Gallon	Liters	Inches	Inches	Inches	Lbs.
JBPR-22-011	158	600	30	58	1 1/2	375
JBPR-22-012	211	800	30	76	1 1/2	447
JBPR-22-013	264	1,000	36	67	2	551
JBPR-22-014	317	1,200	36	78 1/2	2	615
JBPR-22-015	370	1,400	36	91	2	694
JBPR-22-016	422	1,600	48	63 1/2	2	1,098
JBPR-22-017	528	2,000	48	77 1/4	2	1,239

Features

Options

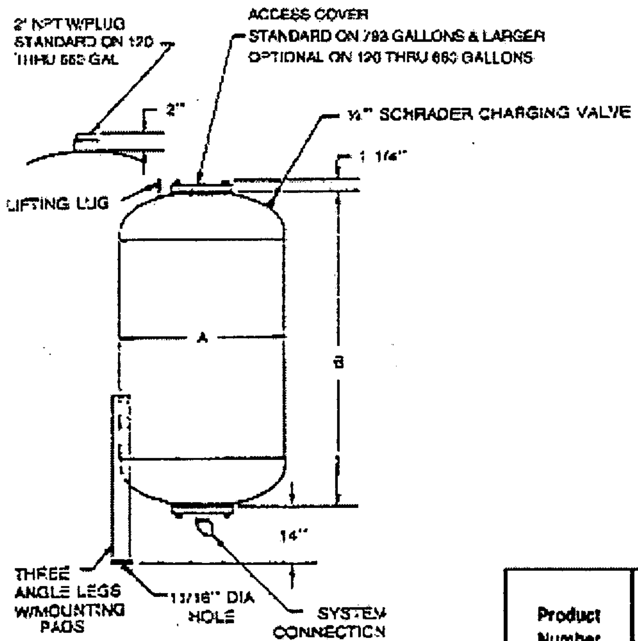
- Full Volume Flexible Elastomer Bag
- Bag Easily Replaceable
- Water and Air Separation Eliminates Corrosion
- Eliminates Water Logging
- Smaller Tank Saves Space & Installation Costs
- Carbon Steel Construction
- Bag Design Tested to 60,000 Cycles

- Higher Working Pressures
- Stainless Steel Wetted Parts
- Seismic Mounting Clips
- California Code Sight Glass
- Special Exterior Finish
- Special Design for Precharge Requirements Higher than 80 PSI
- For Options Specifications and Pricing: Consult Factory
- Horizontal Models Available

Refer to Technical Bulletin 002 to determine drawdown capacities for different system operating conditions.
All sizes normally in stock for prompt shipment.
For smaller stock sizes refer to JAPR Series - Specification Sheet 621.
For pricing refer to Form 716.

FORM NO. 635
June 1, 1999

ASME Bottom Outlet Hydro-Pneumatic Tank



Specifications

- Type Design & Construction: ASME Section VIII Division I
- Available Working Pressure: 125 PSI / 200 / 250
- Maximum Operating Temperature: 140° F
- **Factory Precharge: 12 PSI - Adjustable in the field to a maximum of 80 PSI. For higher precharge pressure - consult factory.**
- Finish: Gray Primer
- For Vertical Installation Only

Applications

Product Number	WP	Capacity		Size		System Connection C		Weight	
		Gal.	Liter	Inches	mm	Inches	mm	Lbs.	Kg.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

- For use in hydro-pneumatic applications
- FDA approved potable material
- For sizing tank - please refer to Technical Bulletin 002.

Features

- Full Volume Flexible Elastomer Bag
- Bag Easily Replaceable
- Water and Air Separation Eliminates Corrosion
- Eliminates Water Logging
- Carbon Steel Construction

Options

- Stainless Steel Wetted Parts
- Brass System Connection
- California Code Sight Glass
- Special Exterior Finish
- Other Bladder Materials Available
- **Larger Sizes Available - Up To 3,000 Gallons**
- Horizontal Design Available

For pricing refer to Form 735.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
JOPR-22-011	125	158	600	30 x 58	760 x 1467	1 1/2	38	375	170
JOPR-22-012	125	211	800	30 x 76	760 x 1923	1 1/2	38	447	203
JOPR-22-013	125	264	1000	36 x 67	915 x 1595	2	50	551	250
JOPR-22-014	125	317	1200	36 x 78 1/2	915 x 1986	2	50	615	280
JOPR-22-015	125	370	1400	36 x 91	915 x 2302	2	50	694	315
JOPR-22-016	125	422	1600	48 x 63 1/2	1220 x 1607	2	50	1098	499
JOPR-22-017	125	528	2000	48 x 77 1/4	1220 x 1967	2	50	1239	563
JOPR-22-018	125	660	2508	48 x 94	1220 x 2397	2	50	1500	682
JOPR-22-019	125	793	3013	48 x 122	1220 x 3110	2	50	1625	739
JOPR-22-020	125	1056	4013	54 x 132	1368 x 3365	2 1/2	63	2300	1045
JOPR-22-021	125	1320	5016	54 x 151	1368 x 3849	2 1/2	63	2570	1168

Home | Our Mission | History | Engineering Expertise | Our People
Tanks & Pressure Vessels | Modular Systems | Contact Us | Employment | Disclaimer

ITT Industries RED JACKET Water Products

Tuesday, March 19, 2002

Count on Red Jacket to Keep the Water Running

REDJACKET® Water Products

Welcome

Red Jacket Water Products pumps are the natural choice of well drillers, pump installers, and home owners alike. Built on over 120 years of engineering excellence, the name Red Jacket has become synonymous with quality for generations of customers who enjoy well water.

Whether your needs are home, farm or industrial, choose Red Jacket, the pump generations have come to count on. Red Jacket Water Products are designed to exceed performance requirements in the most demanding applications.

Powered by
4net Software

ITT Industries

RED JACKET
Water Products

Tuesday, March 19, 2002

Count on Red Jacket
to Keep the Water Running

REDJACKET®
Water Products

- Advertising
- PRODUCTS
  - Submersibles
  - Jets
  - Waste Water
  - Accessories
- News

Submersibles

4" High Capacity

The 4" High Capacity submersible pumps are designed for industrial 4" pumping applications, with capacities up to 100GPM for varying well depths.

- Big-Flo[R]

4" Standard Capacity

Rugged and reliable, Red Jacket's 4" Standard Capacity submersible pumps are designed to exceed performance requirements in the most demanding applications.

- Enduro[TM] Submersible Pump
- Grizzly Submersible Pump
- WaterBear[R] Submersible Pump

5" and Larger Submersible Pumps

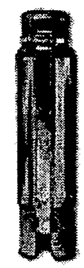
5" and Larger Submersible Pumps are designed for industrial 6 inch pumping applications. Motors for the Big-Flo pump ends deliver between 2 and 50 hp, with capacities up to 300 GPM for varying well depths.

- Big-Flo[R] 6" Submersible

Powered by
4net Software

Tuesday, March 19, 2002

Big-Flo[R] 6" Submersible



Features and Benefits

- Smooth passageways provide low friction radial water flow
- Corrosion resistant pump and motor assemblies
- Impeller-diffuser assemblies are mounted on a 16 spline steel shaft for positive drive.
- Noryl[R] components

Support Documents

Big-Flo 6" Bulletin

To view the additional product information, you will need to have the Adobe(R) Acrobat (R) Reader installed on your computer.

Get Acrobat Reader

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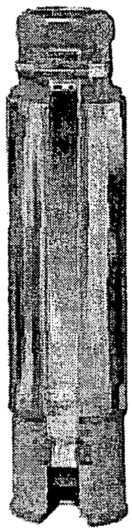
RED JACKET®
Water Products

BIG-FLO®

6" Submersibles



Smooth passageways provide low friction radial water flow.
Noryl® impeller-diffuser assemblies are encased in a corrosion resistant stainless steel shell.
Pump and motor assembly are corrosion resistant.
Efficient operation in either horizontal or vertical position.
Impeller-diffuser assemblies are mounted on a 16-spline steel shaft for positive drive.
A top bearing is provided in the cast-iron discharge head for better shaft alignment.
Replaceable journals protect shafts at bearings. Multi-stage construction permits modular or individual part replacements.
Noryl®-staged components (impellers/diffusers) are permanently bonded by a reliable, foolproof, ultrasonic welding technique.
Powered by Franklin Electric. Motors are interchangeable with any competitive pump end of comparable horsepower.

Big-Flo submersible pump/motor units are designed for industrial 6 inch pumping applications. Motors for the Big-Flo pump ends deliver between 2 and 50 horsepower with capacities up to 300 GPM for varying well depths.

Visit us at: www.redjacketwaterproducts.com

BRJ6BFLO

ITT Industries

RED JACKET®
Water Products

"PB" Series Pumps
225 GPM
6"

Performance

The pump and motor of the "PB" Series are most efficient at 225 GPM. This should be considered when selecting the desired model. Performances shown do not include drop pipe friction.

"PB" Series, 225 GPM, Performance Table (Recommended Operating Ranges)

Depth to Water Level in Feet	Capacity in Gallons per Minute Against Discharge Pressures Shown																															
	0 PSI								20 PSI								40 PSI								60 PSI							
Pump No.	1PB	2PB	3PB	4PB	5PB	6PB	8PB	10PB	1PB	2PB	3PB	4PB	5PB	6PB	8PB	10PB	1PB	2PB	3PB	4PB	5PB	6PB	8PB	10PB	1PB	2PB	3PB	4PB	5PB	6PB	8PB	10PB
HP	5	10	15	20	25	30	40	50	5	10	15	20	25	30	40	50	5	10	15	20	25	30	40	50	5	10	15	20	25	30	40	50
40	270									285								175	290								240	290				
80	100	295								200	295								240	285							175	255	295			
120		260	300								250	295							175	255	295							215	270	290		
160			260	300							180	260	295							220	260	290						150	240	260		
200			200	265								225	275	295						150	240	260	295						200	250	290	
240				230	288	295						170	240	275							200	250	285						150	225	275	
280				175	258	275							210	255	295						150	225	275							190	260	295
320					215	265	295						165	230	280							190	260							125	245	285
360					170	235	280							200	265	300						120	245								225	275
400						200	265	300						145	250	290							235								200	260
440						150	250	290							230	280							210								170	245
480							230	275							205	265							185								120	230
520							210	265							180	250							160									210
560							180	250							135	235							110									185
600							140	235								215																155
640								215								190																110
680								195								165																
720								165								125																
760								130																								

"PB" Series, 225 GPM, Specifications

Model Number	HP	No. of Stages	Volts	Phase	Pump Length	Motor Length	Pump Weight	Motor Weight
506F1-1PB6-4 506F4-1PB6-4 506F5-1PB6-4	5	1	230 230 460/380	1 3 3	14 13/16"	25.4" 22.9" 22.9"	22	112 98 98
1006F4-2PB6 1006F5-2PB6 1006F14-2PB6	10	2	230 460/380 200	3	19 1/8" 19 1/8" 19	25.4"	33	114
1506F4-3PB6 1506F5-3PB6 1506F14-3PB6	15	3	230 460/380 200	3	23 7/16" 23 7/16" 24	28.0"	38	128
2006F4-4PB6 2006F5-4PB6 2006F14-4PB6	20	4	230 460.380 200	3	27 3/4" 27 3/4" 28"	30.6"	44	142
2506F4-5PB6 2506F5-5PB6 2506F14-5PB6	25	5	230 460/380 200	3	32 1/16" 32 1/16" 32"	33.1"	48	154
3006F4-6PB6 3006F5-6PB6 3006F14-6PB6	30	6	230 460/380 200	3	36 3/8" 36 3/8" 36"	35.7"	57	168
4006F5-8PB6	40	8	460/380	3	45"	40.8"	67	202
5006F5-10PB6	50	19	460/380	3	53 5/8"	55.3"	77	300

Notes:
All "PB" Series pumps have 5 3/4" maximum "O.D."

All "PB" Series pumps have discharge head tapped 3" NPT.

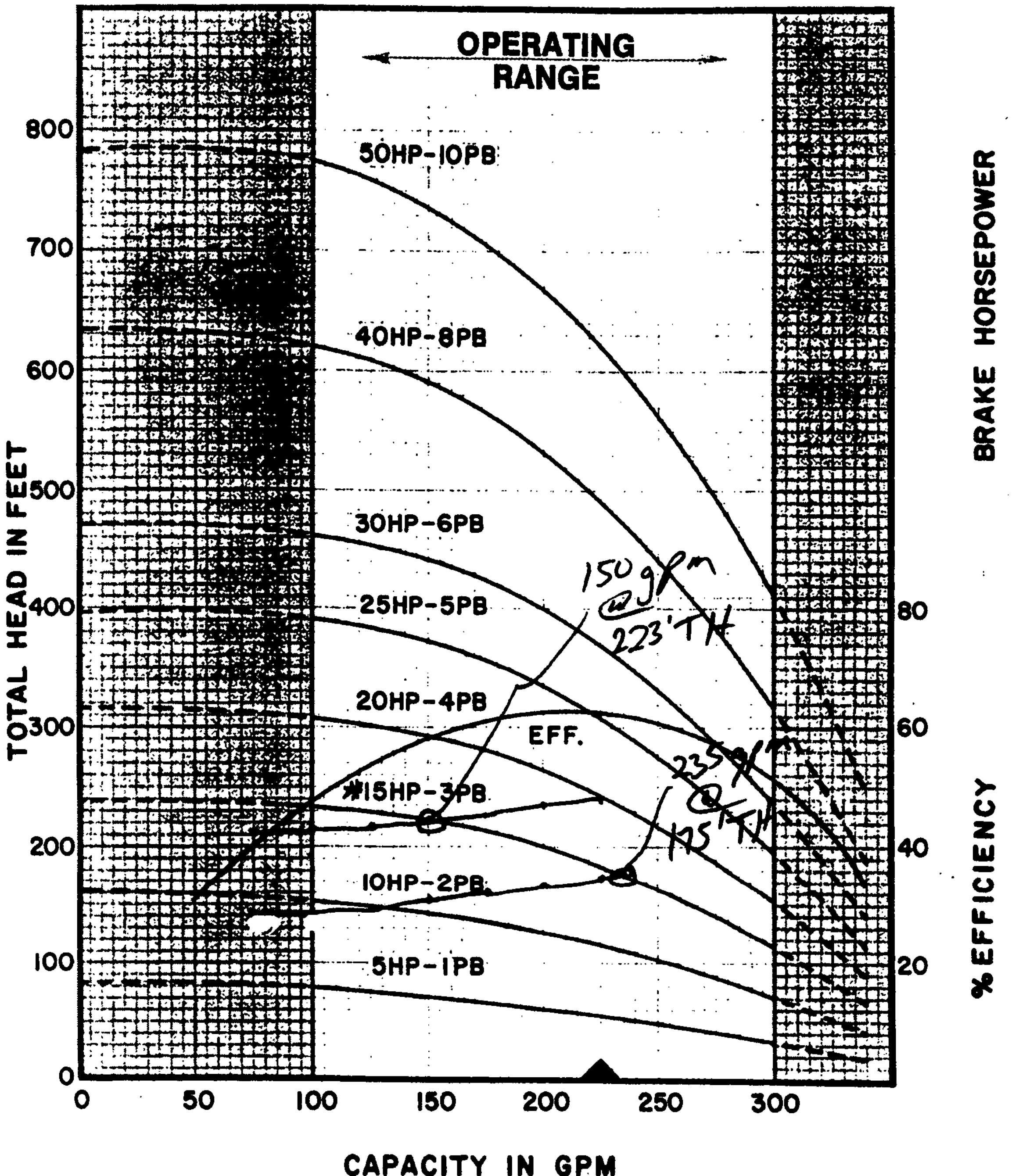
Important:
Check valve not furnished.

Minimum Well Size:
6" I.D.

ITT Industries

225 GPM SERIES "PB" PUMPS

PERFORMANCE CURVES



15-20 HP

▲ RATED FLOW

Note: Continuous operation outside operating range will void warranty.

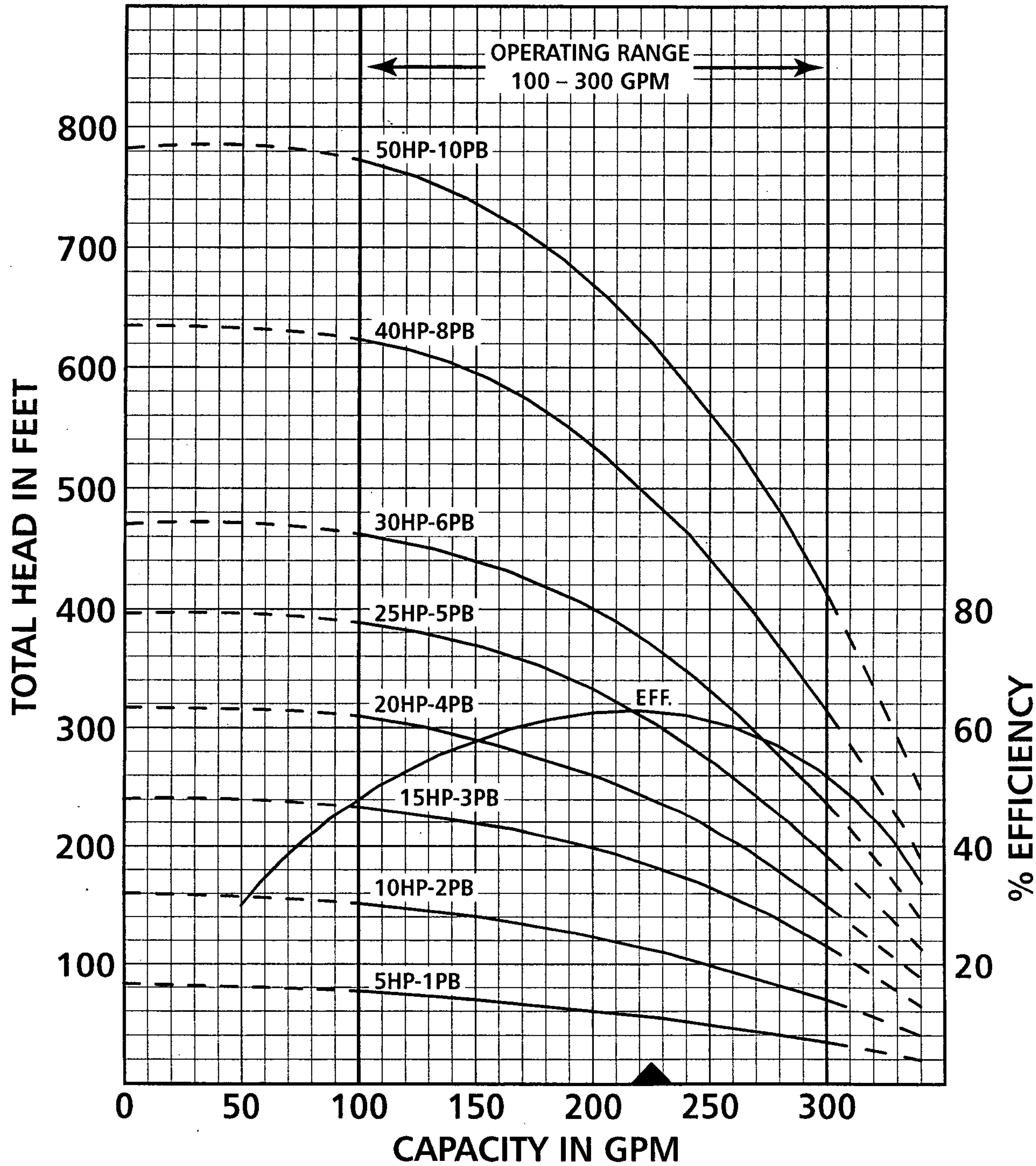
MODEL PB 225 GPM — RPM 3450
STAGE "PB" SERIES

GUARANTEED AS MINIMUM PERFORMANCE ONLY IF CERTIFIED

MINIMUM WELL SIZE 6" I.D.

RED JACKET®
Water Products

"PB" Series Pumps
225 GPM
6"



▲ Rated Flow at Best Efficiency
"PB" Series, 225 GPM
RPM 3450
Guaranteed as minimum performance only if certified.
Minimum Well Size: 6" I.D.
Note: Continuous operation outside operating range will void warranty.

Red Jacket Water Products is a licensed trademark.
Big Flo is a registered trademark.
Noryl is a trademark of GE Plastic.
trademark and tradename of ITT Industries.

BRJ6BFLO

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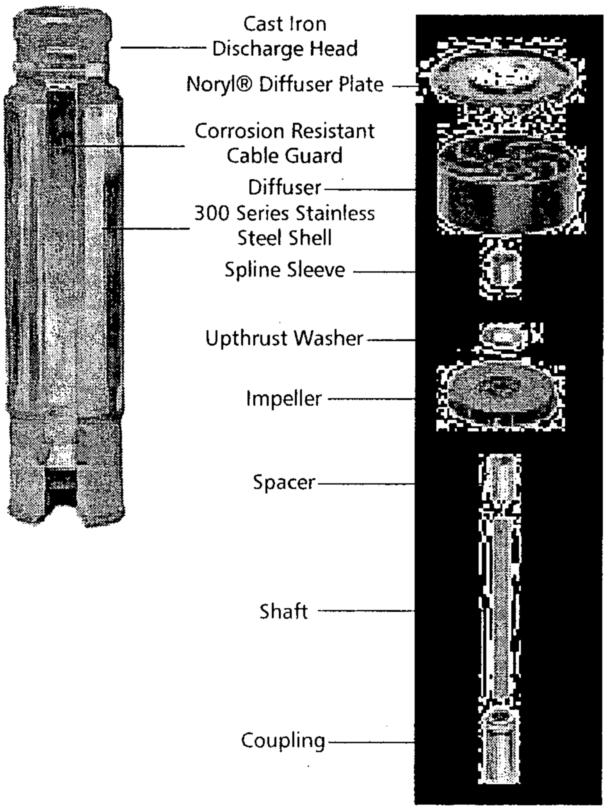
RED JACKET®
Water Products

Typical Components
6" Submersible

HB/LB/MB/PB Pumps
55 through 225 GPM



Visit us at: www.redjacketwaterproducts.com

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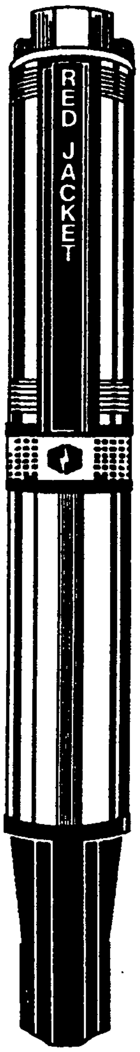
ITT Industries

13
11

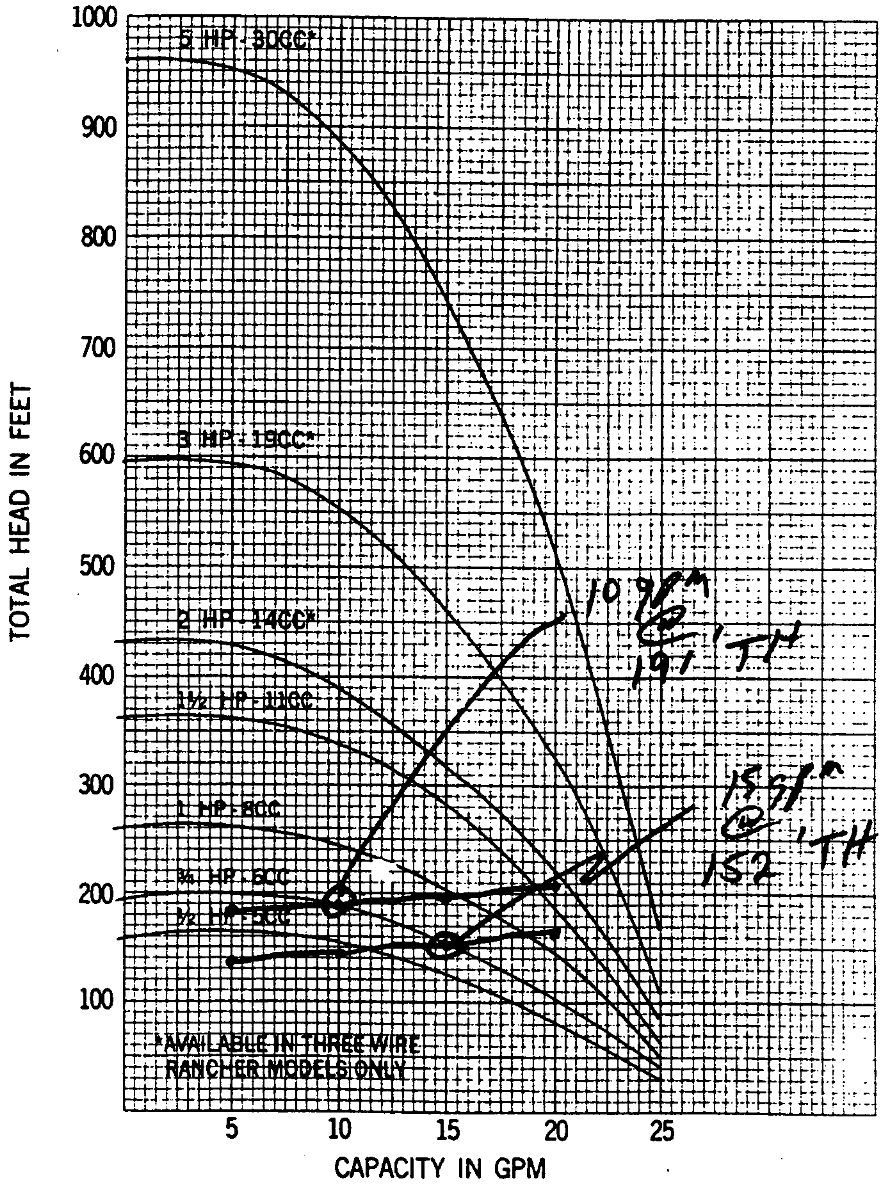
RED JACKET® PUMPS
A Marley Pump Company

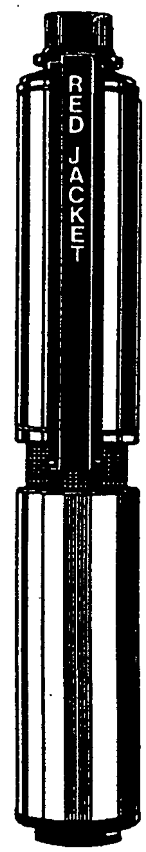
CN & U‡ MODELS
"CC" SUBMERSIBLE PUMPS
18 G.P.M. SERIES — Available in 2 & 3 Wire Models

With capacities for large homes and many farms, 18 GPM Series Submersible pumps feature Red Jacket Engineered Simplicity including an exclusive combination of 16 spline stainless steel shaft and abrasion resistant Noryl impellers and diffusers. The result is "balanced drive" which quiets any vibration and assures longer pump life.



PERFORMANCE CURVES FOR 18 GPM SUBMERSIBLE SERIES "CC"





*3-Wire Standard Construction Only.
‡"U" Available in 1/2 thru 1 HP Only.
RED JACKET PUMPS • A MARLEY PUMP COMPANY
DAVENPORT, IOWA

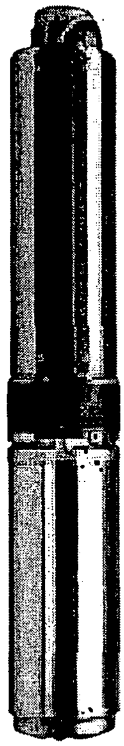
MODEL CC 18 GPM RPM 3450

GUARANTEED AS MINIMUM PERFORMANCE ONLY IF CERTIFIED

MINIMUM WELL SIZE — 4" I.D.

RED JACKET®
Water Products

Enduro™ STAINLESS STEEL



Utilizes an internal spring-loaded check valve design.
Pump shell (casing) constructed of heavy gauge 300-series stainless steel.
300-series stainless steel shaft/coupling provides greater power transfer.
Stainless steel discharge head and suction base (motor adapter) for maximum corrosion resistance.
Powered by Franklin Electric Motors.
Discharge head, casing, and suction base have left-hand threads.

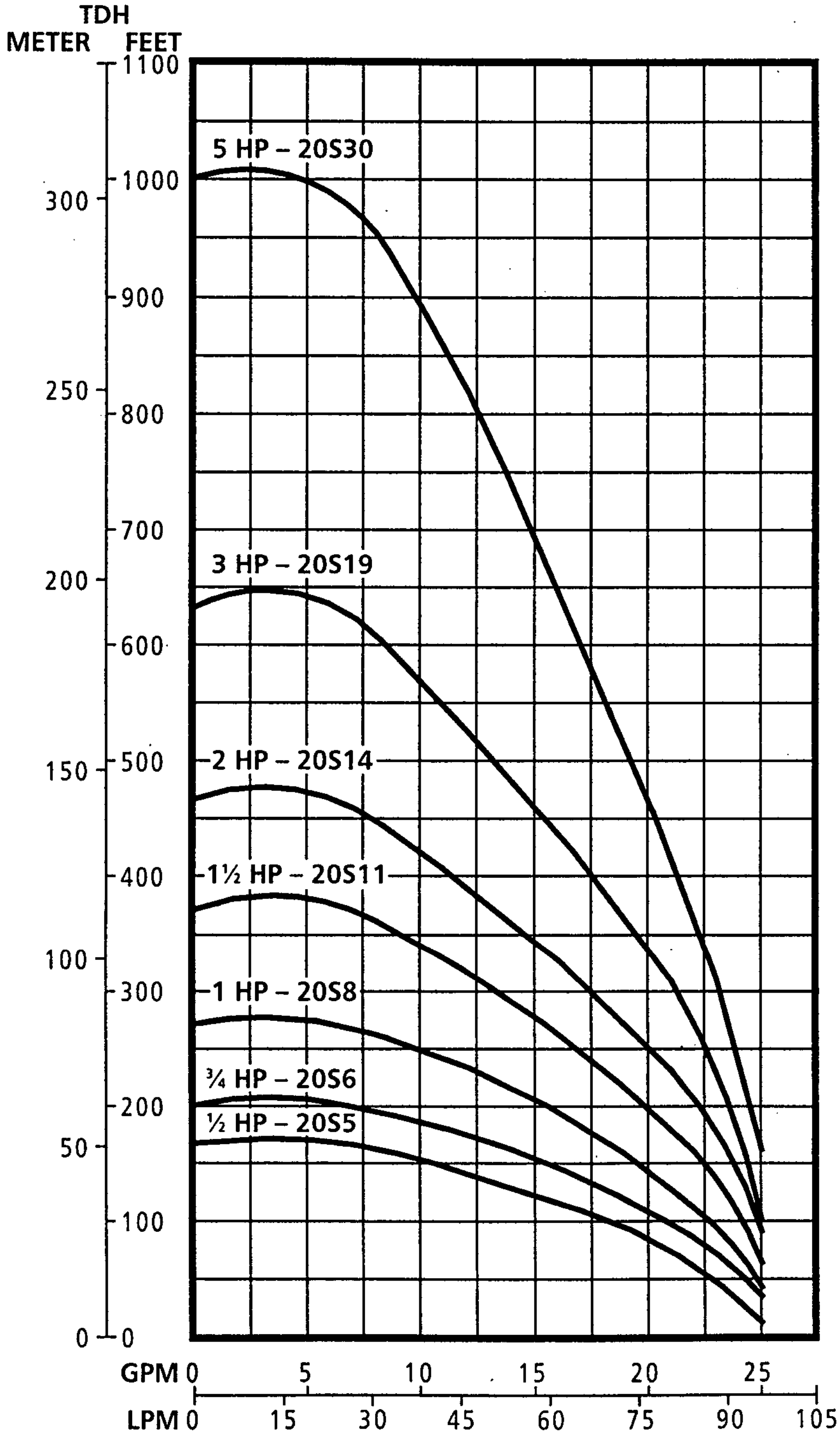
Water Pumps from Red Jacket are the natural choice of well drillers, pump installers and home owners alike. Built on over 120 years of engineering excellence, the name Red Jacket has become synonymous with quality for generations of customers who enjoy well water. The Enduro submersible pump is no exception. Rugged and reliable, the Enduro is designed to exceed performance requirements in the most demanding applications. Whether your needs are home, farm or industrial, choose the Red Jacket pump generations have come to count on.

Visit us at: www.redjacketwaterproducts.com
BRJENDURO

ITT Industries

RED JACKET®
Water Products

"20S" Submersible Pump Series
Available in 2 & 3 Wire Models
Best Efficiency can be reached at 18 GPM



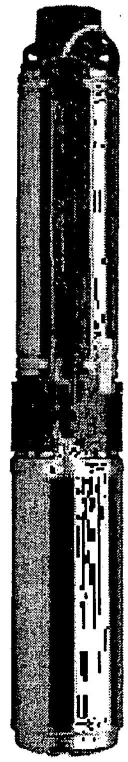
RED JACKET®
Water Products

¾ HP Stainless Steel Submersible Pumps Available in 2 & 3 Wire

Motor		3/4 HP					3/4 HP					3/4 HP					3/4 HP									
Pump End		6S21					8S16					12S12					20S6									
Discharge Pressure		20#	30#	40#	50#	60#	20#	30#	40#	50#	60#	20#	30#	40#	50#	60#	20#	30#	40#	50#	60#	20#	30#	40#	50#	60#
Depth of Water in Feet	0		8.9	8.5	8.1	7.7										13.8		23.0	21.4	19.2	16.9					
	20	9.0	8.5	8.2	7.7	7.3					9.7				13.8	13.3	23.2	21.6	19.4	17.7	14.4					
	40	8.6	8.2	7.8	7.4	6.9				9.7	9.3			13.9	13.4	12.3	21.9	19.9	17.4	14.7	11.5					
	60	8.3	7.8	7.5	7.1	6.7			9.8	9.4	8.8		14.0	13.5	12.7	11.6	20.1	17.6	15.0	11.8						
	80	7.9	7.5	7.1	6.8	6.4		9.8	9.4	8.9	8.3		13.5	12.7	11.6	10.5	18.0	15.5	12.1							
	100	7.6	7.2	6.8	6.4	6.1	9.9	9.5	9.0	8.3	7.7	13.6	12.8	11.7	10.7	9.7	16.0	12.5								
	120	7.2	6.8	6.5	6.1	5.7	9.5	9.0	8.4	7.8	7.1	13.2	11.9	10.8	9.8	8.7	13.1									
	140	6.9	6.5	6.1	5.8	5.4	9.1	8.5	7.9	7.2	6.5	12.1	10.9	10.0	8.7	7.6	9.9									
	160	6.6	6.2	5.9	5.5	5.1	8.6	7.9	7.3	6.6	5.9	11.1	10.1	8.9	7.8	6.7										
	180	6.3	5.8	5.5	5.2	4.9	8.0	7.3	6.7	6.0	5.4	10.2	9.1	7.9	6.8	5.6										
	200	5.9	5.6	5.3	4.9	4.5	7.4	6.8	6.1	5.4	4.8	9.3	8.1	6.9	5.7											
	220	5.6	5.3	4.9	4.6	4.2	6.8	6.2	5.4	4.9	4.2	8.2	7.1	5.9												
	240	5.3	5.0	4.7	4.3	3.8	6.3	5.6	5.0	4.3	3.6	7.2	6.0													
	260	5.0	4.7	4.3	3.9	3.4	5.7	5.0	4.4	3.7	2.8	5.9	5.0													
	280	4.7	4.3	3.9	3.5	3.0	5.1	4.5	3.8	2.9	1.5	5.1														
	300	4.4	4.0	3.6	3.1	2.5	4.6	3.9	3.0	1.8																
	320	4.1	3.6	3.1	2.5	1.9	4.0	3.1	2.0																	
	340	3.7	3.2	2.6	2.0	1.4	3.3	2.2																		
	360	3.3	2.7	2.1	1.4		2.3																			
	380	2.8	2.1	1.5			1.1																			
	400	2.3	1.5																							
	420	1.7																								
	440	1.0																								
	460																									
	480																									
	500																									
	520																									
	540																									
	560																									
	580																									
	600																									
	620																									
	640																									
	660																									
	680																									
	700																									
	720																									
	740																									
Shutoff Head		513' —222#					430' —186#					360' —156#					200' —87#									
Best Efficiency		5 GPM					7 GPM					10 GPM					18 GPM									

RED JACKET®
Water Products

GRIZZLY



Nylon impact and corrosion resistant discharge head and base.
Pump shell constructed with a press and roll process for better performance.
303 stainless steel shaft/couplings provides greater power transfer.
Pump and motor made of 303 stainless steel for maximum corrosion resistance.
Powered by Franklin Electric Submersible Motors.

Water Pumps from Red Jacket are the natural choice of well drillers, pump installers and home owners alike. Built on over 120 years of engineering excellence, the name Red Jacket has become synonymous with quality for generations of customers who enjoy well water. The Grizzly submersible pump is no exception. Rugged and reliable, the Grizzly is designed to exceed performance requirements in the most demanding applications. Whether your needs are home, farm or industrial, choose the Red Jacket pump generations have come to count on.

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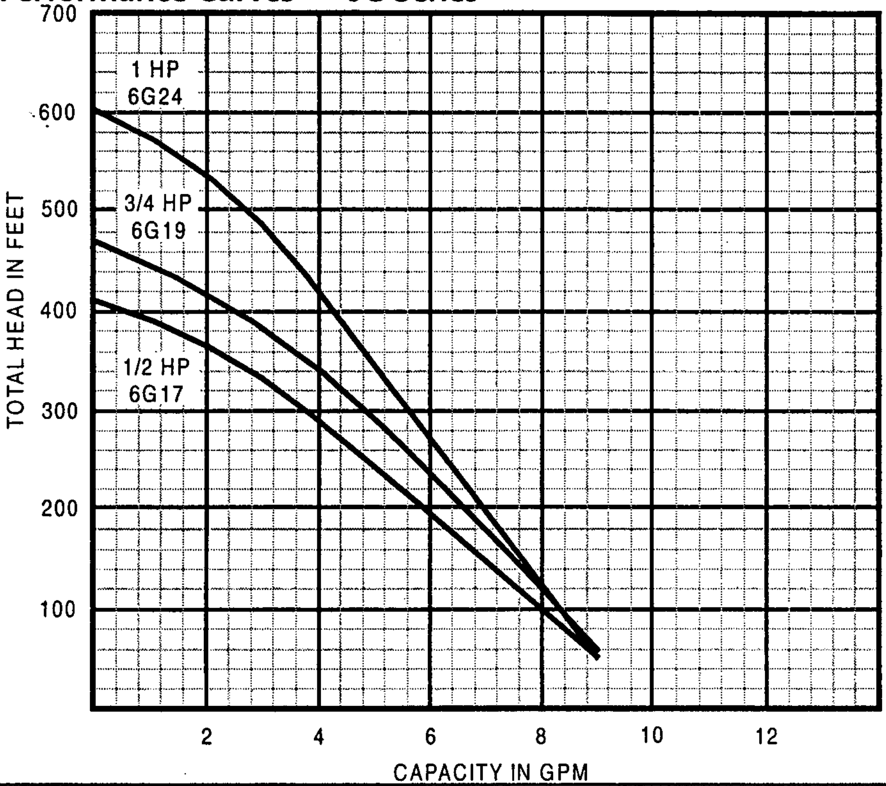
RED JACKET®
Water Products

Performance Curves — 6G Series



Note: Model 6G, 3450 RPM.

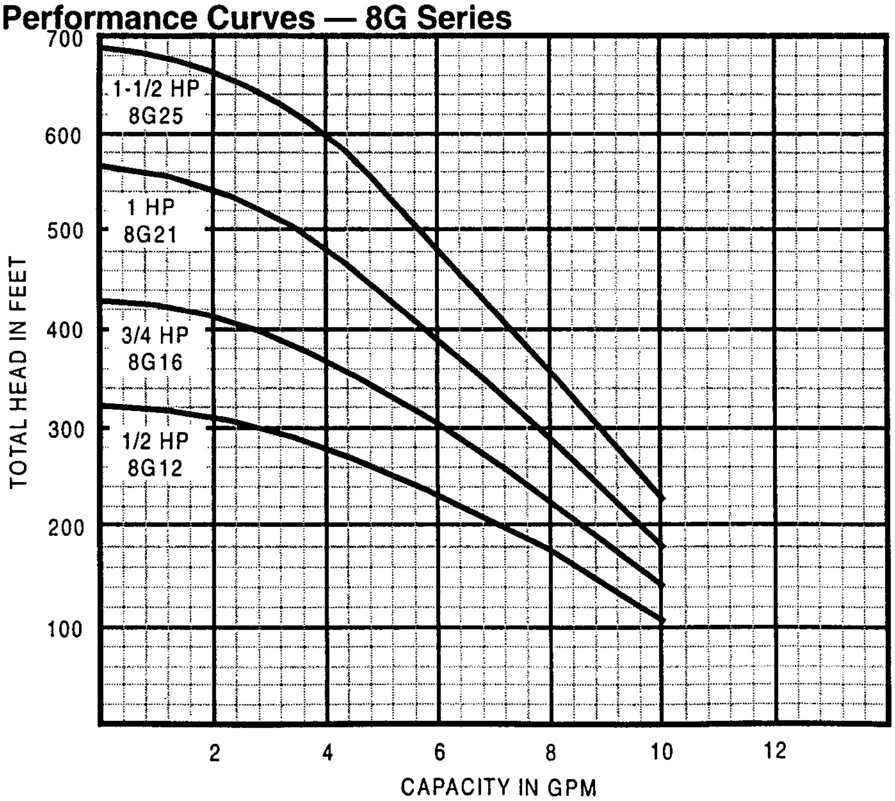
Available in 2-wire and 3-wire models.

Guaranteed as minimum performance only if certified.

Minimum well size is 4-inch inside diameter.

Best efficiency can be reached at 5 GPM.

Performance Curves — 8G Series



Note: Model 8G, 3450 RPM.

Available in 2-wire and 3-wire models.

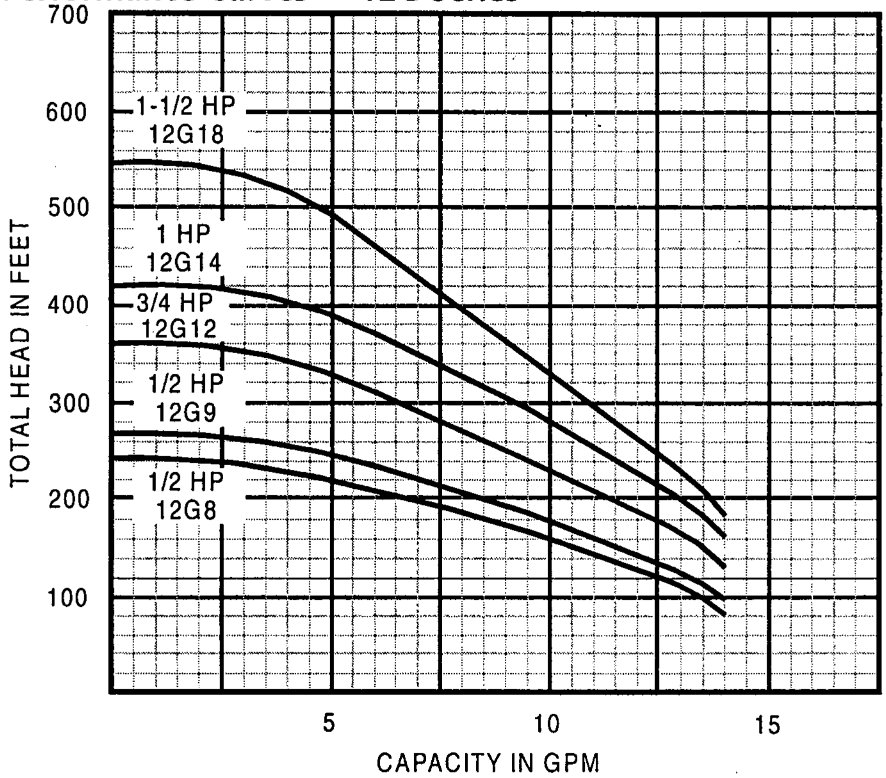
Guaranteed as minimum performance only if certified.

Minimum well size is 4-inch inside diameter.

Best efficiency can be reached at 7 GPM.

RED JACKET®
Water Products

Performance Curves — 12G Series



Note: Model 12G, 3450 RPM.

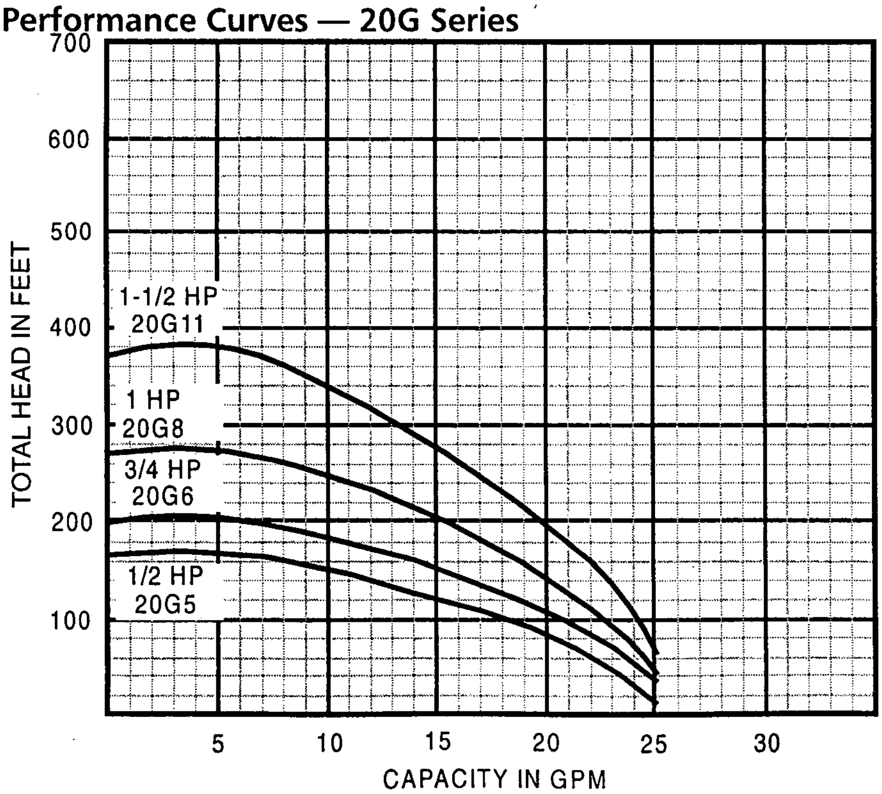
Available in 2-wire and 3-wire models.

Guaranteed as minimum performance only if certified.

Minimum well size is 4-inch inside diameter.

Best efficiency can be reached at 10 GPM.

Performance Curves — 20G Series



Note: Model 20G, 3450 RPM.

Available in 2-wire and 3-wire models.

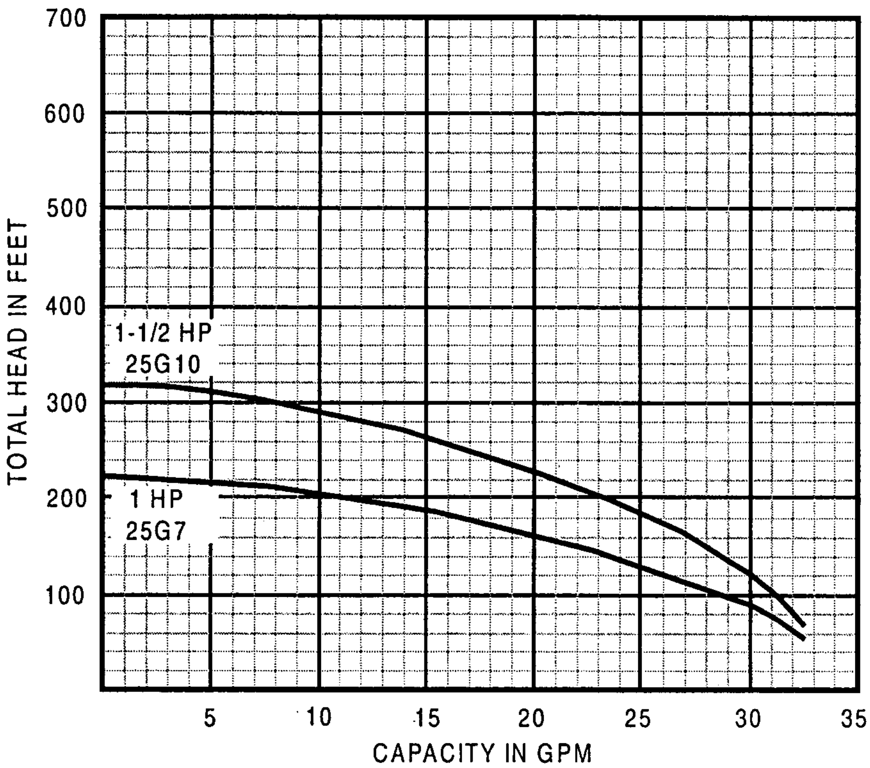
Guaranteed as minimum performance only if certified.

Minimum well size is 4-inch inside diameter.

Best efficiency can be reached at 18 GPM.

RED JACKET®
Water Products

Performance Curves — 25G Series



Note: Model 25G, 3450 RPM.

Available in 2-wire and 3-wire models.

Guaranteed as minimum performance only if certified.

Minimum well size is 4-inch inside diameter.

Best efficiency can be reached at 22 GPM.

Red Jacket Water Products reserves the right to make design improvements and pricing modifications as necessary and without notice.

PRINTED IN U.S.A.

ITT Industries

PRICE SCHEDULE **CPI 030102**
EFFECTIVE DATE: **MARCH 1, 2002**
SUPERCEDES: **CPI 070100**

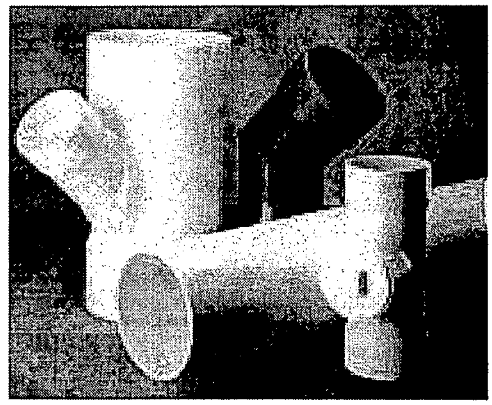
FP *Freedom Plastics, Inc.*

Commercial Plumbing & Industrial Price Catalog

Schedule 40/80 PVC Pipe & Fittings
Freedom-Flo™ PE-3408 Polyethylene Pipe

ISO 9001 Certified

Freedom Plastics manufactures a full-line of Polyvinyl Chloride (PVC) and Polyethylene (PE) pipe and large diameter fabricated fittings. We are the United State's only manufacturer of the "Complete Package" of pipe and fabricated fittings. Serving the Municipal, Commercial Plumbing and Industrial, and Irrigation markets, Freedom Plastics is the logical choice for the development of a total quality piping system.



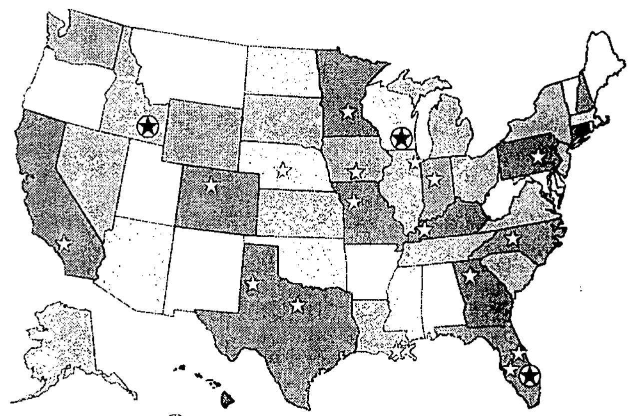
☐ **ISO 9001 Certified:**
In December of 1998 Freedom Plastics was awarded ISO 9001, the highest standard of quality assurance and excellence. Demand quality and reliability by specifying the only ISO 9001 certified large diameter PVC pipe and fabricated fittings package from Freedom Plastics.

☐ **Complete Quality Control:**
Freedom Plastics controls the entire manufacturing process from powder...to pipe...to fabricated fittings. Our comprehensive quality assurance program ensures dimensional conformity and the highest quality components from one manufacturer.

☐ **The Freedom Advantage:**
Our fittings are fabricated from specially formulated Freedom Plastics pipe, capable of enduring the fabrication process. As the nation's only fittings fabricator to manufacture their own pipe we have the advantage of utilizing our state-of-the-art compound blending facility, which formulates pipe compounds with fitting fabrication in mind!

☐ **Single Shipment Solution:**
Freedom Plastics will eliminate costly job site delays and inventory problems with our "Single Shipment Solution". Your entire piping system of PVC pipe and fittings can be shipped together on the same truck, and delivered the day you need it.

☐ **Regional Warehousing:**
Freedom Plastics has strategically located regional warehouse facilities throughout the United States. These warehouses provide immediate access to inventory and faster deliveries to your job site.



⊛ Manufacturing/Warehousing Location
☆ Warehousing Location

CONDITIONS OF SALE

PRICING: Prices are subject to change at any time without notice. All orders are subject to credit approval prior to shipment. All prices are F.O.B. plant or other Freedom Plastics, Inc. warehouses.

FREIGHT: Full Freight Allowed on orders of:

PVC Pipe: One-half truckload or more of PVC pipe shipped from any one location.

PVC Fittings: Minimum $1000.00 net order shipped from any one location.

Polyethylene: Minimum $2500.00 net order shipped from any one location.

Combination Orders:

1) Any Fittings and PE pipe that can be loaded with a Freight Allowed PVC pipe shipment
2) Combined Fittings and PE pipe minimum $2500.00 net order shipped from any one location.

RETURNS AND RESTOCKING:

- A **Return of Materials Authorization (RMA)** is **required** for all returns. Contact Customer Service for details at 800-356-9432 or *custsvc@freedomplastics.com*.
- All returned items will be assessed a 25% restocking fee upon return and inspection of product. Items must be in "saleable condition" to qualify for credit authorization.
- Items marked NR in this catalog are a non-standard item and are **non-returnable.**

CANCELLATION: Nonstandard or custom products are non-cancelable once production has begun. Large quantities of a single product may require a non-cancelable agreement.

Schedule 40 and 80 Pressure Fittings...Freedom Plastics' **Schedule 40 and 80** solvent weld bell pressure fittings have been designed and manufactured to accommodate and perform as in-line fittings in pressurized systems. Standard fittings are tested and certified to the maximum operating pressure listed below, unless otherwise noted:

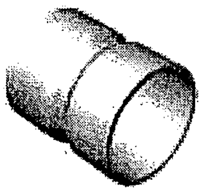
Schedule 40: 130 psi @ 73°F
Schedule 80: 230 psi @ 73°F

Special Note: Applications with temperatures in excess of 73°F will result in a de-rating of the piping systems maximum internal pressure capabilities. Temperatures falling below 73°F will increase the tensile strength of the piping system, while decreasing the impact strength.

Caution: Freedom Plastics' PVC piping products should not be tested or used to transport or store compressed air or gases. Using Freedom Plastics' products for this type of application will automatically void any product warranties, and any damage or liability caused by misapplication will be the responsibility of the installer.

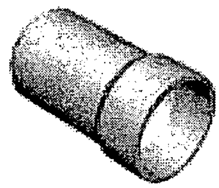
Contact Customer Service for price and availability on items not listed.

ADAPTER
IPS Hub x C900/C905 Hub



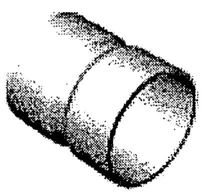
4 x 4	41-438NR	—
6 x 6	41-439NR	—
8 x 8	41-440NR	$91.42
10 x 10	41-441NR	$135.45
12 x 12	41-442NR	$172.55
14 x 14	41-443NR	$257.96
16 x 16	41-444NR	$322.45
18 x 18	41-445NR	$515.06
20 x 20	41-446NR	$644.86
24 x 24	41-447NR	$830.70

ADAPTER
IPS Spigot x C900/C905 Hub



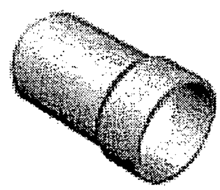
4 x 4	41-448NR	—
6 x 6	41-449NR	—
8 x 8	41-450NR	$91.42
10 x 10	41-451NR	$135.45
12 x 12	41-452NR	$172.55
14 x 14	41-453NR	$257.96
16 x 16	41-454NR	$322.45
18 x 18	41-455NR	$515.06
20 x 20	41-456NR	$644.86
24 x 24	41-457NR	$830.70

ADAPTER
IPS Hub x SWR Hub



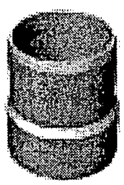
4 x 4	41-458NR	$7.01
6 x 6	41-459NR	$7.38
8 x 8	41-460NR	$20.55
10 x 10	41-461NR	$28.56
12 x 12	41-462NR	$48.73
14 x 15	41-463NR	$106.60
16 x 15	41-464NR	$117.26
18 x 18	41-465NR	$133.25
20 x 21	41-466NR	$401.11
24 x 24	41-467NR	$576.83

ADAPTER
IPS Spigot x SWR Hub



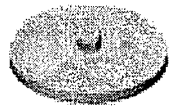
4 x 4	41-468NR	$7.71
6 x 6	41-469NR	$8.12
8 x 8	41-470NR	$22.61
10 x 10	41-471NR	$31.42
12 x 12	41-472NR	$53.60
14 x 15	41-473NR	$117.26
16 x 15	41-474NR	$128.99
18 x 18	41-475NR	$146.58
20 x 21	41-476NR	$441.22
24 x 24	41-477NR	$634.51

THREADED ADAPTER
Hub x Male Thread



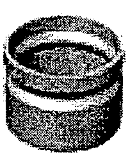
8	81-77	$77.92
10	81-78	$93.25
12	81-79	$116.33

THREADED PLUG
Hex Head



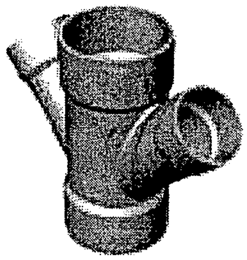
8	80-117	$114.02
10	80-119	$151.88
12	80-118	$209.05

THREADED ADAPTER
Hub x Female Thread

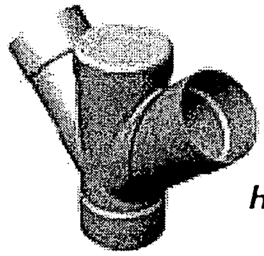


8	81-51	$77.92
10	81-53	$93.25
12	81-55	$116.33

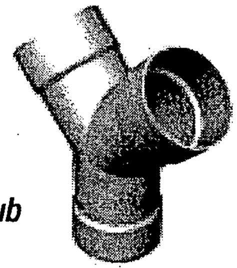
Schedule 40/80 DWV Fittings



DOUBLE WYE
Hub x Hub x Hub x Hub



TRUE WYE
Hub x Hub x Hub



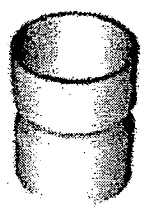
6 x 4	40-525	$49.99		
6 x 6	40-43	$56.30		
8 X 4	40-44	$60.78	80-13[NR]	$127.67
8 X 6	40-45	$77.31	80-14[NR]	$171.07
8 X 8	40-46	$101.48	80-15[NR]	$211.15
10 X 4	40-47	$112.56	80-16[NR]	$233.06
10 X 6	40-48	$143.32	80-17[NR]	$273.69
10 X 8	40-49	$172.83	80-18[NR]	$320.75
10 X 10	40-50	$197.60	80-19[NR]	$376.88
12 X 4	40-51	$174.31	80-20[NR]	$376.34
12 X 6	40-52	$190.31	80-21[NR]	$410.56
12 X 8	40-53	$226.04	80-22[NR]	$456.19
12 X 10	40-54	$253.14	80-23[NR]	$535.98
12 X 12	40-55	$320.96	80-24[NR]	$570.21
14 X 4	40-56[NR]	$372.91	80-320[NR]	$599.10
14 X 6	40-57[NR]	$406.97	80-321[NR]	$656.21
14 X 8	40-58[NR]	$426.07	80-322[NR]	$727.02
14 X 10	40-59[NR]	$468.18	80-323[NR]	$759.11
14 X 12	40-60[NR]	$565.79	80-324[NR]	$804.55
14 X 14	40-61[NR]	$615.30	80-325[NR]	$866.01
16 X 4	40-62[NR]	$435.71	80-326[NR]	$716.43
16 X 6	40-63[NR]	$479.52	80-327[NR]	$771.07
16 X 8	40-64[NR]	$508.83	80-328[NR]	$812.54
16 X 10	40-65[NR]	$593.03	80-329[NR]	$889.53
16 X 12	40-66[NR]	$612.98	80-123[NR]	$983.62
16 X 14	40-67[NR]	$657.03	80-330[NR]	$1,060.60
16 X 16	40-68[NR]	$708.39	80-331[NR]	$1,124.77
18 X 4	40-69[NR]	$574.55	80-332[NR]	$1,246.63
18 X 6	40-70[NR]	$598.72	80-333[NR]	$1,299.06
18 X 8	40-71[NR]	$622.88	80-334[NR]	$1,351.50
18 X 10	40-72[NR]	$671.15	80-335[NR]	$1,456.25
18 X 12	40-73[NR]	$695.28	80-336[NR]	$1,508.57
18 X 14	40-74[NR]	$719.44	80-337[NR]	$1,561.01
18 X 16	40-75[NR]	$782.16	80-338[NR]	$1,697.15
18 X 18	40-627[NR]	$825.68	80-339[NR]	$1,791.41
20 X 4	40-76[NR]	$689.46		
20 X 6	40-77[NR]	$718.47		
20 X 8	40-78[NR]	$747.46		
20 X 10	40-79[NR]	$805.34		
20 X 12	40-80[NR]	$834.31		
20 X 14	40-81[NR]	$863.32		
20 X 16	40-82[NR]	$938.58		
20 X 18	40-83[NR]	$990.75		
20 X 20	40-628[NR]	$1,021.16		
24 X 4	40-629[NR]	$1,147.98		
24 X 6	40-630[NR]	$1,344.08		
24 X 8	40-631[NR]	$1,454.44		
24 X 10	40-632[NR]	$1,470.92		
24 X 12	40-633[NR]	$1,503.29		
24 X 14	40-634[NR]	$1,514.77		
24 X 16	40-635[NR]	$1,517.94		
24 X 18	40-636[NR]	$2,153.61		
24 X 20	40-637[NR]	$2,367.97		
24 X 24	40-638[NR]	$2,609.78		

8	40-973[NR]	$300.66	80-576[NR]	$395.86
10	40-974[NR]	$410.89	80-577[NR]	$534.48
12	40-975[NR]	$538.79	80-578[NR]	$718.22
14	40-976[NR]	$858.56	80-579[NR]	$868.58
16	40-977[NR]	$1,137.04	80-580[NR]	$1,361.04
18	40-978[NR]	$1,682.81	80-581[NR]	$2,103.51
20	40-979[NR]	$2,103.51	—	—
24	40-980[NR]	$2,693.17	—	—

Schedule 40/80 Pressure Fittings

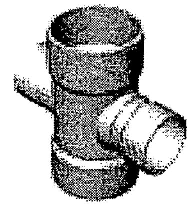
CAP
Hub x Cap

8	41-26	$51.91	81-102	$61.33
10	41-27	$75.95	81-29	$137.26
12	41-28	$101.43	81-30	$241.52
14	41-29	$126.42	81-123	$279.06
16	41-30[NR]	$197.47	81-124[NR]	$321.49
18	41-129[NR]	$345.58	81-300[NR]	$562.61
20	41-232[NR]	$604.76	—	—
24	41-233[NR]	$918.23	—	—



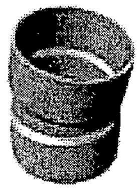
STOP COUPLING
Hub x Hub

8	41-31	$29.78	81-80	$59.22
10	41-32	$41.99	81-81	$95.22
12	41-33	$61.80	81-82	$143.13
14	41-34	$100.36	81-117	$207.10
16	41-35[NR]	$111.93	81-118[NR]	$298.61
18	41-139[NR]	$196.46	81-301[NR]	$453.73
20	41-221[NR]	$343.00	—	—
24	41-222[NR]	$465.50	—	—

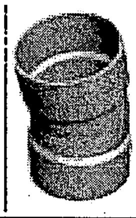


CROSS
Hub x Hub x Hub x Hub

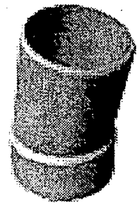
8 X 4	41-1	$190.55	81-1	$328.69
8 X 6	41-2	$222.14	81-2	$355.20
8 X 8	41-3	$276.56	81-3	$441.42
10 X 4	41-4	$294.54	81-4	$452.97
10 X 6	41-5	$328.84	81-5	$474.03
10 X 8	41-6	$369.67	81-6	$609.62
10 X 10	41-7	$444.97	81-7	$711.97
12 X 4	41-8	$394.51	81-8	$516.30
12 X 6	41-9	$414.90	81-9	$599.56
12 X 8	41-10	$447.59	81-10	$716.19
12 X 10	41-11	$510.06	81-11	$816.12
12 X 12	41-12	$627.06	81-12	$1,002.63
14 X 4	41-13	$531.36	81-302	$763.46
14 X 6	41-14	$623.61	81-303	$843.24
14 X 8	41-15	$679.63	81-304	$959.24
14 X 10	41-16	$735.49	81-305	$1,108.32
14 X 12	41-17	$793.31	81-306	$1,253.60
14 X 14	41-18	$854.07	81-13	$1,611.42
16 X 4	41-19[NR]	$658.95	81-14[NR]	$965.64
16 X 6	41-20[NR]	$712.77	81-15[NR]	$1,044.36
16 X 8	41-21[NR]	$834.92	81-16[NR]	$1,168.11
16 X 10	41-22[NR]	$899.78	81-17[NR]	$1,272.88
16 X 12	41-23[NR]	$1,015.37	81-307[NR]	$1,429.66
16 X 14	41-24[NR]	$1,123.48	81-308[NR]	$1,790.44
16 X 16	41-25[NR]	$1,235.83	81-309[NR]	$1,826.23
18 X 4	41-156[NR]	$1,009.28	81-310[NR]	$1,482.42
18 X 6	41-157[NR]	$1,118.93	81-311[NR]	$1,678.39
18 X 8	41-123[NR]	$1,138.61	81-312[NR]	$1,707.91
18 X 10	41-124[NR]	$1,219.20	81-313[NR]	$1,828.80
18 X 12	41-125[NR]	$1,295.11	81-314[NR]	$1,942.66
18 X 14	41-126[NR]	$1,596.86	81-315[NR]	$2,395.29
18 X 16	41-127[NR]	$1,632.48	81-316[NR]	$2,448.71
18 X 18	41-128[NR]	$1,792.72	81-317[NR]	$2,689.08
20 X 4	41-158[NR]	$1,195.77		
20 X 6	41-159[NR]	$1,326.03		
20 X 8	41-160[NR]	$1,365.39		
20 X 10	41-161[NR]	$1,417.87		
20 X 12	41-162[NR]	$1,469.41		
20 X 14	41-163[NR]	$1,607.17		
20 X 16	41-164[NR]	$1,893.93		
20 X 18	41-234[NR]	$2,079.48		
20 X 20	41-436[NR]	$2,197.56		
24 X 4	41-165[NR]	$1,733.69		
24 X 6	41-166[NR]	$1,922.05		
24 X 8	41-167[NR]	$1,968.90		
24 X 10	41-168[NR]	$2,018.57		
24 X 12	41-169[NR]	$2,074.80		
24 X 14	41-170[NR]	$2,191.00		
24 X 16	41-171[NR]	$2,283.77		
24 X 18	41-235[NR]	$3,024.11		
24 X 20	41-236[NR]	$3,189.97		
24 X 24	41-437[NR]	$3,508.60		



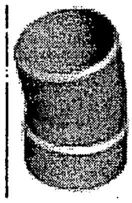
ELBOW - 11 1/4
Hub x Hub



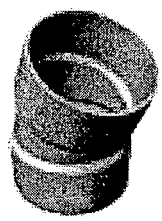
8	41-237	$52.30	81-318	$80.13
10	41-300	$73.50	81-319	$142.04
12	41-42	$115.31	81-320	$207.60
14	41-301	$184.24	81-321	$405.70
16	41-231NR	$259.21	81-322NR	$492.98
18	41-302NR	$386.33	81-323NR	$865.65
20	41-303NR	$732.99	—	—
24	41-226NR	$902.14	—	—



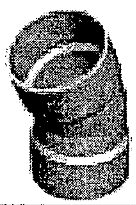
ELBOW - 11 1/4
Hub x Spigot



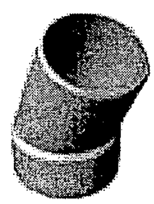
8	41-304	$52.30	81-324	$80.13
10	41-305	$73.50	81-325	$142.04
12	41-306	$115.31	81-326	$207.60
14	41-307	$184.24	81-327	$405.70
16	41-308NR	$259.21	81-328NR	$492.98
18	41-309NR	$386.33	81-329NR	$865.65
20	41-310NR	$732.99	—	—
24	41-311NR	$902.14	—	—



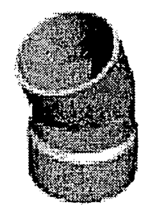
ELBOW - 22 1/2
Hub x Hub



8	41-36	$52.30	81-32	$80.13
10	41-39	$73.50	81-37	$142.04
12	41-43	$115.31	81-40	$207.60
14	41-46	$184.24	81-129	$405.70
16	41-49NR	$259.21	81-130NR	$492.98
18	41-136NR	$386.33	81-330NR	$865.65
20	41-215NR	$732.99	—	—
24	41-216NR	$902.14	—	—



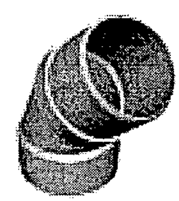
ELBOW - 22 1/2
Hub x Spigot



8	41-312	$52.30	81-331	$80.13
10	41-313	$73.50	81-332	$142.04
12	41-314	$115.31	81-333	$207.60
14	41-315	$184.24	81-334	$405.70
16	41-316NR	$259.21	81-335NR	$492.98
18	41-317NR	$386.33	81-336NR	$865.65
20	41-318NR	$732.99	—	—
24	41-319NR	$902.14	—	—

ELBOW - 45
Hub x Hub

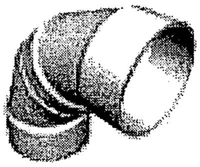
8	41-37	$137.74	81-33	$172.65
10	41-40	$151.52	81-38	$428.59
12	41-44	$291.73	81-41	$452.86
14	41-47	$302.54	81-119	$498.82
16	41-50NR	$399.83	81-120NR	$610.67
18	41-137NR	$503.60	81-337NR	$908.94
20	41-217NR	$955.50	—	—
24	41-218NR	$1,176.00	—	—



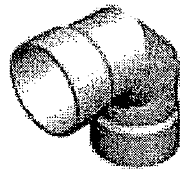
ELBOW - 45
Hub x Spigot

8	41-320	$137.74	81-34	$179.18
10	41-321	$141.78	81-338	$243.19
12	41-322	$210.11	81-339	$313.70
14	41-323	$245.13	81-340	$412.66
16	41-324NR	$332.95	81-341NR	$505.20
18	41-325NR	$478.43	81-342NR	$865.66
20	41-326NR	$907.73	—	—
24	41-327NR	$1,117.20	—	—

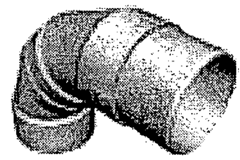
Schedule 40/80 Pressure Fittings



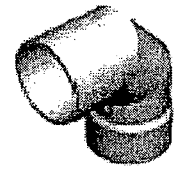
ELBOW - 90
Hub x Hub



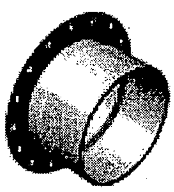
8	41-38	$191.10	81-35	$227.53
10	41-41	$287.00	81-39	$473.63
12	41-45	$384.92	81-42	$617.43
14	41-48	$455.43	81-121	$644.96
16	41-51[NR]	$591.44	81-122[NR]	$802.12
18	41-138[NR]	$726.40	81-343[NR]	$1,146.59
20	41-219[NR]	$1,179.61	—	—
24	41-220[NR]	$1,715.01	—	—



ELBOW - 90
Hub x Spigot



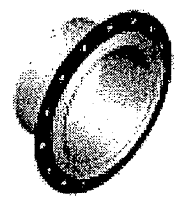
8	41-328	$162.89	81-36	$193.03
10	41-329	$217.03	81-344	$365.70
12	41-330	$291.07	81-345	$476.71
14	41-331	$369.00	81-346	$606.48
16	41-332[NR]	$528.02	81-347[NR]	$723.51
18	41-333[NR]	$726.18	81-348[NR]	$1,112.20
20	41-225[NR]	$1,179.61	—	—
24	41-334[NR]	$1,629.26	—	—



FLANGE – VAN STONE STYLE
Flange x Hub

8	—	—	81-390	$65.07
10	—	—	81-391	$102.36
12	—	—	81-392	$110.33
14	41-335	$556.98	81-393	$586.29
16	41-336[NR]	$733.60	81-394[NR]	$772.21
18	41-337[NR]	$765.87	81-395[NR]	$806.18
20	41-338[NR]	$1,012.22	—	—
24	41-339[NR]	$1,440.54	—	—

PSI Rating
4" – 12" Flanges: 150psi • 14" – 24" Flanges: 100psi



FLANGE – VAN STONE STYLE
Flange x Spigot

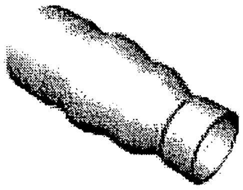
8	—	—	81-349	$72.07
10	—	—	81-350	$102.36
12	—	—	81-351	$110.33
14	41-340	$556.98	81-95	$586.29
16	41-341[NR]	$733.60	81-96[NR]	$772.21
18	41-342[NR]	$765.87	81-352[NR]	$806.18
20	41-343[NR]	$1,012.22	—	—
24	41-344[NR]	$1,440.54	—	—

PSI Rating
4" – 12" Flanges: 150psi • 14" – 24" Flanges: 100psi

FLANGE - BLIND

8	—	—	81-396	$153.60
10	—	—	81-397	$256.82
12	—	—	81-398	$400.05
14	41-345	$623.36	81-399	$690.73
16	41-346[NR]	$739.19	81-400[NR]	$819.06
18	41-347[NR]	$831.31	81-401[NR]	$921.11
20	41-348[NR]	$1,343.68	—	—
24	41-349[NR]	$1,791.41	—	—

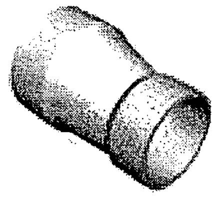
Schedule 40/80 Pressure Fittings



INCREASER COUPLING

Hub x Hub

4 X 6	41-223	—		
4 X 8	41-52	—	81-66	—
4 X 10	41-53	$92.53	81-67	$197.26
4 X 12	41-54	$153.75	81-68	$283.96
4 X 14	41-55	$226.37	81-353	$365.68
4 X 16	41-56[NR]	$432.09	81-354[NR]	$598.59
4 X 18	41-172[NR]	$511.49	81-355[NR]	$769.53
4 X 20	41-173[NR]	$842.00		
4 X 24	41-174[NR]	$1,490.49		
6 X 8	41-57	$37.80	81-69	$66.15
6 X 10	41-58	$78.88	81-70	$159.54
6 X 12	41-59	$151.35	81-71	$218.20
6 X 14	41-60	$240.59	81-356	$348.26
6 X 16	41-61[NR]	$418.44	81-357[NR]	$539.26
6 X 18	41-175[NR]	$543.62	81-358[NR]	$846.49
6 X 20	41-176[NR]	$829.01		
6 X 24	41-177[NR]	$1,476.84		
8 X 10	41-62	$56.62	81-72	$80.48
8 X 12	41-63	$122.27	81-73	$210.32
8 X 14	41-64	$243.67	81-131	$294.63
8 X 16	41-65[NR]	$389.35	81-359[NR]	$488.32
8 X 18	41-178[NR]	$560.42	81-360[NR]	$931.14
8 X 20	41-179[NR]	$801.32		
8 X 24	41-180[NR]	$1,447.75		
10 X 12	41-66	$103.99	81-74	$119.18
10 X 14	41-67	$250.98	81-125	$300.50
10 X 16	41-68[NR]	$339.56	81-361[NR]	$434.06
10 X 18	41-181[NR]	$522.90	81-362[NR]	$1,024.26
10 X 20	41-182[NR]	$753.90		
10 X 24	41-183[NR]	$1,397.96		
12 X 14	41-69	$139.16	81-75	$233.99
12 X 16	41-70[NR]	$320.51	81-76[NR]	$367.97
12 X 18	41-130[NR]	$575.19	81-363[NR]	$1,075.48
12 X 20	41-184[NR]	$719.11		
12 X 24	41-185[NR]	$1,325.49		
14 X 16	41-71[NR]	$189.33	81-126[NR]	$334.52
14 X 18	41-131[NR]	$603.95	81-364[NR]	$1,129.26
14 X 20	41-186[NR]	$700.68		
14 X 24	41-187[NR]	$1,204.19		
16 X 18	41-132[NR]	$630.50	81-365[NR]	$866.61
16 X 20	41-188[NR]	$667.31		
16 X 24	41-189[NR]	$1,058.40		
18 X 20	41-190[NR]	$660.30		
18 X 24	41-191[NR]	$1,260.00		
20 X 24	41-192[NR]	$1,146.35		

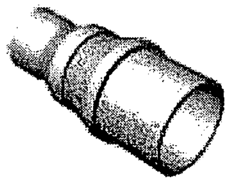


INCREASER COUPLING - ECCENTRIC

Hub x Hub

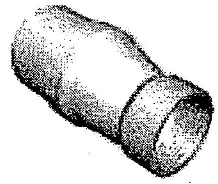
4 X 6			
4 X 8			
4 X 10	41-350	$113.97	
4 X 12	41-351	$146.43	
4 X 14	41-352	$215.59	
4 X 16	41-353[NR]	$263.16	
4 X 18	41-354[NR]	$487.14	
4 X 20	41-355[NR]	$584.11	
4 X 24	41-356[NR]	$762.76	
6 X 8	41-357	$80.15	
6 X 10	41-358	$123.48	
6 X 12	41-359	$156.78	
6 X 14	41-360	$229.14	
6 X 16	41-361[NR]	$279.69	
6 X 18	41-362[NR]	$517.74	
6 X 20	41-363[NR]	$620.78	
6 X 24	41-364[NR]	$810.67	
8 X 10	41-365	$115.78	
8 X 12	41-366	$152.83	
8 X 14	41-367	$235.98	
8 X 16	41-368[NR]	$286.43	
8 X 18	41-369[NR]	$533.76	
8 X 20	41-370[NR]	$639.98	
8 X 24	41-371[NR]	$835.74	
10 X 12	41-372	$145.62	
10 X 14	41-373	$245.31	
10 X 16	41-374[NR]	$309.34	
10 X 18	41-375[NR]	$588.34	
10 X 20	41-376[NR]	$659.78	
10 X 24	41-377[NR]	$861.58	
12 X 14	41-378	$233.63	
12 X 16	41-379[NR]	$315.00	
12 X 18	41-380[NR]	$597.78	
12 X 20	41-381[NR]	$666.51	
12 X 24	41-382[NR]	$888.24	
14 X 16	41-383[NR]	$295.59	
14 X 18	41-384[NR]	$660.29	
14 X 20	41-385[NR]	$780.40	
14 X 24	41-386[NR]	$969.78	
16 X 18	41-387[NR]	$605.26	
16 X 20	41-388[NR]	$835.00	
16 X 24	41-389[NR]	$1,027.06	
18 X 20	41-390[NR]	$765.71	
18 X 24	41-391[NR]	$1,077.60	
20 X 24	41-392[NR]	$1,026.29	

Schedule 40/80 Pressure Fittings



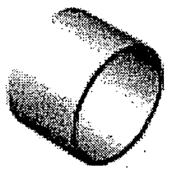
REDUCER BUSHING
Spigot x Hub

6 X 4	41-193	—		
8 X 4	41-72	—	81-57	—
10 X 4	41-73	$92.53	81-58	$197.26
12 X 4	41-74	$153.75	81-59	$283.96
14 X 4	41-75	$226.37	81-132	$365.68
16 X 4	41-76[NR]	$432.09	81-366[NR]	$598.59
18 X 4	41-194[NR]	$511.49	81-367[NR]	$769.53
20 X 4	41-195[NR]	$842.00		
24 X 4	41-196[NR]	$1,490.49		
8 X 6	41-77	$37.80	81-60	$66.15
10 X 6	41-78	$78.88	81-61	$159.54
12 X 6	41-79	$151.35	81-62	$218.20
14 X 6	41-80	$240.59	81-368	$348.26
16 X 6	41-81[NR]	$418.44	81-369[NR]	$539.26
18 X 6	41-197[NR]	$543.62	81-370[NR]	$846.49
20 X 6	41-198[NR]	$829.01		
24 X 6	41-199[NR]	$1,476.84		
10 X 8	41-82	$56.62	81-63	$80.48
12 X 8	41-83	$122.27	81-64	$210.32
14 X 8	41-84	$243.67	81-371	$294.63
16 X 8	41-85[NR]	$389.35	81-372[NR]	$488.32
18 X 8	41-200[NR]	$560.42	81-373[NR]	$931.14
20 X 8	41-201[NR]	$801.32		
24 X 8	41-202[NR]	$1,447.75		
12 X 10	41-86	$103.99	81-65	$119.18
14 X 10	41-87	$250.98	81-113	$300.50
16 X 10	41-88[NR]	$339.56	81-374[NR]	$434.06
18 X 10	41-203[NR]	$522.90	81-375[NR]	$1,024.26
20 X 10	41-204[NR]	$753.90		
24 X 10	41-205[NR]	$1,397.96		
14 X 12	41-89	$139.16	81-114	$233.99
16 X 12	41-90[NR]	$320.51	81-115[NR]	$367.97
18 X 12	41-133[NR]	$575.19	81-376[NR]	$1,075.48
20 X 12	41-206[NR]	$719.11		
24 X 12	41-207[NR]	$1,325.49		
16 X 14	41-91[NR]	$189.33	81-116[NR]	$334.52
18 X 14	41-134[NR]	$603.95	81-377[NR]	$1,129.26
20 X 14	41-208[NR]	$700.68		
24 X 14	41-209[NR]	$1,204.09		
18 X 16	41-135[NR]	$630.50	81-378[NR]	$866.61
20 X 16	41-210[NR]	$667.31		
24 X 16	41-211[NR]	$1,058.40		
20 X 18	41-212[NR]	$660.30		
24 X 18	41-213[NR]	$1,260.00		
24 X 20	41-214[NR]	$1,146.35		



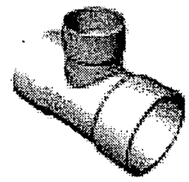
REDUCER BUSHING - ECCENTRIC
Spigot x Hub

6 X 4			
8 X 4			
10 X 4	41-393	$113.97	
12 X 4	41-394	$146.43	
14 X 4	41-395	$215.59	
16 X 4	41-396[NR]	$263.16	
18 X 4	41-397[NR]	$487.14	
20 X 4	41-398[NR]	$584.11	
24 X 4	41-399[NR]	$762.76	
8 X 6	41-400	$80.15	
10 X 6	41-401	$123.48	
12 X 6	41-402	$156.78	
14 X 6	41-403	$229.14	
16 X 6	41-404[NR]	$279.69	
18 X 6	41-405[NR]	$517.74	
20 X 6	41-406[NR]	$620.78	
24 X 6	41-407[NR]	$810.67	
10 X 8	41-408	$115.78	
12 X 8	41-409	$152.83	
14 X 8	41-410	$235.98	
16 X 8	41-411[NR]	$286.43	
18 X 8	41-412[NR]	$533.76	
20 X 8	41-413[NR]	$639.98	
24 X 8	41-414[NR]	$835.74	
12 X 10	41-415	$145.62	
14 X 10	41-416	$245.31	
16 X 10	41-417[NR]	$309.34	
18 X 10	41-418[NR]	$588.34	
20 X 10	41-419[NR]	$659.78	
24 X 10	41-420[NR]	$861.58	
14 X 12	41-421	$233.63	
16 X 12	41-422[NR]	$315.00	
18 X 12	41-423[NR]	$597.78	
20 X 12	41-424[NR]	$666.51	
24 X 12	41-425[NR]	$888.24	
16 X 14	41-426[NR]	$295.59	
18 X 14	41-427[NR]	$660.29	
20 X 14	41-428[NR]	$780.40	
24 X 14	41-429[NR]	$969.78	
18 X 16	41-430[NR]	$605.26	
20 X 16	41-431[NR]	$835.00	
24 X 16	41-432[NR]	$1,027.06	
20 X 18	41-433[NR]	$765.71	
24 X 18	41-434[NR]	$1,077.60	
24 X 20	41-435[NR]	$1,026.29	



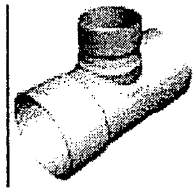
FLUSH REDUCER BUSHING

10 X 6		81-44	$163.72
10 X 8		81-45	$122.63
12 X 8		81-46	$189.16
12 X 10		81-47	$101.39
14 X 10		81-127	$227.21
14 X 12		81-49	$97.48
16 X 12		81-128[NR]	$203.83
16 X 14		81-50[NR]	$196.75



TEE - FULL OR REDUCING

Hub x Hub x Hub



8 X 4	41-92	$160.07	81-83	$210.62
8 X 6	41-93	$185.65	81-84	$231.69
8 X 8	41-94	$209.61	81-85	$254.86
10 X 4	41-95	$211.57	81-86	$327.57
10 X 6	41-96	$232.81	81-87	$370.45
10 X 8	41-97	$262.38	81-88	$415.59
10 X 10	41-98	$310.08	81-89	$494.78
12 X 4	41-99	$274.30	81-90	$435.63
12 X 6	41-100	$304.90	81-91	$463.37
12 X 8	41-101	$339.63	81-92	$516.08
12 X 10	41-102	$379.57	81-93	$573.47
12 X 12	41-103	$441.27	81-94	$698.74
14 X 4	41-104	$498.10	81-379	$646.28
14 X 6	41-105	$527.83	81-103	$697.67
14 X 8	41-106	$556.25	81-104	$788.55
14 X 10	41-107	$651.04	81-105	$822.15
14 X 12	41-108	$739.49	81-106	$868.35
14 X 14	41-109	$732.42	81-107	$1,214.41
16 X 4	41-110[NR]	$494.25	81-380[NR]	$778.05
16 X 6	41-111[NR]	$534.29	81-381[NR]	$855.86
16 X 8	41-112[NR]	$626.21	81-108[NR]	$883.05
16 X 10	41-113[NR]	$775.63	81-109[NR]	$926.08
16 X 12	41-114[NR]	$817.95	81-110[NR]	$1,020.57
16 X 14	41-115[NR]	$926.10	81-111[NR]	$1,122.63
16 X 16	41-116[NR]	$1,034.25	81-112[NR]	$1,579.10
18 X 4	41-140[NR]	$994.90	81-382[NR]	$1,381.44
18 X 6	41-141[NR]	$1,101.62	81-383[NR]	$1,530.27
18 X 8	41-117[NR]	$1,120.14	81-384[NR]	$1,555.63
18 X 10	41-118[NR]	$1,185.41	81-385[NR]	$1,646.04
18 X 12	41-119[NR]	$1,254.21	81-386[NR]	$1,741.95
18 X 14	41-120[NR]	$1,418.26	81-387[NR]	$1,970.17
18 X 16	41-121[NR]	$1,512.63	81-388[NR]	$2,101.37
18 X 18	41-122[NR]	$1,587.60	81-389[NR]	$2,205.00
20 X 4	41-142[NR]	$1,143.96		
20 X 6	41-143[NR]	$1,267.44		
20 X 8	41-144[NR]	$1,298.31		
20 X 10	41-145[NR]	$1,339.76		
20 X 12	41-146[NR]	$1,414.73		
20 X 14	41-147[NR]	$1,510.87		
20 X 16	41-148[NR]	$1,584.08		
20 X 18	41-241[NR]	$1,791.35		
20 X 20	41-224[NR]	$1,844.27		
24 X 4	41-149[NR]	$1,640.52		
24 X 6	41-150[NR]	$1,818.69		
24 X 8	41-151[NR]	$1,840.74		
24 X 10	41-152[NR]	$1,865.43		
24 X 12	41-153[NR]	$1,878.66		
24 X 14	41-154[NR]	$1,950.99		
24 X 16	41-155[NR]	$1,988.91		
24 X 18	41-238[NR]	$2,478.42		
24 X 20	41-239[NR]	$2,511.06		
24 X 24	41-227[NR]	$2,575.44		

Freedom-Flo™ PE-3408

Freedom Plastics' Freedom-Flo™ pressure rated High Density Polyethylene pipe is manufactured from the highest-grade virgin material. Our pipe has been tested and certified by NSF-International to meet or exceed all requirements of ASTM D2239, D2737 or D3035 (as applicable), and is certified for potable water. Freedom-Flo™ pressure pipe is the perfect choice for municipal, industrial and mining, and irrigation applications.

This high performance HDPE material has been developed to withstand the demanding requirements of pressure pipe applications, such as:

- Good long-term hoop strength performance
- Very high melt strength
- Outstanding toughness even at low temperatures

Property	ASTM	Measure English/SI
Density	D1505	0.944g/cm^3
Melt Index	D1238	0.11g/10min
ESCR, 100% Igepal (Cond. A,B&C)	D1693	>1,000 h
Tensile Strength (2" per min) @Yield / @Break	D638	3,200psi (22Mpa) / 5,000psi (34Mpa)
Ultimate Elongation (2" per min)	D638	>500%
Brittleness Temperature	D746	< -130°F (< -90°C)
Flexural Modulus	D3350 / D790	110,000psi (760Mpa) / 140,000psi (960Mpa)
Pipe Ring ESCR	F1248	>2,000 h
Hydrostatic Design Basis 73°F (23°C) / 140°F (60°C)	D2837	1,600psi (11Mpa) / 800psi (5.5Mpa)
Carbon Black	D1603	2.6%
Cell Classification	D3350	345464C

1/2"	100	10	1000	60
	400	7	2,800	58
3/4"	100	10	900	60
	400	4/5	1,600/2,000	58
	500	4	2,000	58
1"	100	10	1,000	60
	300	5	1,500	58
1-1/4"	100	6/7	600/700	56
	300	4	1,200	56
1-1/2"	100	6/7	600/700	24
	250	4	1,000	20
	300	4	900	20
2"	100	5	500	16
	200	3	600	16
	300	3	900	16

* Reflects CTS ASTM D2737 pallet specifications.

SIDR-19 80 PSI						
1"	1.049	0.060	9.3	80	100/300	$27.16
1-1/4"	1.380	0.073	14.8	80	100/300	$43.22
1-1/2"	1.610	0.100	23.1	80	100/250	$67.45
2"	2.067	0.109	32.4	80	100/200	$94.61
SIDR-15 100 PSI						
3/4"	0.824	0.060	7.4	100	100/400	$21.65
1"	1.049	0.070	10.9	100	100/300	$31.00
1-1/4"	1.380	0.092	18.7	100	100/300	$54.10
1-1/2"	1.610	0.107	25.1	100	100/250	$77.26
2"	2.067	0.138	41.6	100	100/200	$126.49
SIDR-11.5 125 PSI						
1/2"	0.622	0.060	5.7	125	100/400	$16.96
3/4"	0.824	0.072	9.0	125	100/400	$26.32
1"	1.049	0.091	14.3	125	100/300	$41.52
1-1/4"	1.380	0.120	24.6	125	100/300	$71.64
1-1/2"	1.610	0.140	33.5	125	100/250	$101.87
SIDR-9 160 PSI						
1/2"	0.622	0.069	6.6	160	100/400	$19.27
3/4"	0.824	0.092	11.6	160	100/400	$33.63
1"	1.049	0.117	18.6	160	100/300	$54.09
1-1/4"	1.380	0.153	32.0	160	100/300	$92.11
1-1/2"	1.610	0.179	43.0	160	100/250	$132.34
2"	2.067	0.230	71.0	160	100/200	$216.68
SIDR-7 200 PSI						
1/2"	0.622	0.089	8.7	200	100/400	$25.40
3/4"	0.824	0.118	15.2	200	100/400	$44.44
1"	1.049	0.150	24.6	200	100/300	$71.05
1-1/4"	1.380	0.197	42.4	200	100/300	$121.64
1-1/2"	1.610	0.230	57.8	200	100/250	$173.58
2"	2.067	0.295	95.2	200	100/200	$284.40

SDR-9	**200 PSI**						
3/4"	0.671	0.875	0.097	10.3	200	100/500	$30.12
1"	0.865	1.125	0.125	17.0	200	100/300	$49.12
1-1/4"	1.060	1.375	0.153	25.4	200	100/300	$73.10
1-1/2"	1.253	1.625	0.181	35.3	200	100/300	$107.72
2"	1.637	2.125	0.236	60.2	200	100/300	$183.74

Freedom-Flo™ may be joined by flared or compression type fittings specifically designed for CTS polyethylene.

SDR-11 160 PSI							
1-1/4"	1.358	1.660	0.151	32.0	160	100/300	$93.44
1-1/2"	1.554	1.900	0.173	42.0	160	100/250	$122.64
2"	1.943	2.375	0.216	64	160	100/200	$186.88

3" SDR-11 available upon request. Call for details

Pallet & Truckload Specifications

Freedom Plastics has a long-standing reputation for manufacturing the highest quality PVC pipe available today. Our fierce pride and dedication to quality did not come by accident. We understood not being the biggest meant we had to be the best. Our goal was simple: produce a product preferred and requested by the end user.

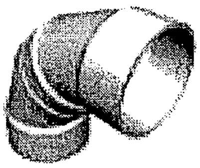
Today Freedom Plastics is ISO 9001 certified in both pipe producing plants, located in Wisconsin and Florida. From these plants we serve the Municipal, Plumbing, Industrial, Irrigation, Telecommunication, and Conduit markets. Utilizing state-of-the-art blending facilities we control the entire process, from powder to pipe.

	JANESVILLE, WI PLANT		FT. PIERCE, FL PLANT	
PIPE SIZE	**FEET/PALLET**	**PALLETS/TRUCKLOAD**	**FEET/PALLET**	**PALLETS/TRUCKLOAD**
4"	*840/1092	*24/18	**1140/988	**16/18
6"	*400/520	*24/18	**480/429	**16/18
8"	312	18	**240/182	**16/18
10"	156	18	156	18
12"	104	24	78	24
15"	78	18	78	18
18"	26 & 39	30	26 & 39	30
21"	26	24	NA	NA
24"	26	18	NA	NA

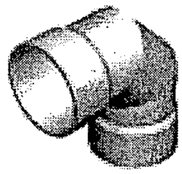
	JANESVILLE, WI PLANT		FT. PIERCE, FL PLANT	
PIPE SIZE	**FEET/PALLET**	**PALLETS/TRUCKLOAD**	**FEET/PALLET**	**PALLETS/TRUCKLOAD**
1/2"	9600	28	9600	28
3/4"	6000	28	6000	28
1"	4800	28	4800	28
1 1/4"	4800	28	4800	28
1 1/2"	2580	32	3360	28
2"	1760	32	1980	28
2 1/2"	1360	16	1360	16
3"	1620	16	1620	16
4"	1020	16	1020	16
5"	NA	-	660	16
6"	480	16	480	16
8"	280	16	240	16
10"	240	12	160	16
12"	120 & 160	12	120 & 160	12
14"	120	12	60	16
16"	60	20	40	20
18"	40 & 60	20	40 & 60	20
20"	40	16	NA	NA
24"	40	12	NA	NA

	JANESVILLE, WI PLANT		FT. PIERCE, FL PLANT	
PIPE SIZE	**FEET/PALLET**	**PALLETS/TRUCKLOAD**	**FEET/PALLET**	**PALLETS/TRUCKLOAD**
4"	860	16	860	16
6"	560	12	560	12
8"	200	20	200	20
10"	160	16	160	16
12"	120 & 160	12	120 & 160	12
16"	40 & 60	20	40 & 60	20

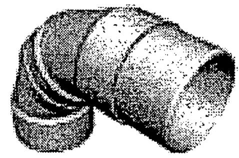
Schedule 40/80 Pressure Fittings



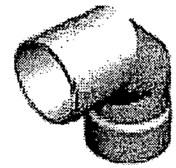
ELBOW - 90
Hub x Hub



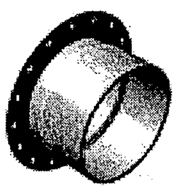
8	41-38	$191.10	81-35	$227.53
10	41-41	$287.00	81-39	$473.63
12	41-45	$384.92	81-42	$617.43
14	41-48	$455.43	81-121	$644.96
16	41-51[NR]	$591.44	81-122[NR]	$802.12
18	41-138[NR]	$726.40	81-343[NR]	$1,146.59
20	41-219[NR]	$1,179.61	—	—
24	41-220[NR]	$1,715.01	—	—



ELBOW - 90
Hub x Spigot



8	41-328	$162.89	81-36	$193.03
10	41-329	$217.03	81-344	$365.70
12	41-330	$291.07	81-345	$476.71
14	41-331	$369.00	81-346	$606.48
16	41-332[NR]	$528.02	81-347[NR]	$723.51
18	41-333[NR]	$726.18	81-348[NR]	$1,112.20
20	41-225[NR]	$1,179.61	—	—
24	41-334[NR]	$1,629.26	—	—

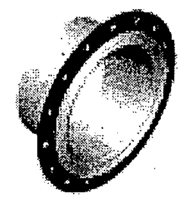


FLANGE – VAN STONE STYLE
Flange x Hub

8	—	—	81-390	$65.07
10	—	—	81-391	$102.36
12	—	—	81-392	$110.33
14	41-335	$556.98	81-393	$586.29
16	41-336[NR]	$733.60	81-394[NR]	$772.21
18	41-337[NR]	$765.87	81-395[NR]	$806.18
20	41-338[NR]	$1,012.22	—	—
24	41-339[NR]	$1,440.54	—	—

PSI Rating

4" – 12" Flanges: 150psi • 14" – 24" Flanges: 100psi



FLANGE – VAN STONE STYLE
Flange x Spigot

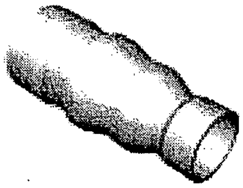
8	—	—	81-349	$72.07
10	—	—	81-350	$102.36
12	—	—	81-351	$110.33
14	41-340	$556.98	81-95	$586.29
16	41-341[NR]	$733.60	81-96[NR]	$772.21
18	41-342[NR]	$765.87	81-352[NR]	$806.18
20	41-343[NR]	$1,012.22	—	—
24	41-344[NR]	$1,440.54	—	—

PSI Rating

4" – 12" Flanges: 150psi • 14" – 24" Flanges: 100psi

FLANGE - BLIND

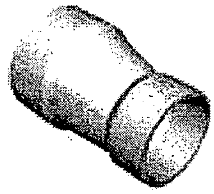
8	—	—	81-396	$153.60
10	—	—	81-397	$256.82
12	—	—	81-398	$400.05
14	41-345	$623.36	81-399	$690.73
16	41-346[NR]	$739.19	81-400[NR]	$819.06
18	41-347[NR]	$831.31	81-401[NR]	$921.11
20	41-348[NR]	$1,343.68	—	—
24	41-349[NR]	$1,791.41	—	—



INCREASER COUPLING

Hub x Hub

4 X 6	41-223	—		
4 X 8	41-52	—	81-66	—
4 X 10	41-53	$92.53	81-67	$197.26
4 X 12	41-54	$153.75	81-68	$283.96
4 X 14	41-55	$226.37	81-353	$365.68
4 X 16	41-56[NR]	$432.09	81-354[NR]	$598.59
4 X 18	41-172[NR]	$511.49	81-355[NR]	$769.53
4 X 20	41-173[NR]	$842.00		
4 X 24	41-174[NR]	$1,490.49		
6 X 8	41-57	$37.80	81-69	$66.15
6 X 10	41-58	$78.88	81-70	$159.54
6 X 12	41-59	$151.35	81-71	$218.20
6 X 14	41-60	$240.59	81-356	$348.26
6 X 16	41-61[NR]	$418.44	81-357[NR]	$539.26
6 X 18	41-175[NR]	$543.62	81-358[NR]	$846.49
6 X 20	41-176[NR]	$829.01		
6 X 24	41-177[NR]	$1,476.84		
8 X 10	41-62	$56.62	81-72	$80.48
8 X 12	41-63	$122.27	81-73	$210.32
8 X 14	41-64	$243.67	81-131	$294.63
8 X 16	41-65[NR]	$389.35	81-359[NR]	$488.32
8 X 18	41-178[NR]	$560.42	81-360[NR]	$931.14
8 X 20	41-179[NR]	$801.32		
8 X 24	41-180[NR]	$1,447.75		
10 X 12	41-66	$103.99	81-74	$119.18
10 X 14	41-67	$250.98	81-125	$300.50
10 X 16	41-68[NR]	$339.56	81-361[NR]	$434.06
10 X 18	41-181[NR]	$522.90	81-362[NR]	$1,024.26
10 X 20	41-182[NR]	$753.90		
10 X 24	41-183[NR]	$1,397.96		
12 X 14	41-69	$139.16	81-75	$233.99
12 X 16	41-70[NR]	$320.51	81-76[NR]	$367.97
12 X 18	41-130[NR]	$575.19	81-363[NR]	$1,075.48
12 X 20	41-184[NR]	$719.11		
12 X 24	41-185[NR]	$1,325.49		
14 X 16	41-71[NR]	$189.33	81-126[NR]	$334.52
14 X 18	41-131[NR]	$603.95	81-364[NR]	$1,129.26
14 X 20	41-186[NR]	$700.68		
14 X 24	41-187[NR]	$1,204.19		
16 X 18	41-132[NR]	$630.50	81-365[NR]	$866.61
16 X 20	41-188[NR]	$667.31		
16 X 24	41-189[NR]	$1,058.40		
18 X 20	41-190[NR]	$660.30		
18 X 24	41-191[NR]	$1,260.00		
20 X 24	41-192[NR]	$1,146.35		

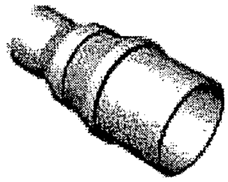


INCREASER COUPLING - ECCENTRIC

Hub x Hub

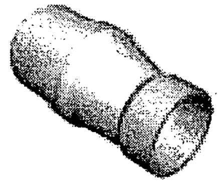
4 X 6			
4 X 8			
4 X 10	41-350	$113.97	
4 X 12	41-351	$146.43	
4 X 14	41-352	$215.59	
4 X 16	41-353[NR]	$263.16	
4 X 18	41-354[NR]	$487.14	
4 X 20	41-355[NR]	$584.11	
4 X 24	41-356[NR]	$762.76	
6 X 8	41-357	$80.15	
6 X 10	41-358	$123.48	
6 X 12	41-359	$156.78	
6 X 14	41-360	$229.14	
6 X 16	41-361[NR]	$279.69	
6 X 18	41-362[NR]	$517.74	
6 X 20	41-363[NR]	$620.78	
6 X 24	41-364[NR]	$810.67	
8 X 10	41-365	$115.78	
8 X 12	41-366	$152.83	
8 X 14	41-367	$235.98	
8 X 16	41-368[NR]	$286.43	
8 X 18	41-369[NR]	$533.76	
8 X 20	41-370[NR]	$639.98	
8 X 24	41-371[NR]	$835.74	
10 X 12	41-372	$145.62	
10 X 14	41-373	$245.31	
10 X 16	41-374[NR]	$309.34	
10 X 18	41-375[NR]	$588.34	
10 X 20	41-376[NR]	$659.78	
10 X 24	41-377[NR]	$861.58	
12 X 14	41-378	$233.63	
12 X 16	41-379[NR]	$315.00	
12 X 18	41-380[NR]	$597.78	
12 X 20	41-381[NR]	$666.51	
12 X 24	41-382[NR]	$888.24	
14 X 16	41-383[NR]	$295.59	
14 X 18	41-384[NR]	$660.29	
14 X 20	41-385[NR]	$780.40	
14 X 24	41-386[NR]	$969.78	
16 X 18	41-387[NR]	$605.26	
16 X 20	41-388[NR]	$835.00	
16 X 24	41-389[NR]	$1,027.06	
18 X 20	41-390[NR]	$765.71	
18 X 24	41-391[NR]	$1,077.60	
20 X 24	41-392[NR]	$1,026.29	

Schedule 40/80 Pressure Fittings



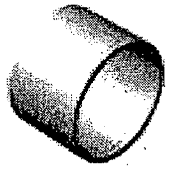
REDUCER BUSHING
Spigot x Hub

6 X 4	41-193	—		
8 X 4	41-72	—	81-57	—
10 X 4	41-73	$92.53	81-58	$197.26
12 X 4	41-74	$153.75	81-59	$283.96
14 X 4	41-75	$226.37	81-132	$365.68
16 X 4	41-76[NR]	$432.09	81-366[NR]	$598.59
18 X 4	41-194[NR]	$511.49	81-367[NR]	$769.53
20 X 4	41-195[NR]	$842.00		
24 X 4	41-196[NR]	$1,490.49		
8 X 6	41-77	$37.80	81-60	$66.15
10 X 6	41-78	$78.88	81-61	$159.54
12 X 6	41-79	$151.35	81-62	$218.20
14 X 6	41-80	$240.59	81-368	$348.26
16 X 6	41-81[NR]	$418.44	81-369[NR]	$539.26
18 X 6	41-197[NR]	$543.62	81-370[NR]	$846.49
20 X 6	41-198[NR]	$829.01		
24 X 6	41-199[NR]	$1,476.84		
10 X 8	41-82	$56.62	81-63	$80.48
12 X 8	41-83	$122.27	81-64	$210.32
14 X 8	41-84	$243.67	81-371	$294.63
16 X 8	41-85[NR]	$389.35	81-372[NR]	$488.32
18 X 8	41-200[NR]	$560.42	81-373[NR]	$931.14
20 X 8	41-201[NR]	$801.32		
24 X 8	41-202[NR]	$1,447.75		
12 X 10	41-86	$103.99	81-65	$119.18
14 X 10	41-87	$250.98	81-113	$300.50
16 X 10	41-88[NR]	$339.56	81-374[NR]	$434.06
18 X 10	41-203[NR]	$522.90	81-375[NR]	$1,024.26
20 X 10	41-204[NR]	$753.90		
24 X 10	41-205[NR]	$1,397.96		
14 X 12	41-89	$139.16	81-114	$233.99
16 X 12	41-90[NR]	$320.51	81-115[NR]	$367.97
18 X 12	41-133[NR]	$575.19	81-376[NR]	$1,075.48
20 X 12	41-206[NR]	$719.11		
24 X 12	41-207[NR]	$1,325.49		
16 X 14	41-91[NR]	$189.33	81-116[NR]	$334.52
18 X 14	41-134[NR]	$603.95	81-377[NR]	$1,129.26
20 X 14	41-208[NR]	$700.68		
24 X 14	41-209[NR]	$1,204.09		
18 X 16	41-135[NR]	$630.50	81-378[NR]	$866.61
20 X 16	41-210[NR]	$667.31		
24 X 16	41-211[NR]	$1,058.40		
20 X 18	41-212[NR]	$660.30		
24 X 18	41-213[NR]	$1,260.00		
24 X 20	41-214[NR]	$1,146.35		



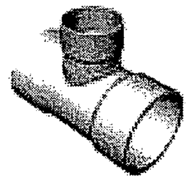
REDUCER BUSHING - ECCENTRIC
Spigot x Hub

6 X 4			
8 X 4			
10 X 4	41-393	$113.97	
12 X 4	41-394	$146.43	
14 X 4	41-395	$215.59	
16 X 4	41-396[NR]	$263.16	
18 X 4	41-397[NR]	$487.14	
20 X 4	41-398[NR]	$584.11	
24 X 4	41-399[NR]	$762.76	
8 X 6	41-400	$80.15	
10 X 6	41-401	$123.48	
12 X 6	41-402	$156.78	
14 X 6	41-403	$229.14	
16 X 6	41-404[NR]	$279.69	
18 X 6	41-405[NR]	$517.74	
20 X 6	41-406[NR]	$620.78	
24 X 6	41-407[NR]	$810.67	
10 X 8	41-408	$115.78	
12 X 8	41-409	$152.83	
14 X 8	41-410	$235.98	
16 X 8	41-411[NR]	$286.43	
18 X 8	41-412[NR]	$533.76	
20 X 8	41-413[NR]	$639.98	
24 X 8	41-414[NR]	$835.74	
12 X 10	41-415	$145.62	
14 X 10	41-416	$245.31	
16 X 10	41-417[NR]	$309.34	
18 X 10	41-418[NR]	$588.34	
20 X 10	41-419[NR]	$659.78	
24 X 10	41-420[NR]	$861.58	
14 X 12	41-421	$233.63	
16 X 12	41-422[NR]	$315.00	
18 X 12	41-423[NR]	$597.78	
20 X 12	41-424[NR]	$666.51	
24 X 12	41-425[NR]	$888.24	
16 X 14	41-426[NR]	$295.59	
18 X 14	41-427[NR]	$660.29	
20 X 14	41-428[NR]	$780.40	
24 X 14	41-429[NR]	$969.78	
18 X 16	41-430[NR]	$605.26	
20 X 16	41-431[NR]	$835.00	
24 X 16	41-432[NR]	$1,027.06	
20 X 18	41-433[NR]	$765.71	
24 X 18	41-434[NR]	$1,077.60	
24 X 20	41-435[NR]	$1,026.29	



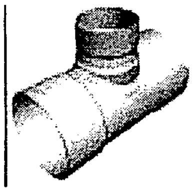
FLUSH REDUCER BUSHING

10 X 6		81-44	$163.72
10 X 8		81-45	$122.63
12 X 8		81-46	$189.16
12 X 10		81-47	$101.39
14 X 10		81-127	$227.21
14 X 12		81-49	$97.48
16 X 12		81-128NR	$203.83
16 X 14		81-50NR	$196.75



TEE - FULL OR REDUCING

Hub x Hub x Hub



8 X 4	41-92	$160.07	81-83	$210.62
8 X 6	41-93	$185.65	81-84	$231.69
8 X 8	41-94	$209.61	81-85	$254.86
10 X 4	41-95	$211.57	81-86	$327.57
10 X 6	41-96	$232.81	81-87	$370.45
10 X 8	41-97	$262.38	81-88	$415.59
10 X 10	41-98	$310.08	81-89	$494.78
12 X 4	41-99	$274.30	81-90	$435.63
12 X 6	41-100	$304.90	81-91	$463.37
12 X 8	41-101	$339.63	81-92	$516.08
12 X 10	41-102	$379.57	81-93	$573.47
12 X 12	41-103	$441.27	81-94	$698.74
14 X 4	41-104	$498.10	81-379	$646.28
14 X 6	41-105	$527.83	81-103	$697.67
14 X 8	41-106	$556.25	81-104	$788.55
14 X 10	41-107	$651.04	81-105	$822.15
14 X 12	41-108	$739.49	81-106	$868.35
14 X 14	41-109	$732.42	81-107	$1,214.41
16 X 4	41-110NR	$494.25	81-380NR	$778.05
16 X 6	41-111NR	$534.29	81-381NR	$855.86
16 X 8	41-112NR	$626.21	81-108NR	$883.05
16 X 10	41-113NR	$775.63	81-109NR	$926.08
16 X 12	41-114NR	$817.95	81-110NR	$1,020.57
16 X 14	41-115NR	$926.10	81-111NR	$1,122.63
16 X 16	41-116NR	$1,034.25	81-112NR	$1,579.10
18 X 4	41-140NR	$994.90	81-382NR	$1,381.44
18 X 6	41-141NR	$1,101.62	81-383NR	$1,530.27
18 X 8	41-117NR	$1,120.14	81-384NR	$1,555.63
18 X 10	41-118NR	$1,185.41	81-385NR	$1,646.04
18 X 12	41-119NR	$1,254.21	81-386NR	$1,741.95
18 X 14	41-120NR	$1,418.26	81-387NR	$1,970.17
18 X 16	41-121NR	$1,512.63	81-388NR	$2,101.37
18 X 18	41-122NR	$1,587.60	81-389NR	$2,205.00
20 X 4	41-142NR	$1,143.96		
20 X 6	41-143NR	$1,267.44		
20 X 8	41-144NR	$1,298.31		
20 X 10	41-145NR	$1,339.76		
20 X 12	41-146NR	$1,414.73		
20 X 14	41-147NR	$1,510.87		
20 X 16	41-148NR	$1,584.08		
20 X 18	41-241NR	$1,791.35		
20 X 20	41-224NR	$1,844.27		
24 X 4	41-149NR	$1,640.52		
24 X 6	41-150NR	$1,818.69		
24 X 8	41-151NR	$1,840.74		
24 X 10	41-152NR	$1,865.43		
24 X 12	41-153NR	$1,878.66		
24 X 14	41-154NR	$1,950.99		
24 X 16	41-155NR	$1,988.91		
24 X 18	41-238NR	$2,478.42		
24 X 20	41-239NR	$2,511.06		
24 X 24	41-227NR	$2,575.44		

Freedom-Flo™ PE-3408

Freedom Plastics' Freedom-Flo™ pressure rated High Density Polyethylene pipe is manufactured from the highest-grade virgin material. Our pipe has been tested and certified by NSF-International to meet or exceed all requirements of ASTM D2239, D2737 or D3035 (as applicable), and is certified for potable water. Freedom-Flo™ pressure pipe is the perfect choice for municipal, industrial and mining, and irrigation applications.

This high performance HDPE material has been developed to withstand the demanding requirements of pressure pipe applications, such as:

- Good long-term hoop strength performance
- Very high melt strength
- Outstanding toughness even at low temperatures

Property	ASTM	Measure English/SI
Density	D1505	0.944g/cm^3
Melt Index	D1238	0.11g/10min
ESCR, 100% Igepal (Cond. A,B&C)	D1693	>1,000 h
Tensile Strength @Yield (2" per min) @Break	D638	3,200psi (22Mpa) 5,000psi (34Mpa)
Ultimate Elongation (2" per min)	D638	>500%
Brittleness Temperature	D746	< -130°F (< -90°C)
Flexural Modulus	D3350 D790	110,000psi (760Mpa) 140,000psi (960Mpa)
Pipe Ring ESCR	F1248	>2,000 h
Hydrostatic Design Basis 73°F (23°C) 140°F (60°C)	D2837	1,600psi (11Mpa) 800psi (5.5Mpa)
Carbon Black	D1603	2.6%
Cell Classification	D3350	345464C

1/2"	100	10	1000	60
	400	7	2,800	58
3/4"	100	10	900	60
	400	4/5	1,600/2,000	58
	500	4	2,000	58
1"	100	10	1,000	60
	300	5	1,500	58
1-1/4"	100	6/7	600/700	56
	300	4	1,200	56
1-1/2"	100	6/7	600/700	24
	250	4	1,000	20
	300	4	900	20
2"	100	5	500	16
	200	3	600	16
	300	3	900	16

* Reflects CTS ASTM D2737 pallet specifications.

SIDR-19 80 PSI						
1"	1.049	0.060	9.3	80	100/300	$27.16
1-1/4"	1.380	0.073	14.8	80	100/300	$43.22
1-1/2"	1.610	0.100	23.1	80	100/250	$67.45
2"	2.067	0.109	32.4	80	100/200	$94.61
SIDR-15 100 PSI						
3/4"	0.824	0.060	7.4	100	100/400	$21.65
1"	1.049	0.070	10.9	100	100/300	$31.00
1-1/4"	1.380	0.092	18.7	100	100/300	$54.10
1-1/2"	1.610	0.107	25.1	100	100/250	$77.26
2"	2.067	0.138	41.6	100	100/200	$126.49
SIDR-11.5 125 PSI						
1/2"	0.622	0.060	5.7	125	100/400	$16.96
3/4"	0.824	0.072	9.0	125	100/400	$26.32
1"	1.049	0.091	14.3	125	100/300	$41.52
1-1/4"	1.380	0.120	24.6	125	100/300	$71.64
1-1/2"	1.610	0.140	33.5	125	100/250	$101.87
SIDR-9 160 PSI						
1/2"	0.622	0.069	6.6	160	100/400	$19.27
3/4"	0.824	0.092	11.6	160	100/400	$33.63
1"	1.049	0.117	18.6	160	100/300	$54.09
1-1/4"	1.380	0.153	32.0	160	100/300	$92.11
1-1/2"	1.610	0.179	43.0	160	100/250	$132.34
2"	2.067	0.230	71.0	160	100/200	$216.68
SIDR-7 200 PSI						
1/2"	0.622	0.089	8.7	200	100/400	$25.40
3/4"	0.824	0.118	15.2	200	100/400	$44.44
1"	1.049	0.150	24.6	200	100/300	$71.05
1-1/4"	1.380	0.197	42.4	200	100/300	$121.64
1-1/2"	1.610	0.230	57.8	200	100/250	$173.58
2"	2.067	0.295	95.2	200	100/200	$284.40

SDR-9	**200 PSI**						
3/4"	0.671	0.875	0.097	10.3	200	100/500	$30.12
1"	0.865	1.125	0.125	17.0	200	100/300	$49.12
1-1/4"	1.060	1.375	0.153	25.4	200	100/300	$73.10
1-1/2"	1.253	1.625	0.181	35.3	200	100/300	$107.72
2"	1.637	2.125	0.236	60.2	200	100/300	$183.74

Freedom-Flo™ may be joined by flared or compression type fittings specifically designed for CTS polyethylene.

SDR-11 160 PSI							
1-1/4"	1.358	1.660	0.151	32.0	160	100/300	$93.44
1-1/2"	1.554	1.900	0.173	42.0	160	100/250	$122.64
2"	1.943	2.375	0.216	64	160	100/200	$186.88

3" SDR-11 available upon request. Call for details

Pallet & Truckload Specifications

Freedom Plastics has a long-standing reputation for manufacturing the highest quality PVC pipe available today. Our fierce pride and dedication to quality did not come by accident. We understood not being the biggest meant we had to be the best. Our goal was simple: produce a product preferred and requested by the end user.

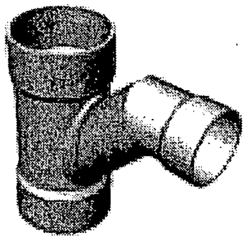
Today Freedom Plastics is ISO 9001 certified in both pipe producing plants, located in Wisconsin and Florida. From these plants we serve the Municipal, Plumbing, Industrial, Irrigation, Telecommunication, and Conduit markets. Utilizing state-of-the-art blending facilities we control the entire process, from powder to pipe.

	JANESVILLE, WI PLANT		FT. PIERCE, FL PLANT	
PIPE SIZE	FEET/PALLET	PALLETS/TRUCKLOAD	FEET/PALLET	PALLETS/TRUCKLOAD
4"	*840/1092	*24/18	**1140/988	**16/18
6"	*400/520	*24/18	**480/429	**16/18
8"	312	18	**240/182	**16/18
10"	156	18	156	18
12"	104	24	78	24
15"	78	18	78	18
18"	26 & 39	30	26 & 39	30
21"	26	24	NA	NA
24"	26	18	NA	NA

	JANESVILLE, WI PLANT		FT. PIERCE, FL PLANT	
PIPE SIZE	FEET/PALLET	PALLETS/TRUCKLOAD	FEET/PALLET	PALLETS/TRUCKLOAD
1/2"	9600	28	9600	28
3/4"	6000	28	6000	28
1"	4800	28	4800	28
1 1/4"	4800	28	4800	28
1 1/2"	2580	32	3360	28
2"	1760	32	1980	28
2 1/2"	1360	16	1360	16
3"	1620	16	1620	16
4"	1020	16	1020	16
5"	NA	-	660	16
6"	480	16	480	16
8"	280	16	240	16
10"	240	12	160	16
12"	120 & 160	12	120 & 160	12
14"	120	12	60	16
16"	60	20	40	20
18"	40 & 60	20	40 & 60	20
20"	40	16	NA	NA
24"	40	12	NA	NA

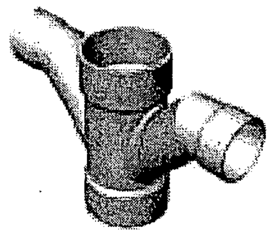
	JANESVILLE, WI PLANT		FT. PIERCE, FL PLANT	
PIPE SIZE	FEET/PALLET	PALLETS/TRUCKLOAD	FEET/PALLET	PALLETS/TRUCKLOAD
4"	860	16	860	16
6"	560	12	560	12
8"	200	20	200	20
10"	160	16	160	16
12"	120 & 160	12	120 & 160	12
16"	40 & 60	20	40 & 60	20

Schedule 40/80 DWV Fittings



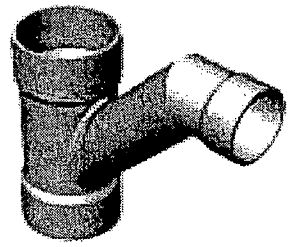
SANITARY TEE - WYE
Hub x Hub x Hub

6 x 4	40-397	$54.21		
6 x 6	40-665	$71.94		
8 X 4	40-398	$84.08	80-39[NR]	$153.32
8 X 6	40-399	$103.79	80-40[NR]	$170.73
8 X 8	40-400	$148.90	80-41[NR]	$378.34
10 X 4	40-401	$121.63	80-42[NR]	$190.08
10 X 6	40-402	$148.84	80-43[NR]	$240.76
10 X 8	40-403	$200.88	80-44[NR]	$493.76
10 X 10	40-404	$313.84	80-45[NR]	$654.46
12 X 4	40-405	$154.54	80-46[NR]	$304.12
12 X 6	40-406	$160.53	80-47[NR]	$340.54
12 X 8	40-407	$222.81	80-48[NR]	$597.42
12 X 10	40-408	$376.16	80-49[NR]	$748.73
12 X 12	40-409	$455.62	80-50[NR]	$943.70
14 X 4	40-410[NR]	$266.88	80-382[NR]	$469.17
14 X 6	40-411[NR]	$336.45	80-383[NR]	$550.41
14 X 8	40-412[NR]	$378.90	80-384[NR]	$763.38
14 X 10	40-413[NR]	$559.95	80-385[NR]	$929.52
14 X 12	40-414[NR]	$660.77	80-386[NR]	$1,093.12
14 X 14	40-415[NR]	$710.24	80-387[NR]	$1,357.50
16 X 4	40-416[NR]	$341.20	80-388[NR]	$600.30
16 X 6	40-417[NR]	$361.07	80-389[NR]	$635.16
16 X 8	40-418[NR]	$439.28	80-390[NR]	$919.61
16 X 10	40-419[NR]	$623.63	80-391[NR]	$1,094.68
16 X 12	40-420[NR]	$669.44	80-392[NR]	$1,273.27
16 X 14	40-421[NR]	$725.38	80-393[NR]	$1,633.40
16 X 16	40-422[NR]	$833.99	80-394[NR]	$1,821.12
18 X 4	40-423[NR]	$444.21	80-395[NR]	$963.81
18 X 6	40-424[NR]	$468.33	80-396[NR]	$1,016.18
18 X 8	40-425[NR]	$492.48	80-397[NR]	$1,068.57
18 X 10	40-426[NR]	$624.86	80-398[NR]	$1,175.43
18 X 12	40-427[NR]	$687.35	80-399[NR]	$1,292.97
18 X 14	40-428[NR]	$756.08	80-400[NR]	$1,422.27
18 X 16	40-429[NR]	$831.69	80-401[NR]	$1,564.50
18 X 18	40-528[NR]	$914.86	80-402[NR]	$1,720.95
20 X 4	40-430[NR]	$533.03		
20 X 6	40-431[NR]	$562.01		
20 X 8	40-432[NR]	$590.98		
20 X 10	40-433[NR]	$749.82		
20 X 12	40-434[NR]	$824.80		
20 X 14	40-435[NR]	$907.28		
20 X 16	40-436[NR]	$998.01		
20 X 18	40-437[NR]	$1,097.82		
20 X 20	40-579[NR]	$1,207.61		
24 X 4	40-580[NR]	$975.33		
24 X 6	40-581[NR]	$1,031.85		
24 X 8	40-582[NR]	$1,066.28		
24 X 10	40-583[NR]	$1,377.46		
24 X 12	40-584[NR]	$1,542.76		
24 X 14	40-585[NR]	$1,727.90		
24 X 16	40-586[NR]	$1,935.24		
24 X 18	40-587[NR]	$2,167.45		
24 X 20	40-588[NR]	$2,427.56		
24 X 24	40-589[NR]	$2,718.86		



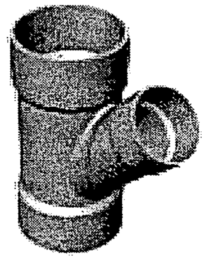
DOUBLE TEE - WYE
Hub x Hub x Hub x Hub

8 X 4	40-985[NR]	$124.19	80-582[NR]	$267.47
8 X 6	40-986[NR]	$153.29	80-583[NR]	$296.30
8 X 8	40-987[NR]	$219.92	80-584[NR]	$363.80
10 X 4	40-988[NR]	$179.64	80-585[NR]	$328.09
10 X 6	40-989[NR]	$219.82	80-586[NR]	$412.74
10 X 8	40-990[NR]	$296.70	80-587[NR]	$539.70
10 X 10	40-991[NR]	$419.40	80-588[NR]	$740.78
12 X 4	40-992[NR]	$228.23	80-589[NR]	$518.57
12 X 6	40-993[NR]	$237.10	80-590[NR]	$579.42
12 X 8	40-994[NR]	$329.08	80-591[NR]	$687.90
12 X 10	40-995[NR]	$502.68	80-592[NR]	$804.31
12 X 12	40-996[NR]	$608.87	80-593[NR]	$929.95
14 X 4	40-997[NR]	$394.14	80-594[NR]	$808.09
14 X 6	40-998[NR]	$496.99	80-595[NR]	$919.58
14 X 8	40-999[NR]	$559.57	80-596[NR]	$962.36
14 X 10	43-1[NR]	$748.28	80-597[NR]	$1,094.66
14 X 12	43-2[NR]	$883.02	80-598[NR]	$1,329.47
14 X 14	43-3[NR]	$949.13	80-599[NR]	$1,422.06
16 X 4	43-4[NR]	$503.93	80-600[NR]	$1,012.86
16 X 6	43-5[NR]	$533.26	80-601[NR]	$1,071.22
16 X 8	43-6[NR]	$648.76	80-602[NR]	$1,217.02
16 X 10	43-7[NR]	$833.39	80-603[NR]	$1,333.43
16 X 12	43-8[NR]	$894.61	80-604[NR]	$1,431.30
16 X 14	43-9[NR]	$969.36	80-605[NR]	$1,550.90
16 X 16	43-10[NR]	$1,114.49	80-606[NR]	$1,783.20
18 X 4	43-11[NR]	$656.03	80-607[NR]	$1,711.74
18 X 6	43-12[NR]	$691.67	80-608[NR]	$1,804.74
18 X 8	43-13[NR]	$727.32	80-609[NR]	$1,897.79
18 X 10	43-14[NR]	$823.14	80-610[NR]	$2,087.57
18 X 12	43-15[NR]	$918.53	80-611[NR]	$2,296.32
18 X 14	43-16[NR]	$1,010.38	80-612[NR]	$2,525.95
18 X 16	43-17[NR]	$1,111.42	80-613[NR]	$2,778.55
18 X 18	43-18[NR]	$1,222.56	80-614[NR]	$3,056.41
20 X 4	43-19[NR]	$787.22		
20 X 6	43-20[NR]	$830.00		
20 X 8	43-21[NR]	$872.78		
20 X 10	43-22[NR]	$1,002.02		
20 X 12	43-23[NR]	$1,102.22		
20 X 14	43-24[NR]	$1,212.44		
20 X 16	43-25[NR]	$1,333.69		
20 X 18	43-26[NR]	$1,467.06		
20 X 20	43-27[NR]	$1,613.77		
24 X 4	43-28[NR]	$1,440.55		
24 X 6	43-29[NR]	$1,523.88		
24 X 8	43-30[NR]	$1,574.72		
24 X 10	43-31[NR]	$1,840.76		
24 X 12	43-32[NR]	$2,061.66		
24 X 14	43-33[NR]	$2,309.05		
24 X 16	43-34[NR]	$2,586.13		
24 X 18	43-35[NR]	$2,896.48		
24 X 20	43-36[NR]	$3,244.04		
24 X 24	43-37[NR]	$3,633.34		



COMBO WYE
Hub x Hub x Hub

6 x 4	40-123	$56.72		
6 x 6	40-124	$78.48		
8 X 4	40-125	$71.30	80-27[NR]	$168.65
8 X 6	40-126	$103.41	80-28[NR]	$187.80
8 X 8	40-127	$125.15	80-29[NR]	$416.17
10 X 4	40-128	$109.31	80-30[NR]	$209.09
10 X 6	40-129	$137.41	80-31[NR]	$264.84
10 X 8	40-130	$171.11	80-32[NR]	$543.14
10 X 10	40-131	$241.37	80-33[NR]	$719.91
12 X 4	40-132	$169.97	80-34[NR]	$334.53
12 X 6	40-133	$176.57	80-35[NR]	$374.59
12 X 8	40-134	$215.29	80-36[NR]	$657.16
12 X 10	40-135	$289.31	80-37[NR]	$823.60
12 X 12	40-136	$350.42	80-38[NR]	$1,038.07
14 X 4	40-137[NR]	$290.70	80-340[NR]	$516.09
14 X 6	40-138[NR]	$330.76	80-341[NR]	$605.45
14 X 8	40-139[NR]	$363.93	80-342[NR]	$839.72
14 X 10	40-140[NR]	$430.65	80-343[NR]	$1,022.47
14 X 12	40-141[NR]	$508.21	80-344[NR]	$1,202.43
14 X 14	40-142[NR]	$546.27	80-345[NR]	$1,493.25
16 X 4	40-143[NR]	$378.61	80-346[NR]	$660.33
16 X 6	40-144[NR]	$385.32	80-347[NR]	$698.68
16 X 8	40-145[NR]	$423.93	80-348[NR]	$1,011.57
16 X 10	40-146[NR]	$479.66	80-349[NR]	$1,204.15
16 X 12	40-147[NR]	$514.88	80-350[NR]	$1,400.60
16 X 14	40-148[NR]	$557.92	80-351[NR]	$1,796.74
16 X 16	40-149[NR]	$641.44	80-352[NR]	$2,003.23
18 X 4	40-150[NR]	$488.61	80-353[NR]	$1,060.19
18 X 6	40-151[NR]	$515.20	80-354[NR]	$1,117.80
18 X 8	40-152[NR]	$541.73	80-355[NR]	$1,175.43
18 X 10	40-153[NR]	$687.35	80-356[NR]	$1,292.97
18 X 12	40-154[NR]	$756.09	80-357[NR]	$1,422.27
18 X 14	40-155[NR]	$831.69	80-358[NR]	$1,564.50
18 X 16	40-156[NR]	$914.86	80-359[NR]	$1,720.95
18 X 18	40-639[NR]	$1,006.35	80-360[NR]	$1,893.05
20 X 4	40-157[NR]	$586.31		
20 X 6	40-158[NR]	$618.20		
20 X 8	40-159[NR]	$650.05		
20 X 10	40-160[NR]	$824.80		
20 X 12	40-161[NR]	$907.28		
20 X 14	40-162[NR]	$998.01		
20 X 16	40-163[NR]	$1,097.81		
20 X 18	40-164[NR]	$1,207.60		
20 X 20	40-640[NR]	$1,328.37		
24 X 4	40-641[NR]	$1,072.93		
24 X 6	40-642[NR]	$1,135.01		
24 X 8	40-643[NR]	$1,172.85		
24 X 10	40-644[NR]	$1,515.21		
24 X 12	40-645[NR]	$1,697.04		
24 X 14	40-646[NR]	$1,900.69		
24 X 16	40-647[NR]	$2,128.76		
24 X 18	40-648[NR]	$2,384.20		
24 X 20	40-649[NR]	$2,670.32		
24 X 24	40-650[NR]	$2,990.75		



WYE - FULL OR REDUCING
Hub x Hub x Hub

6 x 4	40-480	$37.03		
6 x 6	40-481	$41.70		
8 X 4	40-482	$45.02	80-105[NR]	$94.57
8 X 6	40-483	$57.27	80-106[NR]	$126.72
8 X 8	40-484	$75.17	80-107[NR]	$156.41
10 X 4	40-485	$83.38	80-108[NR]	$172.64
10 X 6	40-486	$106.16	80-109[NR]	$202.73
10 X 8	40-487	$128.02	80-110[NR]	$237.59
10 X 10	40-488	$146.37	80-111[NR]	$279.17
12 X 4	40-489	$129.12	80-112[NR]	$278.77
12 X 6	40-490	$140.97	80-113[NR]	$304.12
12 X 8	40-491	$167.44	80-114[NR]	$337.92
12 X 10	40-492	$187.51	80-115[NR]	$397.02
12 X 12	40-493	$237.75	80-116[NR]	$422.38
14 X 4	40-494[NR]	$276.23	80-304[NR]	$443.78
14 X 6	40-495[NR]	$301.46	80-305[NR]	$486.08
14 X 8	40-496[NR]	$315.60	80-306[NR]	$538.53
14 X 10	40-497[NR]	$346.80	80-307[NR]	$562.30
14 X 12	40-498[NR]	$419.10	80-308[NR]	$595.96
14 X 14	40-499[NR]	$455.78	80-309[NR]	$641.49
16 X 4	40-500	$322.75	80-310[NR]	$530.69
16 X 6	40-501	$355.20	80-128[NR]	$571.16
16 X 8	40-502	$376.91	80-132[NR]	$601.88
16 X 10	40-503	$439.28	80-130[NR]	$658.91
16 X 12	40-504	$454.06	80-124[NR]	$728.61
16 X 14	40-505	$486.69	80-311[NR]	$785.63
16 X 16	40-506	$524.73	80-312[NR]	$833.16
18 X 4	40-507	$425.60	80-313[NR]	$923.43
18 X 6	40-508	$443.49	80-314[NR]	$962.27
18 X 8	40-509	$461.39	80-315[NR]	$1,001.11
18 X 10	40-510	$497.15	80-133[NR]	$1,078.70
18 X 12	40-511	$515.02	80-316[NR]	$1,117.46
18 X 14	40-512	$532.92	80-317[NR]	$1,156.30
18 X 16	40-513	$579.38	80-318[NR]	$1,257.15
18 X 18	40-514	$611.62	80-319[NR]	$1,326.97
20 X 4	40-515[NR]	$510.71		
20 X 6	40-516[NR]	$532.20		
20 X 8	40-517[NR]	$553.67		
20 X 10	40-518[NR]	$596.55		
20 X 12	40-519[NR]	$618.01		
20 X 14	40-520[NR]	$639.49		
20 X 16	40-521[NR]	$695.25		
20 X 18	40-522[NR]	$733.89		
20 X 20	40-533[NR]	$756.41		
24 X 4	40-572[NR]	$850.36		
24 X 6	40-542[NR]	$995.61		
24 X 8	40-573[NR]	$1,077.37		
24 X 10	40-543[NR]	$1,089.57		
24 X 12	40-574[NR]	$1,113.55		
24 X 14	40-575[NR]	$1,122.06		
24 X 16	40-576[NR]	$1,124.40		
24 X 18	40-577[NR]	$1,595.27		
24 X 20	40-578[NR]	$1,754.05		
24 X 24	40-534[NR]	$1,933.17		

Schedule 40/80 DWV Fittings

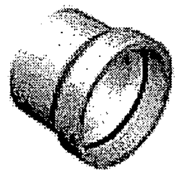
*ASTM F-1866 Tested and Certified...*Freedom Plastics' **Schedule 40** DWV fabricated fittings are third party tested and certified by NSF to meet or exceed all performance specifications of ASTM F-1866; the specification written and promoted by Freedom Plastics in an effort to promote and assure high quality manufacturing standards.

All **Schedule 40 and 80** fittings are fabricated from Schedule 40 and 80 Freedom pipe, which meets or exceeds all performance specifications of ASTM D-1785. The basic material used in the manufacture of the pipe conforms to ASTM D-1784 with a cell classification of 12454 B, Type 1, Grade 1.

Contact Customer Service for price and availability on items not listed.

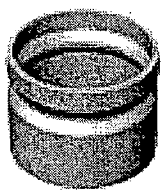
CAP
Hub x Cap

8	40-110	$36.01	80-120	$55.32
10	40-111	$52.11	80-25	$94.18
12	40-112	$65.92	80-26	$156.97
14	40-113	$109.94	80-554	$242.68
16	40-114	$140.78	80-556	$300.48
18	40-115	$162.81	80-557	$469.10
20	40-116	$356.69	—	—
24	40-535	$407.68	—	—



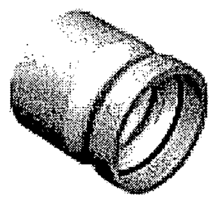
CLEANOUT ADAPTER
Spigot x Straight Thread

8	40-914	$108.80	80-521	$140.28
10	40-915	$190.84	80-522	$234.26
12	40-916	$273.79	80-523	$327.06
14	40-917NR	$287.48	80-524NR	$584.40
16	40-918NR	$380.23	80-525NR	$792.13
18	40-919NR	$577.93	80-526NR	$1,204.04
20	40-920NR	$720.61	—	—
24	40-921NR	$958.43	—	—



FEMALE ADAPTER
Hub x Female Iron Pipe Thread (FIPT)

8	40-930	$108.80	80-533	$154.31
10	40-931	$190.84	80-534	$257.69
12	40-932	$273.79	80-535	$359.77
14	40-933NR	$287.48	80-536NR	$642.84
16	40-934NR	$380.23	80-537NR	$871.34
18	40-935NR	$577.93	80-538NR	$1,324.44
20	40-936NR	$720.61	—	—
24	40-937NR	$958.43	—	—



CLEANOUT ADAPTER
Hub x Straight Thread

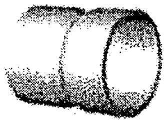
8	40-922	$114.24	80-527	$147.29
10	40-923	$200.38	80-528	$245.97
12	40-924	$287.48	80-529	$343.41
14	40-925NR	$301.85	80-530NR	$613.62
16	40-926NR	$399.24	80-531NR	$831.74
18	40-927NR	$606.83	80-532NR	$1,264.24
20	40-928NR	$756.64	—	—
24	40-929NR	$1,006.35	—	—

THREADED PLUG
Male Iron Pipe Thread (MIPT)

8	40-946	$31.46	80-545	$78.66
10	40-947	$43.43	80-546	$108.59
12	40-948	$53.27	80-547	$133.15
14	40-949NR	$70.13	80-548NR	$175.32
16	40-950NR	$95.05	80-549NR	$237.64
18	40-951NR	$144.49	80-550NR	$361.23
20	40-952NR	$192.17	—	—
24	40-953NR	$255.58	—	—

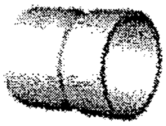
THREADED PLUG
Straight Male Thread

8	40-938	$31.46	80-539	$78.66
10	40-939	$43.43	80-540	$108.59
12	40-940	$53.27	80-541	$133.15
14	40-941NR	$70.13	80-542NR	$175.32
16	40-942NR	$95.05	80-543NR	$237.64
18	40-943NR	$144.49	80-544NR	$361.23
20	40-944NR	$192.17	—	—
24	40-945NR	$255.58	—	—



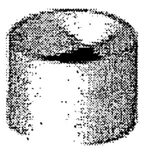
ADAPTER
IPS Hub x SWR Hub

6 x 4	40-85NR	$15.36	
6 x 6	40-87NR	$18.92	
8 x 8	40-91NR	$28.06	
10 x 10	40-96NR	$35.21	
12 x 12	40-101NR	$48.45	
14 x 15	40-105NR	$127.92	
16 x 15	40-106NR	$159.85	
18 x 18	40-954NR	$275.86	
20 x 21	40-955NR	$481.33	
24 x 24	40-956NR	$692.19	



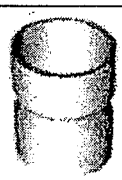
ADAPTER
IPS Hub x C900/C905 Hub

8 x 8	40-957NR	$109.71	
10 x 10	40-958NR	$162.54	
12 x 12	40-959NR	$207.06	
14 x 14	40-960NR	$309.55	
16 x 16	40-961NR	$386.94	
18 x 18	40-962NR	$618.07	
20 x 20	40-963NR	$773.83	
24 x 24	40-964NR	$996.84	



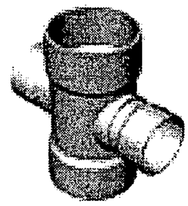
REPAIR COUPLING
Hub x Hub

6	40-309	$29.23	—	—
8	40-310	$37.58	80-497	$53.05
10	40-311	$51.58	80-498	$78.40
12	40-312	$82.08	80-499	$90.36
14	40-313	$93.75	80-500NR	$180.71
16	40-314	$104.55	80-501NR	$214.84
18	40-315	$171.41	80-502NR	$273.54
20	40-316	$257.48	—	—
24	40-607	$289.67	—	—



STOP COUPLING
Hub x Hub

6	40-526	$18.07	—	—
8	40-390	$22.51	80-90	$53.05
10	40-391	$35.68	80-91	$78.40
12	40-392	$60.81	80-92	$90.36
14	40-393	$93.75	80-143NR	$180.71
16	40-394	$104.55	80-503NR	$214.84
18	40-395	$171.41	80-121NR	$273.54
20	40-396	$257.48	—	—
24	40-537	$289.67	—	—

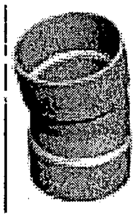


CROSS
Hub x Hub x Hub x Hub

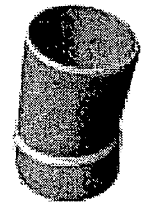
6 x 4	40-1	$32.85		
6 x 6	40-2	$44.12		
8 X 4	40-3	$54.55	80-1NR	$116.02
8 X 6	40-4	$73.50	80-2NR	$150.38
8 X 8	40-5	$97.61	80-3NR	$187.56
10 X 4	40-6	$119.52	80-4NR	$218.62
10 X 6	40-7	$125.13	80-5NR	$267.14
10 X 8	40-8	$170.80	80-6NR	$352.53
10 X 10	40-9	$203.37	80-7NR	$401.24
12 X 4	40-10	$130.12	80-8NR	$290.98
12 X 6	40-11	$152.63	80-9NR	$337.87
12 X 8	40-12	$177.32	80-10NR	$403.60
12 X 10	40-13	$220.55	80-11NR	$459.92
12 X 12	40-14	$239.61	80-12NR	$565.42
14 X 4	40-15NR	$327.71	80-361NR	$466.43
14 X 6	40-16NR	$368.64	80-362NR	$523.48
14 X 8	40-17NR	$414.12	80-363NR	$602.10
14 X 10	40-18NR	$423.78	80-364NR	$720.97
14 X 12	40-19NR	$448.29	80-365NR	$844.71
14 X 14	40-20NR	$471.90	80-366NR	$1,005.37
16 X 4	40-21NR	$392.15	80-367NR	$594.16
16 X 6	40-22NR	$448.93	80-368NR	$642.68
16 X 8	40-23NR	$525.88	80-369NR	$752.83
16 X 10	40-24NR	$610.43	80-370NR	$866.94
16 X 12	40-25NR	$643.58	80-371NR	$1,029.88
16 X 14	40-26NR	$675.05	80-372NR	$1,214.54
16 X 16	40-27NR	$698.58	80-373NR	$1,274.57
18 X 4	40-28NR	$483.59	80-374NR	$698.50
18 X 6	40-29NR	$507.68	80-375NR	$755.55
18 X 8	40-30NR	$555.01	80-376NR	$885.05
18 X 10	40-31NR	$574.92	80-377NR	$1,019.21
18 X 12	40-32NR	$597.94	80-378NR	$1,210.76
18 X 14	40-33NR	$610.29	80-379NR	$1,427.86
18 X 16	40-34NR	$635.06	80-380NR	$1,498.41
18 X 18	40-670NR	$666.32	80-381NR	$1,873.01
20 X 4	40-35NR	$525.32		
20 X 6	40-36NR	$567.79		
20 X 8	40-37NR	$606.42		
20 X 10	40-38NR	$637.32		
20 X 12	40-39NR	$666.30		
20 X 14	40-40NR	$710.72		
20 X 16	40-41NR	$751.26		
20 X 18	40-42NR	$799.56		
20 X 20	40-590NR	$846.49		
24 X 4	40-591NR	$978.84		
24 X 6	40-592NR	$1,207.11		
24 X 8	40-593NR	$1,239.30		
24 X 10	40-594NR	$1,253.13		
24 X 12	40-595NR	$1,280.58		
24 X 14	40-596NR	$1,290.39		
24 X 16	40-597NR	$1,293.18		
24 X 18	40-598NR	$1,780.63		
24 X 20	40-599NR	$2,088.89		
24 X 24	40-600NR	$2,487.56		

Schedule 40/80 DWV Fittings

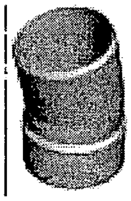
ELBOW - 11 1/4
Hub x Hub



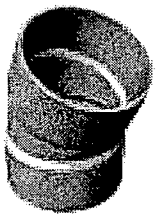
6	40-981	$32.90	—	—
8	40-182	$55.61	80-457	$91.57
10	40-189	$84.00	80-458	$162.34
12	40-196	$144.35	80-459	$237.25
14	40-890	$249.19	80-460[NR]	$363.22
16	40-668	$296.42	80-461[NR]	$485.51
18	40-662	$324.06	80-462[NR]	$675.79
20	40-539	$581.82	—	—
24	40-667	$865.73	—	—



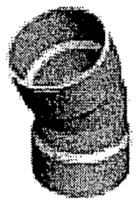
ELBOW - 11 1/4
Hub x Spigot



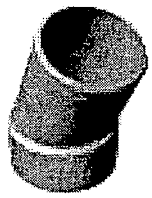
6	40-982	$32.13	—	—
8	40-891	$62.38	80-463	$91.57
10	40-892	$91.75	80-464	$162.34
12	40-893	$145.65	80-465	$237.25
14	40-894	$257.84	80-466[NR]	$363.22
16	40-895	$296.42	80-467[NR]	$485.51
18	40-896	$312.44	80-468[NR]	$675.79
20	40-897	$576.82	—	—
24	40-898	$843.24	—	—



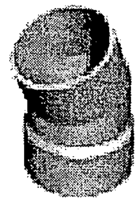
ELBOW - 22 1/2
Hub x Hub



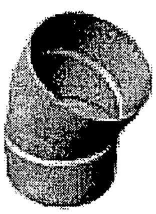
6	40-176	$30.74	—	—
8	40-183	$51.52	80-51	$91.57
10	40-190	$77.74	80-57	$162.34
12	40-197	$124.43	80-63	$237.25
14	40-204	$199.13	80-469[NR]	$363.22
16	40-210	$246.36	80-470[NR]	$485.51
18	40-216	$294.01	80-471[NR]	$675.79
20	40-222	$531.66	—	—
24	40-601	$765.44	—	—



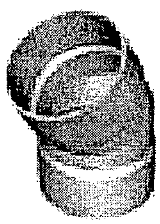
ELBOW - 22 1/2
Hub x Spigot



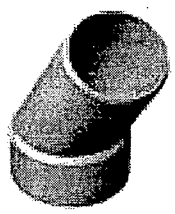
6	40-177	$29.81	—	—
8	40-184	$57.72	80-52	$91.57
10	40-191	$84.31	80-58	$162.34
12	40-198	$116.43	80-64	$237.25
14	40-205	$227.78	80-472[NR]	$363.22
16	40-211	$246.36	80-473[NR]	$485.51
18	40-217	$294.01	80-474[NR]	$675.79
20	40-223	$531.66	—	—
24	40-604	$765.44	—	—



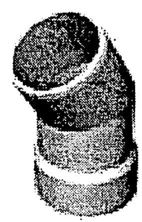
ELBOW - 30
Hub x Hub



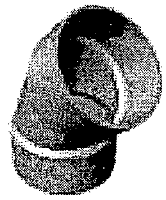
6	40-983	$33.97	—	—
8	40-899	$56.93	80-475	$83.96
10	40-900	$85.90	80-476	$153.82
12	40-901	$137.50	80-477	$219.91
14	40-902	$220.04	80-478[NR]	$316.02
16	40-903	$272.23	80-479[NR]	$409.23
18	40-904	$324.88	80-480[NR]	$563.16
20	40-905	$587.49	—	—
24	40-906	$845.81	—	—



ELBOW - 30
Hub x Spigot

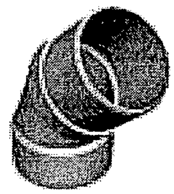


6	40-984	$32.94	—	—
8	40-907	$63.78	80-481	$83.96
10	40-908	$93.16	80-482	$153.82
12	40-199	$128.66	80-483	$219.91
14	40-909	$251.70	80-484[NR]	$316.02
16	40-910	$272.23	80-485[NR]	$409.23
18	40-911	$324.88	80-486[NR]	$563.16
20	40-912	$587.49	—	—
24	40-913	$845.81	—	—



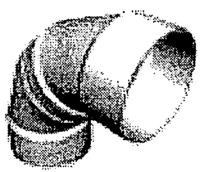
ELBOW - 45
Hub x Hub

6	40-178	$29.51	—	—
8	40-185	$45.15	80-53	$83.97
10	40-192	$81.19	80-59	$153.82
12	40-200	$111.71	80-65	$219.91
14	40-206	$227.78	80-487NR	$316.02
16	40-212	$246.38	80-127NR	$409.23
18	40-218	$335.49	80-488NR	$569.62
20	40-224	$514.62	—	—
24	40-602	$739.35	—	—

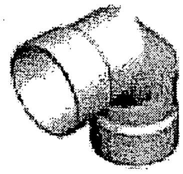


ELBOW - 45
Hub x Spigot

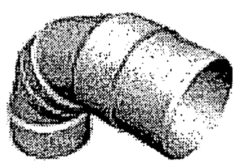
6	40-179	$29.51	—	—
8	40-186	$45.16	80-54	$83.97
10	40-193	$81.27	80-60	$153.82
12	40-201	$124.48	80-66	$219.91
14	40-207	$222.38	80-489NR	$316.02
16	40-213	$246.38	80-490NR	$409.23
18	40-219	$331.85	80-491NR	$569.62
20	40-225	$514.62	—	—
24	40-605	$739.35	—	—



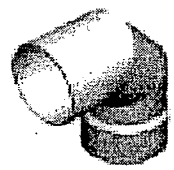
ELBOW - 90
Hub x Hub



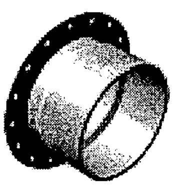
6	40-180	$47.24	—	—
8	40-187	$49.23	80-55	$129.00
10	40-194	$96.73	80-61	$220.22
12	40-202	$149.01	80-67	$321.14
14	40-208	$241.41	80-142NR	$472.48
16	40-214	$361.99	80-492NR	$587.63
18	40-220	$448.05	80-493NR	$817.96
20	40-226	$650.92	—	—
24	40-603	$901.47	—	—



ELBOW - 90
Hub x Spigot

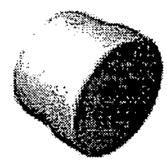


6	40-181	$46.72	—	—
8	40-188	$48.73	80-56	$129.00
10	40-195	$96.84	80-62	$220.22
12	40-203	$149.03	80-68	$321.14
14	40-209	$241.41	80-494NR	$472.48
16	40-215	$357.67	80-495NR	$587.63
18	40-221	$445.26	80-496NR	$817.96
20	40-227	$650.92	—	—
24	40-606	$901.47	—	—



FLANGE - VAN STONE STYLE
Flange x Hub

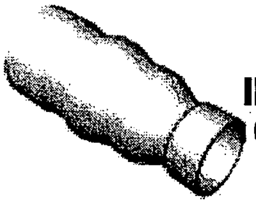
8	—	—	80-570NR	$65.44
10	—	—	80-571NR	$102.94
12	—	—	80-572NR	$110.99
14	40-968NR	$589.74	80-573NR	$589.74
16	40-969NR	$776.75	80-574NR	$776.75
18	40-970NR	$810.91	80-575NR	$810.91
20	40-971NR	$1,018.16	—	—
24	40-972NR	$1,449.01	—	—



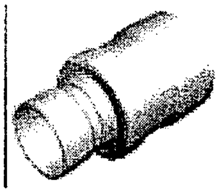
PLUG
Cap x Spigot

6	40-301	$23.17	—	—
8	40-302	$38.94	80-87	$76.95
10	40-303	$51.75	80-88	$102.67
12	40-304	$64.87	80-89	$128.26
14	40-305NR	$125.17	80-551NR	$219.98
16	40-306NR	$157.04	80-552NR	$269.89
18	40-307NR	$180.98	80-553NR	$319.78
20	40-308NR	$293.10	—	—
24	40-626NR	$440.78	—	—

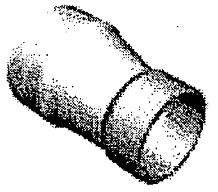
Schedule 40/80 DWV Fittings



INCREASER COUPLING
Hub x Hub

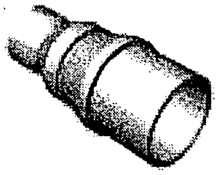


4 X 6	40-228	$17.55		
4 X 8	40-229	$43.40	80-69[NR]	$86.34
4 X 10	40-230	$57.25	80-70[NR]	$167.38
4 X 12	40-231	$63.99	80-71[NR]	$178.30
4 X 14	40-232	$124.73	80-200[NR]	$225.10
4 X 16	40-233	$148.82	80-201[NR]	$267.12
4 X 18	40-234	$266.46	80-203[NR]	$395.33
4 X 20	40-235[NR]	$319.75		
4 X 24	40-546[NR]	$584.42		
6 X 8	40-236	$37.34	80-72[NR]	$79.46
6 X 10	40-237	$91.20	80-73[NR]	$193.22
6 X 12	40-238	$101.45	80-74[NR]	$198.11
6 X 14	40-239	$126.49	80-204[NR]	$250.12
6 X 16	40-240	$153.45	80-205[NR]	$281.17
6 X 18	40-241	$280.75	80-206[NR]	$416.14
6 X 20	40-242[NR]	$336.89		
6 X 24	40-547[NR]	$588.18		
8 X 10	40-243	$60.87	80-75[NR]	$86.50
8 X 12	40-244	$93.03	80-76[NR]	$208.54
8 X 14	40-245	$142.51	80-207[NR]	$277.90
8 X 16	40-246	$176.77	80-208[NR]	$295.97
8 X 18	40-247	$302.36	80-209[NR]	$438.05
8 X 20	40-248[NR]	$346.03		
8 X 24	40-548[NR]	$594.90		
10 X 12	40-249	$101.22	80-77[NR]	$128.09
10 X 14	40-250	$189.07	80-210[NR]	$292.52
10 X 16	40-251	$198.56	80-211[NR]	$311.54
10 X 18	40-252	$323.69	80-212[NR]	$461.09
10 X 20	40-253[NR]	$354.07		
10 X 24	40-549[NR]	$603.53		
12 X 14	40-254	$167.91	80-213[NR]	$187.01
12 X 16	40-255	$197.58	80-214[NR]	$327.94
12 X 18	40-256	$329.02	80-215[NR]	$485.35
12 X 20	40-257[NR]	$358.89		
12 X 24	40-550[NR]	$613.17		
14 X 16	40-258[NR]	$201.55	80-216[NR]	$276.48
14 X 18	40-259[NR]	$357.66	80-217[NR]	$718.32
14 X 20	40-260[NR]	$363.73		
14 X 24	40-551[NR]	$634.19		
16 X 18	40-261[NR]	$241.41	80-218[NR]	$628.58
16 X 20	40-262[NR]	$368.55		
16 X 24	40-552[NR]	$643.77		
18 X 20	40-263[NR]	$412.19		
18 X 24	40-538[NR]	$665.84		
20 X 24	40-553[NR]	$778.79		



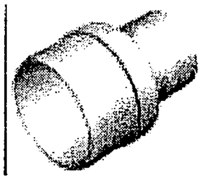
INCREASER COUPLING - ECCENTRIC
Hub x Hub

4 X 6	40-800	$18.95		
4 X 8	40-801	$46.87	80-230[NR]	$93.25
4 X 10	40-802	$61.83	80-231[NR]	$180.77
4 X 12	40-803	$69.11	80-232[NR]	$192.56
4 X 14	40-804	$134.71	80-233[NR]	$243.11
4 X 16	40-805	$160.72	80-234[NR]	$288.49
4 X 18	40-806	$287.78	80-235[NR]	$426.96
4 X 20	40-807[NR]	$345.33		
4 X 24	40-808[NR]	$631.17		
6 X 8	40-809	$40.33	80-236[NR]	$85.82
6 X 10	40-810	$98.50	80-237[NR]	$208.68
6 X 12	40-811	$109.57	80-238[NR]	$213.96
6 X 14	40-812	$136.60	80-239[NR]	$270.13
6 X 16	40-813	$165.73	80-240[NR]	$303.66
6 X 18	40-814	$303.21	80-241[NR]	$449.43
6 X 20	40-815[NR]	$363.84		
6 X 24	40-816[NR]	$635.23		
8 X 10	40-817	$65.74	80-242[NR]	$93.42
8 X 12	40-818	$100.47	80-243[NR]	$225.22
8 X 14	40-819	$153.91	80-244[NR]	$300.13
8 X 16	40-820	$190.92	80-245[NR]	$319.65
8 X 18	40-821	$326.55	80-246[NR]	$473.09
8 X 20	40-822[NR]	$373.72		
8 X 24	40-823[NR]	$642.49		
10 X 12	40-824	$109.32	80-247[NR]	$138.34
10 X 14	40-825	$204.20	80-248[NR]	$315.92
10 X 16	40-826	$214.44	80-249[NR]	$336.46
10 X 18	40-827	$349.59	80-250[NR]	$497.98
10 X 20	40-828[NR]	$382.39		
10 X 24	40-829[NR]	$651.81		
12 X 14	40-830	$181.34	80-251[NR]	$201.97
12 X 16	40-831	$213.38	80-252[NR]	$354.18
12 X 18	40-832	$355.34	80-253[NR]	$524.18
12 X 20	40-833[NR]	$387.60		
12 X 24	40-834[NR]	$662.22		
14 X 16	40-835[NR]	$217.68	80-254[NR]	$298.60
14 X 18	40-836[NR]	$386.27	80-255[NR]	$775.79
14 X 20	40-837[NR]	$392.83		
14 X 24	40-838[NR]	$684.93		
16 X 18	40-839[NR]	$260.72	80-256[NR]	$678.87
16 X 20	40-840[NR]	$398.04		
16 X 24	40-841[NR]	$695.27		
18 X 20	40-842[NR]	$445.17		
18 X 24	40-843[NR]	$719.11		
20 X 24	40-844[NR]	$841.09		

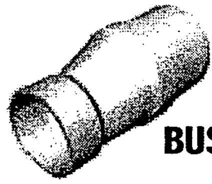


REDUCER BUSHING

Spigot x Hub



6 X 4	40-264	$23.24		
8 X 4	40-265	$43.37	80-78NR	$86.34
10 X 4	40-266	$46.73	80-79NR	$167.38
12 X 4	40-267	$81.05	80-80NR	$178.30
14 X 4	40-268	$124.72	80-137NR	$225.10
16 X 4	40-269	$148.82	80-219NR	$267.12
18 X 4	40-270	$185.08	80-220NR	$395.33
20 X 4	40-271NR	$289.70		
24 X 4	40-554NR	$535.98		
8 X 6	40-272	$42.37	80-81NR	$79.46
10 X 6	40-273	$68.04	80-82NR	$193.22
12 X 6	40-274	$101.09	80-83NR	$198.11
14 X 6	40-275	$126.27	80-221NR	$250.12
16 X 6	40-276	$153.23	80-131NR	$281.17
18 X 6	40-277	$189.11	80-222NR	$416.14
20 X 6	40-278NR	$296.13		
24 X 6	40-555NR	$547.04		
10 X 8	40-279	$75.35	80-84NR	$128.02
12 X 8	40-280	$105.01	80-85NR	$208.54
14 X 8	40-281	$142.51	80-223NR	$277.90
16 X 8	40-282	$176.77	80-136NR	$295.97
18 X 8	40-283	$193.13	80-224NR	$438.05
20 X 8	40-284NR	$302.56		
24 X 8	40-556NR	$554.69		
12 X 10	40-285	$106.20	80-86NR	$169.16
14 X 10	40-286	$159.78	80-138NR	$292.52
16 X 10	40-287	$198.56	80-135NR	$311.54
18 X 10	40-288	$201.17	80-225NR	$461.09
20 X 10	40-289NR	$309.01		
24 X 10	40-541NR	$562.93		
14 X 12	40-290	$173.20	80-226NR	$255.80
16 X 12	40-291	$200.69	80-125NR	$327.94
18 X 12	40-292	$210.84	80-227NR	$485.35
20 X 12	40-293NR	$315.46		
24 X 12	40-557NR	$574.75		
16 X 14	40-294NR	$208.18	80-228NR	$307.44
18 X 14	40-295NR	$222.09	80-229NR	$718.32
20 X 14	40-296NR	$321.86		
24 X 14	40-558NR	$592.97		
18 X 16	40-297NR	$233.36	80-134NR	$628.58
20 X 16	40-298NR	$302.56		
24 X 16	40-559NR	$608.30		
20 X 18	40-299NR	$328.31		
24 X 18	40-560NR	$624.65		
24 X 20	40-561NR	$729.19		

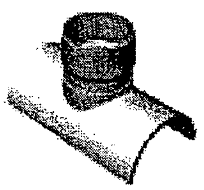


REDUCER BUSHING - ECCENTRIC

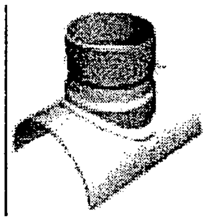
Spigot x Hub

6 X 4	40-845	$25.10	80-257NR	—
8 X 4	40-846	$46.84	80-258NR	$93.25
10 X 4	40-847	$50.47	80-259NR	$180.77
12 X 4	40-848	$87.53	80-260NR	$192.56
14 X 4	40-849	$134.70	80-261NR	$243.11
16 X 4	40-850	$160.72	80-262NR	$288.49
18 X 4	40-851	$199.89	80-263NR	$426.96
20 X 4	40-852NR	$312.87		
24 X 4	40-853NR	$578.86		
8 X 6	40-854	$45.76	80-264NR	$85.82
10 X 6	40-855	$73.48	80-265NR	$208.68
12 X 6	40-856	$109.18	80-266NR	$213.96
14 X 6	40-857	$136.38	80-267NR	$270.13
16 X 6	40-858	$165.48	80-268NR	$303.66
18 X 6	40-859	$204.24	80-269NR	$449.43
20 X 6	40-860NR	$319.82		
24 X 6	40-861NR	$590.81		
10 X 8	40-862	$81.38	80-270NR	$138.26
12 X 8	40-863	$113.41	80-271NR	$225.22
14 X 8	40-864	$153.91	80-272NR	$300.13
16 X 8	40-865	$190.92	80-273NR	$319.65
18 X 8	40-866	$208.58	80-274NR	$473.09
20 X 8	40-867NR	$326.77		
24 X 8	40-868NR	$599.07		
12 X 10	40-869	$114.70	80-275NR	$182.69
14 X 10	40-870	$172.57	80-276NR	$315.92
16 X 10	40-871	$214.44	80-277NR	$336.46
18 X 10	40-872	$217.26	80-278NR	$497.98
20 X 10	40-873NR	$333.73		
24 X 10	40-874NR	$607.96		
14 X 12	40-875	$187.05	80-279NR	$276.26
16 X 12	40-876	$216.75	80-280NR	$354.18
18 X 12	40-877	$227.71	80-281NR	$524.18
20 X 12	40-878NR	$340.69		
24 X 12	40-879NR	$620.73		
16 X 14	40-880NR	$224.84	80-282NR	$332.04
18 X 14	40-881NR	$239.86	80-283NR	$775.79
20 X 14	40-882NR	$347.61		
24 X 14	40-883NR	$640.41		
18 X 16	40-884NR	$252.03	80-284NR	$678.87
20 X 16	40-885NR	$326.77		
24 X 16	40-886NR	$656.97		
20 X 18	40-887NR	$354.58		
24 X 18	40-888NR	$674.62		
24 X 20	40-889NR	$787.53		

Schedule 40/80 DWV Fittings

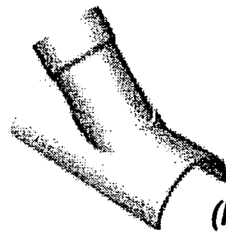


SADDLE TEE
Saddle x Hub



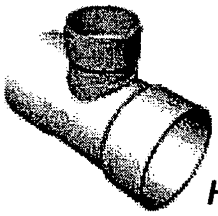
(Includes Stainless Steel Straps)

6 x 4	40-317	$20.28
8 X 4	40-318	$28.65
8 X 6	40-319	$29.51
10 X 4	40-320	$32.84
10 X 6	40-321	$38.25
10 X 8	40-322	$61.65
12 X 4	40-323	$39.63
12 X 6	40-324	$46.04
12 X 8	40-325	$72.77
12 X 10	40-326	$95.08
14 X 4	40-327	$44.19
14 X 6	40-328	$50.35
14 X 8	40-329	$77.02
14 X 10	40-330	$99.35
14 X 12	40-331	$106.63
16 X 4	40-332	$47.11
16 X 6	40-333	$53.72
16 X 8	40-334	$80.36
16 X 10	40-335	$102.49
16 X 12	40-336	$113.87
16 X 14	40-337	$118.21
18 X 4	40-338	$69.94
18 X 6	40-339	$74.01
18 X 8	40-340	$108.51
18 X 10	40-341	$120.39
18 X 12	40-342	$172.12
18 X 14	40-343	$187.91
18 X 16	40-344	$246.01
20 X 4	40-345[NR]	$71.74
20 X 6	40-346[NR]	$75.31
20 X 8	40-347[NR]	$108.53
20 X 10	40-348[NR]	$120.37
20 X 12	40-349[NR]	$172.12
20 X 14	40-350[NR]	$187.91
20 X 16	40-351[NR]	$246.03
20 X 18	40-352[NR]	$279.04
24 X 4	40-608[NR]	$73.11
24 X 6	40-609[NR]	$76.68
24 X 8	40-610[NR]	$109.90
24 X 10	40-611[NR]	$121.77
24 X 12	40-612[NR]	$172.95
24 X 14	40-613[NR]	$189.27
24 X 16	40-614[NR]	$259.41
24 X 18	40-615[NR]	$293.15
24 X 20	40-616[NR]	$330.01



SADDLE WYE
Saddle x Hub
(Includes Stainless Steel Straps)

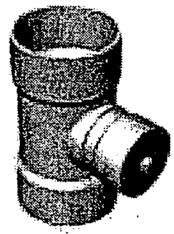
6 x 4	40-353	$20.28
8 X 4	40-354	$28.65
8 X 6	40-355	$29.51
10 X 4	40-356	$32.84
10 X 6	40-357	$38.25
10 X 8	40-358	$85.96
12 X 4	40-359	$39.63
12 X 6	40-360	$46.04
12 X 8	40-361	$121.06
12 X 10	40-362	$144.95
14 X 4	40-363	$44.19
14 X 6	40-364	$50.35
14 X 8	40-365	$123.92
14 X 10	40-366	$147.82
14 X 12	40-367	$150.61
16 X 4	40-368	$47.11
16 X 6	40-369	$53.72
16 X 8	40-370	$126.74
16 X 10	40-371	$150.61
16 X 12	40-372	$153.45
16 X 14	40-373	$156.31
18 X 4	40-374	$70.65
18 X 6	40-375	$74.63
18 X 8	40-376	$165.57
18 X 10	40-377	$184.72
18 X 12	40-378	$221.55
18 X 14	40-379	$237.93
18 X 16	40-380	$264.03
20 X 4	40-381[NR]	$72.26
20 X 6	40-382[NR]	$78.84
20 X 8	40-383[NR]	$165.53
20 X 10	40-384[NR]	$184.72
20 X 12	40-385[NR]	$221.55
20 X 14	40-386[NR]	$237.92
20 X 16	40-387[NR]	$264.03
20 X 18	40-388[NR]	$279.04
24 X 4	40-617[NR]	$73.67
24 X 6	40-618[NR]	$80.21
24 X 8	40-619[NR]	$166.95
24 X 10	40-620[NR]	$186.21
24 X 12	40-621[NR]	$222.95
24 X 14	40-622[NR]	$239.35
24 X 16	40-623[NR]	$268.67
24 X 18	40-624[NR]	$293.15
24 X 20	40-625[NR]	$330.01



TEE - FULL OR REDUCING

Hub x Hub x Hub

6 x 4	40-438	$34.53		
6 x 6	40-439	$36.41		
8 X 4	40-440	$41.02	80-93[NR]	$66.46
8 X 6	40-441	$53.00	80-94[NR]	$112.79
8 X 8	40-442	$66.30	80-95[NR]	$182.53
10 X 4	40-443	$75.88	80-96[NR]	$163.98
10 X 6	40-444	$93.35	80-97[NR]	$200.38
10 X 8	40-445	$104.74	80-98[NR]	$268.62
10 X 10	40-446	$118.18	80-99[NR]	$300.94
12 X 4	40-447	$102.59	80-100[NR]	$218.22
12 X 6	40-448	$117.15	80-101[NR]	$253.90
12 X 8	40-449	$134.03	80-102[NR]	$302.70
12 X 10	40-450	$159.85	80-103[NR]	$344.94
12 X 12	40-451	$196.51	80-104[NR]	$424.06
14 X 4	40-452[NR]	$232.99	80-285[NR]	$359.38
14 X 6	40-453[NR]	$265.43	80-286[NR]	$421.73
14 X 8	40-454[NR]	$279.59	80-144[NR]	$505.28
14 X 10	40-455[NR]	$320.67	80-287[NR]	$608.72
14 X 12	40-456[NR]	$383.03	80-288[NR]	$613.88
14 X 14	40-457[NR]	$419.72	80-139[NR]	$630.90
16 X 4	40-458	$286.68	80-289[NR]	$445.62
16 X 6	40-459	$319.14	80-290[NR]	$482.02
16 X 8	40-460	$340.84	80-291[NR]	$564.63
16 X 10	40-461	$403.25	80-292[NR]	$709.34
16 X 12	40-462	$418.02	80-293[NR]	$801.43
16 X 14	40-463	$450.71	80-294[NR]	$828.72
16 X 16	40-464	$488.94	80-295[NR]	$989.66
18 X 4	40-465	$389.84	80-296[NR]	$620.28
18 X 6	40-466	$416.68	80-297[NR]	$670.84
18 X 8	40-467	$434.55	80-298[NR]	$785.75
18 X 10	40-468	$452.44	80-299[NR]	$887.68
18 X 12	40-469	$456.00	80-300[NR]	$989.42
18 X 14	40-470	$470.31	80-301[NR]	$1,020.44
18 X 16	40-471	$487.57	80-302[NR]	$1,275.55
18 X 18	40-540	$623.29	80-303[NR]	$1,451.29
20 X 4	40-472[NR]	$467.79		
20 X 6	40-473[NR]	$499.95		
20 X 8	40-474[NR]	$521.45		
20 X 10	40-475[NR]	$542.93		
20 X 12	40-476[NR]	$547.20		
20 X 14	40-477[NR]	$564.36		
20 X 16	40-478[NR]	$585.08		
20 X 18	40-479[NR]	$747.92		
20 X 20	40-562[NR]	$774.00		
24 X 4	40-563[NR]	$851.16		
24 X 6	40-564[NR]	$1,049.66		
24 X 8	40-565[NR]	$1,077.65		
24 X 10	40-566[NR]	$1,089.68		
24 X 12	40-567[NR]	$1,113.55		
24 X 14	40-568[NR]	$1,122.08		
24 X 16	40-569[NR]	$1,124.50		
24 X 18	40-570[NR]	$1,548.37		
24 X 20	40-571[NR]	$1,816.43		
24 X 24	40-536[NR]	$2,163.09		



CLEAN-OUT TEE WITH PLUG

Hub x Hub x Plug (MIPT)

6 x 4	40-165	$36.51	
6 x 6	40-166	$58.22	
8 X 4	40-651	$54.00	
8 X 6	40-167	$79.34	
8 X 8	40-168	$122.87	
10 X 4	40-652	$128.92	
10 X 6	40-169	$175.01	
10 X 8	40-653	$272.11	
12 X 4	40-654	$166.75	
12 X 6	40-171	$214.22	
12 X 8	40-655	$298.21	
14 X 4	40-656[NR]	$292.15	
14 X 6	40-173[NR]	$350.31	
14 X 8	40-657[NR]	$437.95	
16 X 4	40-174[NR]	$325.97	
16 X 6	40-175[NR]	$390.28	
16 X 8	40-658[NR]	$480.34	

Freedom Plastics Manufactured PVC Pipe

PSM	SDR35	O.D.									4.215	6.275	8.400	10.500	12.500		15.300		18.701		22.047	24.803
	ASTM D3034	WALL									0.120	0.180	0.240	0.300	0.360		0.437		0.536		0.632	0.711
	& F679 Sewer	PSI									-	-	-	-	-							-
	SDR26	O.D.									4.215	6.275	8.400	10.500	12.500		15.300		18.701		22.047	
	ASTM D3034	WALL									0.162	0.241	0.323	0.404	0.481		0.588		0.719		0.848	
	HW Sewer	PSI										-		-								
IPS	CL100	O.D.								3.500	4.500	6.625	8.625	10.750	12.750							
	SDR41	WALL								0.085	0.110	0.162	0.210	0.262	0.311							
		PSI								100	100	100	100	100	100							
	CL125	O.D.							2.875	3.500	4.500	6.625	8.625	10.750	12.750							
	SDR32.5	WALL							0.088	0.108	0.138	0.204	0.265	0.331	0.392							
		PSI							125	125	125	125	125	125	125							
	CL160	O.D				1.660	1.900	2.375	2.875	3.500	4.500	6.625	8.625	10.750	12.750							
	SDR26	WALL				0.064	0.073	0.091	0.110	0.135	0.173	0.255	0.332	0.413	0.490							
		PSI				160	160	160	160	160	160	160	160	160	160							
	CL200	O.D.		1.050	1.315	1.660	1.900	2.375	2.875	3.500	4.500	6.625	8.625	10.750	12.750							
	SDR21	WALL		0.060	0.063	0.079	0.090	0.113	0.137	0.167	0.214	0.316	0.410	0.511	0.606							
		PSI		200	200	200	200	200	200	200	200	200	200	200	200							
	CL315	O.D	0.840																			
	SDR13.5	WALL	0.062																			
		PSI	315																			
	SCH 40	O.D.	0.840	1.050	1.315	1.660	1.900	2.375	2.875	3.500	4.500	6.625	8.625	10.750	12.750	14.000		16.000	18.000	20.000		24.000
	(Dual-Rated	WALL	0.109	0.113	0.133	0.140	0.145	0.154	0.203	0.216	0.237	0.280	0.322	0.365	0.406	0.437		0.500	0.562	0.593		0.687
	1-1/4"-12")	PSI	600	480	450	370	330	280	300	260	220	180	160	140	130	130		130	130	120		120
		O.D.	0.840	1.050	1.315	1.660	1.900	2.375	2.875	3.500	4.500	6.625	8.625	10.750	12.750							
	SCH 80	WALL	0.147	0.154	0.179	0.191	0.200	0.218	0.276	0.300	0.337	0.432	0.500	0.593	0.687							
		PSI	850	690	630	520	470	400	420	370	320	280	250	230	230							
	ASTM F891	O.D.					1.900	2.375		3 500	4.500	6.625										
	COEX-FOAM	WALL					0.145	0.154		0.216	0.237	0.280										
	CORE	PSI						-				-										
CIOD	C900	O.D.										6.900	9.060	11 100	13.200							
	DR14	WALL										0 493	0.646	0.793	0.943							
		PSI										200	200	200	200							
	C900	O.D.									4.800	6.900	9.060	11.100	13.200							
	DR18	WALL									0.267	0.383	0.503	0.617	0.733							
		PSI									150	150	150	150	150							
	C905	O.D.																17 400				
	DR18	WALL																0.967				
		PSI																235				
	C905	O.D.																17 400				
	DR25	WALL																0.696				
		PSI																165				

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Fort Pierce, FL 34982
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WEST PLANT
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Preston, Idaho 83263
TEL: 800-635-2790
FAX: 208-852-3020

ISO 9001 CERTIFIED

E-mail:
custsvc@freedomplastics.com
www.freedomplastics.com

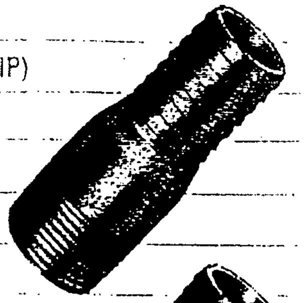
03/02

STEEL INSERT FITTINGS

(ZINC PLATED) FOR FLEXIBLE (POLYETHYLENE) PLASTIC PIPE

STEEL MALE ADAPTERS

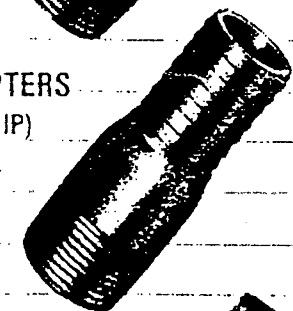
- Plastic Pipe to Male Iron Pipe (MIP)



STEEL ORDER NO.	INSERT SIZE X MIP SIZE	STEEL PCS./ CTN.	STEEL LBS./ CTN.
SMA50	½" x ½"	25	3.8
SMA75	¾" x ¾"	25	5.5
SMA100	1" x 1"	20	9.0
SMA125	1¼" x 1¼"	20	10.4
SMA150	1½" x 1½"	10	6.8
SMA200	2" x 2"	10	9.4
SMA300	3" x 3"	..	..

STEEL REDUCING MALE ADAPTERS

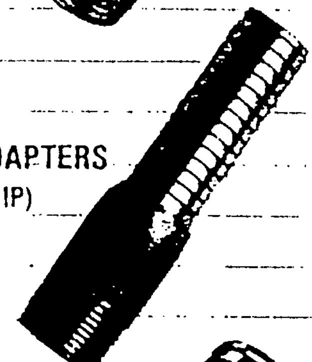
- Plastic Pipe to Male Iron Pipe (MIP)



STEEL ORDER NO.	INSERT SIZE X MIP SIZE	STEEL PCS./ CTN.	STEEL LBS./ CTN.
SMA7550	¾" x ½"	10	2.6
SMA1075	1" x ¾"	10	3.7
SMA2510	1¼" x 1"	10	6.0
SMA15012	1½" x 1¼"	10	7.6
SMA5075	½" x ¾"	10	2.6
SMA7510	¾" x 1"	10	3.8
SMA10125	1" x 1¼"	10	5.6
SMA12515	1¼" x 1½"	10	5.3
SMA15020	1½" x 2"	10	9.4

STEEL EXTRA LONG MALE ADAPTERS

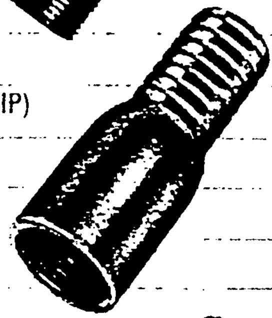
- Plastic Pipe to Male Iron Pipe (MIP)



STEEL ORDER NO.	INSERT SIZE X MIP SIZE	STEEL PCS./ CTN.	STEEL LBS./ CTN.
SMA100XL	1" x 1"	10	5.6
SMA125XL	1¼" x 1¼"	10	7.9
SMA150XL	1½" x 1½"	10	10.1

STEEL FEMALE ADAPTERS

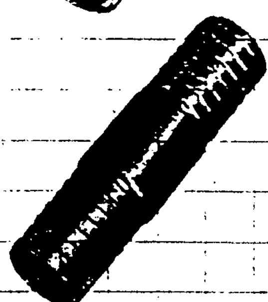
- Plastic Pipe to Female Iron Pipe (FIP)



STEEL ORDER NO.	INSERT SIZE X FIP SIZE	STEEL PCS./ CTN.	STEEL LBS./ CTN.
SFA50	½" x ½"	25	5.6
SFA75	¾" x ¾"	25	9.3
SFA100	1" x 1"	20	9.4
SFA125	1¼" x 1¼"	20	11.3
SFA150	1½" x 1½"	10	9.2
SFA200	2" x 2"	10	17.0

STEEL COUPLINGS

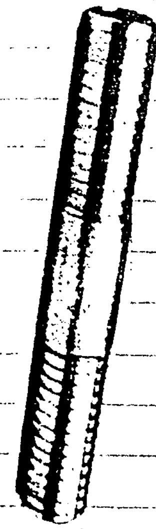
- Plastic Pipe to Plastic Pipe



STEEL ORDER NO.	INSERT SIZE X INSERT SIZE	STEEL PCS./ CTN.	STEEL LBS./ CTN.
SCP50	½" x ½"	25	2.5
SCP75	¾" x ¾"	25	4.3
SCP100	1" x 1"	20	5.0
SCP125	1¼" x 1¼"	20	8.0
SCP150	1½" x 1½"	10	5.4
SCP200	2" x 2"	10	14.0

STEEL REDUCING COUPLINGS

- Plastic Pipe to Plastic Pipe



STEEL ORDER NO.	INSERT SIZE X INSERT SIZE	STEEL PCS./ CTN.	STEEL LBS./ CTN.
SCP7550	¾" x ½"	10	2.5
SCP1075	1" x ¾"	10	3.9
SCP12510	1¼" x 1"	10	6.9
SCP15012	1½" x 1¼"	10	7.1
SCP20015	2" x 1½"	10	13.8

STEEL EXTRA LONG COUPLINGS

- Plastic Pipe to Plastic Pipe

STEEL ORDER NO.	INSERT SIZE X INSERT SIZE	STEEL PCS./ CTN.	STEEL LBS./ CTN.
SCP100XL	1" x 1"	20	13.8
SCP125XL	1¼" x 1¼"	10	6.3

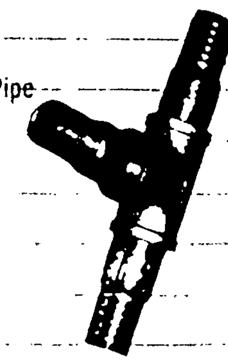
STEEL ELBOWS

- Plastic Pipe to Plastic Pipe

STEEL ORDER NO.	INSERT SIZE X INSERT SIZE	STEEL PCS./ CTN.	STEEL LBS./ CTN.
SEP50	½" x ½"	10	5.6
SEP75	¾" x ¾"	10	8.2
SEP100	1" x 1"	10	13.2
SEP125	1¼" x 1¼"	5	10.7
SEP150	1½" x 1½"	5	12.8
SEP200	2" x 2"	5	19.7

STEEL TEES

- Plastic Pipe to Plastic Pipe to Plastic Pipe

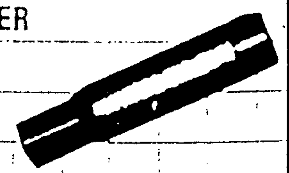


STEEL ORDER NO.	INSERT SIZE X INSERT SIZE	STEEL PCS./ CTN.	STEEL LBS./ CTN.
STP50	½"x½"x½"	10	7.8
STP75	¾"x¾"x¾"	10	12.5
STP100	1"x1"x1"	10	18.2
STP125	1¼"x1¼"x1¼"	5	15.1
STP150	1½"x1½"x1½"	5	17.8
STP200	2"x2"x2"	5	26.6

STEEL WELL SEAL ELL

STEEL ORDER NO.	INSERT SIZE	PCS./ CTN.	LBS./ CTN.
SWSE100	1"	12	20.12
SWSE125	1¼"	12	26.5

STEEL VENTURI MALE ADAPTER



STEEL ORDER NO.	PIPE SIZE	LENGTH	PCS./ CTN.	LBS./ CTN.
SVMA1006	1"	6"	10	6.7
SVMA1256	1¼"	6"	10	9.8

Made in U.S.A.

MERRILL MANUFACTURING

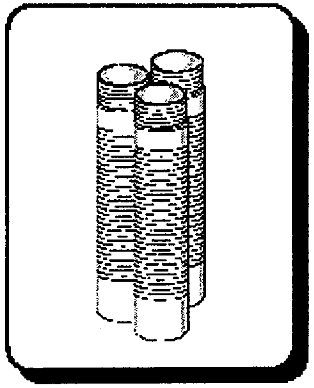
P. O. BOX 392 STORM LAKE, IOWA 50588

and Iowa

Fax No. (712) 732-4401

PVC Screen & Riser

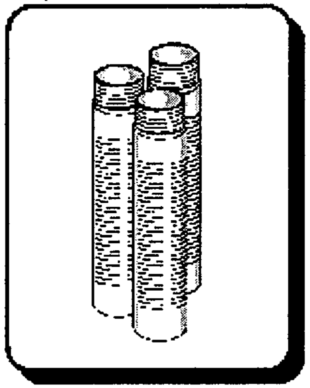
PVC Vee-Wire® Screens



Global Drilling Suppliers offers Johnson PVC Vee-Wire screens, the only continuous slot wire-wrapped, non-metallic screens available without a restricting pipe base. Offers more open area per foot than any other non-metallic screen, enabling a more representative sample to be collected.

Pipe Size	Diameter		Shipping Weight (lbs./ft.)	Open Area (sq. in./ft.)			Strength		
	O.D. (In.)	I.D. (In.)		6-Slot	10-Slot	20-Slot	Collapse (psi)	Tensile (lbs.)	Hanging Wt. (lbs.)
2 INCH	2.56	2.00	0.8	4.8	7.4	13.8	85	1,700	425
4 INCH	4.62	4.00	1.7	7.2	11.6	21.8	75	2,100	525
6 INCH	6.63	5.75	3.7	8.1	13.2	25.0	75	4,600	1,150
8 INCH	9.38	7.50	4.6	N/A	21.6	40.6	55	5,500	1,375

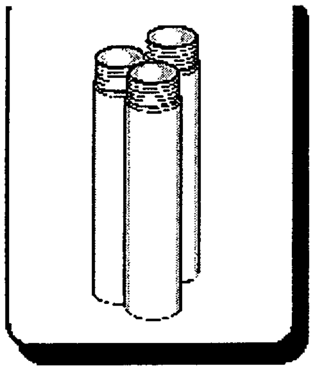
PVC Slotted Pipe



Slotted PVC pipe is used when monitoring applications do not require the performance of Vee-Wire screen. Schedule 40 PVC specs illustrated. Schedule 80 PVC also available.

Pipe Size	Diameter		Shipping Weight (lbs./ft.)	Open Area (sq. in./ft.)			Strength		
	O.D. (In.)	I.D. (In.)		6-Slot	10-Slot	20-Slot	Collapse (psi)	Tensile (lbs.)	Hanging Wt. (lbs.)
3/4 IN.	1.05	0.84	0.3	0.63	1.12	2.12			
1 IN.	1.32	1.03	0.4	0.95	1.49	2.83			
1-1/4 IN.	1.66	1.36	0.6	1.13	2.05	3.72			
1-1/2 IN.	1.90	1.59	0.7	1.19	2.05	3.72			
2 IN.	2.38	2.06	0.8	1.80	3.10	5.60	190	2,100	525
4 IN.	4.50	4.02	2.2	N/A	5.90	10.60	97	7,500	1,875
6 IN.	6.63	6.06	4.0	N/A	6.60	13.40	53	11,000	2,750
8 IN.	8.63	7.96	5.7	N/A	8.50	15.90	37	11,600	2,900
10 IN.	10.75	9.98	8.7	N/A	N/A	21.24			
12 IN.	12.75	10.89	11.5	N/A	N/A	24.78			

PVC Riser Pipe



Feature straight and square joints with precise threads to minimize the chance of cross- threading and poor alignment. Schedule 40 PVC specs illustrated. Sch80 also available.

Pipe Size (In.)	Diameter		Shipping Weight (lbs./ft.)	Strength			
	O.D. (In.)	I.D. (In.)		Collapse (psi)	Tensile (lbs.)	Column (lbs.)	Hanging Wt. (lbs.)
3/4 IN.	1.05	0.84	0.3				
1 IN.	1.32	1.03	0.4				
1-1/4 IN.	1.66	1.36	0.6				
1-1/2 IN.	1.90	1.59	0.7				
2 IN.	2.38	2.06	0.8	276	2,100	37	525
4 IN.	4.50	4.02	2.2	142	7,500	405	1,825
6 IN.	6.63	6.06	4.0	78	11,000	1,575	2,750
8 IN.	8.63	7.96	5.7	54	11,600	4,140	2,900
10 IN.	10.75	9.98	8.7				
12 IN.	12.75	10.89	11.5				

Global Drilling Suppliers, Inc.

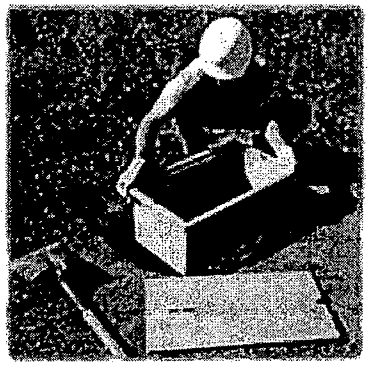
0104001

For more information send e-mail: to sales@globaldrilsup.com

Back to Global Drilling Suppliers home page

Strongwell Service Boxes

Polymer concrete provides high strength, cost effective products for a wide variety of applications.



Advantages

- Strong - Compressive, flexural and with a tensile strength 3 to 5 times stronger than traditional concrete
- Durable - not affected by freeze/thaw cycles
- Lightweight - reduces installation costs: 1/10 to 1/3 the weight of concrete.
- Resistant to impact - absorbs energy, corrosion - alkalines, acids, weathering, temperature extremes and is non-conductive, non-abosorbent and non-flammable.
- Lower Life Cycle Costs

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Send mail to **markland@pipe-etc.com** with questions or comments about this web site.
Last modified: Jul. 14 [illegible]

Index of Enclosure Drawings

Box Size	Box Vertical Design/Test Load #	CA Cover Design/Test Load #	HA Cover Design/Test Load #	HH Cover Design/Test Load #	Box Style	Cover Style	Page No.
SMALL ENCLOSURES							
6 x 8*	15,000 / 22,568	8,000 / 12,000	N/A	N/A	PC	PC	2
8 x 18*	15,000 / 22,568	8,000 / 12,000	15,000 / 22,568	N/A	PC	PC	3
11 x 18*	22,568 / 33,852	8,000 / 12,000	15,000 / 22,568	22,568 / 33,852	PG	PG	4
11 x 18*	15,000 / 22,568	8,000 / 12,000	15,000 / 22,568	N/A	PC	PC	5
12 x 12*	15,000 / 22,568	8,000 / 12,000	15,000 / 22,568	N/A	PC	PC	6
12 x 12	15,000 / 22,568	8,000 / 12,000	15,000 / 22,568	N/A	LX	PC	7
13 x 24*	22,568 / 33,852	8,000 / 12,000	15,000 / 22,568	22,568 / 33,852	PG	PG	8
13 x 24*	5,200 / 11,284	5,200 / 11,284	N/A	N/A	PC	PC	9
13 x 24*	15,000 / 22,568	8,000 / 12,000	15,000 / 22,568	N/A	PT	PT	10
13 x 24*	5,200 / 11,284	5,200 / 11,284	N/A	N/A	PX	PX	11
17 x 30*	22,568 / 33,852	8,000 / 12,000	15,000 / 22,568	22,568 / 33,852	PG	PG	12
17 x 30	22,568 / 33,852	8,000 / 12,000	15,000 / 22,568	22,568 / 33,852	PD	PG	13
17 x 30	5,200 / 11,284	5,200 / 11,284	N/A	N/A	PC	PC	14
17 x 30	15,000 / 22,568	8,000 / 12,000	15,000 / 22,568	N/A	PT	PT	15
17 x 30	5,200 / 11,284	5,200 / 11,284	N/A	N/A	PX	PX	16
LARGE ENCLOSURES							
24 x 24	15,000 / 22,568	8,000 / 12,000	15,000 / 22,568	N/A	PG	PG	17
24 x 36*	22,568 / 33,852	8,000 / 12,000	15,000 / 22,568	22,568 / 33,852	PG	PG	18
30 x 48*	22,568 / 33,852	8,000 / 12,000	15,000 / 22,568	22,568 / 33,852	PG	PG	19
30 x 48	22,568 / 33,852	8,000 / 12,000	15,000 / 22,568	22,568 / 33,852	PD	PG	20
30 x 60	22,568 / 33,852	5,000 / 7,500	15,000 / 22,568	22,568 / 33,852	PG	LG / PG	21
36 x 36	22,568 / 33,852	8,000 / 12,000	15,000 / 22,568	22,568 / 33,852	PG	PG	22
36 x 60	22,568 / 33,852	5,000 / 7,500	15,000 / 22,568	22,568 / 33,852	PG	LG / PG	23
36 x 72	22,568 / 33,852	5,000 / 7,500	15,000 / 22,568	22,568 / 33,852	PG	LG / PG	24
48 x 48	22,568 / 33,852	5,000 / 7,500	15,000 / 22,568	22,568 / 33,852	PG	LG / PG	25

48 x 72	22,568 / 33,852	5,000 / 7,500	15,000 / 22,568	22,568 / 33,852	PG	LG / PG	26
48 x 96	22,568 / 33,852	5,000 / 7,500	15,000 / 22,568	22,568 / 33,852	PG	LG / PG	27

ROUND ENCLOSURES

27" Diameter	22,568 / 33,852	8,000 / 12,000	15,000 / 22,568	N/A	PR	PR	30
39" Diameter	22,568 / 33,852	5,000 / 7,500	15,000 / 22,568	N/A	LR	PR	31

— Product is UL Listed

Return to QUAZITE Information Page

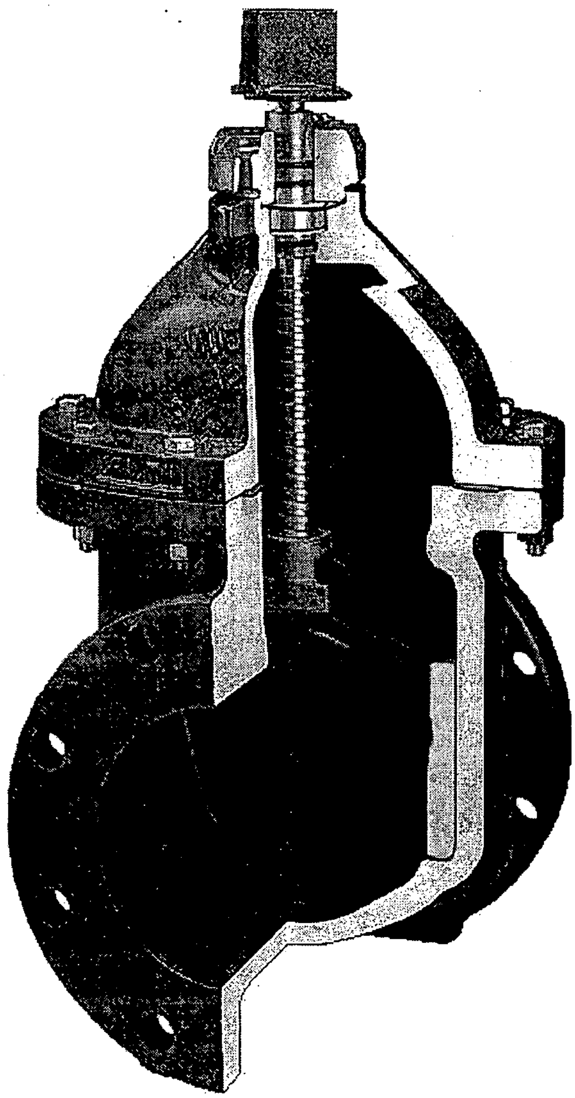
MUELLER® 2360 SERIES™ RESILIENT WEDGE GATE VALVE

Mueller Co. **10.1**

Rev. 12-01

MUELLER® 2-1/2"-12" Resilient Wedge Gate Valve

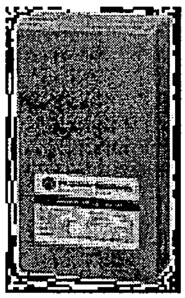
- TWO ANTI - FRICTION WASHERS — polymer washers (one above and one below the thrust collar) further reduce operating torque in both the opening and closing directions.
- STEM — machined from forged manganese bronze bar stock for strength where it is needed most, at the thrust collar.
- WEDGE — cast iron, fully encapsulated in molded rubber complying with ASTM D2000.
- MUELLER® PRO-GARD™ FUSION EPOXY COATING— of nominal 10 mils protects all interior and exterior exposed iron surfaces and complies fully with AWWA C550 and is certified to NSF 61.
- MANUFACTURED AND TESTED — in compliance with ANSI/AWWA C509 Standard and is certified to ANSI/NSF 61. Manufactured at facility with ISO 9001 certification and UL 262, FM 1120/1130.
- BI-DIRECTIONAL FLOW
- FLAT BOTTOM SURFACES -- allow all 2360 series valves to stand upright for ease of handling and storage.
- TRIPLE O-RING SEALS — two above the thrust collar; one below. Uppermost serves as dirt seal. Retain lubrication on thrust collar and isolate it from waterway and outside contamination. Top two can be replaced with valve fully open and under pressure.



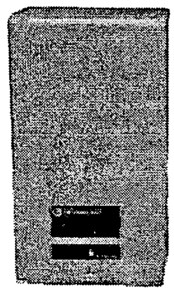
- 250 PSIG MAXIMUM WORKING PRESSURE— hydrostatically tested at 500 psig. Surpasses ANSI/AWWA C509 standards by 25% (UL/FM 200 psig working pressure, 400 psig hydrostatic pressure).
- EXTENDED WEDGE GUIDES— molded as part of the wedge, fit into guide channels in the valve body and maintain optimum wedge alignment with the stem throughout the wedge's travel, preventing the disc from tilting downstream during operation.
- GUIDE CAP BEARINGS — protective guide cap bearings made of a polymer bearing material snap over each rubber encapsulated guide on the wedge, providing a bearing interface between the wedge guides and the body's interior guide channels, protecting both from wear, even after thousands of cycles under severe pressure and flow conditions.
- SMOOTH, OVERSIZED FLOW WAY — all Mueller 2360 series RW Valves have a full, round, unobstructed flow way which accommodates full-sized shell cutters without interference and which provides superior flow characteristics.
- TEN YEAR LIMITED WARRANTY — (see separate Mueller Warranty document for terms).

RED JACKET®
Water Products

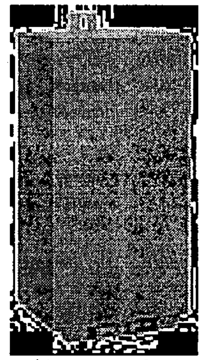
Single Phase Control Boxes



⅓ HP – 1 HP



½ HP – 1 HP



1½ HP – 10 HP

FRANKLIN MOTOR CONTROL BOX

For three-wire single phase Franklin Motors

- Type 3R
- ⅓ through 1 HP includes solid state switch and capacitor*
- 1½ through 10 HP includes relays, overloads and capacitors

HP	Voltage	Order No.
½	115	50F301CB
½	230	50F311CB
¾	230	75F311CB
1	230	100F311CB
1½	230	150F311CB
2	230	200F311CB
3	230	300F311CB
5 (4", 6")	230	500F311CB

Red Jacket Water Products Brand Control Boxes

HP	Voltage	Order No.
½	115	S50N0CB
½	230	S50N1CB
¾	230	S75N1CB
1	230	S100150N1CB

Deluxe Franklin Motor control box with magnetic contactor and lightning arrestor*

- Type 3R
- Includes relays, overloads and capacitors

HP	Size	Voltage	Order No.
2	4"	230	200F311CBC
3	4"	230	300F311CBC
5	4", 6"	230	506F311CBC
7½*	6"	230	756F311CBC
10*	6"	230	1006F311CBC
15*	6"	230	1506F311CBC

See Price Sheet for control box component parts.
*Includes lightning arrestor.

Franklin QD control box with run capacitor

HP	Size	Voltage	Order No.
½	4"	230	50F311CRC
¾	4"	230	75F311CRC
1	4"	230	100F311CRC

Visit us at: www.redjacketwaterproducts.com

Effective July, 2001

BRJCONTRO

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RED JACKET®
Water Products

Submersible Pump Cable Selection

SINGLE PHASE MOTOR MAXIMUM CABLE LENGTH (motor to service entrance) (2)

Motor Rating		Copper Wire Size (1)								
Volts	HP	14	12	10	8	6	4	2	0	00
115	⅓	130	210	340	540	840	1300	1960	2910	3540
	½	100	160	250	390	620	960	1460	2160	2630
230	⅓	550	880	1390	2190	3400	5250	7960	11770	
	½	400	650	1020	1610	2510	3880	5880	8720	
	¾	300	480	760	1200	1870	2890	4370	6470	7870
	1	250	400	630	990	1540	2380	3610	5360	6520
	1.5	190	310	480	770	1200	1870	2850	4280	5240

Motor Rating		Copper Wire Size (1)								
Volts	HP	14	12	10	8	6	4	2	0	00
230 (Cont.)	2	150	250	390	620	970	1530	2360	3620	4480
	3	120*	190	300	470	750	1190	1850	2890	3610
	5	0	0	180*	280	450	710	1110	1740	2170
	7.5	0	0	0	200*	310	490	750	1140	1410
	10	0	0	0	0	250*	390	600	930	1160
	15	0	0	0	0	170*	270*	430	660	820

(1) This table is based on copper wire. If aluminum wire is used it must be two sizes larger. Example: When the table calls for #12 copper wire you would use #10 aluminum wire.

(2) Single phase control boxes may be connected at any point of the total cable length.

THREE PHASE MOTOR MAXIMUM CABLE LENGTH (motor to service entrance) (3)

Motor Rating		Copper Wire Size (1)										
Volts	HP	14	12	10	8	6	4	2	0	00	000	0000
200 V 60 Hz	.5	710	1140	1800	2840	4420						
	.75	510	810	1280	2030	3160						
	1	430	690	1080	1710	2670	4140					
	1.5	310	500	790	1260	1960	3050					
	2	240	390	610	970	1520	2360	3610	5420			
	3	180	290	470	740	1160	1810	2760	4130			
	5	110*	170	280	440	690	1080	1660	2490	3050	3670	4440
	7.5	0	0	200	310	490	770	1180	1770	2170	2600	3150
	10	0	0	0	230*	370	570	880	1330	1640	1970	2390
	15	0	0	0	160*	250	390	600	910	1110	1340	1630
	20	0	0	0	0	190*	300*	460	700	860	1050	1270
	25	0	0	0	0	0	240*	370*	570	700	840	1030
	30	0	0	0	0	0	0	310*	470	580	700	850
230 V 60 Hz	.5	930	1490	2350	3700	5760	8910					
	.75	670	1080	1700	2580	4190	6490	9860				
	1	560	910	1430	2260	3520	5460	8290				
	1.5	420	670	1060	1670	2610	4050	6160	9170			
	2	320	510	810	1280	2010	3130	4770	7170	8780		
	3	240	390	620	990	1540	2400	3660	5470	6690	8020	9680
	5	140*	230	370	590	920	1430	2190	3290	4030	4850	5870
	7.5	0	160*	260	420	650	1020	1560	2340	2870	3440	4160
	10	0	0	190*	310	490	760	1170	1760	2160	2610	3160
	15	0	0	0	210*	330	520	800	1200	1470	1780	2150
	20	0	0	0	0	250*	400	610	930	1140	1380	1680
	25	0	0	0	0	0	320*	500	750	920	1120	1360
	30	0	0	0	0	0	260*	410	620	760	930	1130

Motor Rating		Copper Wire Size (1)										
Volts	HP	14	12	10	8	6	4	2	0	00	000	0000
460 V 60 Hz	.5	3770	6020	9460								
	.75	2730	4350	6850								
	1	2300	3670	5770	9070							
	1.5	1700	2710	4270	6730							
	2	1300	2070	3270	5150	8050						
	3	1000	1600	2520	3970	6200						
	5	590	950	1500	2360	3700	5750					
	7.5	420	680	1070	1690	2640	4100	6260				
	10	310	500	790	1250	1960	3050	4680	7050			
	15	0	340*	540	850	1340	2090	3200	4810	5900	7110	
	20	0	0	410	650	1030	1610	2470	3730	4580	5530	
	25	0	0	0	530*	830	1300	1990	3010	3700	4470	5430
	30	0	0	0	430*	680	1070	1640	2490	3060	3700	4500
	40	0	0	0	0	500*	790	1210	1830	2250	2710	3290
	50	0	0	0	0	0	640*	980	1480	1810	2190	2650
	60	0	0	0	0	0	540*	830*	1250	1540	1850	2240
	75	0	0	0	0	0	0	680*	1030	1260	1520	1850
	100	0	0	0	0	0	0	0	760*	940*	1130	1380
	125	0	0	0	0	0	0	0	0	740*	890*	1000*
	150	0	0	0	0	0	0	0	0	0	760*	920*
	175	0	0	0	0	0	0	0	0	0	0	810*
	200	0	0	0	0	0	0	0	0	0	0	0
575 V 60 Hz	.5	5900	9410									
	.75	4270	6810									
	1	3630	5800	9120								
	1.5	2620	4180	6580								
	2	2030	3250	5110	8060							
	3	1580	2530	3980	6270							
	5	920	1480	2330	3680	5750						
	7.5	660	1060	1680	2650	4150						
	10	490	780	1240	1950	3060	4770					
	15	330*	530	850	1340	2090	3260					
	20	0	410*	650	1030	1610	2520	3860	5830			
	25	0	0	520*	830	1300	2030	3110	4710			
	30	0	0	430*	680	1070	1670	2560	3880	4770	5780	7030
	40	0	0	0	500*	790	1240	1900	2860	3510	4230	5140
	50	0	0	0	0	640*	1000	1540	2310	2840	3420	4140
	60	0	0	0	0	0	850*	1300	1960	2400	2890	3500
	75	0	0	0	0	0	690*	1060	1600	1970	2380	2890
	100	0	0	0	0	0	0	790*	1190*	1460	1770	2150
	125	0	0	0	0	0	0	0	950*	1160*	1400	1690
	150	0	0	0	0	0	0	0	800*	990*	1190*	1440
	175	0	0	0	0	0	0	0	0	870*	1050*	1270*
	200	0	0	0	0	0	0	0	0	0	920*	1110*

(3) The portion of the total cable which is between the service entrance and a three phase motor starter should not exceed 25% of the total maximum length to assure reliable starter operation.

Lengths marked * meet the U.S. National Electrical Code ampacity only for individual conductor 75°C cable. Only the lengths without * meet the code for jacketed 75°C cable. Local code requirements may vary.

For additional cable information, go to www.franklin-electric.com or call Franklin Electric at 1-800-348-2420.

Caution: Use of wire size smaller than listed will void warranty.

1 foot = .3048 meter

Red Jacket Water Products reserves the right to make design improvements and pricing modifications as necessary and without notice.

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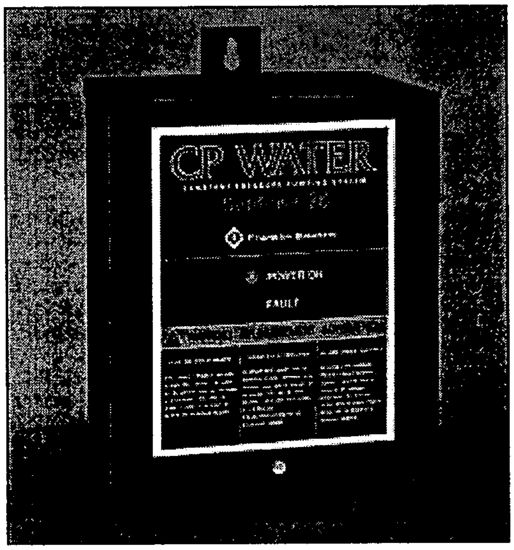
ITT Industries

CP WATER - SUBDRIVE 75



CONSTANT PRESSURE CONTROLLER

The CP Water - SubDrive 75 uses state-of-the-art electronics technology to provide constant water pressure through variable speed control of standard ¾ Hp 4" submersible water well pumps, adding significant value to residential water systems.

APPLICATION DATA

CP Water - SubDrive 75 is designed for use with a ¾ Hp pump mounted to a 1½ Hp Franklin Electric motor. This innovative variable speed controller is designed for applications with a wide range of flow demand, including large homes, ground source heat pumps, and sprinkler systems. CP Water SubDrive 75 is UL recognized for USA and Canada.

SPECIFICATIONS

Model Number 587 020 3380

Pump Horsepower Rating .... ¾ Hp*

Input (From Power Source)
- Voltage 200-250V/Single-Phase
- Frequency .... 60/50 Hz
- Amps .... 11 A

Output (To Motor)
- Voltage .... Variable V/Three-Phase
- Frequency .... Variable (30-80Hz)
- Amps .... 5.9 A

Enclosure .... NEMA 1

Pressure Sensor (Included) .... External

Controller Weight .... 13.8 lbs/6.25 Kg

Carton Size .... 16.5" x 12" x 9"

Shipping Weight .... 17 Lbs./7.7 Kg

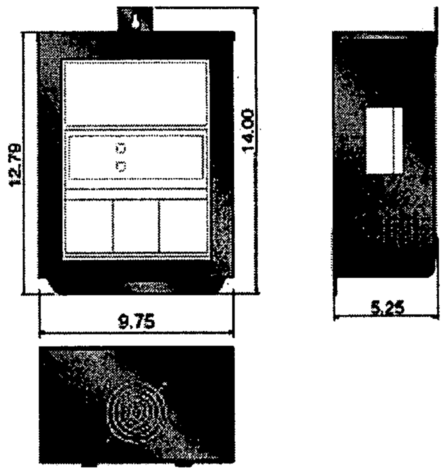
For use with
- Pump Rating .... ¾ Hp

FEATURES & BENEFITS

- Constant water pressure with a wide range of settings (25 to 80psi).
- Works with a standard pump mounted to a standard 3-phase Franklin Electric submersible motor.
  - 1½ Hp performance from a ¾ Hp pump
  - Pump brand of your choice
  - Proven Franklin motor
  - State-of-the-art electronics
- Works with small pressure tanks or larger tanks already in place.
  - Minimum tank volume: 2 gallons
  - Water system fits into smaller spaces
- Water faucets can be installed between wellhead and controller.
- Excellent radio frequency interference shielding.
- Installation is as simple as a control box.
- Three-phase performance using single-phase input.
  - High starting torque
  - More efficient
  - Smooth running
- Soft start means less motor stress and longer motor life.

Built-in diagnostics and protection.
  - Surge protection
  - Open circuit

- Motor Rating ...... 1½ Hp, 23 VAC, 3-Phase



- Underload
- Short circuit
- Undervoltage
- Overheated controller
- Locked pump

• Smart Reset® technology allows well recovery before restarting the pump.

M1457 - 5.01

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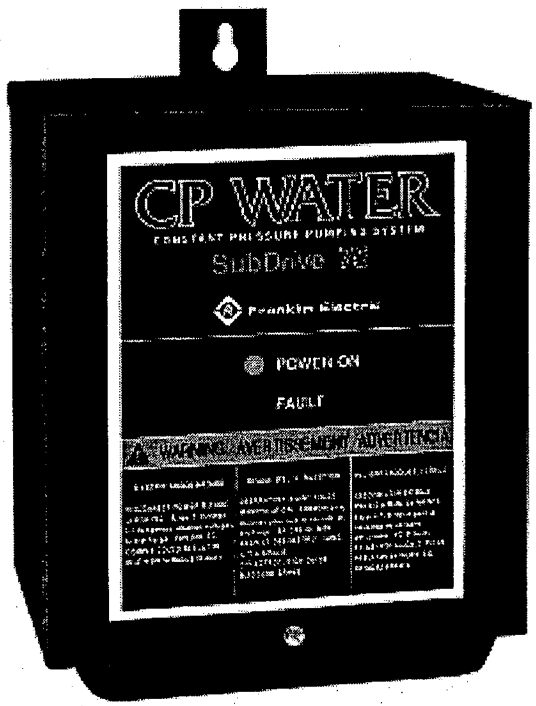
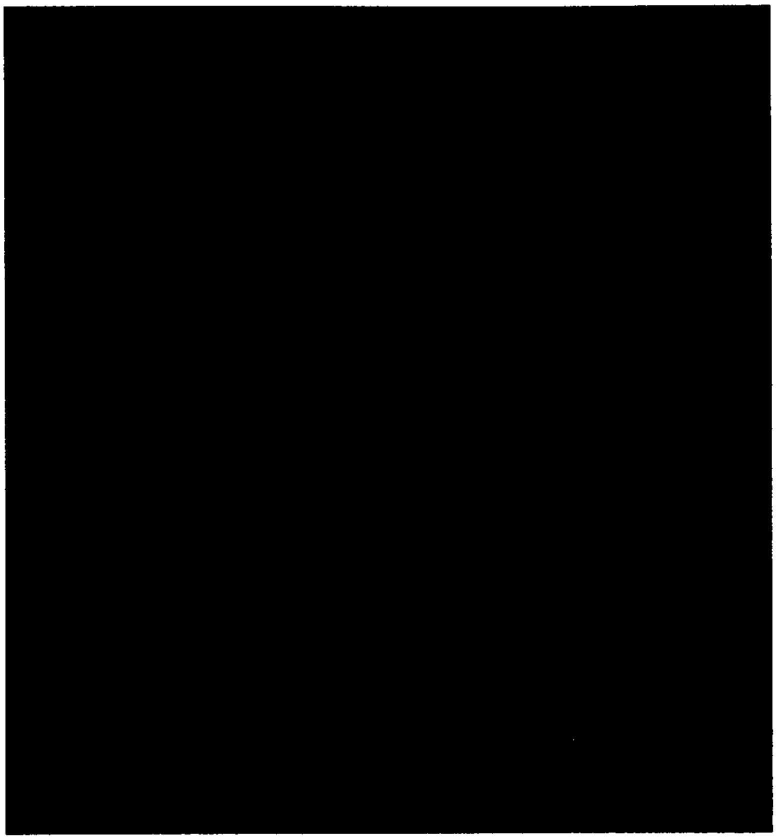
Franklin Electric Company, Inc. 400 E. Spring St., Bluffton, IN, 46714, U.S.A.
E-mail: webmaster@fele.com Tel: 260.824.2900 Fax: 260.824.2909

Installation Manual

P/N 587 020 3380



Franklin Electric



Franklin Electric

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Bluffton, IN 46714
Tel: 260-824-2900
Fax: 260-824-2909
www.franklin-electric.com

Contents

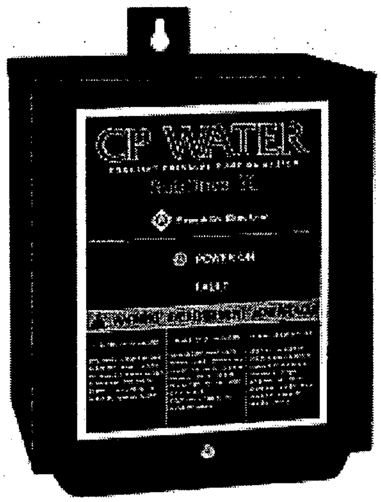
Declaration of Conformity

Franklin Electric declares under our sole responsibility, the SubDrive Series Model# 587 020 3380 is in conformity with the Council Directives on the approximation to the laws of the EEC member states relating to the following:

- Electromagnetic Compatibility (89/336/EEC): Adjustable Speed Electrical Power Drive Systems: Standard EN61800-3
- Low-Voltage Electrical Safety (73/23/EEC) (amending 93/68/EEC): Safety of Household and Similar Electrical Appliances: Standard EN60335-1

C UL US
LISTED

Description and Features



The Franklin Electric CP WATER SD75 is a dependable residential water system controller that uses advanced electronics to enhance the performance of standard submersible pumps. When used with a Franklin Electric 3-phase motor (234 514 XXXX), the CP WATER SD75 eliminates pressure cycling associated with conventional water well systems and owners of private water well systems can enjoy "city-like" water pressure.

In addition, the reduced tank size (2 gal. min.) allows installation in small spaces. Key features of the CP WATER SD75 include:

- Constant water pressure with a wide range of settings (25-80 PSI)
- Smaller pressure tank can be used
- Fits the motor to the pump – motor speed is controlled to provide the optimum performance without overloading the motor
- Flexibility – you can use this unit with standard off-the-shelf 3/4 Hp pumps
- No in-rush current
- Active Power factor correction
- Protection features
  - Dry well conditions – using smart pump monitoring (see page 20)
  - Bound pump - with auto-reversing torque
  - High voltage / lightning surge
  - Low line voltage
  - Open motor circuit, Short circuit

How It Works

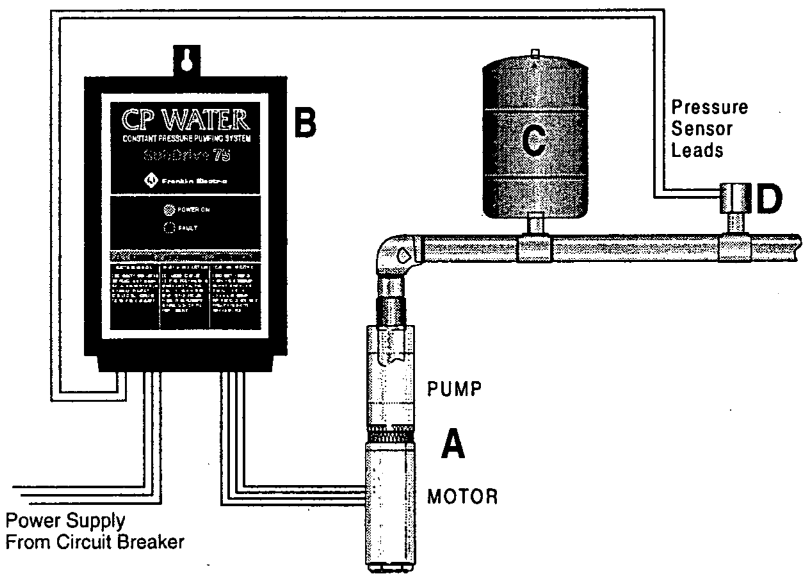
The Franklin Electric CP WATER SD75 is designed to be part of a system that consists of only four components:

A. Standard pump/motor assembly 3/4 Hp pump with 1.5 Hp Franklin Electric motor (234 514 XXXX (60 Hz) or 234 555 xxxx (50 Hz)).

B. CP WATER SD75 controller (P/N 587 020 3380)

C. 2 gallon (volume) Pressure Tank (for pumps rated 12 gpm or more, a 4 gallon pressure tank is recommended to reduce pressure fluctuations)

D. Franklin Electric Pressure Sensor (provided)



The Franklin Electric CP WATER SD75 provides constant pressure using advanced electronics to drive a standard 3-phase motor according to the pressure demands indicated by a highly accurate, heavy-duty, long-life pressure sensor. By adjusting the motor speed between 1,800 rpm and 4,800 rpm, the CP WATER SD75 can deliver constant pressure dependably, even as water demand changes.

For example, a small demand on the system, such as a bathroom faucet, results in the motor/pump running at a relatively low speed. As greater demands are placed on the system from the opening of additional faucets or the use of appliances, the motor speed increases accordingly to maintain the desired system pressure.

In most cases, whenever there is a demand for water, the CP WATER SD75 will be operating. However, if the demand for water is small, the system may cycle on and off at its minimum speed of 1,800 rpm. This will not harm the motor or the pressure sensor.

In addition, the CP WATER SD75 "ramps up" the motor speed, gradually increasing voltage, resulting in a cooler motor and lower in-rush current compared to conventional water systems.

Pump Sizing

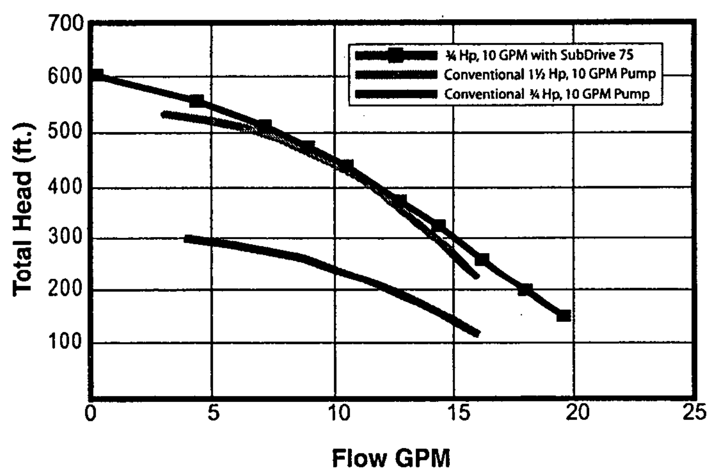
The CP WATER SD75 is intended for use with 3/4 Horsepower (Hp) pumps that are mounted to 1.5 Hp Franklin Electric 3-phase motors. **In general, the CP WATER SD75 will enhance the performance of a 3/4 Hp pump to a similar or better performance than a conventional 1 1/2 Hp pump of the same flow rating (pump series).**

Pump Selection Process

Within the same pump family, use the 1 1/2 Hp curve to choose the proper 3/4 Hp pump to use with the SubDrive 75.

- Choose the family of curves that provide the desired flow rate.
- If the performance curve for the 1 1/2 Hp pump is sufficient for your head and flow needs, then the 3/4 Hp pump in the same pump series (flow rating) will provide this performance when used with the CPWATER SubDrive 75.
- When used on the CP WATER SubDrive 75, the 3/4 Hp pump should provide similar or better performance than a conventional 1 1/2 Hp pump of the same flow rating. An example of this is illustrated in the graph provided below:

Typical CP Water SubDrive Performance



* For the head needed, pick the pump with the highest flow rating. This will allow the application to enjoy greater water capacity, while reducing the maximum system pressure.

Specifications

Phase	Single-Phase
Voltage	200 – 250 VAC
Frequency	50/60 Hz
Current (Maximum)	11 Amps RMS (single phase)
Power Factor	1 (constant)
Power	2400 Watts

Phase	Three-Phase
Voltage	Variable
Frequency	Variable
Current (Maximum)	5.9 Amps RMS (three phase)

Factory preset	50 psi
Adjustable Range	25 to 80 psi

Installation - General Information

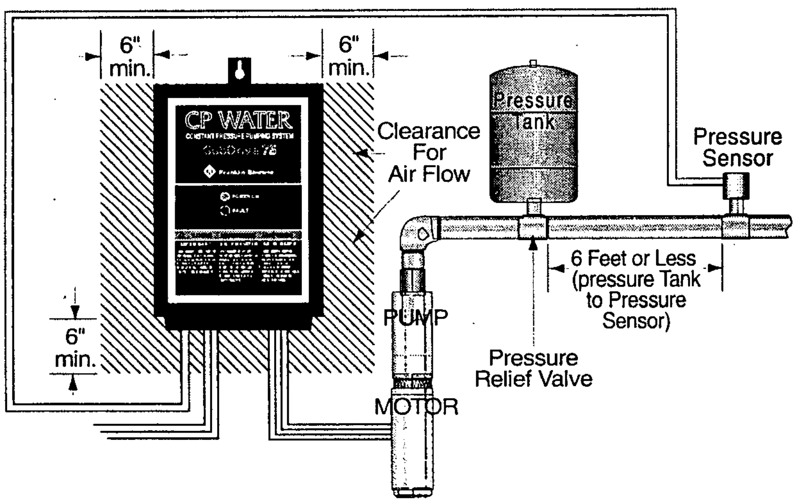
[redacted]

Controller Location Selection

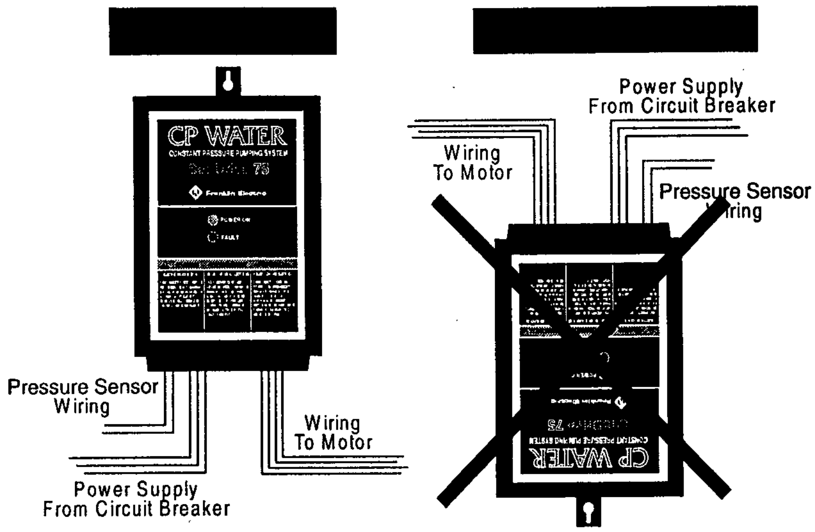
The CP WATER SD75 controller is intended for indoor use and for operation in ambient temperatures up to 104° F (40° C). The following recommendations will help in selection of the proper location of the CP WATER SD75 unit:

1. A tank tee is recommended for mounting the tank, pressure sensor, pressure gauge, and pressure relief valve at one junction. If a tank tee is not used, the pressure sensor should be located within 6 ft. (1.8 meters) of the pressure tank to minimize pressure fluctuations. There should be no elbows between the tank and pressure sensor.
2. The unit should be mounted on a sturdy supporting structure such as a wall or supporting post – please account for the fact that the unit weighs approximately 13.8 pounds (6.25 Kg).
3. The electronics inside the CP WATER SD75 are air-cooled. As a result, there should be at least 6 inches of clearance on each side and below the unit to allow room for air flow.

[redacted]



There should be no elbows between the tank and pressure sensor.



4. The CP WATER SD 75 should only be mounted with the wiring end oriented downward. The controller should not be placed in direct sunlight or other locations subject to extreme temperatures or humidity (mounting location should not be subjected to freezing conditions or condensation).
5. The mounting location should have access to 230V electrical supply and to the submersible motor wiring.

Wire Sizing

The maximum allowable wire lengths for connection of motor to the CP WATER SD75 are given in the following table*:

Copper Wire Size (AWG)	14	12	10
Maximum Length (Feet)	240	390	610
Maximum Length (Meters)	73	119	186

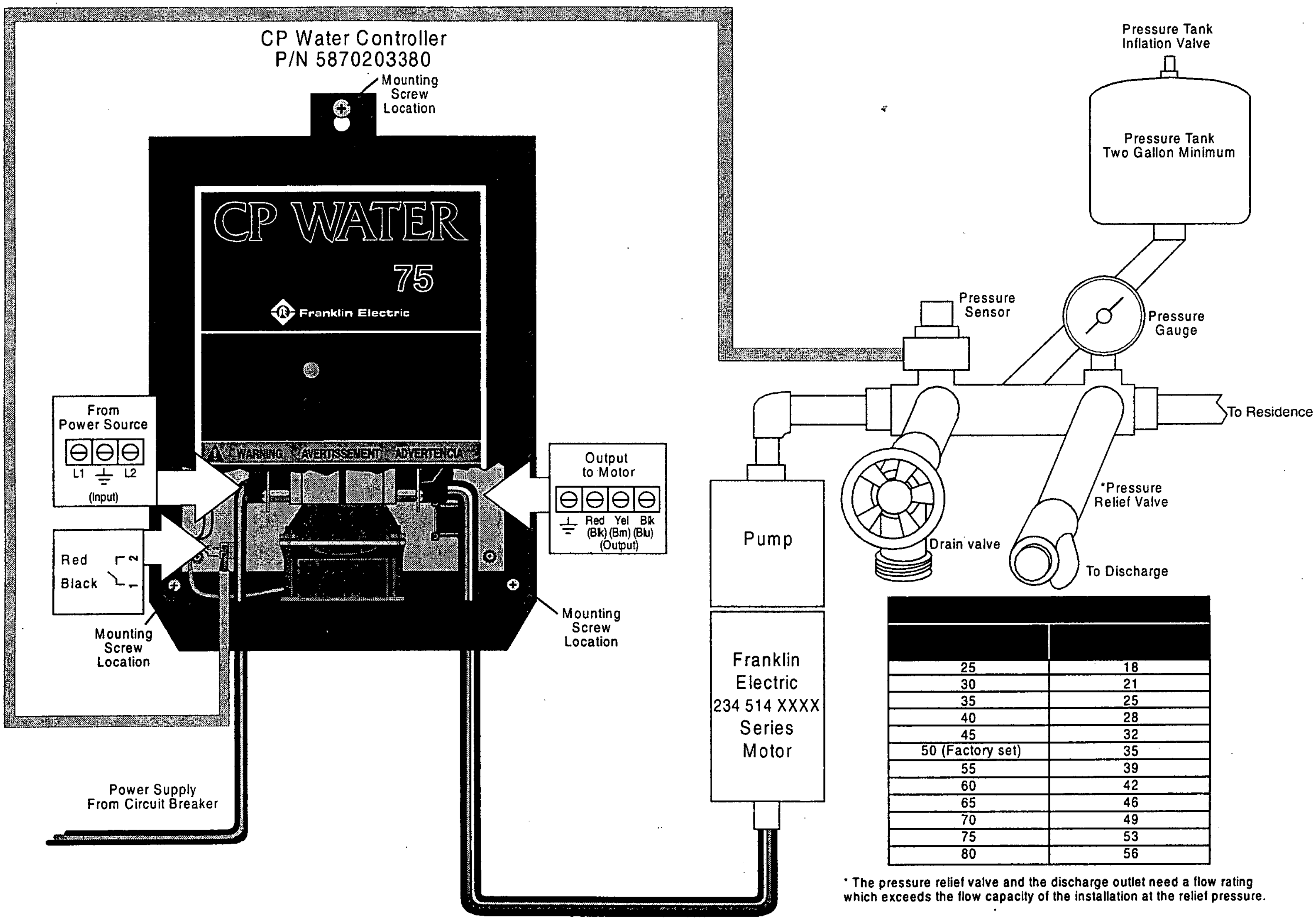
*These lengths do not correspond to the Franklin Electric AIM Manual due to maximum resistance requirements for the SD75 monitoring software.

A 10 foot section of cable is provided with the CP WATER SD75 to connect the pressure sensor.

NOTE:

- Maximum allowable wire lengths are measured between the SD75 controller and motor.
- Aluminum wires should not be used with the CP Water SD75.
- The CP Water SD75 requires a standard 15 or 20 AMP circuit breaker.

Quick Reference Guide CP Water SubDrive 75 (not to scale)



25	18
30	21
35	25
40	28
45	32
50 (Factory set)	35
55	39
60	42
65	46
70	49
75	53
80	56

* The pressure relief valve and the discharge outlet need a flow rating which exceeds the flow capacity of the installation at the relief pressure.

Motor/Pump Installation

The CP WATER SD75 requires the combination of a 3/4 Hp pump (see "Sizing" section at the beginning of this manual) and a Franklin Electric 1 1/2 Hp submersible motor (234 514 xxxx or 234 555 xxxx). If the pump and motor must be assembled in the field, please ensure proper alignment when assembling pump to motor. Also, please follow the wire sizing guidelines on page 9.

Otherwise, there are no special requirements for installing the CP WATER SD75 motor and pump. Refer to Franklin Electric's Application, Installation, and Maintenance (AIM) manual for general motor considerations.

Pressure Tank

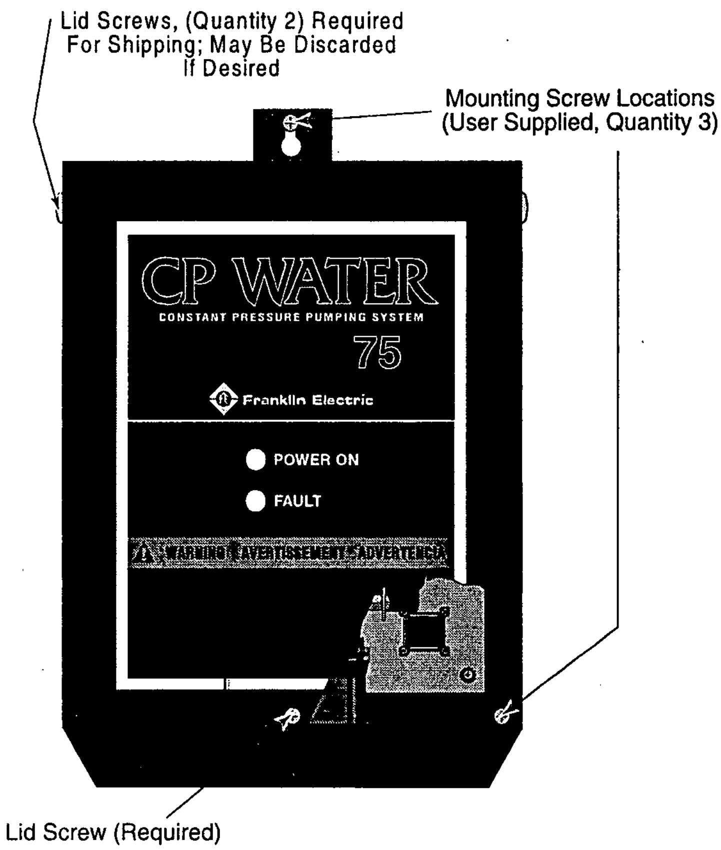
The CP WATER SD75 can maintain constant pressure in many applications with a pressure tank of 2 gallon (volume) minimum capacity. For pumps rated 12 gpm or more, a 4 gallon (volume) pressure tank is recommended for optimum pressure regulation. The CP WATER SD75 can also use an existing tank with a much larger capacity.

The pressure tank pre-charge setting should be 30% below the system pressure sensor setting, as indicated in the following table.

2518	
30	21
35	25
40	28
45	32
50 (factory set)	35
55	39
60	42
65	46
70	49
75	53
80	56

Installation – Procedure

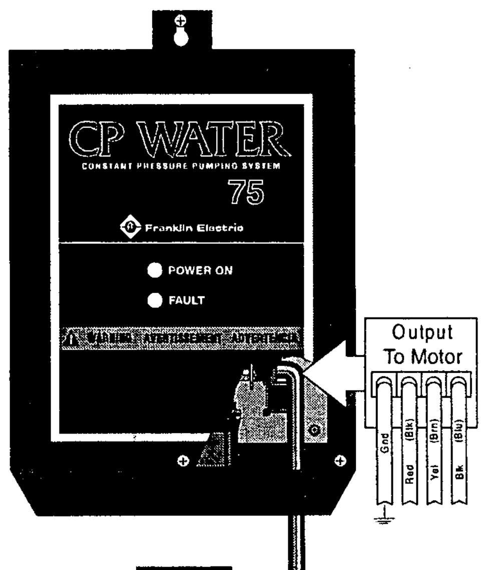
1. Disconnect electrical power at the main breaker
2. Drain the system (if applicable)
3. Install pressure sensor – the pressure sensor has a 1/4 - 18 National Pipe Thread (NPT) connection.
4. Remove the CP WATER SD75 cover by removing the three lid screws. Install the unit to the wall using the three mounting screws (not included) as shown in Figure 1.



Wiring Connections

[redacted]

1. Verify that the power has been shut off at the main breaker.
2. Verify that the dedicated branch circuit for the CP WATER SD75 is equipped with a 15 or 20 AMP circuit breaker.
3. Remove the CP WATER SD75 lid.
4. Feed the motor leads through the opening on the bottom right side of the unit and connect them to the terminal block positions marked (green ground wire), Red (Black) Yellow (Brown) and Black (Blue) (Figure 2).



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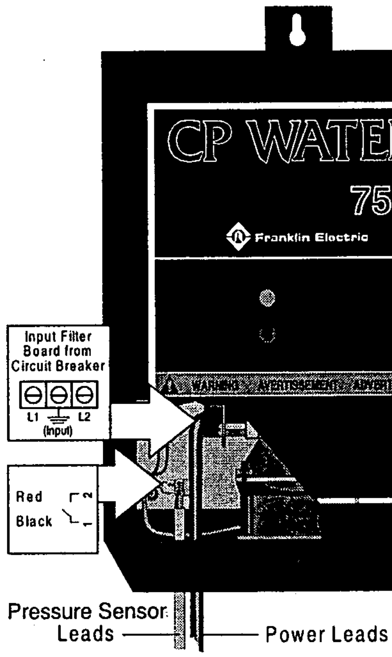
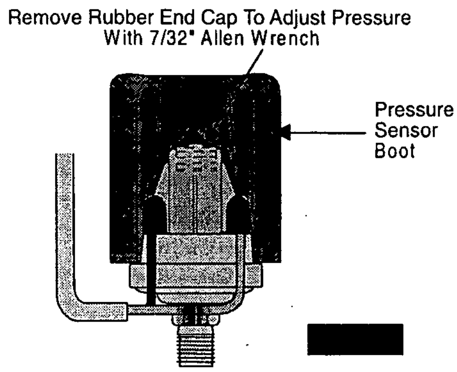


[redacted]

5. Feed the 230V power leads through the larger opening on the bottom left side of the CP WATER SD75 controller and connect them to the terminals marked L1, GND, and L2 (Figure 3).
6. Feed the pressure sensor leads through the smaller opening on the bottom left side of the CP WATER SD75 unit and connect the red and black leads to the terminals marked "1" and "2" (interchangeable) with a small screwdriver (provided).
7. Use the appropriate strain relief or conduit connectors.
8. Replace the cover. Do not over-tighten the screw.



[redacted]

9. Connect the other end of the pressure sensor cable with the two spade terminals to the pressure sensor. The connections are interchangeable (Fig. 4).
10. Set the pressure tank pre-charge at 30% below the desired water pressure setting. To check the tank's pre-charge, de-pressurize the water system by opening a tap. Measure the tank pre-charge with a pressure gauge at its inflation valve and make the necessary adjustments.
11. The pressure sensor communicates the system pressure to the CP WATER SD75 controller. The sensor is preset at the factory to 50 psi, but can be adjusted by the installer using the following procedure:
    a. Remove the rubber end-cap (Fig. 4).
    b. Using a 7/32" Allen wrench (provided), turn the adjusting screw clockwise to increase pressure and counter-clockwise to decrease pressure. The adjustment range is between 25 and 80 psi (1/4 turn = approximately 3 psi).
    c. Replace the rubber end cap.
    d. Reset the pressure tank pre-charge to the appropriate pressure

[redacted]

12. Cover the pressure sensor terminals with the rubber boot provided (Fig. 4).

Start-Up Operation

Apply power to the controller. A steady green light indicates that the CP water subdrive 75 has power but the pump is not running. The green light will flash continuously when the pump is running.

NOTE:

Conventional private water systems intermittently fill a pressure tank as commanded by a standard pressure switch (e.g. 30 - 50 psi). The CP Water SD75 maintains a constant pressure at the pressure sensor up to the maximum capability of the motor and pump.

Although the pressure is constant at the pressure sensor, pressure drops may be noticeable in other areas of the home when additional taps are opened. This is due to limitations in the plumbing and will be more pronounced the further the taps are from the pressure sensor. This would be true of any system, and if observed, should not be interpreted as a failure in the performance of the CP Water SD75.

System Troubleshooting

Should an application or system problem occur, built-in diagnostics will protect the system. The red "FAULT" light on the front of the CP Water SD75 controller will flash a given number of times to indicate the nature of the fault. In some cases, the system will shut itself off until corrective action has been taken. Fault codes and the recommended corrective action for each are listed in the following table.

1	Motor underload	Overpumped or dry well. Worn pump. Broken motor shaft. Blocked pump or screen.	Wait for well to recover and automatic restart timer to time out. If the problem does not correct, check motor and pump. See description of "Smart Reset" on page 20.
2	Undervoltage	Low line voltage	Check for loose connections. Check line voltage. Report low voltage to the power company. Unit will start automatically when the proper power is supplied.
3	Locked pump	Motor/pump misaligned. Abrasive/Sand-bound pump.	Unit will attempt to free a locked pump. If unsuccessful, check the motor and pump.
4	NOT USED		
5	Open circuit	Loose connection. Defective motor or cable.	Check motor wiring. Make certain all connections are tight. Make certain proper motor is installed. Cycle input power* to reset.
6	Short circuit	Defective cable, splice, or motor	Check motor wiring. *Cycle input power to reset.
7	Overheated controller	High ambient temperature. Direct sunlight. Obstruction of air-flow.	This fault automatically resets when the temperature returns to a safe level.

* "Cycle input power" means, turn the power off until both lights fade off and then apply power again.

Troubleshooting Guide

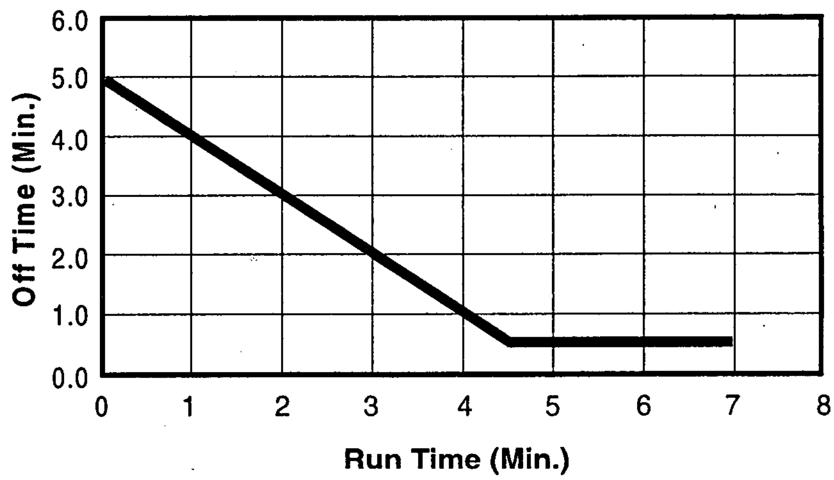
Water flow rate is not as high as expected.	Motor is running backwards.	Switch two of the three wires leading from the controller to the motor (3-phase motor).
	Temperature in the controller is too high. If the controller's heat exchanger becomes too hot, the controller will reduce the speed of the pump to lower the power consumption.	Make sure there is at least 6 inches of room around the controller for movement of air.
	Pump capacity can not supply the demand.	Use pump with higher flow rating (if head requirement is still satisfied).
Excessive pressure fluctuations.	Waterlogged tank.	Check tank for bladder damage - replace if necessary.
		Reset the tank pre-charge pressure (should be 70% of pressure sensor setting).
	Pressure tank is too small for flow rating of the pump.	Use larger tank (4 gal tank for pumps rated above 12 gpm).
Motor runs continously with no flow demand from the house.	Leak in the pitless adapter.	Re-seat the pitless adapter.
	Leak in the household or outdoor plumbing.	Check for leaky faucets, valves and pipe fittings and repair.

TOLL-FREE HELP FROM A FRIEND
Franklin Electric Service Hotline
800-348-2420

Smart Reset

If a motor underload fault condition occurs, the most likely cause is an overpumped or dry well. To allow the well to recover, the CP Water SD75 will wait 30 seconds to 5 minutes, determined by duration of the previous run time, before restarting the motor. For example, the first time the fault occurs, the CP Water SD75 will wait 30 seconds before attempting to restart the pump. If the system would then run for 1 minute and an underload fault reoccurs, the controller will wait 4 minutes before attempting to restart the pump. This schedule allows for the minimum off-time possible based on the recovery time of the well.

CP Water Pump Underload "Smart Reset"



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Submersible Motors & Controls

SubDrive 75 Frequently Asked Questions

How do I determine which pump to use?

The SD 75, used with a 3/4 Hp pump on 1 1/2 Hp motor, provides the performance similar to the 1 1/2 Hp standard curve in the same pump series. In other words, you will be using a ¾ Hp pump to get the performance of the 1 ½ Hp curve in the same series....use the 1 ½ Hp curve when choosing the proper ¾ Hp pump to use.

Top

Whose pump can I use?

Any 3/4 Hp pump that is in the same pump series as the 1 ½ Hp pump appropriate for the desired head and flow performance.

Top

Why use a 3/4 Hp pump on a 1 1/2 Hp, 3-phase motor?

The SubDrive 75 will spin the pump at a rate that will produce constant pressure without overloading the motor or exceeding a maximum speed of 80 Hz (@ 4,800 rpm). This means that the speed of the pump may exceed the conventional speed of 3,450 rpm. As speed increases, head increases by the square of speed (exponentially), so you get a lot of head performance with just a small increase in speed. If a 1 ½ pump is used on the 1 ½ Hp 3-phase motor, the SubDrive 75 controller would never let the pump speed up past 3,450 rpm, since a higher speed would overload the motor.

Top

Can I put other pump ratings on SD 75

It is possible to use a 1 Hp pump on a 1 ½, 3-phase motor, but it is important to remember that you will still get the performance of the 1 ½ Hp curve in that series. Use of the 1 Hp pump is recommended only in flow ranges where a 1 Hp pump is available but a ¾ Hp pump is not.

Top

What is the range of operating speeds for the SubDrive 75?

Minimum = 1,800, Maximum = 4,800 rpm

Top

Can I repair the SubDrive 75 controller?

Currently, the only option for repair of a faulty or damaged SubDrive 75 controller is replacement.

Top

What about lightning?

The SubDrive 75 is equipped with premium surge protection. MOVs (Metal Oxide Varistors) are designed to protect the SD75 input terminals from voltages above 325 volts and output terminals from voltages above 375 volts. These are the same devices used in computer surge protectors, and serve the same function in protecting the electronics from surges experienced during thunderstorms.

Top

Can I install a faucet at the wellhead?

Yes. The SubDrive 75 is air-cooled and is therefore not dependent on uninterrupted water flow between the wellhead and controller.

Top

What are the differences between CP1 and SubDrive 75?

	CP Water 1	CP Water - SubDrive 75
Pump/Motor	Special	Standard
Max RPM	6,300	4,800
Cooling	Water	Air
Installation	Like a 3-wire Control Box, plumb water to flow through rear of controller	Like a 3-wire Control Box, no plumbing
Tap at wellhead?	No	Yes
Enclosure	NEMA 3R	NEMA 1
Pressure Sensor	Integrated transducer	Non-integrated pressure switch (heavy duty, megacycle)
Power Factor Correction (PFC)	No	Yes

Top

What is Power Factor Correction?

The SubDrive 75 has a power factor correction feature to keep voltage and current constantly in phase (power factor = 1). This minimizes amp draw on the input side, and significantly improves voltage distortion on the input side. Power Factor correction reduces heat stress on the main supply transformer to the house, thus extending its life. This makes the utility company happy and avoids the additional fees being considered in the future for utility customers with poor power factor loading.

Top

Will a leak cause the SubDrive 75 to run the pump continuously?

The size of the leak and the capacity of the tank used will determine the run time of the pump. If we use the smallest tank possible, it would require a leak of approximately 1 cup per minute to drive the pump continuously. Larger tanks would require a higher rate to cause continuous pumping. This, however, is not specific to the SubDrive 75 alone. All variable speed drive systems would react similarly. Additionally, power consumption in this case would be very low due to the fact that the pump is turning at minimum revolutions. Also, since the SD75 has a soft start (no in-rush current), the motor is not stressed during starting as much as it is in a conventional system.

Top

Can I expect energy savings, and if so, how much?

Depends on application...In general, you should get some energy savings if average daily flow is more than approximately 3 to 5 gpm

Top

How does the unit hold pressure (the dithering)?

The pressure switch tells the controller to speed up the motor if the pressure is below the pressure setting and to slow down the motor if the pressure is above the pressure setting. It is not constantly turning the motor on and off. The result is a continuous ramping up and down around the pressure set point. This "pressure dither" may or may not be visible at the gauge, but is generally not noticeable at a faucet or tap.

Top

Life of pressure sensor?

Millions of cycles. This sensor is rated for 500 psi. It is a heavy-duty sensor that carries less than 5 volts. It does not carry load, so there is no arcing and consequently much less deterioration of the contact points compared to conventional pressure switches. The range of motion of the contacts is very small (millimeters), and there is no "snap action" invloved. The result is a very durable sensor.

Top

Will the orifice of the pressure sensor be clogged?

The orifice has been enlarged to a maximum diameter and we don't expect to have obstruction problems from particles or chemical build-up (calcification, iron deposits). Since the orifice of the SubDrive 75 pressure sensor is larger than most, if not all standard pressure switches, there is less chance of obstruction compared to conventional systems. Although mounting orientation is not usually a problem, it is desirable to avoid mounting the sensor in an inverted orientation (with black part down). This could allow the orifice to collect debris and block the pressure sensing capability of the sensor.

Top

Does the SubDrive 75 use the same enclosure as the FE medium control box?

No

Top

What breaker size should I use?

It is possible to use a 15 or a 20 amp breaker with the SubDrive 75.

Top

Can I put SD 75 outside or in direct sunlight?

SD 75 should be installed inside and out of direct sunlight. Outside installations are possible if the SubDrive 75 controller is protected from wind-driven rain and temperature extremes, as long as the SubDrive and the surrounding area remain well-ventilated (see Installation Manual, page 10).

Top

Can I use this as a generic Variable Speed Drive?

At this time, SD 75 is not recommended for application other than submersible pumps.

Top

What happens if I put another submersible on it? (Motor other than FE)

The SubDrive 75 is designed to work with a 1 ½ Hp, 230 Volt, 3-phase motor. If another type of motor is used, it is very likely that the motor will never start. Also, the fault indications and motor protection features may not work properly.

Top

What size cable?

- Max: 390 ft of 12 AWG or 610 ft of 10 AWG (manual pg 11)
- lengths do not correspond to AIM manual due to max resistance requirements for fault detection

Top

Is this a special motor for SD 75?

No. The motor to be used with the SubDrive 75 is a standard 3-phase, 230 V, 1 1/2 Hp (23451492XX) that is readily available from pump suppliers.

Top

Can I use with generators or solar inverters?

Generators, Yes......Solar inverter, No

Top

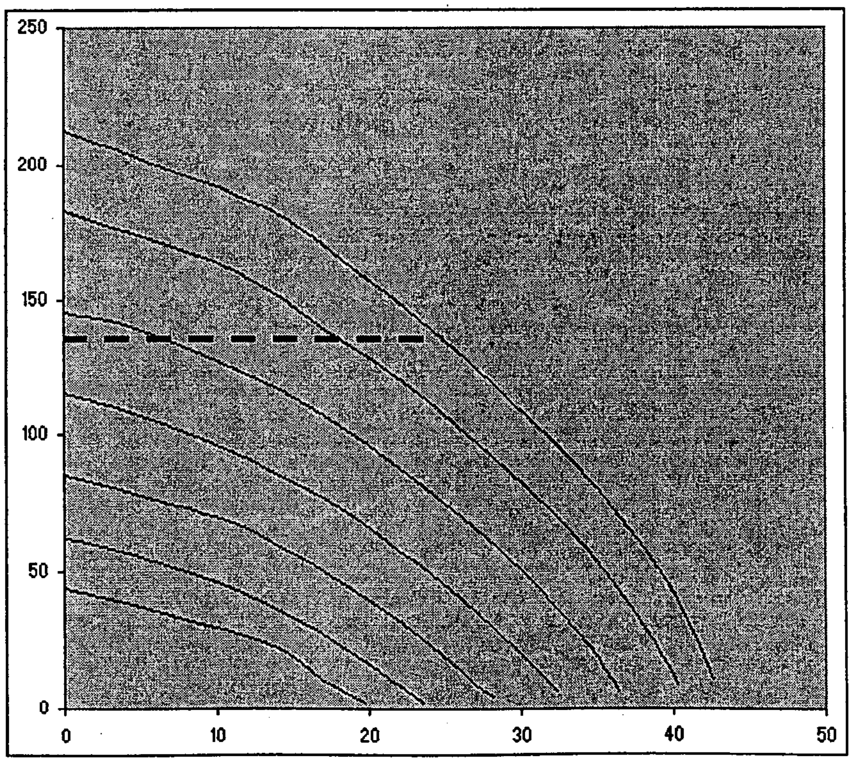
Can I mount this in a damp environment?

The SubDrive 75 should not be mounted where condensation can occur.

Top

Why does pressure fall off when the all faucets are open?

In this case, it is possible that the pump has reached its maximum performance for the flow demanded. At this point, the performance will follow the curve as in the case of a conventional pump (see graph below).



Another way that pressure at a particular tap may drop is simply due to restriction in the plumbing. If a faucet shares a branch with another tap, pressure at one may drop when the other is opened simply because there is restriction to that branch. Restriction increases with smaller pipe diameter, longer runs, or more elbows and tees. If the gauge reading agrees with the pressure setting but faucet pressure drops when another tap opens, the pressure drop is due to restriction downstream of the sensor.

If there is distance between the gauge and the pressure sensor, the pressure at the gauge can appear to rise and fall as flow varies. This is due to restriction between the gauge and the sensor. As flow increases, the difference between the pressures at the sensor vs. the gauge will be greater. The best practice is first to mount the pressure sensor as close to pressure tank as possible (with minimum restriction), then mount the gauge close to the sensor.

Top

Does the SubDrive 75 go to S.F. amps or to F.L.A.?

The maximum amp draw (S.F. Load) on a SubDrive 75 (motor lead from the controller to the motor) corresponds to the S.F. amps listed in the AIM manual for the 3-phase, 230 volt, 1 ½ Hp motor (5.9 amps).

Top

What happens if the pressure switch cable is cut?

The SubDrive 75 will shut off.

Top

Can I use SD75 in hot water applications (140 degrees)?

FE recommends de-rating the motor in hot water applications. Since the SD75 uses one motor type, this is not an option at this time.

Top

Can I use a GFCI with the SubDrive 75?

Due to the nature of the RFI filtering process in the SubDrive 75, a GFCI will most likely be tripped on start-up and the motor will not run.

Top

Can the motor run backward?

Yes. If the output leads to the motor are connected incorrectly, the motor will run in reverse. The first indication of this is typically a much lower production of water. The solution is to switch any two of the output leads.

Top

Home Corporate Submersible Division CMPD - Fractional HP Motors Fueling Systems International TOP

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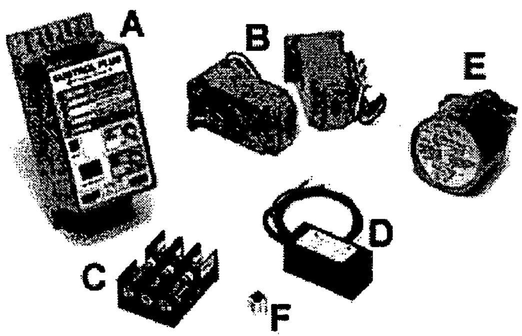
SUBTROL-PLUS



SUBTROL-PLUS offers superior protection for Franklin three phase six-and eight-inch water well motors. SUBTROL-PLUS tur the motor off when it senses an overload, underload, overheat, o rapid cycling condition. It provides a visual fault display and offer auto-restart capabilities.

A SUBTROL-PLUS kit can be easily installed in virtually any thre phase pump panel. Each kit includes:(1)

A. SUBTROL-PLUS receiver
B. Sensor coils (2)
C. fuse block w/fuses
D. suppressor module
E. lightning arrestor

SUBTROL-PLUS is calibrated to a specific Franklin motor by:

F. Rating Insert (2)

Rating Inserts must be ordered separately (see table below).

SUBTROL-PLUS overheat transmitters are standard in 40 through 150 horsepower Franklin three-phase submersible moto They are optional in six-inch 5 through 30 horsepower three-pha motors. The SUBTROL-PLUS kit must be used with a Subtrol-equipped motor for full protection.

Complete Kits

Volts	Horsepower	Kit Number(3)
200/220/230	up to 30	286 230 4000
380/460	up to 100	286 460 4000
380/460	125	286 460 4200
380/460	150	286 460 4400
575	up to 125	286 575 4000
575	150	286 575 4200

Rating Insert (2) (3)

SUBTROL-PLUS is calibrated to a specific Franklin motor by a rating insert, ordered separately from the table be

HP	200 Volt 50 Hz	200 Volt 60 Hz	220 Volt 50 Hz	230 Volt 60 Hz	380 Volt 60 Hz	460/380 Volt 60/50 Hz	575 Vol 60 Hz
5	152 041 950	152 040 901		152 040 902	152 040 941	152 040 903	152 040 9
7 1/2	152 041 951	152 040 905	152 041 901	152 040 906	152 040 942	152 040 907	152 040 9
10	152 041 952	152 040 909	152 041 904	152 040 910	152 040 943	152 040 911	152 040 9
15	152 041 953	152 040 913	152 041 907	152 040 914	152 040 944	152 040 915	152 040 9
20	152 041 954	152 040 917	152 041 910	152 040 918	152 040 945	152 040 919	152 040 9
25	152 041 955	152 040 921	152 041 913	152 040 922	152 040 946	152 040 923	152 040 9
30	152 041 956	152 040 925	152 041 916	152 040 926	152 040 947	152 040 927	152 040 9
40	152 041 957		152 041 919		152 040 948	152 040 929	152 040 9
50			152 041 922		152 040 949	152 040 931	152 040 9
60					152 140 930	152 040 933	152 040 9
75					152 140 931	152 040 935	152 040 9
100					152 140 932	152 040 937	152 040 9
125					152 140 933	152 140 901	152 140 9
150						152 140 903	152 140 9

A three-year warranty is available for SUBTROL-PLUS protected systems. Consult Franklin Electric for details.

FOOTNOTES:

(1) Individual kit components may be ordered separately as spare parts. See Dimensional Information

(2) Hp, hertz, and voltage of rating insert must match motor for complete motor protection.

(3) Consult factory for other voltage & horsepower ratings.

Click Here for Dimensional Informat

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Home Corporate Submersible Division EMPD - Fractional HP Motors Fueling Systems International

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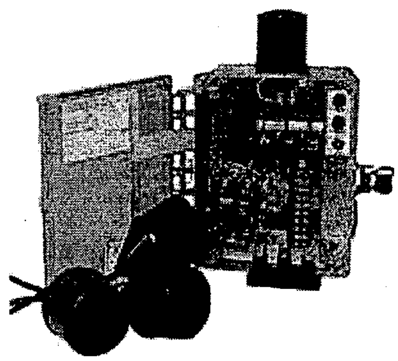
Electrical Control Panel

For Simplex Installations

An Electrical Control Panel is used on a Simplex pump application where automatic electrical cycling of the pump is desired for added protection in residential or commercial applications. A Control Panel is required for all systems using a nonautomatic pump. The built-in alarm system, a standard feature, can be connected to sound when the water level becomes unusually high. All electrical systems must be installed by a qualified electrician and according to the National Electrical Code. (See Section 430-71 though 430-113, plus any others that apply.)

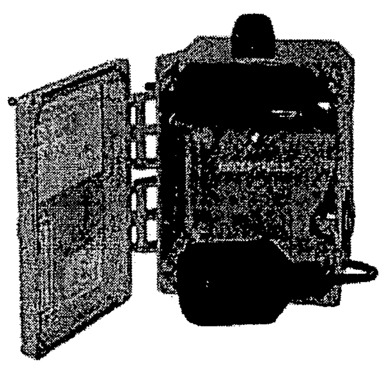
Single Phase Control Panel Features:

- 115-208-230 Volt/Single Phase.
- Clear dead front panel.
- Complete with (3) 20 ft. control float switches.
- Equipment disconnect.
- Motor contactor (all models except 10-1019 and 10-1023)
- NEMA 4X enclosure with lockable latch.
- Top mounted alarm light.
- Alarm horn provides audio warning of alarm condition *83 to 85 decibel rating.
- Pump run indicator light.
- Horn silence and test toggle switches.
- HOA switch.
- Complete installation instructions included.
- U.L. listed for US & Canada.
- 2 Year Warranty.
- Dry auxiliary contacts.



Single Phase Simplex Plug-in Control Panel:

- 115 model 10-1029 or 230 Volt model 10-1023.
- NEMA 4X enclosure with hinged cover.
- Receptacle for use with piggyback pump switch.
- Alarm Horn (83 to 85 decibel rating).
- Terminal strip.
- Horn silence switch to turn alarm on or off.
- Alarm Float only.



Three Phase Simplex Control Panel Features:

- 208-230-400-575 Volt/Three Phase.
- Nema 4X - watertight enclosure with lockable latch.
- Hand-off-toggle switch.
- Green pump run light.
- Alarm test & silence switches.
- Red alarm beacon and audible alarm for a high water condition (83 to 85 decibel rating.
- Motor protection switch with overload protection.
- Magnetic starter.
- Numbered terminal strip for connecting pumps and variable level float switches.
- Dry auxiliary contacts for remote alarm devices.
- Three or float float operation (floats not included - See FM0526).
- UL Listed.
- The use of off-the-shelf components provide for relatively easy field maintenance and repair.
- 2 Year Warranty.

Three Phase - Dead Front Cover

View the Catalog Sheet for Simplex Electrical Control Panels.
View the Recommended Applications for Simplex Electrical Control Panels (Requires **Adobe Acrobat Reader 3.0 or Higher.**)

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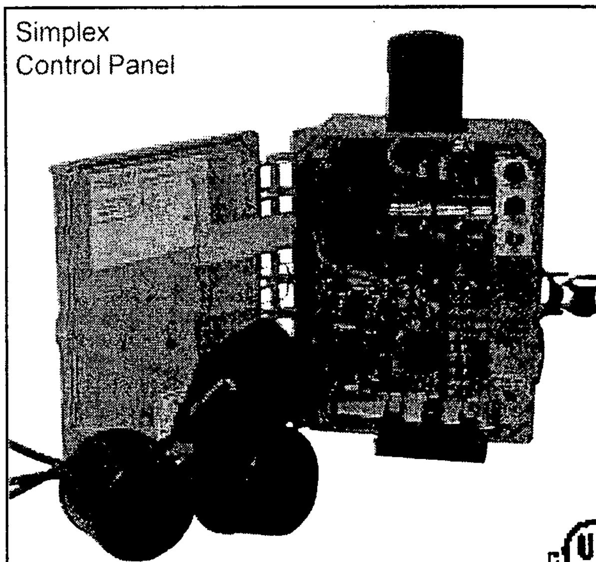
ELECTRICAL CONTROL PANELS - FOR SIMPLEX INSTALLATIONS

An Electrical Control Panel is used on a Simplex pump application where automatic electrical cycling of the pump is desired for added protection in residential or commercial applications. A Control Panel is required for all systems using a nonautomatic pump. The built-in alarm system, a standard feature, will activate when the water level becomes unusually high. All electrical systems must be installed by a qualified electrician and according to the National Electrical Code. (See Section 430-71 though 430-113, plus any others that apply.)

SINGLE PHASE CONTROL PANEL FEATURES

- 115-208-230 Volts.
- Clear dead front panel.
- Complete with (3) 20 ft. control float switches.
- Equipment disconnect.
- Motor contactor (all models except 10-1019 and 10-1023)
- NEMA 4X watertight enclosure with lockable latch.
- Top mounted alarm light.
- Alarm horn provides audio warning of alarm condition (83 to 85 decibel rating).
- Pump run indicator light.
- Horn silence and alarm test toggle switches.
- HOA switch.
- Complete installation instructions included.
- U.L. listed for US & Canada.
- Lockable Latch.
- 2 Year Warranty.
- Dry auxiliary contacts.

Simplex Control Panel

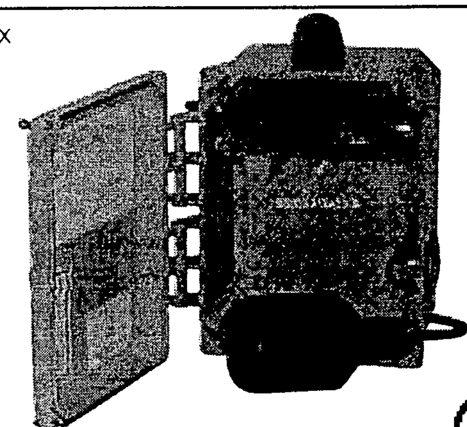


Model 10-0125

SINGLE PHASE SIMPLEX PLUG-IN CONTROL PANEL

- 115V model 10-1019 or 230V model 10-1023.
- NEMA 4X enclosure with hinged cover.
- Receptacle for use with piggyback pump switch.
- Alarm Horn (83 to 85 decibel rating).
- Terminal strip.
- Horn silence switch to turn alarm on or off.
- Alarm Float only.

Simplex Plug-In Panel



Model 10-1019

SINGLE PHASE SIMPLEX PUMP CONTROL/ALARM SYSTEM

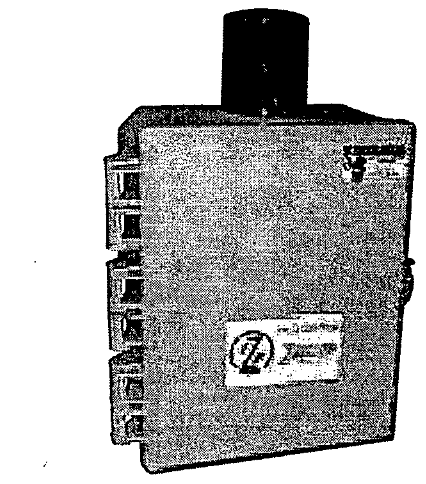
Model #	Volts	Amp Range	Float Switches Included	Features
10-1019	115V	0-15	Alarm Float Only	Plug-In
10-1023	230V	0-15	Alarm Float Only	Plug-In
10-1036	115V, 208-230V	0-7	Three-20' Control Floats	Circuit Breaker Disconnect
10-1037	115V, 208-230V	7-15	Three-20' Control Floats	Circuit Breaker Disconnect
10-1038	115V, 208-230V	15-20	Three-20' Control Floats	Circuit Breaker Disconnect
10-0125*	115V, 208-230V	0-20	Three-20' Control Floats	Pull Out Disconnect

NOTE: 600 and 700 Series single phase pumps require special panels that include start components. See Selection Guide FM1228 for correct panel selection.

(1) Alarm Float Switch not included, purchase separately. See FM0526.
* 10-0125 Branch Circuit Protection provided by the installing electrician.

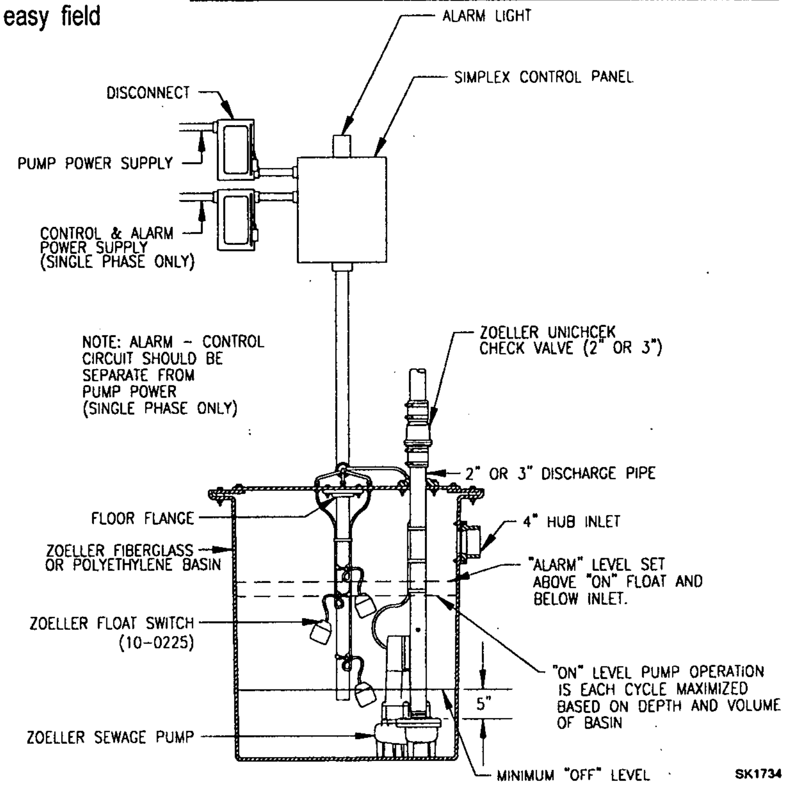
THREE PHASE SIMPLEX CONTROL PANEL FEATURES

- 208-230-460-575 Volts.
- Nema 4X - watertight enclosure with lockable latch.
- Hand-off-toggle switch.
- Green pump run light.
- Alarm test & silence switches.
- Red alarm beacon and audible alarm for a high water condition (83 to 85 decibel rating).
- Motor protection switch with overload protection.
- Magnetic starter.
- Numbered terminal strip for connecting pumps and variable level float switches.
- Dry auxiliary contacts for remote alarm devices.
- Three or four float operation (floats not included - See FM0526).
- UL Listed.
- The use of off-the-shelf components provide for relatively easy field maintenance and repair.
- 2 Year Warranty.



Three Phase - Dead Front Cover

THREE PHASE SIMPLEX PUMP CONTROL PANELS			
MODEL #	DIMENSIONS	VOLTS	AMP RANGE
10-1074	12 X 10 X 6	208/230/460	1.1 - 1.6
10-1075	12 X 10 X 6	208/230/460	1.4 - 2.0
10-1076	12 X 10 X 6	208/230/460	1.8 - 2.5
10-1077	12 X 10 X 6	208/230/460	2.2 - 3.2
10-1078	12 X 10 X 6	208/230/460	2.8 - 4.0
10-1079	12 X 10 X 6	208/230/460	3.5 - 5.0
10-1080	12 X 10 X 6	208/230/460	4.5 - 6.3
10-1081	12 X 10 X 6	208/230/460	5.5 - 8.0
10-1082	12 X 10 X 6	208/230/460	7.0 - 10.0
10-1083	12 X 10 X 6	208/230/460	9.0 - 12.5
10-1084	12 X 10 X 6	208/230/460	11.0 - 16.0
10-1085	12 X 10 X 6	208/230/460	14.0 - 20.0
10-1133	12 X 10 X 6	575	2.2 - 3.2
10-1134	12 X 10 X 6	575	2.8 - 4.0



SEQUENCE OF OPERATION FOR SIMPLEX PANEL

1. Operation can begin after the following:
   - Correct voltage is supplied to Panel
   - A good ground is supplied to Panel
   - Pump is connected correctly to Panel or Starter Pak
   - Panel Circuit Breaker is closed
   - Floats are installed properly
   - Overload Protection is adjusted to Pump nameplate amps
   - Pump HOA Switch is set to "Auto"
   - Control On/Off Switch is set to "On"
2. When the "Stop" and "Start" floats are closed the Pump will energize and the External Pump Run Light will illuminate. The Pump will remain operational until the "Stop" float opens.
3. In the event the liquid level continues to rise the "Alarm" float will be closed. When the "Alarm" float is closed the following will occur:
   - The External High Water Light will illuminate
   - The Audible High Water Horn will sound
   - The Auxiliary Dry Contacts will close
4. The Audible High Water Horn can be silenced by pressing the Alarm Silence Button. When the "Alarm" float is opened the External High Water Light, Audible High Water Horn and Dry Auxiliary Contacts will be reset.
5. If the Pump is equipped with a Thermal Cutout Circuit the Pump will deactivate in the event the motor temperature becomes excessive.
6. If the Pump is equipped with a Seal Failure Relay the Seal Failure Indicator will illuminate in the event the Pump lower seal fails.

   NOTE: The Seal Failure Relay does not deactivate the Pump.

*A Three Phase Panel has a multi-tap transformer with secondary fusing.

⚠ CAUTION All electrical systems must be installed by a qualified licensed electrician according to the National Electrical Code. (See section 430-71 through 430-113 plus any others that apply)

Refer to FM1228 for correct selection of Simplex Panels.

CPChem™

PERFORMANCE PIPE™

a division of Chevron Phillips Chemical Company LP

Polyethylene Piping for Water Distribution and Transmission

Bulletin: PP 501

Municipal Water Distribution
Industrial Water Distribution
Raw and Potable Water
Water Transmission
Potable Water Fire Main

High Density Polyethylene Piping For Water Distribution and Transmission

Municipal Water Distribution
Industrial Water Distribution
Raw and Potable Water
Water Transmission
Potable Water Fire Main

Performance Pipe

PERFORMANCE PIPE is the successor to Plexco[1] and Driscopipe[2]. On July 1, 2000, Chevron Chemical Company and Phillips Chemical Company joined to form Chevron Phillips Chemical Company LP. Performance Pipe, a division of Chevron Phillips Chemical Company LP, succeeds Plexco and Driscopipe as North America's largest producer of polyethylene piping products for gas, industrial, municipal, mining, oilfield, and utility applications.

Performance Pipe offers more than forty years of polyethylene piping experience, twelve ISO Certified manufacturing facilities in nine states, and two manufacturing facilities in Mexico.

Performance Pipe manufactures 1/2" through 54" outside diameter controlled polyethylene pipe and tubing, 18" through 120" DriscoPlex™ 2000 Spirolite® inside diameter controlled polyethylene profile-wall pipe, molded fittings, fabricated fittings, manholes, tanks, and fabricated structures for domestic and international markets.

To enhance the outstanding quality and performance of Performance Pipe™ polyethylene piping, Chevron Phillips Chemical Company LP further strengthens Performance Pipe with over four decades of quality polyolefin plastic resin production.

DRISCOPLEX™ Piping for Water Distribution and Transmission

Polyethylene pressure pipe is used worldwide for water distribution and transmission systems as the preferred material of construction. DriscoPlex™ OD-controlled, high-density polyethylene pipe, fittings and connection components are a complete, integrated system developed specifically for water distribution and transmission. DriscoPlex™ 4000 and DriscoPlex™ 4100 high-density polyethylene piping components are made from pressure-rated PE 3408, extra-high molecular weight, high-density polyethylene material to provide an optimum balance of performance and properties to meet the stringent demands of today's municipal and industrial water distribution and transmission systems.

[1] Formerly - Plexco, a Division of Chevron Chemical Company
[2] Formerly - Phillips Driscopipe, A Division of Phillips Petroleum Company

NOTICE - This publication is intended for use as a guide to support the designer of piping systems. It is not intended to be used as installation instructions, and should not be used in place of the advice of a professional engineer. It does not constitute a guarantee or warranty for piping installations. Performance Pipe has made every reasonable effort to ensure the accuracy of this publication, but it may not provide all necessary information, particularly with respect to special or unusual applications. This publication may be changed from time to time without notice. Contact Performance Pipe to determine if you have the most current edition.

Why Polyethylene Piping is Preferred for Water Distribution

DriscoPlex™ 4000 and DriscoPlex™ 4100 PE 3408 piping products for water distribution have outstanding performance features for municipal and industrial water distribution.

- High strength and stiffness to withstand long-term internal pressure and external loads.
- Long-term strength for extended life and performance.
- Resilience for enhanced resistance to recurrent and intermittent surge and water hammer.
- Flexible, tough, lightweight and impact resistant for lower cost installation, narrower trenches (reduced excavation)
- Fewer fittings required - Flexible PE pipe can be cold-bent in the field to follow contours and easements, reducing the need for fittings.
- DriscoPlex™ 4000 and DriscoPlex™ 4100 PE 3408 piping is the material of choice for horizontal directional drilling, plowing, river and water body crossings, pipe bursting, sliplining and other trenchless installation technologies.

- Chemical resistance to withstand corrosive chemicals (pH from I to 14), and aggressive soils.
- Does not rust, rot, corrode, tuberculate or support biological growth.
- Resistant to ultraviolet and thermal degradation.
- Can be connected using heat fusion, electrofusion, heat fusion saddles, mechanical couplings, flanges, mechanical-joint adapters and mechanical service and tapping saddles[3].
- Leak-tight heat fusion joints are fully restrained and as strong as the pipe itself.
- Retains flexibility even in sub-freezing temperatures - water can freeze in the pipe without damaging the pipe.
- Retains low resistance to liquid flows for reduced pumping and operating costs.

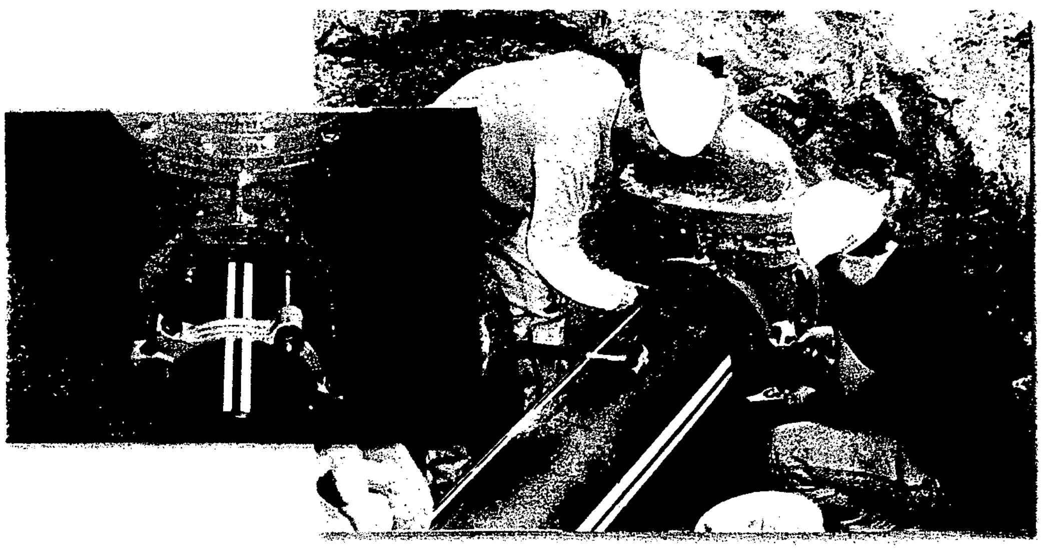
[3]Performance Pipe recommended heat fusion procedures available upon request. Electrofusion devices should be installed in accordance with the device manufacturer's instructions. Stiffeners should be installed in the ID of the pipe end or plain-end fitting outlet when OD compression couplings are used. Install mechanical joining devices in accordance with the device manufacturer's instructions. Additional restraint may be required for mechanical joining devices that do not provide sufficient pullout resistance.

- Standard colors for water service identification:
- DriscoPlex™ 4000 and DriscoPlex™ 4100 pipe can be tapped with standard tapping equipment and mechanical tapping saddles for HDPE pipe.
- Safe - no extractable additives or compounds that could compromise water quality - NSF Certification available.
- DriscoPlex™ 4000 and DriscoPlex™ 4100 are manufactured in accordance with AWWA C906 and ASTM F 714 (Sizes > 4")[4].

Table 1 DRISCOPLEX™ Color Identification

Series	IPS/DIPS	Standard Color Identification	Also Available
DRISCOPLEX™ 4000	DIPS	3 equally spaced pairs of blue stripes	Blue shell
DRISCOPLEX™ 4100	IPS	Black	4 equally spaced blue stripes or blue shell
DRISCOPLEX™ 1500	IPS	4 equally spaced red stripes (NSF approved)	4 equally spaced blue stripes (NSF approved)
DRISCOPLEX™ 1600	DIPS	3 equally spaced pairs of red strips (Not NSF approved)	3 equally spaced pairs of blue strips (NSF approved)

DriscoPlex™ 4000 4" DIPS through 48" DIPS pressure pipe sizes are OD compatible with ductile iron pipe. DriscoPlex™ 4100 3" IPS through 54" IPS pressure pipe sizes are OD compatible with steel pipe. DriscoPlex™ 4000 and DriscoPlex™ 4100 piping components are produced in four standard Pressure Classes - 80 psi, 100 psi, 130 psi and through 160 psi - for water at 73°F (23°C). Additional pressure classes below 80 psi and up to 255 psi are available depending upon pipe size. NSF Certification in accordance with NSF Standard 61 is available for potable water applications. DriscoPlex™ Series water piping products are summarized on the following page.



[4] 3" pipe manufactured to AWWA C901 and ASTM F714; pipe < 3" manufactured to AWWA C901 and ASTM D3035.

Table 2 DRISCOPLEX™ Products for Municipal and Industrial Applications

Typical Markets for Pipe and Fittings	DRISCOPLEX™ Series	Typical Features	Previous Designations	
			Former Plexco Product	Former Driscopipe
Water Distribution	DRISCOPLEX™ 4000	5, 6	BLUESTRIPE™ (DIPS)	4000 BLUESHELL (DIPS)
	DRISCOPLEX™ 4100	1, 2, 8	BLUESTRIPE™ (IPS)	4100 BLUESHELL (IPS)
Water Service Tubing	DRISCOPLEX™ 5100	7	BLUESTRIPE™	5100 ULTRA-LINE®
	DRISCOPLEX™ 1500	3	BLUESTRIPE™ FM	—
FMR & NSF Approved Underground Fire Main	DRISCOPLEX™ 1600	4	—	—

NOTICE. Capabilities vary from manufacturing plant to manufacturing plant. Contact Performance Pipe to determine the availability of specific products and for the availability of particular stripe or shell colors, striping patterns, and IPS or DIPS sizing.

Legend for Typical Features:

1. IPS sizing system. Blue color stripes or blue color shell available on special order. The IPS longitudinal color stripe pattern is four equally spaced single color stripes extruded into the pipe OD.
2. 3" IPS – 28" IPS DR 11, 13.5, 17, 21; 30" IPS – 36" IPS DR 13.5, 17, 21; 42" IPS DR 17, 21; 48" IPS – 54" IPS DR 21
3. FMR Approved, NSF Approved and made to ASTM F 714 (2" is made to D 3035). 2" IPS through 24" IPS Class 150 or Class 200. Blue color stripes standard. The IPS longitudinal color stripe pattern is four equally spaced single color stripes extruded into the pipe OD.
4. FMR Approved, NSF Approved and made to ASTM F 714. 4" DIPS through 24" DIPS Class 150 or Class 200. Blue color stripes standard. The DIPS longitudinal color stripe pattern is three equally spaced pairs of color stripes extruded into the pipe OD.
5. DIPS sizing system. Blue color stripes standard. The DIPS longitudinal color stripe pattern is three equally spaced pairs of color stripes extruded into the pipe OD.
6. 4" DIPS through 30" DIPS DR 11, 13.5, 17, 21; 36" DIPS through 40" DIPS DR 13.5, 17, 21; 48" DIPS DR 17, 21. All sizes made to ASTM F 714, AWWA C906 and NSF 61.
7. NSF Approved. CTS, IPS, and SIDR in 1/2" – 2" sizes. No color stripes.
8. 2" IPS and 3" IPS made to ASTM D 3035, AWWA C901 and NSF 61. 4" IPS and larger sizes made to ASTM F 714, AWWA C906 and NSF 61.

This bulletin primarily addresses DriscoPlex™ 4000 and DriscoPlex™ 4100 products. For information on DriscoPlex™ 5100 products, see Bulletin PP-503. For information on DriscoPlex™ 1500 and DriscoPlex™ 1600 FM Approved products, see Bulletin PP-504.

Table 3 DRISCOPLEX™ 4000 - DIPS Pipe Sizing System

Size		DR 21 (80 psi PC†)		DR 17 (100 psi PC)		DR 13.5 (130 psi PC)		DR 11 (160 psi PC)	
DIPS Pipe Size	OD, in.	Minimum Wall, in.	Weight‡, lb/ft	Minimum Wall, in.	Weight, lb/ft	Minimum Wall, in.	Weight, lb/ft	Minimum Wall, in.	Weight, lb/ft
4◊	4.80	0.229	1.44	0.282	1.75	0.356	2.17	0.436	2.61
6	6.90	0.329	2.97	0.406	3.62	0.511	4.48	0.627	5.39
8	9.05	0.431	5.11	0.532	6.23	0.670	7.71	0.823	9.28
10	11.10	0.529	7.68	0.653	9.37	0.822	11.60	1.009	11.95
12	13.20	0.629	10.86	0.776	13.25	0.978	16.40	1.200	19.73
16	17.40	0.829	18.87	1.024	23.02	1.289	28.49	1.582	34.29
18	19.50	0.929	23.70	1.147	28.92	1.444	35.78	1.773	43.07
20	21.60	1.029	29.08	1.271	35.48	1.600	43.91	1.964	52.84
24	25.80	1.229	41.05	1.518	50.62	1.911	62.64	2.345	75.39
30††	32.00	1.524	63.83	1.882	77.86	2.370	96.38	2.909	115.99
36††	38.30	1.824	91.43	2.253	111.54	2.837	138.04		
42††	44.50	2.119	123.44	2.618	150.60	3.296	186.35		
48††	50.80	2.419	160.86	2.988	196.27				

† Pressure class ratings are for water at 80°F (27°C) or less. Pressure class ratings can vary for other fluids and service temperatures. ◊ OD size and minimum wall thickness per AWWA C906. For flow calculations, average ID may be estimated using: Avg. ID = OD Size – (2.12 x min. wall). For actual ID (for stiffeners, etc.), consult AWWA C906 for tolerances and other factors affecting pipe ID. ‡ Pipe weight calculated per PPI TR-7. †† 30" DIPS and larger sizes subject to minimum order quantities.

Table 4 DRISCOPLEX™ 4100 - IPS Pipe Sizing System

Size		DR 21 (80 psi PC†)		DR 17 (100 psi PC)		DR 13.5 (130 psi PC)		DR 11 (160 psi PC)	
DIPS Pipe Size	OD, in.	Minimum Wall, in.	Weight‡, lb/ft	Minimum Wall, in.	Weight, lb/ft	Minimum Wall, in.	Weight, lb/ft	Minimum Wall, in.	Weight, lb/ft
3*	3.500	0.167	0.77	0.206	0.93	0.259	1.15	0.318	1.39
4◊	4.500	0.214	1.26	0.265	1.54	0.333	1.90	0.409	2.29
6	6.625	0.315	2.73	0.390	3.34	0.491	4.13	0.602	4.97
8	8.625	0.411	4.64	0.507	5.65	0.639	7.00	0.784	8.42
10	10.750	0.512	7.21	0.632	8.78	0.796	1.087	0.977	13.09
12	12.750	0.607	10.23	0.750	12.36	0.944	15.29	1.159	18.41
14	14.000	0.667	12.22	0.824	14.91	1.037	18.44	1.273	22.20
16	16.000	0.762	15.96	0.941	19.46	1.185	24.09	1.455	29.00
18	18.000	0.857	20.19	1.059	24.64	1.333	30.48	1.636	36.69
20	20.000	0.952	24.93	1.176	30.41	1.481	37.63	1.818	45.30
22	22.000	1.048	30.18	1.294	36.80	1.630	45.56	2.000	54.82
24	24.000	1.143	35.91	1.412	43.81	1.778	54.21	2.182	65.24
26††	26.000	1.238	42.14	1.529	51.39	1.926	63.62	2.364	76.55
28††	28.000	1.333	48.86	1.647	59.62	2.074	73.78	2.545	88.79
30††	30.000	1.429	56.12	1.765	68.45	2.222	84.69		
32††	32.000	1.524	63.84	1.882	77.86	2.370	96.35		
36††	36.000	1.714	80.78	2.118	98.57	2.667	121.98		
42††	42.000	2.000	109.97	2.470	134.15				
48††	48.000	2.286	143.65						
54††	54.000	2.571	181.80						

† Pressure class ratings are for water at 80°F (27°C) or less. Pressure class ratings can vary for other fluids and service temperatures. * 3" IPS OD and minimum wall thickness per AWWA C901. ◊ 4" IPS and larger OD and minimum wall thickness per AWWA C906. For flow calculations, Avg. ID may be estimated by: Avg. ID = OD Size – (2.12 x min. wall). Consult AWWA C906 for tolerances and other factors affecting actual pipe ID. ‡ Pipe weight calculated per PPI TR-7. †† 26" IPS and larger sizes subject to minimum order quantities.

Pressure Rating

Water system piping must be designed for the continuous internal pressure and for transient (surge) pressures imposed by the particular application. DriscoPlex™ PE 3408 high-density polyethylene pipe provides a unique balance of properties that are especially well suited for water distribution and transmission. DriscoPlex™ PE 3408 HDPE has outstanding long-term strength that provides durability for long-term continuous internal pressure service. DriscoPlex™ PE 3408 HDPE also provides exceptional ductile elastic properties that provide exceptional fatigue resistance and reserve strength necessary for recurrent or intermittent pressure surges.

Continuous Internal Pressure

The continuous internal pressure, exclusive of transient pressure surges, is defined as "working pressure". A pipe's working pressure capacity is a function of the allowable hoop stress and pipe thickness. Allowable hoop stress is determined by testing plastic pipe at various internal pressures, analyzing the test data, and categorizing the result. The categorized result is defined as the hydrostatic design basis (HDB). The HDB is used in the pressure rating equations that follow.

Table 5 HDB for Performance Pipe™ PE 3408

Service Temperature	Hydrostatic Design Basis, HDB
73°F (23°C)	1600 psi (11.03 MPa)
140°F (60°C)	800 psi (5.52 MPa)

Pressure Surge

When there is a sudden increase or decrease in water system flow velocity, a pressure surge will occur. Recurrent pressure surges, P_{RS}, are repetitive surge events that occur frequently such as during pump start-stop operation. Occasional pressure surges, P_{OS}, are irregularly occurring surges such as a sudden flow change due to firefighting or check valve operation. Surge pressure magnitude corresponds directly to velocity change; greater velocity change produces greater surge pressure. The magnitude of a pressure surge due to a rapid flow velocity change may be approximated by the following equations:

$$P_S = \frac{aV}{2.31\,g} \qquad a = \frac{4660}{\sqrt{1 + \frac{K}{E}(DR - 2)}}$$

Where:

P_S	=	pressure surge, lb/in²
a	=	wave velocity, ft/s
g	=	acceleration of gravity, 32.2 ft/s²
V	=	flow velocity change, ft/s
E	=	instantaneous elastic modulus for PE, lb/in² (150,000 lb/in² for PE 3408 at ≤80°F)
K	=	liquid bulk modulus, lb/in² (300,000 lb/in² for water at ≤80°F)
DR	=	pipe dimension ratio

$$DR = \frac{OD}{t_{min}}$$

OD	=	pipe outside diameter, in
t_{min}	=	pipe minimum wall thickness, in

With its unique ductile elastic properties, flexibility, resilience and superb fatigue resistance, DriscoPlex™ 4000 and DriscoPlex™ 4100 pipes have tremendous tolerance for surge cycles. Its low elastic modulus provides a dampening mechanism for shock loads. These short-term properties result in lower surge pressures compared to more rigid systems such as steel, ductile iron or PVC. For the same velocity change in water piping systems, surge pressures in DriscoPlex™ 4000 and DriscoPlex™ 4100 polyethylene pipe are about 86% less than in steel pipe, about 80% less than in ductile iron pipe and about 50% less than in PVC pipe.

Unlike other plastic and metal pipes, surge pressures in DriscoPlex™ 4000 and DriscoPlex™ 4100 polyethylene pipe are handled above the working pressure capacity of the pipe.

Pressure Class (PC)

AWWA uses the term "Pressure Class" to define the pressure capacity under a pre-defined set of operating conditions. For polyethylene, the PC denotes the maximum allowable working pressure for water with a predefined allowance for pressure surges and a maximum pipe operating temperature of 80 °F.

$$PC = \frac{2 \times HDB \times DF}{(DR - 1)}$$

Where terms are previously defined and:

PC	=	pressure class, lb/in²
HDB	=	hydrostatic design basis for PE 3408, lb/in² (Table 5)
DF	=	design factor (0.50 for clean water)

Table 6 shows Pressure Class ratings, surge allowance and corresponding allowable sudden change in flow velocity for standard DR's of DriscoPlex™ 4000 and DriscoPlex™ 4100 water pipe.

Table 6 Pressure Class, Surge Allowance and Corresponding Sudden Velocity Change for Pipe Operating at 80 °F

DR	PC, psi	Recurring Surge Events - P_{RS}		Occasional Surge Events - P_{OS}	
		Surge Allowance, P_{RS}, lb/in^2	Corresponding Sudden Velocity Change, ft/s	Surge Allowance, P_{OS}, lb/in^2	Corresponding Sudden Velocity Change, ft/s
21	80	40.0	4.0	80	8.0
17	100	50.0	4.4	100	8.9
13.5	128	64.0	5.0	128	10.0
11	160	80.0	5.6	160	11.1

For the vast majority of municipal systems, DriscoPlex™ 4000 and DriscoPlex™ 4100 polyethylene water pipe have considerably more surge and velocity capabilities than necessary, even under temporary high flow conditions such as flushing or fire-fighting.

- Surge allowance and temperature effects vary from pipe material to pipe material and erroneous conclusions may be drawn when comparing the PC of two different piping materials. For instance, the PC defined by AWWA for C900 PVC pipe includes a surge allowance corresponding to a flow velocity of 2 ft/sec. At flow velocities greater than 2 ft/sec, C900 PVC pipe should be de-rated. When both working pressure capacity and surge capacity are accounted for at velocities approaching 5 ft/sec, virtually the same DR is required for C906 PE and C900 PVC.

Working Pressure Rating (WPR)

As described, a pipeline containing flowing liquid is periodically subjected to two modes of hydrostatic stress: sustained stress from working pressure and transient stress from sudden water velocity changes. The pipe must be designed to handle both stress modes. As defined in AWWA Standards, Working Pressure Rating (WPR) is the capacity to resist working pressure (WP) with sufficient capacity against the actual anticipated positive pressure surges above working pressure. The only "pressure rating" the water distribution system designer should consider is the Working Pressure Rating, WPR. The sustained operating pressure applied to the pipe (working pressure) must be no greater than the WPR. Pressure Class and Working Pressure Rating are closely related. Pressure Class is a rating based on operating conditions that are predefined in the AWWA Standard, where WPR is calculated based on the anticipated operating conditions of the actual application. The predetermined Pressure Class from the AWWA Standard may or may not be appropriate for the actual application.

The following relationship between WP, WPR, and PC applies:

$$WP \leq WPR \leq PC$$

Working Pressure Rating for Typical Operating Conditions

When expected flow velocities are within the limits given in Table 6, and the pipe operates at 80 °F or less, the following equation applies:

$$WPR = PC$$

Working Pressure Rating for Other Operating Conditions

In applications where the pipe operates at temperatures above 80 °F or where exceptionally high flow demands exceed the PC surge allowance, WPR must be calculated. WPR is equal to the lesser of the following three conditions:

Condition 1 The pipe's nominal PC adjusted for temperature when above 80°F:

$$WPR = (PC)\, F_T$$

or

Condition 2 One and one half times the pipe's PC adjusted for temperature less the maximum pressure resulting from recurring pressure surges (P_{RS}):

$$WPR = 1.5\,(PC)\, F_T - P_{RS}$$

or

Condition 3 Two times the pipe's PC adjusted for temperature less the maximum pressure resulting from occasional pressure surges (P_{OS}):

$$WPR = 2.0\,(PC)\, F_T - P_{OS}$$

Surge allowance, P_{RS} or P_{OS}, may be approximated using the equations in "Pressure Surge" above. As the equations show, operating at a working pressure less than the pipe's nominal PC provides additional surge pressure capacity.

Temperature reduction factors, FT, are presented in Table 7. (See following page)

Table 7 Temperature Factor, F_T

Service Temperature, °F (°C)	≤ 80 (27)†	≤ 90 (32)	≤ 100 (38)	≤ 110 (43)	≤ 120 (49)	≤ 130 (54)	≤ 140 (60)‡
Temperature Factor, F_T	1.00	0.90	0.78	0.75	0.63	0.60	0.50

† Use 80°F (27°C) service factor for 80°F (27°C) and lower service temperatures. ‡ The maximum service temperature for DRISCOPLEX™ PE 3408 pressure pipe is 140°F (60°C).

Water Flow

DriscoPlex™ 4000 and DriscoPlex™ 4100 piping has unique surface properties that reduce flow resistance, and help retain reduced flow resistance properties over the long term. HDPE has a water repellent surface that does not rust, rot, corrode, tuberculate or support biological growth. Turbulence at moderate flow velocities helps prevent deposition and sedimentation to help retain long-term reduced flow resistance and reduce the need for maintenance flushing.

Designers use various methods to determine flow resistance. For traditional flow resistance equations developed by Darcy-Weisbach, Fanning, Colebrook, and Moody, an absolute roughness of 5 x 10^{-6} ft. (1 x 10^{-8} m) is typically used in design. For the empirical Hazen-Williams formula (given below), a C-Factor of 150-155 is typically used in design.

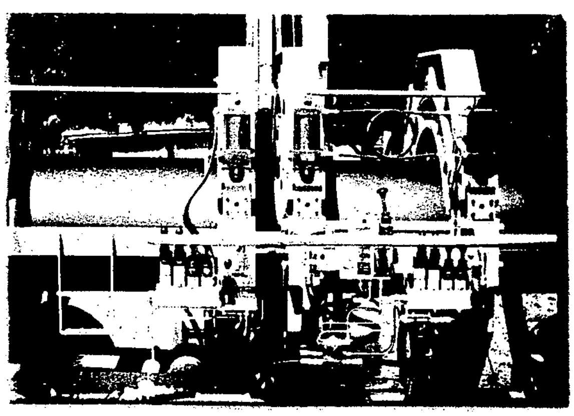
$$h_f = 0.002083\, L \left(\frac{100}{C}\right)^{1.85} \left(\frac{Q^{1.85}}{d^{4.8655}}\right)$$

$$p_f = 0.0009015\, L \left(\frac{100}{C}\right)^{1.85} \left(\frac{Q^{1.85}}{d^{4.8655}}\right)$$

Where h_f = friction (head) loss for water, ft.
L = pipe length, ft.
C = C-Factor
Q = flow, gal/min
d = pipe inside diameter, in.
p_f = friction loss for water, psi

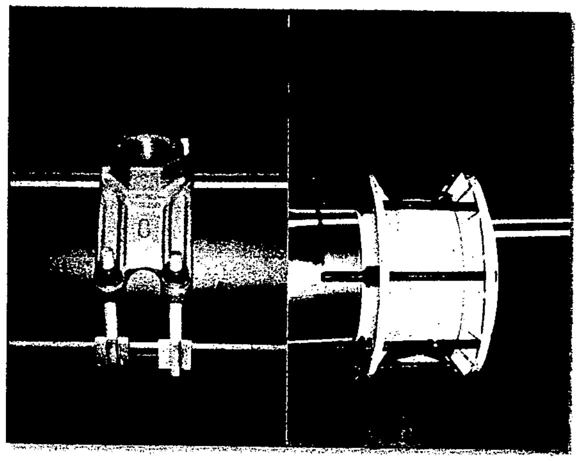
Joining

DriscoPlex™ Series HDPE pipe and fittings are joined using heat fusion, flanges, mechanical connections that are designed for PE pipe, and electrofusion. Heat fusion is a simple, visual procedure that utilizes controlled temperature and pressure to melt and fusion-join PE pipe materials together. Butt fusion is used to join components end to end; saddle fusion to attach a branch outlet to a main pipe, and socket fusion to join smaller pipes to socket fittings. Heat fusion joints are reliable, leak-free, fully restrained, and as strong as the pipe itself. Contact Performance Pipe for recommended joining procedures.

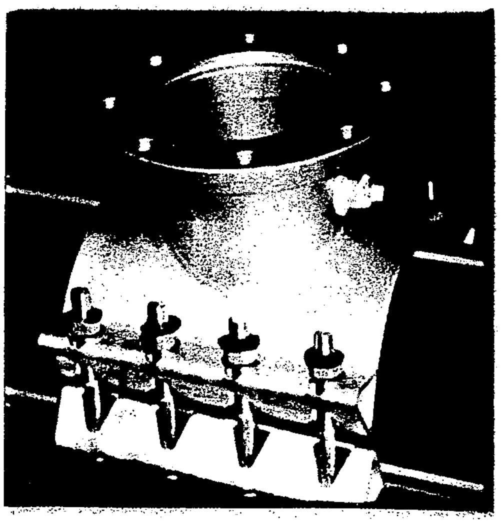


With heat fusion, there are no gaskets to leak, joint restraints are not required, and thrust blocks are necessary only under unusual circumstances. A leakage allowance common to gasketed-bell-and-spigot joined pressure pipes is unnecessary with the Performance Pipe™ PE 3408 pressure piping system. Heat fusion joints are fully restrained and as strong as the pipe itself. Because water flow pressure cannot push heat fusion joined off the pipe end, thrust blocks are not required. Thrust anchoring may be required to control Poisson effect forces where PE pipes are connected to bell and spigot piping.

Performance Pipe PE 3408 pipe and fittings may also be joined together or transitioned to other materials with flanges, mechanical connections that are designed for PE pipe, or electrofusion. These connections must be made in accordance with the connection manufacturer's instructions. Some connections such as mechanical OD compression couplings may require a stiffener in the pipe bore.



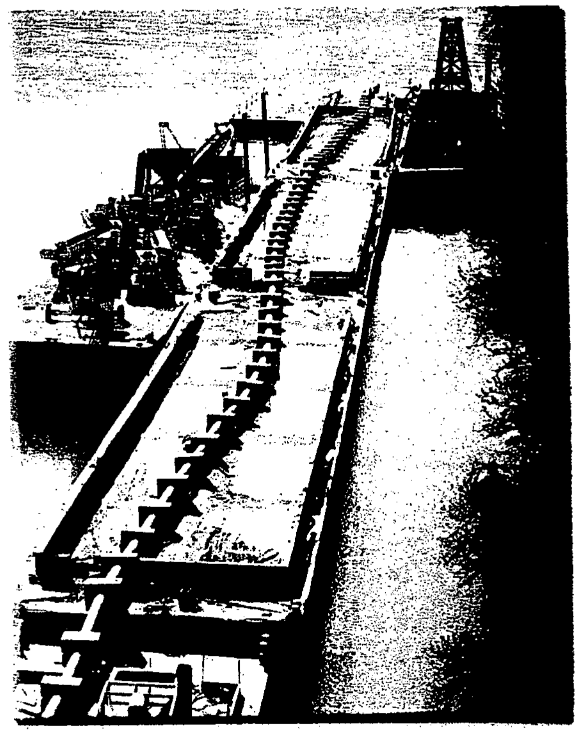
DriscoPlex™ Series HDPE piping products cannot be joined with adhesive or solvent cement. Threaded joining and joining by hot air (hot gas) or extrusion welding techniques are not recommended for pressure service.



Tapping

DriscoPlex™ 4000, DriscoPlex™ 4100, DriscoPlex™ 1500 and DriscoPlex™ 1600 may be tapped with conventional water main tapping equipment. The tapping operation is essentially the same as that used for any water main. A tapping sleeve for HDPE pipe is installed on the main, an open tapping valve is connected to the sleeve, and then a tapping machine is connected to the valve. A rotating shell cutter in the tapping machine is advanced through the pipe wall, and then retracted. The valve is closed and the tapping machine is removed. Branch line piping is then connected to the valve. When the main is not pressurized, the valve can be omitted. For HDPE piping, the tapping machine shell cutter has few teeth and large chip clearance between the teeth.

Installation



DriscoPlex™ 4000 and DriscoPlex™ 4100 piping materials are stabilized against UV degradation and can be permanently installed on or above the surface[5]. Surface and above grade applications must be properly supported, and must take thermal expansion and contraction into account. If the external environment subjects the line to freezing conditions, water in the pipe may freeze, however, the pipe will expand as the ice forms and will not break. To prevent freezing, the line may be insulated and may be heat traced if necessary. Heat tracing equipment should not exceed 120°F (49°C).

Although DriscoPlex™ 4000 and DriscoPlex™ 4100 piping can be installed on or above grade, most water applications are installed underground. (DriscoPlex™ 1500 and DriscoPlex™ 1600 piping must be installed underground.) Installation methods include direct burial, horizontal directional drilling, pulling, plowing and planting.

DriscoPlex™ 4000 and DriscoPlex™ 4100 are also used to rehabilitate existing pipelines. Rehabilitation techniques include sliplining, pipe bursting, and proprietary techniques for installing tight-fitting liners.

Direct Burial

Direct burial involves opening a trench, laying the pipe in the trench, then backfilling with appropriate materials. Pipes are joined into long strings before placing them in the trench. DriscoPlex™ 4000 and DriscoPlex™ 4100 pipes should be installed in accordance with ASTM D 2774 *Standard Practice for Underground Installation of Thermoplastic Pressure Piping.*

Like all piping materials, HDPE piping must be properly installed. HDPE is a flexible piping material that works together with its soil embedment to sustain the earthloads and live loads above it. Suitable embedment soils are required to provide support around the pipe, and embedment soils must be placed so that the pipe is properly surrounded in embedment materials. In general, coarse, angular sands and gravels are preferred, but other materials may be used under the direction of the design engineer. See ASTM D 2774 for embedment material size. Embedment materials must be placed in the haunch areas below the pipe springline and above the pipe so that the pipe is fully encapsulated without voids in the embedment. Compacted embedment is preferred. See the *Performance Pipe Engineering Manual* for information about the design of underground installations.

[5] DriscoPlex™ 4000 and DriscoPlex™ 4100 piping with a blue shell should not be used for on or above surface applications. These products are UV stabilized to allow unprotected outdoor storage for up to 18 months.

Horizontal Directional Drilling

Horizontal directional drilling is a technique for installing pipes and utility lines below ground using a surface-mounted drill rig that launches and places a drill string at a shallow angle to the surface and has tracking and steering capabilities. When the drill is advanced underground, it creates a borehole along its path. As the destination is reached, the drill string is angled upwards to penetrate the surface. After the borehole has been opened, a backreamer is attached to the head of the drill string, and the HDPE pipe is attached to the backreamer. The drill string is then retracted. During retraction, the borehole is expanded by the backreamer and the HDPE pipe is drawn into the borehole. To protect HDPE pipe against excessive pulling load, a weak-link or breakaway device should always be used at the head of the HDPE pipe. The allowable tensile load for setting weak-link devices is determined using ASTM F 1804 *Standard Practice for Determining Allowable Tensile Load for Polyethylene (PE) Gas Pipe During Pull-In Installation.* Horizontal Directional Drilling (HDD) applications should be installed in accordance with ASTM F1962 *Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit under Obstacle, Including river Crossings, Plastic Pipe Institute (PPI) Polyethylene Pipe for Horizontal Directional Drilling,* and the *Mini Horizontal Directional Drilling Manual published by the North American Society of Trenchless Technology (NASTT).* Additional information is available in Performance Pipe Technical Note PP-800 HDD - *Horizontal Directional Drilling.*

Planting, Plowing and Pulling

Planting and plowing are limited to suitable soils and site conditions. In planting, wheel or chain type trenchers are used to cut a narrow, round bottom trench. A long pipe string or pipe from a coil is fed over the trencher and directly into the trench. Backfilling follows after trenching and laying. In plowing, a plow rather than a trencher is used to open the trench. The plow may be fitted with a chute to feed pipe down through the plow into the trench bottom. See the Performance Pipe Engineering Manual for the minimum bend radius of the pipe feed plow chute. Flexible HDPE pipe is ideal for these installations.

Pulling involves opening a trench then pulling the pipe into the trench from one end. Sometimes a truck is fitted with an outrigger that extends over and down into the trench. The pipe is attached to the outrigger and then the truck is driven along the trench to drag the pipe into the trench. As with horizontal directional drilling, the pipe should always be protected with a weak-link or breakaway device at the leading end.

Rehabilitation

In sliplining, a slightly smaller pipe is pulled or pushed inside the old pipe. Typically, the new pipe must be at least 10% smaller in outside diameter than the inside diameter of the host pipe. The host pipe must be depressurized and cleaned, and tight bends removed. A sloped entrance pit is excavated, and a section of the top of the host pipe is removed. Then the new pipe is pushed or pulled or push-pulled into the host pipe. Once installed, the new pipe is connected to the system at both ends. In many cases, the improved flow characteristics of DriscoPlex™ 4000 and DriscoPlex™ 4100 HDPE pipe can deliver flows comparable to the original capacity, even though the new pipe is smaller. See ASTM F 585 *Standard Practice for Insertion of Flexible Liners into Existing Sewers.*

In pipe bursting, preparations are similar to pull-in sliplining, but a bursting head is placed ahead of the new pipe. The bursting head breaks the host pipe into fragments so an equal size or larger new pipe can be pulled inside. Pipe bursting is limited to host pipes that can be fragmented.

Other rehabilitation techniques include tight-fitting liners where proprietary techniques are used to install liner inside the host pipe in intimate contact with the host pipe ID. These proprietary techniques typically use a mechanical procedure such as rollers, swaging or deformation into a u-shape to reduce the diameter of a liner. It is then installed inside the host pipe similar to sliplining, and then re-expanded against the host pipe ID using various means to revert the liner pipe to its original diameter[6].

After Installation

Post installation procedures generally include leak testing and disinfecting for potable water lines.

Leak Testing

Take all necessary precautions to ensure the safety of persons and property while conducting leak tests. Leak tests should always be conducted using hydrostatic leak testing procedures. In general, the maximum allowable test pressure for leak testing is 150% of the pipe working pressure at the lowest elevation in the line; the maximum time allotted to conduct a leak test is eight (8) hours including bringing the line up to pressure, maintaining test pressure, and depressurizing; if leaks are found, depressurize the line before repairs are made; and if retesting is necessary, allow the line to relax for at least eight (8) hours before repressurizing the line. See Performance Pipe Technical Note PP-802 *Leak Testing for recommended leak testing procedures.*

WARNING - Correctly made fusion joints do not leak. When pressurized, leakage at a faulty fusion joint may immediately precede catastrophic separation and result in violent and dangerous movement of piping or parts and the release of pipeline contents under pressure. Never approach or attempt to repair or stop leaks while the pipeline is pressurized. Always depressurize the pipeline before making corrections. Faulty fusion joints cannot be repaired, they must be cut out and rejoined using proper heat fusion procedures.

Disinfecting

Applicable procedures for disinfecting new and repaired potable water mains are presented in standards such as ANSI/AWWA C651 *Disinfecting Water Mains.* ANSI/AWWA C651 uses liquid chlorine, sodium hypochlorite or calcium hypochlorite to chemically disinfect the main. Disinfecting solutions must not exceed 12% active chlorine because greater concentration can chemically attack and degrade polyethylene. After disinfecting, all disinfecting solution must be flushed from the system, especially from dead-end lines.

[6]Because some proprietary tight-fitting liner installation techniques can impose high stresses on a polyethylene liner, the installer should provide validation data and information, and should certify the long-term performance of the installed liner.

Repairs

Damage generally requires replacing the damaged section. With larger pipes, replacing the damaged section with a flanged section of pipe is usually necessary. Smaller pipes may be flexible enough to fuse a replacement pipe section at one end, and then deflect the other end to the side so a fully restrained mechanical coupling or electrofusion fitting can be installed.

Temporary repairs to seal minor leaks or punctures, or to reinforce damaged areas until permanent repairs can be performed typically employ a full encirclement repair clamp. Polyethylene pressure pipe cannot be repaired or restored to full service capacity using extrusion or hot air welding to fill or plug damaged areas.

Cautions

Observe all local, state and federal codes and regulations, and general handling, installation, construction and operating safety precautions. The following are some additional precautions that should be observed when using Performance Pipe polyethylene piping products.

Fusion and Joining

During heat fusion, equipment and products can exceed 400°F (204°C). Take care to prevent burns.

Do not bend pipes into alignment against open butt fusion machine clamps. The pipe may spring out and cause injury or damage.

Performance Pipe polyethylene piping products cannot be joined with adhesive or solvent cement. Pipe-thread joining and joining by hot air (gas) welding or extrusion welding techniques are not recommended for pressure service.

Liquid hydrocarbon permeation may occur when liquid hydrocarbons are present in the pipe, or where soil surrounding the pipe is contaminated with liquid hydrocarbons. Polyethylene pipe that has been permeated should be joined using suitable mechanical connections because fusion joining to liquid hydrocarbon permeated pipes may result in a low strength joint. Mechanical fittings must be installed in accordance with the fitting manufacturer's instructions. Obtain these instructions from the fitting manufacturer. See Performance Pipe Bulletin PP 750 and the *Performance Pipe Engineering Manual.*

Weight, Unloading and Handling

Although polyethylene piping is lightweight compared to some other piping products, significant weight may be involved. Move polyethylene piping with proper handling and lifting equipment. Use fabric slings. Do not use chains or wire ropes. Do not roll or drop pipe off the truck, or drag piping over sharp rocks or other abrasive objects. Improper handling or abuse can damage piping and compromise system performance or cause injury or property damage. ***Obtain and observe the handling instructions provided by the delivery driver.***

Striking the pipe with an instrument such as a hammer may result in uncontrolled rebound. Store DriscoPlex™ products so that the potential for damage or injury is minimized. See the *Performance Pipe Engineering Manual.*

Testing

When testing is required, observe all safety measures, restrain pipe against movement in the event of catastrophic failure, and observe limitations of temperature, test pressure, test duration and making repairs. See Performance Pipe Technical Note PP-802 *Leak Testing PE Piping Systems.*

Protection Against Shear and Bending Loads

Where a polyethylene branch or service pipe is joined to a branch fitting and where pipes enter or exit casings or walls, structural support such as properly placed, compacted backfill and a protective sleeve should be used. Whether or not a protective sleeve is installed, the area surrounding the connection must be structurally supported by embedment in properly placed compacted backfill or other means to protect the polyethylene pipe against shear and bending loads. See the Performance Pipe Engineering Manual and ASTM D 2774.

Subfreezing Temperatures

Water can be frozen solid in polyethylene pipe without damaging the pipe, but an ice plug in the pipe will stop flow. *Do not apply pressure to a frozen line that has an ice plug.* Allow ice plugging to thaw before applying pressure to the line. Severe water hammer (such as from an ice plug stopping suddenly at an obstruction) in a frozen, surface or above grade pipeline can rupture and possibly fragment the pipeline and cause injury or property damage.

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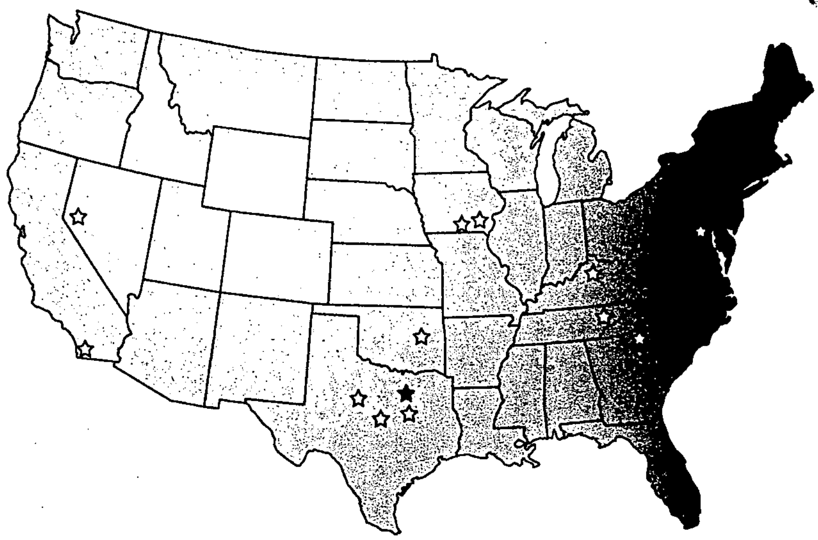

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Product Literature

Technical Notes & Bulletins*:

Bulletin: PP 502	Polyethylene Piping for Sewer Rehabilitation
Bulletin: PP 503	Polyethylene Piping for Municipal & Industrial Applications
Bulletin: PP 109-DS	PE 3408 Data Sheet
Bulletin: PP 110-DS	Spirolite™ Data Sheet
Bulletin: PP 152	Municipal & Industrial Size and Dimension Sheet - IPS
Bulletin: PP 153	Municipal & Industrial Size and Dimension Sheet - DIPS
Bulletin: PP 750	Performance Pipe General Fusion Brochure
Bulletin: PP 900	Performance Pipe Engineering Manual

* Additional product literature will be available upon completion. Visit Performance Pipe on the web for the latest completed literature.