TECHNICAL SPECIFICATIONS AND DESIGN ANALYSIS

•FINAL•

A-Zone Groundwater Recovery System
Brown & Bryant Superfund Site
Arvin, California

Prepared for:
U.S. Army Corps of Engineers
Albuquerque District
Albuquerque, New Mexico

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TECHNICAL SPECIFICATIONS AND DESIGN ANALYSIS

•FINAL•

A-Zone Groundwater Recovery System
Brown & Bryant Superfund Site
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1.0 GENERAL

1.1 PROJECT

Arbor Well Design at Brown & Bryant Superfund Site (Site), Arvin, California.

1.2 CONTRACT

Eco & Associates, Inc. (Eco) was retained by the United States Army Corps of Engineers (USACE) to perform the work under an indefinite delivery contract for Multifaceted Environmental Services Activities (MESA) for HTRW Environmental Remediation Services, Contract No. W912PP-10-D-0014.

1.3 SCOPE

The history of groundwater well contamination at the Site has been well documented since 1993 when the Site was placed on the National Priorities List. The large diameter well, or arbor well, was selected as a remedy in the OU2 Record of Decision (ROD) as a source of reduction in the A-zone. The OU2 Remedial Investigation/Feasibility Study (RI/FS) and ROD describes these wells as 8-foot diameter wells with an average depth of 75 feet below ground surface (bgs). In past groundwater extraction tests, the A-zone formation has been very tight allowing only an average of 0.25 gallons per minute intermittent extraction. These wells would function as sumps to allow a larger volume of the A-zone groundwater to collect and then be extracted and treated for proper disposal. Ultimately, this would also reduce the amount of A-zone groundwater that would infiltrate to the B-zone, thereby reducing a continuing contamination source to the B-zone.

1.3.1 TASK 1 – 30 PERCENT CONCEPTUAL DESIGN

Task 1 is to provide a 30 percent Conceptual Design for the large arbor wells. The effort includes conceptual plan drawings, unedited technical specifications (Unified Facilities Guide Specifications [UFGS]), and design analysis notes which identify the technical approach and basis for this design. Written responses to all comments on the 30 percent Conceptual Design were also provided.

1.3.2 TASK 2 – 65 PRECENT DRAFT DESIGN

This task is to provide a 65 percent Draft Design for the large arbor wells. The 65 percent Draft Design submittal shall incorporate all comments made on the 30 percent Conceptual Design. This effort includes draft plan drawings, edited technical specifications, and design analysis notes which document the designer's notes, calculations, and all information used to develop the design. Written responses to all comments on the 65 percent Draft Design were also provided.

1.3.3 TASK 3 – 95 PERCENT FINAL DESIGN

Task 3 is to provide a 95 percent Final Design for the large arbor wells. The 95 percent Final Design submittal incorporates all comments made on the 65 percent Draft Design. This effort includes final plan drawings, technical specifications, and design analysis.

1.3.4 TASK 4 – 100 PERCENT CORRECTED FINAL DESIGN

This task is to provide a 100 percent Final Design for the large arbor wells. The 100 percent Corrected Final Design Submittal incorporates all comments made on the 95 percent Final Design. This effort includes final corrections for plan drawings, technical specifications, and design analysis documentation.

1.4 CRITERIA

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

1.5 PROJECT DESCRIPTION

This document provides the technical specifications and design analysis to be used for the construction of an A-zone groundwater recovery system at the former Brown & Bryant, Inc. Superfund Site located in the City of Arvin, California.

2.0 TECHNICAL SPECIFICATIONS

(see next page)

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SUBMERSIBLE PUMP, AXIAL-FLOW AND MIXED-FLOW TYPE
07/07

PART 1 GENERAL

1.1 LUMP SUM PRICE

a. Payment will be made for costs associated with furnishing and installing the submersible pump, axial-flow or mixed-flow type, as specified.

b. Unit of measure: lump sum.

1.2 REFERENCES

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

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S2.19	(1999; R 2004) Mechanical Vibration - Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Permissible Residual Unbalance, Including Marine Applications

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11	(1990; R 1999) Load Ratings and Fatigue Life for Roller Bearings
ABMA 9	(1990; R 2000) Load Ratings and Fatigue Life for Ball Bearings

ASTM INTERNATIONAL (ASTM)

ASTM A 167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 176	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 276	(2008a) Standard Specification for Stainless Steel Bars and Shapes
ASTM A 312/A 312M	(2009) Standard Specification for Seamless, Welded, and Heavily Worked Austenitic Stainless Steel Pipes

ASTM A 668/A 668M	(2004) Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM D 2000	(2008) Standard Classification System for Rubber Products in Automotive Applications
ASTM F 1476	(2007) Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications

HYDRAULIC INSTITUTE (HI)

HI 1.3	(2000) Design and Application
HI 2.3	(2000) Design and Application
HI 2.6	(2000) Vertical Pump Tests
HI 9.1-9.5	(2000) Pumps - General Guidelines for Types, Applications, Definitions, Sound Measurements and Documentation
HI 9.6.4	(2000) Centrifugal and Vertical Pumps, Vibration Measurements and Allowable Values

CALIFORNIA DEPARTMENT OF WATER RESOURCES (DWR)

Water Well Standards, Bulletins 74-81 and 74-90

ISA - INTERNATIONAL SOCIETY OF AUTOMATION (ISA)

ISA RP2.1	(1978) Manometer Tables

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2007; Errata 2008) Standard for Motors and Generators
NEMA WC 70	(2009) Standard for Non-Shielded Power Cable 2000 V or Less for the Distribution of Electrical Energy
NEMA WC 72	(1999; R 2004) Standard for Continuity of Coating Testing for Electrical Conductors

1.3 SYSTEM DESCRIPTION

1.3.1 General Project Requirements

Design, furnish, and install 4 identical pumping units for the 4 Extraction Wells shown on Drawing No. M1 001. Water pumped will not exceed 104 degrees F.

1.3.2 Pumping Unit Description

In general, each pumping unit includes a pump/motor, discharge tube, cable, and controls. Each pump shall be of the vertical, axial or mixed-flow submersible type for well water attached to the same shaft with a submersible electric motor. The pump/motor shall be electrically operated and installed in a discharge tube. Except as otherwise stated or noted, the terms pump and pump/motor both refer to a pump/motor integral unit.

1.3.3 General Design Requirements

a. The pump shall meet head, capacity, speed, efficiency, pump sump design, range of operation, cavitation, and vibration requirements as specified.

b. Design the pump for runaway speed as calculated by the Contractor for the system shown and specified. Waterhammer calculations shall be included when long discharge lines exist. The reverse speed shall be calculated assuming power failure and discharge valves fail to close.

c. The pump shall, as a minimum, meet the applicable design, materials, and manufacture requirements of HI 1.3, HI 2.3, HI 9.1-9.5 and these specifications.

d. The pumping unit design and performance shall have been demonstrated by previous successful operation of pumps of the required type and of equal design complexity the manufacturer.

e. The pump shall operate in a discharge tube. The discharge tube shall fit within the dimensions shown so that installation and maintenance can be carried out by an overhead bridge crane. The weight of the pump/motor integral unit shall not exceed 10 lb.

f. The pump shall be designed for the calculated hydraulic pressure including waterhammer to which the pump parts are exposed.

g. The pump losses, as calculated and provided in in the final design analysis, are in addition to the specified head and shall be allowed for when computing the pump system output.

h. The pump shall have a continuously rising head characteristic with decreasing capacity over the required range of operation specified. The pump shall not have an unstable operating characteristic over the required range of operation.

i. The pump shall meet all requirements for net positive suction head required (NPSHR) and operate without surging.

j. Associated pumping equipment including, but not limited to, electrical controls, instrumentation, and pump control center shall be suitable for outdoor operation.

1.3.4 Design of Discharge System

The pumping unit shall discharge into the discharge system shown on the design drawings. The pump loss curve is included in the Product Cut Sheets at the end of this document to permit determination of total head.

1.3.5 Operating Conditions

a. The pump shall be capable of operating in the dry (for the purpose of maintenance and operating checks) for short periods of time as stated in the manufacturer's operating instruction.

b. The pump manufacturer shall establish and state in the operating manual the procedures for starting and stopping the pumps, including setting of valves or any sequential operations.

1.3.6 Performance Requirements

a. When operated in the dry, the maximum level of vibration of the assembled pumping unit shall not be greater than the value of the lower limit of the good range of the "General Machinery Vibration Severity Chart". This chart can be obtained from Entek IRD, 1700 Edison Drive, Cincinnati, Ohio 45150. Measurements shall be taken at pump operating speed during the Factory Test and the field start-up test.

b. The pump shall be capable of operating without instability over the required range of head.

1.3.7 Capacities

Discharge shall not be less than 5 gpm against total design head 85 ft with water surface in the sump at elevation of 2 ft above pump.

1.3.8 Efficiency

The pump shall have an efficiency of not less than 70 percent at 5 gpm.

1.3.9 Equipment

Submit the names of the manufacturers, performance capacities, and other relevant information for the machinery and other equipment contemplated to be incorporated into the work.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval and information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G; ED

Drawings of sufficient size to be easily read, within 90 days of Notice of Award. Submit information in the English language. Dimensions shall be in metric with English conversion.

SD-03 Product Data

Materials

A list designating materials to be used for each pump part along with the submittal of the drawings.

If deviation from specified materials is desired, submit complete specifications for the proposed deviating materials after award of the contract.

Equipment; G; ED

Within 60 days of Notice of Award, a list of equipment as specified.

Spare Parts

Manufacturers complete parts list showing all parts, spare parts, and bulletins for pump. Clearly show all details, parts, and adequately describe parts or have proper identification marks. The parts lists, appropriately formatted using sections and tables, shall be printed on good quality 8-1/2 by 11 inch paper, bound separately of the Operation and maintenance manual with a flexible, durable cover. Drawings incorporated in the parts lists may be reduced to page size provided they are clear and legible, or they may be folded into the bound lists to page size. Photographs or catalog cuts of components may be included for identification.

Computations; G; ED

Sufficient hydraulic computations to substantiate pump selection and demonstrate that the selected pump can meet the project design and operating requirements as specified.

Installation Instruction Manual; G; ED

No later than 30 days prior to time of pump delivery, three copies of a typed and bound manual describing procedures to be followed by the installation engineer in assembling, installing, and dry- and/or wet-testing the pump. Coordinate and consolidate the description of the pump with similar descriptions for other specified pump parts. The description shall be of such a nature that it may be comprehended by an engineer or mechanic without extensive experience in erecting or installing pumps of this type. The description shall be a step-by-step explanation of operations required, and shall include, where applicable, such as alignment procedures, bolt torque values, recommended instrument setups, recommended gauges and instruments, and similar details.

Factory Tests

A description of the factory test setup and test procedure proposed. Submit sufficient data and drawings to demonstrate that testing is in compliance with HI 2.6.

Pump Field Tests; G; ED

Field test plan prior to field testing.

SD-06 Test Reports

Factory Test Report; G; ED

Within 30 days of receipt of approval of the witnessed factory test, nine bound copies of a report covering test setup and performance tests. The factory test report shall include the specified information.

Field Test Report; G; ED

Installation and Start-Up Engineer Qualifications; G; ED

Pump Installation and Startup Report; G; ED

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions; G; ED

anual containing complete information on operation, lubrication, adjustment, routine and special maintenance disassembly, repair, reassembly, and trouble diagnostics of pump and auxiliary equipment. The operation and maintenance manual shall be printed on good quality 8-1/2 by 11 inch paper, bound separately from the parts list, and bound between a flexible, durable cover. Drawings incorporated in manual may be reduced to page size provided they are clear and legible, or they may be folded into the manual to page size. Photographs or catalog cuts of components may be included for identification.

1.5 QUALITY ASSURANCE

1.5.1 Pump Supplier Qualifications

The pump manufacturer shall have overall responsibility to supply the pumping unit (submersible pump/motor, discharge tube, cables, instrumentation and accessories) that meet the requirements of this specification. Thus, during start-up, installation, and performance evaluation, the pump manufacturer is the sole responsible party. The pump manufacturer shall supply a list of installations at which pumps of his manufacture, and ones similar to those specified, have been operating for at least 2 years. The components and materials of the pumping unit may occur at different facilities, and be the product of other manufacturers.

1.5.2 Installation and Start-up Engineer

Furnish a competent installation engineer (including those from Contractor's suppliers) fluent in the English language who is knowledgeable and experienced with the installation and start-up procedures for submersible pumps and the associated equipment specified. When so requested, the installation engineer shall be responsible for providing complete and correct direction during installation, initial starting, and subsequent operation of equipment until field tests are completed. The installation engineer shall initiate instructions for actions necessary for proper receipt, inspection, handling, uncrating, assembly, and testing of equipment. The installation engineer shall also keep a record of measurements taken during erection and shall furnish one copy to the

Contracting Officer on request or on the completion of the installation of assembly or part. The erecting engineer shall instruct the Contracting Officer or others as designated in the operation and maintenance features of the pump units.

1.5.3 Detail Drawings

Submit the following:

a. Outline drawings of the pump showing dimensions and weight of the pump/motor.

b. Drawings showing details and dimensions of pump mounting design and layout including any embedded items.

c. Cross-sectional drawings of the pump, showing each component, and major or complicated sections of the pump in detail. On each drawing indicate an itemized list of components showing type, grade, class of material used, and make and model of the standard component used. Include detail and assembly drawings of entire pumping unit assembly.

d. Provide drawings covering the installation that the Contractor intends to furnish to the erecting engineer.

e. The capacity-head curve should indicate efficiency, bhp, and NPSHR.

f. Motor characteristic curves or tabulated data (test or calculated) should indicate the speed, power factor, efficiency, current, and kilowatt input, all plotted or tabulated against percent load as abscissas.

1.6 DELIVERY, STORAGE, AND HANDLING

The pump will be inspected for damage or other distress when received at the project site. Store the pump and associated equipment indoors as recommended by the pump manufacturer, protected from construction or weather hazards at the project site. The pump and equipment shall have adequate short-term storage in a covered, dry, and ventilated location prior to installation. The manufacturer's instructions shall be followed for extended storage. Proper equipment for handling the pump shall be supplied and shall be considered as special tools if not completely standard. Follow the manufacturers recommendations for handling of the pump.

1.7 EXTRA MATERIALS

a. Furnish the following spare parts:

a. One complete set of bearings and seals.
b. Replacement wearing rings and O-rings.
c. One impeller.

b. Furnish one set of all special tools required to completely assemble, disassemble, or maintain the pumps. Special tools refers to oversized or specially dimensioned tools, special attachment or fixtures, or any similar items. Lifting devices required for use in conjunction with the overhead crane shall be furnished.

PART 2 PRODUCTS

2.1 MATERIALS

a. The pumps shall be designed and manufactured by a firm that is regularly engaged in the manufacture of the type of pump described in these specifications. Provide materials and fabrication conforming to the requirements specified herein. Classifications and grade of material incorporated in the work shall be in accordance with designated specifications. Submit deviations from the specified materials in accordance with paragraph SUBMITTALS.

b. Identify the pumping unit by means of a separate nameplate permanently affixed in a conspicuous location. The plate shall bear the manufacturer's name, model designation, serial number, if applicable, and other pertinent information such as horsepower, speed, capacity, type, and direction of rotation. The plate shall be made of corrosion-resistant metal with raised or depressed lettering and a contrasting background.

c. The pumping unit shall be equipped with suitably located instruction plates, including any warnings and cautions, describing any special and important procedures to be followed in starting, operating, and servicing the equipment. Plates shall be made of corrosion-resistant metal with raised or depressed lettering and a contrasting background.

2.2 METALWORK FABRICATION

The materials of construction shall comply with the following:

TABLE 1 - MATERIALS OF CONSTRUCTION

PART	MATERIAL
Discharge Bowl	Stainless steel plate
Suction Bell	Stainless steel plate
Pump bowl	Stainless steel plate
Impeller	Stainless steel or aluminum bronze or polyamide
Shaft	Stainless steel
Wearing ring	Manufacturer's standard
Bolts, key, etc.	Stainless steel
O-rings	Nitrile butadiene rubber
Mechanical seals	Tungsten carbide
Discharge tube	Stainless steel

2.2.1 Designated Materials

Designated materials shall conform to the following specifications, grades, and classifications.

MATERIALS	SPECIFICATION,	GRADE, CLASS
Aluminum-Bronze	ASTM B 148, Alloy No. C95500 Castings	
Copper Alloy Castings	ASTM B 584, Alloy No. C93700	

MATERIALS	SPECIFICATION, GRADE, CLASS
Corrosion-Resistant Alloy Castings	ASTM A 297/A 297M, Grade CA-15, CAGNN and CF-8M
Dimensions for Steel Water Pipe Fittings	AWWA C208
Hot-Rolled Stainless	ASTM A 576, Graded G10200, G10450, and G11410
Ring Flanges	AWWA C207, Class B
Rubber Products in Automotive Applications	ASTM D 2000
Seamless and Welded Austenitic Stainless Steel Pipe	ASTM A 312/A 312M
Stainless Bars and Shapes	ASTM A 276, Grades S30400 and S41000
Steel Forging	ASTM A 668/A 668M, Class F
Stainless Steel Plate	ASTM A 167, UNS S30400 or ASTM A 176, UNS S40500
Quality Steel	ASTM A 36/A 36M
Surface Texture	ASME B46.1

2.2.2 Bolted Connections

2.2.2.1 Bolts, Nuts, and Washers

Bolts, nuts, and washers shall conform to requirements herein specified and the paragraphs SUBMERSIBLE PUMP, DISCHARGE TUBE, and the subparagraph, NUTS AND BOLTS for types required. Use beveled washers where bearing faces have a slope of more than 1:20 with respect to a plane normal to bolt axis.

2.2.2.2 Materials Not Specifically Described

Materials not specifically described shall conform to the latest ASTM specification or to other listed commercial specifications covering class or kinds of materials to be used.

2.2.3 Flame Cutting of Material

Flame cutting of material, other than steel, shall be subject to the approval of the Contracting Officer. Shearing shall be accurately done, and all portions of work neatly finished. Steel may be cut by mechanically guided or hand-guided torches, provided an accurate profile with a smooth surface free from cracks and notches is secured. Surfaces and edges to be welded shall be prepared in accordance with Section 3 of AWS D1.1/D1.1M. Chipping and/or grinding will not be required except where specified and as necessary to remove slag and sharp edges of technically guided or hand-guided cuts not exposed to view. Visible or exposed hand-guided cuts shall be chipped, ground, or machined to metal free of voids,

discontinuities, and foreign materials.

2.2.4 Alignment of Wetted Surfaces

Exercise care to ensure that the correct alignment of wetted surfaces being joined by a flanged joint is being obtained. Where plates of the water passage change thickness, provide a transition on the outer surface, leaving the inner surface properly aligned. When welding has been completed and welds have been cleaned, but prior to stress relieving, joining of plates shall be carefully checked in the presence of a Government Inspector for misalignment of adjoining parts.

2.3 SUBMERSIBLE PUMP

2.3.1 Design and Manufacture

At the Contractor's option, the submersible pump may be either of cast or fabricated construction. The level of manufacture skill shall be consistent with the standards referenced in the specifications. All work performed in the manufacture of the pumps shall be in a skillful and workmanlike manner in accordance with the best modern shop practice and manufacture of finished products similar in nature to those specified herein. The Government reserves the right to observe and witness the manufacture of the pumps and to inspect the pumps for compliance with contract requirements during factory assembly.

2.3.2 Speed

2.3.2.1 Pump Speed

Rotative speed of the pump shall not be greater than 10,700 rpm.

2.3.2.2 Runaway Speed

The pump shall be designed to sustain full runaway speed without damage at maximum head difference across the pump. Based on the system design as shown by the drawings the manufacturer shall compute the maximum reverse runaway speed, and the pump and motor shall be designed to sustain that reverse rotation without damage.

2.3.3 Pump Construction

2.3.3.1 General

The major pump components shall be of materials as described in the design drawings. All the exposed nuts and bolts shall be stainless steel. All mating surfaces. where watertight sealing is required, shall be machined and fitted with nitrile rubber O-rings. The fitting shall be such that the sealing is accomplished by metal-metal contact between machined surfaces which results in controlled compression of the O-rings. Sealing compounds, grease, or secondary devices are not acceptable.

2.3.3.2 Pump Lifting Handle And Lifting Lugs

The lifting handle shall be designed to bear the entire weight of the pumping unit at a conservative factor of safety. Lifting lugs shall be provided where the weight of the separate part requires a lug.

2.3.3.3 Pump and Motor Bearing Arrangement

The pump and motor bearings shall be the standard design of the manufacturer for the pump supplied under this specification. The type and number shall be of proven design as used in previous operating units supplied by the manufacturer. The bearings shall be of the grease lubricated and sealed type. The bearings shall have a minimum B-10 bearing life of 50,000 hr. Each bearing shall be of the correct design to resist the radial and thrust loads applied. Enough bearings shall be provided to ensure the pump rotating elements are supported so that the possibility of excessive vibration is eliminated. Ball and roller bearings life and load ratings shall conform to ABMA 9 and ABMA 11.

2.3.3.4 Mechanical Seals

A mechanical rotating shaft seal system shall be provided between the impeller and motor to ensure the motor housing seal. The mechanical seals shall be in tandem, lapped and face type seals running in lubricant reservoirs for cooling and lubrication. The mechanical seals shall contain both stationary and rotating tungsten carbide face rings unless otherwise specified. In order to avoid seal failure from sticking, clogging, and misalignment from elements contained in the mixed media, only the seal faces of the outer seal assembly and its retaining clips shall be exposed to the mixed media. All other components shall be contained in the lubricant housing. All seal faces must be solid material capable of being relapped. The seals shall require neither maintenance nor adjustment, but shall be easy to check and replace. Shaft seals without positively driven rotating members shall not be considered acceptable or equal.

2.3.3.5 Lubricant Housing

Provide an oil housing with oil, as recommended by the pump manufacturer, to lubricate the shaft sealing system and to dissipate the heat generated by the motor and bearings.

2.3.3.6 Impeller

The impeller design and manufacture shall be the manufacturer's standard. The impeller surface shall be smooth, without holes and fabrication offsets. The attachments to shaft shall be with keys or other fasteners which are to be made of stainless steel. The attachment should be of sturdy construction designed to not loosen, but be easily removed for maintenance. The impeller construction may be cast or fabricated. At the time of assembly the impeller clearances shall be those shown on assembly drawings and may be checked in the field or at the factory at the Contracting Officer's option. The impeller shall be balanced at the design operating speed. The standard balance quality grade is G6.3 in accordance with ASA S2.19. Balancing procedure shall be in accordance with HI 9.6.4, except that a two-plane balance shall be required.

2.3.3.7 Shaft

The shaft shall be one piece integral with the motor of high-strength cold-rolled carbon steel or stainless steel with a factor of safety of five measured against the ultimate strength. The shaft shall be designed for all torque conditions during normal operation and for runaway speed during reverse flow.

2.3.3.8 Bowl Assembly

The bowl assembly may be of cast or fabricated manufacture. The hydraulic design shall be the manufacturer's standard design as used in previous operating installations. The general manufacture quality relating to flange design, drilling, bolts, alignments, etc., shall be in accordance with industry standard practice.

2.3.4 Motor

The motor shall be submersible and conform to the requirements of NEMA MG 1. The motor shall be sized to avoid overload when operating at any point along the characteristic curve of the pump. The motors shall be 1-phase, 50/60-Hz, 100-1,000 V, squirrel cage induction type, NEMA Design B Type. The stator windings and stator leads shall be insulated with a moisture-resistant Class F insulation with temperature resistance of311 degrees F. The service factor shall be 1.0. The temperature rise above ambient for continuous full load rated conditions and for the class of insulation used shall not exceed the values in NEMA MG 1. The motor shall be rated for continuous duty when submerged and shall also be capable of operation in the dry for short periods of time for testing and maintenance purposes.

2.3.4.1 Torque

Starting torque shall be sufficient to start the pump, but in no case less than 60 percent of full-load torque. Break-down torque shall not be less than 150 percent of full-load torque.

2.3.4.2 Support

Thrust bearing support shall have sufficient strength and rigidity to support the weight of the entire rotating element of the motor, pump impeller and shaft, and the hydraulic thrust.

2.3.5 Cable

a. Power and instrumentation cable shall be specifically designed for use with a submersible pump application and shall conform to the requirements of NEMA WC 70 and NEMA WC 72. Submersible cable shall be suitable for continuous immersion in water at the maximum depth encountered. Cable shall have an ampacity of not less than 125 percent of the motor full load current. The cable length shall be determined by the pump manufacturer for the installation shown.

b. Power and instrumentation cables shall enter the motor through a sealing system that prevents water entry into the unit and provides strain relief. The cable entry may be comprised of rubber bushings, flanked by stainless steel washers, having a close tolerance fit against the cable outside diameter and the entry inside diameter for sealing by compression of the bushing, or the entry may be sealed by other gland compression methods.

2.3.6 Pump Control and Monitoring

A self-contained pump control and monitoring system shall be provided. Independent local indication of the alarm and separate contacts for the

remote indication of each alarm and local reset shall be provided. Sensors shall alarm and shut down the pump at an abnormal operating condition. The following sensors shall be provided:

a. Temperature sensors in the stator windings to protect the motor against overheating.

b. Temperature sensors to monitor the main and support bearings.

c. Float-switch sensor positioned between the bearings and the stator-end coils to detect if liquid penetrates the stator housing.

d. A junction box leakage detector and a water-in-oil detector.

2.3.7 Gear Reducer

Not used.

2.3.8 Air Vent

An air vent shall be provided, located as shown on the contract drawings, and shall be a combination air and vacuum valve type. The valve shall be a minimum 125 lb class and sized for the design flow rate. An isolation valve shall be provided at the valve's inlet. Materials of construction shall be cast iron for the valve body; stainless steel for the internal linkage, float, and float stem; and Buna-N for the needle and seat. The valve shall provide a dual function to release air during pump start-up and to permit air to re-enter to break the vacuum during pump shutdown.

2.4 DISCHARGE TUBE

2.4.1 General

a. The design, manufacture and installation of the discharge tube shall be in accordance with the pump manufacturer's instructions. For purposes of performance and this specification it shall be treated as part of the pumping unit. The discharge tube shall be of such size to accommodate the dimensions of the pump supplied in accordance with the manufacturer's requirements. It shall be permanently installed in the pump sump as shown on the drawings.

b. The design shall be such that the pumps will be automatically and firmly connected to the discharge tube when lowered into place and shall be in accordance with the pump manufacturer's instructions. A locking device shall be provided that prohibits rotational movement of the pump within the tube.

c. The pumps shall be easily removable for inspection or service without need to enter the pump sump. The pumps shall not require any bolts, nuts, or fasteners for connection to the discharge housing. Stiffening, guides, or other features shall be provided at the pump support to ensure concentric positioning of the pump in the discharge tube. Means shall be provided such that an effective seal is obtained between the pump and discharge tube. Power cable penetrations shall be watertight.

2.4.2 Flanged Joints

Not used.

2.4.3 Nuts and Bolts

Nuts and bolts shall be of the hexagonal type. Bolts, including assembly, anchor, harness, and dowels, shall be 300 stainless steel. Nuts shall be bronze; washers shall be 300 series stainless steel.

2.4.4 Bolted Lid

Not used.

2.4.5 Harnessed Coupling

Not used.

2.4.6 Wall Thimble

Not used.

2.4.7 Dissimilar Metals

When dissimilar metals are used in intimate contact, suitable protection against galvanic corrosion shall be applied. The anodic member shall be protected by proper electrical insulation of the joint.

2.5 INTAKE DESIGN

2.5.1 General

The intake sump design is the Contracting Officer's responsibility. It is the responsibility of the Contractor to supply a pump that will meet the performance requirements without undue modifications to the sump as shown on the drawings. Any such modifications shall be at no cost to the Government and must receive prior approval.

2.5.2 Formed Suction Intake (FSI)

Not used.

2.6 SHOP ASSEMBLY

The discharge tube shall be assembled in the manufacturer's plant to ensure the proper fitting and alignment of all parts. Prior to disassembly, all parts shall be match-marked to facilitate the correct assembly in the field.

2.7 FACTORY TESTS

2.7.1 Performance Test

Test the pump at the manufacturer's shop to demonstrate that the proposed pump operates without instability and complies with specified performance. Instability is defined when any point in usable range of the head-capacity curve cannot be repeated within 3 percent. When this occurs, the test shall be rerun. Compliance with specifications will be determined from curves required by the paragraph TEST RESULTS. Test procedures, except as herein specified, shall be in accordance with applicable provisions of

HI 2.6. The temperature of the water used for testing shall be approximately the same for all tests run and shall be recorded during test runs.

2.7.1.1 Performance of the Pump

Performance of the pump shall be determined by a series of test points sufficient in number to develop a constant speed curve over the range of total heads corresponding to the requirements of the paragraph CAPACITIES. The test range shall include additional testing at total heads of 2 ft higher than that specified. The lowest total head for testing shall be, as a minimum, the total head determined from the referenced paragraph. If the test setup permits testing at lower total heads, the range of total heads shall be extended 2 ft lower. Testing shall be inclusive for the speed involved. Tests shall be made using heads and a suction water elevation specified in the paragraph CAPACITIES. Test results with this sump elevation shall meet all specified conditions of capacity, head, andbhp. Head differentials between adjacent test points shall not exceed 3 ft, but in no case shall less than 10 points be plotted in the pumping range. If the plot of data indicates a possibility of instability or a dip in the head-capacity curve, a sufficient number of additional points on each side of the instability shall be made to clearly define the head-capacity characteristics.

2.7.1.2 Test Results

Test results shall be plotted to show the total head, static heads, bhp, and efficiency as ordinates. The results should be plotted against pump discharge in gpm as the abscissa. Curves shall be plotted showing pump performance to a scale that will permit reading the head directly to 0.5 ft, capacity to 500 gpm, efficiency to 1 percent, and power input to 25 bhp. Ensure that the water can be successfully pumped from the extraction wells into the tank assembly, as shown in the design drawings. It shall be established that the performance requirements of these specifications and the warranties under this contract have been fulfilled. The performance test shall be made with the pump and motor assembled as an operating unit to simulate field installation unless otherwise approved in writing by the Contracting Officer. Readings shall include one point each within 2 percent of the rated total head, minimum expected head, and maximum expected head. The test shall be conducted in accordance with accepted practices at full speed; and, unless otherwise specified, the procedure and instruments used shall conform to HI 2.6.

2.7.2 Cavitation Test

The net positive suction head required (NPSHR) by the pump shall be determined by the testing procedures provided in HI 2.6. Select the test arrangement and procedure, from the choices provided in HI 2.6, that best suits the Contractor's test facility. NPSHR shall, as a minimum, be determined for five or more capacities over the total range of the specified operating conditions. Plot the test results and define NPSHR as the point where a 3% drop in performance occurs. The value of NPSHR shall be2 ft less than the corresponding net positive suction head available (NPSHA). NPSHA shall be determined using the temperature of the water at the time the tests are run. The water elevations specified in paragraph CAPACITIES shall be used to determine the NPSHA for pumps.

2.7.3 Instrumentation and Procedures

Each instrument shall be described in detail, giving all data applicable, such as manufacturer's name, type, model number, certified accuracy, coefficient, ratios, specific gravity of manometer fluid to be used, and smallest scale division. When necessary for clarity, a sketch of the instrument or instrument arrangement shall be included. A fully detailed narrative description of each proposed method of instrumentation, procedures to be used, and a sample set of computation shall be included. The lowest equivalent static head that is obtainable with the testing when operating along the head-capacity curve of the proposed pump shall be stated.

2.7.3.1 Head Measurements

Head measurements shall be made using either a direct reading water column, mercury-air, mercury-water, a Meriam fluid manometer, or a pressure transducer. Vacuums shall be measured with either a mercury-air manometer, a mercury-water manometer, or a pressure transducer. Fluctuations shall be dampened sufficiently to permit column gauges or a differential pressure transducer to be read to either the closest one one-hundredth (0.01) of 1 ft of water or Meriam fluid or one-tenth (0.1) of 1 inch of mercury. Manometers shall be used as indicated by ISA RP2.1. When pressure transducers are used, their accuracy shall be checked with a manometer.

2.7.3.2 Pump Capacity

Capacity shall be determined by a calibrated venturi flowmeter or a long-radius ASME flow nozzle. Orifice plates shall not be used. Venturi or nozzle taps shall be connected to column gauges equipped with dampening devices that will permit the differential head to be determined to either the closest one-hundredth (0.01) of 1 ft or water or one-tenth (0.1) of 1 inch of mercury. Magnetic flowmeters and flowmeters utilizing ultrasonic flow measurements will be acceptable if the calibration of the flowmeter has been completed within the last 6 months.

2.7.3.3 Rotational Speed of Pump

Rotational speed of the pump shall be measured in accordance with measurement of speed in HI 2.6, except that revolution counters shall not be used. The device used shall permit the speed to be determined to 1 rpm.

2.7.3.4 Power Input

Power input to the pump shall be measured in accordance with power measurements in HI 2.6. A method to permit bhp to be determined to the closest0.5 bhp shall be used.

2.7.4 Witness Test

Factory tests shall be performed in the presence of the Contracting Officer. When the Contractor is satisfied that the pump performs in accordance with the specified requirements, notify the Contracting Officer, two weeks in advance, that the witness tests are ready to be run and furnish two copies of curves required in paragraph TEST RESULTS above. Should the test reveal that the pump does not perform in accordance with the specifications, make necessary changes before again notifying the Contracting officer that witness tests are ready to be run. Copies of all data taken during the testing and plotted preliminary curves shall be given to the Contracting Officer at the conclusion of the test.

2.7.5 Factory Test Report

Each factory test report shall include, as a minimum, the following:

a. Statement of the purpose of test, name of project, contract number, and design conditions. Instances where guaranteed values differ from specified values should be given.

b. Resume of preliminary studies, if such studies were made.

c. Description of pump and motor, including serial numbers, if available.

d. Description of test procedure used, including dates, test personnel, any retest events, and witness test data.

e. List of all test instruments with model numbers and serial numbers.

f. Sample computations (complete).

g. A discussion of test results.

h. Conclusions.

i. Photographic evidence in the form of either 24 color photographs of test equipment, test setup and representative test segments, or a digital recording, at least 30 minutes in length, covering the same information as photographs. All photographic evidence should be labeled with contract number, location, date/time, and test activity. Videotape shall be voice annotated with the same information.

j. Copies of instrument calibration.

k. Copies of all recorded test data.

l. Curves required by the paragraph TESTS RESULTS.

m. Curves showing the performance of the prototype pump.

n. Drawings of the test set-up showing all pertinent dimensions, elevations and cross section of the pump.

PART 3 EXECUTION

3.1 INSTALLATION

Perform correct installation and assembly of the pumping unit in accordance with the drawings and with the manufacturer's installation instruction manual. Furnish all bolts, shims, tools, and other devices necessary for installing the pumping units. The manufacturer's representative(s) familiar with the equipment being installed shall supervise the handling, installation, start-up, and testing of the equipment.

3.2 CLEANUP PRIOR TO START

Not used.

3.3 PUMP FIELD TESTS

Field testing shall be conducted by an experienced field test engineer and will be witnessed by the Contracting Officer. Before initially energizing the pump/motors, ensure that all pumping plant control, monitoring, and protective circuits have bee successfully tested. This thorough electrical checkout procedure shall have followed a detailed step-by-step approved test plan. The motor and other pumping unit elements undergoing tests should also be checked at this time.

3.3.1 Dry Test

Each pumping unit shall be tested in the dry in accordance with the pump manufacturer's instructions to determine whether it has been properly installed. Such tests shall be made when, and as, directed by the Contracting Officer. The pump shall be operated at full rated speed. Should tests reveal a design or installation deficiency or a manufacturing error in pumping unit components, the problem shall be promptly corrected by and at the expense of the Contractor.

3.3.2 Wet Test

Each unit shall be given an operating test under load for a period as directed by the Contracting Officer. Conduct the tests to be witnessed by the Government. During the tests, the operation of the pumping units shall be observed and measurement of noise (in accordance with HI 9.1-9.5), motor-bearing temperatures, voltage, and current shall be recorded for each pump. Measured parameters shall be within the pump manufacturers published limits. Vibration measurements shall be made at the top of the discharge tube for each pump. Vibration limits shall not exceed those recommended by HI 9.6.4. Without additional cost to the Government, the Contractor shall make all changes and correct any errors for which the Contractor is responsible.

3.3.3 Field Test Report

Prepare and submit a test report of the field testing and a manual of Operating and Maintenance Instructions for the completed system in accordance with paragraph SUBMITTALS.

-- End of Section --

SECTION 23 03 00.00 20

BASIC MECHANICAL MATERIALS AND METHODS
01/07

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 within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B 117	(2009) Standing Practice for Operating Salt Spray (Fog) Apparatus

CALIFORNIA CODE OF REGULATIONS (CCR)

24 CCR 5	(2007) Title 24, Part 5, California Plumbing Code

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2007; Errata 2006 & 2007; INT 44-56 2007; INT 47, 49, 50, 52-56 2008; INT 57, 58, 51, 48, 59 2009) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2007; Errata 2008) Standard for Motors and Generators
NEMA MG 10	(2001; R 2007) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 2007) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2008; AMD 1 2008) National Electrical Code - 2008 Edition

1.2 RELATED REQUIREMENTS

This section applies to all sections of Division 22, PLUMBING of this project specification, unless specified otherwise in the individual section.

1.3 QUALITY ASSURANCE

1.3.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.2 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.3 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.4 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.5.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer."

1.3.5.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors shall conform to and have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and shall have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

1.6 ELECTRICAL INSTALLATION REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.6.1 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters (except starters/controllers which are indicated as part of a motor control center), control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits shall be provided under Division 26, except internal wiring for components of package equipment shall be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

1.6.2 Modifications to Existing Systems

Not used.

1.6.3 High Efficiency Motors

1.6.3.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to

the applications listed in NEMA MG 11.

1.6.3.2 High Efficiency Polyphase Motors

Not used.

1.6.4 Three-Phase Motor Protection

Not used.

1.7 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Operations Manual shall be provided and approved by Contracting Officer.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.8 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B 117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no

loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

-- End of Section --

SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS
07/06

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 the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 709	(2001; R 2007) Laminated Thermosetting Materials

CALIFORNIA CODE OF REGULATIONS (CCR)

	(2007) Title 24, Part 3, California Electrical Code

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2007; Errata 2006 & 2007; INT 44-56 2007; INT 47, 49, 50, 52-56 2008; INT 57, 58, 51, 48, 59 2009) National Electrical Safety Code
IEEE C57.12.28	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2005) Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
IEEE Std 100	(2000) The Authoritative Dictionary of IEEE Standards Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2008; AMD 1 2008) National Electrical Code - 2008 Edition

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 13, SPECIAL CONSTRUCTION, and Divisions 22 and 23 PLUMBING and HEATING VENTILATING AND AIR CONTDITIONING. This section applies to sections of Division 26 and 33, ELECTRICAL and UTILITIES, of this project specification unless specified otherwise in the individual sections.

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 208/120 V, three phase, four wire, 60 Hz. Final connections to the power distribution system at the existing panel board shall be made by the Contractor as directed by the Contracting Officer.

1.5 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.5.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.5.3 Operations and Maintenance Data (SD-10)

Operating and Maintenance Instructions; G; DO

Manual containing complete information on operation, routine and special maintenance of equipment shall be submitted. The operations and maintenance manual shall be printed on good quality 8-1/2 by 11 inch paper, bound separately from the parts list, and bound between a flexible and durable cover.

1.6 QUALITY ASSURANCE

1.6.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.6.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.10 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic,0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.11 WARNING SIGNS

Not used.

1.12 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.13 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section.

PART 2 PRODUCTS

2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance

test.

PART 3 EXECUTION

3.1 FIELD APPLIED PAINTING

Not used.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Not used.

-- End of Section --

SECTION 33 11 00

WATER DISTRIBUTION
11/09

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 within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C504	(2006) Standard for Rubber-Seated Butterfly Valves
AWWA C508	(2001) Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS
AWWA C509	(2009) Resilient-Seated Gate Valves for Water Supply Service
AWWA C605	(2005) Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
AWWA C651	(2005; Errata 2005) Standard for Disinfecting Water Mains
AWWA C700	(2009) Standard for Cold Water Meters - Displacement Type, Bronze Main Case
AWWA C701	(2007) Standard for Cold-Water Meters - Turbine Type for Customer Service
AWWA C702	(2001) Cold-Water Meters - Compound Type
AWWA C704	(2008) Propeller-Type Meters for Waterworks Applications
AWWA C706	(1996; R 2005) Direct-Reading, Remote-Registration Systems for Cold-Water Meters
AWWA C707	(2005) Encoder-Type Remote-Registration Systems for Cold-Water Meters
AWWA C800	(2005) Underground Service Line Valves and Fittings
AWWA C900	(2007; Errata 2008) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm

Through 300 mm), for Water Distribution

ASTM INTERNATIONAL (ASTM)

ASTM A 563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 563M	(2007) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM C 150/C 150M	(2009) Standard Specification for Portland Cement
ASTM C 94/C 94M	(2009a) Standard Specification for Ready-Mixed Concrete
ASTM D 1599	(2005) Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D 1784	(2008) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(2009) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(2006) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(2004e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2855	(1996; R 2002) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3139	(1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

ASTM F 402	(2005) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	(2008) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

CALIFORNIA CODE OF REGULATIONS (CCR)

24 CCR 5	(2007) Title 24, Part 5, California Plumbing Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(2008) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 325	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 49	(2003) Hazardous Chemicals Data
NFPA 704	(2006) Identification of the Hazards of Materials for Emergency Response

1.2 UNIT PRICES

Measurement and payment will be based on completed work performed in accordance with the drawings, specifications, and the contract payment schedules. Payment will not be made under this section for excavation, trenching, or backfilling.

1.2.1 Measurement

The length of water lines to be paid for will be determined by measuring along the centerlines of the various sizes of pipe furnished and installed. Pipe will be measured from center of fitting to center of fitting, from center of water distribution line to end of service connection, and from center of water distribution line to center of hydrant. No deduction will be made for the space occupied by valves or fittings.

1.2.2 Payment

Payment will be made for water lines at the contract unit price per linear foot for the various types and sizes of water lines, and will be full compensation for all pipes, joints, specials, and fittings, complete in place. Payment for fire hydrants, gate valves, valve boxes, and standard valve manholes will be made at the respective contract unit price each for such items complete in place. Payment will include the furnishing of all testing, plant, labor, and material and incidentals necessary to complete the work, as specified and as shown.

1.3 DESIGN REQUIREMENTS

1.3.1 Water Distribution Mains

Not used.

1.3.2 Water Service Lines

Provide water service lines indicated as 1/2 inch flexible tubing from extraction wells to storage tanks at the points indicated. Water service lines shall be polyvinyl chloride (PVC) plastic tubing. Polyvinyl chloride (PVC) plastic pipe appurtenances, and valves as specified for water mains may also be used for service lines. Provide water service line appurtenances as specified. Submit design calculations of water piping.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Disinfection Wastewater Plan; G

SD-03 Product Data

Piping Materials

Water service line piping, fittings, joints, valves, and coupling

Indicator posts

Valve boxes

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on and rubber-gasketed bell-and-spigot joints. Include information concerning gaskets with submittal for joints and couplings.

SD-05 Design Data

Design calculations of water piping

SD-06 Test Reports

Bacteriological Disinfection

Test results from commercial laboratory verifying disinfection

SD-07 Certificates

Water service line piping, fittings, joints, valves, and coupling

Ultrasonic Meters

Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the intervals or frequency specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

SD-08 Manufacturer's Instructions

Delivery, storage, and handling

Installation procedures for water piping

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, and valves free of dirt and debris.

1.5.2 Handling

Handle pipe, fittings, valves, hoses, and other accessories in a manner to ensure delivery to the site in sound undamaged condition. Carry, do not drag pipe to the site. 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 installed 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. Store rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

1.5.2.1 Coated and Wrapped Steel Pipe

Not used.

1.5.2.2 Polyethylene (PE) Pipe, Fittings, and Accessories

Handle PE pipe, fittings, and accessories in accordance with AWWA C901.

1.5.2.3 Miscellaneous Plastic Pipe and Fittings

Handle Polyvinyl Chloride (PVC) pipe and fittings in accordance with the manufacturer's recommendations. Store plastic piping and jointing materials that are not to be installed immediately under cover out of direct sunlight.

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS

2.1.1 Piping Materials

Not used.

2.1.2 Valves, Hydrants, and Other Water Main Accessories

2.1.2.1 Tracer Wire for Nonmetallic Piping

Not used.

2.2 WATER SERVICE LINE MATERIALS

2.2.1 Piping Materials

2.2.1.1 Plastic Piping

Plastic pipe and fittings shall bear the seal of the National Sanitation Foundation (NSF) for potable water service. Plastic pipe and fittings shall be supplied from the same manufacturer.

a. Polyvinyl Chloride (PVC) Plastic Piping with Screw Joints: ASTM D 1785, Schedule 80; or ASTM D 2241, with SDR as necessary to provide 150 psi minimum pressure rating. Fittings, ASTM D 2466 or ASTM D 2467. Pipe and fittings shall be of the same PVC plastic material and shall be one of the following pipe/fitting combinations, as marked on the pipe and fitting, respectively: PVC 2120/PVC II; PVC 2116/PVC II. Solvent cement for jointing, ASTM D 2564. Pipe couplings, when used shall be tested as required by ASTM D 2464.

b. Polyvinyl Chloride (PVC) Plastic Piping with Elastomeric-Gasket Joints:

Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 80, with joints meeting the requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified.

c. Polyvinyl Chloride (PVC) Plastic Piping with Solvent Cement Joints:

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.

2.2.2 Water Service Line Appurtenances

2.2.2.1 Service Clamps

Service clamps used for repairing damaged cast-iron, steel, PVC or asbestos-cement pipe shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented

to the body.

2.2.2.2 Check Valves

Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be cast on the body of each valve. Valves 2 inches and larger shall be outside lever and spring type.

a. Valves 2 inches and smaller shall be all bronze designed for screwed fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.

2.2.2.3 Gate Valves 3 Inch Size and Larger

Not used.

2.2.2.4 Gate Valves Smaller than 3 Inch in Size

Gate valves smaller than 3 inch size MSS SP-80, Class 150, solid wedge, nonrising stem. Valves shall have flanged or threaded end connections, with a union on one side of the valve. Provide handwheel operators.

2.2.2.5 Gate Valves Smaller Than 3 Inch Size in Valve Pits

Not used.

2.2.2.6 Displacement Type Meters

Not used.

2.2.2.7 Compound Type Meters

Not used.

2.2.2.8 Meter Boxes

Not used.

2.2.2.9 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Earthwork

Perform earthwork operations in accordance with Section 31 23 00.00 20.

3.1.1.2 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into position. Cut pipe in a neat workmanlike manner accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding. Provide anchors and supports where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads.

3.1.1.3 Installation of Tracer Wire

Not used.

3.1.1.4 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.

3.1.1.5 Flanged Pipe

Not used.

3.1.2 Special Requirements for Installation of Water Service Piping

3.1.2.1 Installation of Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of ASTM D 2774 and ASTM D 2855, unless otherwise specified. Handle solvent cements used to join plastic piping in accordance with ASTM F 402.

a. Jointing: Make solvent-cemented joints for PVC plastic piping using the solvent cement previously specified for this material; assemble joints in accordance with ASTM D 2855. Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

b. Plastic Pipe Connections to Appurtenances: Connect plastic pipe service lines to corporation stops and gate valves in accordance with the recommendations of the plastic pipe manufacturer.

3.1.2.2 Location of Meters

Meters shall be installed at the locations shown on the drawings. The meters shall be installed to allow for reading and ease of removal or maintenance.

3.1.3 Disinfection

Prior to disinfection, obtain Contracting Officer approval of the proposed method for disposal of waste water from disinfection procedures. Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 and 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service. Disinfection of systems supplying nonpotable water is not required.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

Prior to hydrostatic testing, obtain Contracting Officer approval of the proposed method for disposal of waste water from hydrostatic testing. The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications.

3.2.2 Special Testing Requirements

For pressure test, use a hydrostatic pressure50 psi greater than the maximum working pressure of the system. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

3.3 CLEANUP

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

-- End of Section --

SECTION 33 24 00.00 20

EXTRACTION WELLS
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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 within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 312/A 312M	(2009) Standard Specification for Seamless, Welded, and Heavily Worked Austenitic Stainless Steel Pipes
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM C 117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 150/C 150M	(2009) Standard Specification for Portland Cement
ASTM D 1586	(2008a) Penetration Test and Split-Barrel Sampling of Soils
ASTM D 1587	(2008) Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2487	(2006e1) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2488	(2009a) Description and Identification of Soils (Visual-Manual Procedure)
ASTM D 4397	(2009) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 5088	(2002; R 2008) Decontamination of Field Equipment Used at Nonradioactive Waste Sites

ASTM D 5092	(2004e1) Design and Installation of Ground Water Monitoring Wells in Aquifers
ASTM F 480	(2006b) Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80
ASTM F 883	(2009) Padlocks

CALIFORNIA DEPARTMENT OF WATER RESOURCES (DWR)

	Water Well Standards Bulletins 74-81 and 74-90

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008) Safety and Health Requirements Manual

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 530/F-93/004	(1993; Rev O; Updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846)
EPA 600-4-89-034	(1990) Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells
EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards

1.2 DESCRIPTION OF WORK

Provide extraction wells including drilling, casing, well screen, gravel packing, grouting, development, monitoring device, and incidental related work complete and ready for operation.

1.3 GENERAL REQUIREMENTS

Each system, including equipment, materials, installation, and performance, shall be in accordance with local, State, and Federal regulations, ASTM D 5092, and EPA 600-4-89-034 except as modified herein. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" has been substituted for the word "should" wherever it appears. Reference to the "Project Representative" and the "Owner" shall be interpreted to mean the Contracting Officer. Additional requirements are included under Section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS. Mark and secure wells to avoid unauthorized access and tampering.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for Contractor Quality Control approval only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Well construction; G

SD-03 Product Data

Well casing; G

Well screen; G

Filter pack; G

Neat cement grout; G

Bentonite seal; G

SD-07 Certificates

Well Drilling/Development Material Handling Plan; G

Health and Safety Plan; G

Field Sampling and Laboratory Testing Plan; G

Treatment facility permit; G

Well Development Report; G

Borehole Analysis Report; G

SD-11 Closeout Submittals

Well Construction Permit; G

Installation Survey Report; G

Shipment manifests; G

Delivery certificates; G

Treatment and disposal certificates; G

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials in an undamaged condition. Unload and store with minimal handling. Store materials in on-site enclosures or under protective coverings. Store plastic piping and jointing materials, and rubber gaskets under cover, out of direct sunlight. Store materials off the ground. Keep insides of pipes and fittings free of dirt and debris. Replace defective or damaged materials with new materials.

1.6 QUALITY ASSURANCE

1.6.1 Required Drawings

Submit well construction drawings showing components and details of well casing, well screen, filter pack, annular seal, and associated items. Drawings shall be prepared by a State of California certified professional geologist or hydrogeologist, or by a State of California registered professional civil engineer. Drawings shall be sealed.

1.6.2 Well Drilling/Development Material Handling Plan

A material handling plan shall be furnished by the Contractor 15 days prior to initiation of the work that describes phases of dealing with the potentially contaminated soil and groundwater, including the following: a schedule to be employed in the well drilling and development stages, a sequence of operations, the method of drilling and development, material hauling, proposed equipment, handling of the contaminated materials, soil and water testing requirements, and safety precautions and requirements.

1.6.3 Health and Safety Plan (HASP)

Describe safety precautions for each phase of the project as specifically related to handling of soil and water removed during well drilling and development operations. Identify appropriate requirements of 29 CFR 1910 and EM 385-1-1. Identify safety equipment and procedures to be available and used during the project. Furnish the name and qualifications based on education, training, and work experience of the proposed Health and Safety Officer (HASO) and the members of the drill crew.

1.6.4 Field Sampling and Laboratory Testing Plan

Describe field sampling methods and quality control procedures. Identify laboratory and laboratory methods to be used for contamination testing. Sample reports shall show sample identification for location, date, time, sample method, contamination level, name of individual sampler, identification of laboratory, and quality control procedures.

1.6.5 Treatment Facility Permit

Verification that the proposed treatment facility is permitted to accept the contaminated materials specified, prior to the start of excavation.

1.6.6 Well Development Report

Provide report, containing the following data for each well: project name and location, well designation, date and time of well installation, date and time of well development, static water level from top of well casing before development and 24 hours after development, field measurements of pH, temperature, and specific conductivity, depth of well from top of casing to bottom of well, screen length, description of development methodology size/capacity of pump or bailer, pumping rate, and recharge rate.

1.6.7 Well Construction Permit

Submit a completed permit application and a proposed method of construction

to the appropriate state agency prior to construction of the well. Construction of the wells will not be allowed until an approved Well Construction Permit has been submitted to the Contracting Officer.

1.6.8 Shipment Manifests

Copies of manifests and other documentation required for shipment of waste materials within 24 hours after removal of waste from the site. Shipment manifests shall be signed by the Contracting Officer.

1.6.9 Delivery Certificates

Verification that the wastes were actually delivered to the approved treatment facility, within 7 days of shipment.

1.6.10 Treatment and Disposal Certificates

Verification that the wastes were successfully treated and remediated to the levels specified herein.

PART 2 PRODUCTS

2.1 WELL CASING

2.1.1 Stainless Steel Piping

Not used.

2.1.2 PVC Piping

ASTM F 480, Type 1, Grade 1, PVC 12454, NSF wc or NSF pw, Schedule 80, with flush threaded joint fittings. Threaded joints shall be wrapped with flouropolymer tape, and provided with nitrile O-ring gaskets.

2.2 WELL SCREEN

Well screens shall be located as indicated. The length of each screen shall be as indicated. Slot size shall be 0.02 inch. Slotted openings shall be distributed uniformly around the circumference of the screen. Open area shall approach the formation's natural porosity.

2.2.1 Stainless Steel Screens

Not used.

2.2.2 PVC Screens

ASTM D 1785, PVC 1120, NSF wc or NSF pw, Schedule 80, screen, Schedule 80, machine-slotted construction, flush threaded joint ends. Slots shall be even in width, length, and separation.

2.3 PRIMARY FILTER PACK

Provide clean, durable, well-rounded, and washed quartz or granite, with less than 5 percent non-siliceous material. The filter pack shall not contain organic matter or friable materials. The filter pack shall allow free flow of water in the well, and shall prevent the infiltration of

aquifer materials. Filter pack shall have a 30 percent finer than (d-30) grain size of [TBD] inch, and a uniformity coefficient less than 2.5, in accordance with ASTM C 117 and ASTM C 136.

2.4 SECONDARY FILTER PACK

Gradation in accordance with ASTM D 5092. Provide clean, durable, well-rounded, and washed quartz or granite. Pack shall not contain organic matter or friable materials.

2.5 ANNULAR SEALANTS

2.5.1 Bentonite Seal

Provide powdered, granular, pelletized, or chipped sodium or calcium montmorillonite in sealed containers from a commercial source, free of impurities. Diameter of pellets shall be less than one fifth the diameter of the borehole annular space to prevent bridging. Bentonite base grout shall be in accordance with ASTM D 5092.

2.5.2 Neat Cement Grout

Provide neat cement grout in accordance with ASTM D 5092. Cement shall be in accordance with ASTM C 150/C 150M. Quick setting admixtures shall not be allowed. Drilling mud or cuttings shall not be used as a sealing material.

2.6 BOTTOM PLUGS

Provide flush threaded solid plug at the bottom of the well. Plug shall be the same material as the well casing to which it is attached. Joints shall be wrapped with fluoropolymer tape and provided with nitrile O-ring gaskets.

2.7 LOCKING WELL CAP

Provide flush threaded, weatherproof, and non-removable locking well cap on the top of the well. Well cap shall be of the same material as the well casing to which it is attached. Well cap shall accommodate padlock. Provide a long shackled padlock in accordance with ASTM F 883. Provide two keys for the padlock, and turn them over to the Contracting Officer. Locks at the well site shall be keyed alike.

2.8 WELL HEAD COMPLETIONS

Clearly mark and secure the well to avoid unauthorized access and tampering. Cast the words "EXTRACTION WELL" on the well head cover. Provide a sign reading, "WELL IS FOR MONITORING AND IS NOT SAFE FOR DRINKING." Provide stamped metal identification tag as follows:

DO NOT DISTURB
ID #: Date:
Installed By:
Total Depth:
Screened Interval:
TOC Elevation:
Other:
For Information, Call:

2.8.1 Aboveground Completions

.ot used

2.8.2 At-Grade Completions

Not used.

2.9 POLYEHTYLENE SHEETING

ASTM D 4397.

PART 3 EXECUTION

3.1 GENERAL

Notify the Contracting Officer at least 15 days prior to commencement of work. Locations of wells shall be as indicated. Drilling, installation, and development of the extraction wells shall be supervised, directed, and monitored by the Contracting Officer. Drilling, sampling, and well development equipment introduced to the well shall be decontaminated before and after each use in accordance with ASTM D 5088.

3.2 DRILLING

Borehole shall be advanced using conventional 3 foot hollow-stem auger drilling methods. If it is the opinion of contractor that an alternate drilling method is required, justification for a boring method change shall be submitted in writing to the Contracting Officer, and approval for the change granted prior to drilling. Drill crew shall be experienced and trained in drilling and safety requirements for contaminated sites.

3.2.1 Sampling

Obtain samples in accordance with ASTM D 1586 or ASTM D 1587. Perform standard penetration tests at the following depths: 0.0 to 1.5 feet; 1.5 to 3.0 feet; 3.0 to 4.5 feet; and 5 foot centers or at changes in soil formation thereafter. Each soil sample shall be screened in the field with an organic vapor analyzer/flame ionization device (OVA/FID) capable of detecting vapors to a minimum of one ppm. Log boring in accordance with ASTM D 2487 and ASTM D 2488. Groundwater elevation shall be indicated.

3.2.2 Analysis

The contractor shall review the log data from each borehole and compare the data with the well design requirements. The contractor shall verify the adequacy of the well design, or shall offer a proposed modification to the design based on the geologic and hydrogeologic data obtained from the borehole. This review and analysis shall be conducted for each borehole. The contractor shall submit the borehole boring logs, the analysis of the well design, and any proposed design modifications to the Contracting Officer in a Borehole Analysis Report. Any modifications to the well design approved by the Contracting Officer shall be considered a change to the contract documents and shall be negotiated in accordance with the "CHANGES" clause.

3.2.3 Alignment

Verify that the well is straight by lowering a 10 foot section of 8 inch diameter steel pipe in to the well.

3.3 SOIL REMOVED FROM THE BOREHOLE

3.3.1 Temporary Containment of Soil Removed from the Borehole

Soil removed from the borehole shall be placed in a temporary containment area. Provide a temporary containment area near the well site. Cover containment area with 10 mil reinforced polyethylene sheeting. Place soil removed from the boreholes on the impervious barrier and cover with 6 mil reinforced polyethylene sheeting. Provide a straw bale berm around the outer limits of the containment area and cover with polyethylene sheets. Secure edges of sheets with weights to keep the polyethylene sheeting in place. Water runoff shall be diverted from the stockpiled material. As an option, soil may be stockpiled in trucks suitable for transporting contaminated soils as specified herein.

3.3.2 Testing Requirements for Stockpiled Soils

Sampling and analysis of stockpiled soils shall be conducted in accordance with the approved workplan.

3.3.2.1 Sampling

A minimum of one composite sample shall be developed and analyzed for each required test from a composite stockpile of soil removed from each well site. To develop a composite sample of the size necessary to run the required tests, the Contractor shall take several samples from different areas along the surface and in the center of the stockpile. These samples shall be combined and thoroughly mixed to develop the composite sample.

3.3.2.2 Testing

Laboratory analysis of stockpiled soils shall be conducted in accordance with the approved workplan.

3.3.2.3 Disposal of Stockpiled Soils

a. Soils exhibiting TPH less than 100 ppm, BTEX less than 10 ppm, TOX less than 100 ppm, passing TCLP tests, and testing negative for PCB's shall be considered clean as shall be disposed of on-site as directed by the Contracting Officer.

b. Soils failing the TCLP test or exhibiting TOX greater than 100 ppm shall be managed in accordance with applicable State and local regulations. Payment for disposal of materials failing the TCLP metals test or TOX test shall be made in accordance with the "CHANGES" clause of the General Conditions.

c. If the concentration of total BTEX is greater than 10 ppm or TPH greater than 100 ppm, the soil shall be treated and disposed of at a permitted soil recycling facility.

3.4 WELL INSTALLATION

Well installation shall be in accordance with ASTM D 5092 and

EPA 600-4-89-034, and as indicated on the well construction drawings submitted by the contractor and approved by the Contracting Officer. Borehole shall be stable and shall be verified straight before beginning installation.

3.4.1 Casings and Screens

Well casings, screens, plugs, and caps shall be decontaminated prior to delivery by the manufacturer and shall be certified clean. Materials shall be delivered, stored, and handled in such manner as to ensure that grease, oil, or other contaminants do not contact any portion of the well screen and casing assembly prior to installation. If directed by the Contracting Officer, the well screen and casing assembly shall be cleaned with high pressure water prior to installation. Personnel shall wear clean cotton or surgical gloves while handling the assembly. Centralizers shall be used to ensure that the well screen and casing assembly is installed concentrically in the borehole. When the assembly has been installed at the appropriate elevation, it shall be adequately secured to preclude movement during placement of the filter packs and annular seals. The top of the well casing shall be capped during filter pack placement.

3.4.2 Primary and Secondary Filter Packs

Primary and secondary filter packs shall be placed as indicated on the approved well construction drawings to fill the entire annular space between the screen and casing assembly and the outside wall of the borehole. Place both the primary and secondary filters with a tremie pipe in accordance with EPA 600-4-89-034 and ASTM D 5092. Placement of the primary and secondary filters by gravity or free fall methods is not allowed. Control speed of filter placement to prevent bridging and to allow for settlement. Prior to commencement of work, equipment and methods required to place filters shall be approved by the Contracting Officer.

3.4.3 Bentonite Seal

Bentonite shall be placed as a slurry through a tremie pipe. Control speed of bentonite placement to prevent bridging or segregation of slurry. Additional water shall be added to the annular space to ensure complete hydration of the bentonite. Bentonite shall cure a minimum of 48 hours before the placement of cement grout to ensure complete hydration and expansion of the bentonite.

3.4.4 Neat Cement Grout

Cement grout shall be placed in the annular space above the bentonite seal as indicated on the well construction drawings. Cement grout shall be placed as a slurry through a tremie pipe, and injected under pressure to reduce chance of voids. Grout shall be injected in one continuous operation until full strength grout flows out at the ground surface without evidence of drilling cuttings or fluid. Cement grout shall cure a minimum of 48 hours before beginning well development operations.

3.4.5 Well Head Completions

Well head completions shall be as indicated and as specified herein.

3.5 WELL DEVELOPMENT

Well development shall be in accordance with EPA 600-4-89-034 and ASTM D 5092 except as modified herein. Bailing, surging, and pumping/overpumping/backwashing are acceptable development methods. Air surging and jetting are prohibited. Method of development shall be approved by the Contracting Officer. Well development shall not begin until the well installation is complete and accepted by the Contracting Officer. Well development operations shall be conducted continuously until development water flows clear and free of drilling fluids, cuttings, or other materials. At such time representative water samples shall be tested for pH, temperature, and specific conductivity in accordance with EPA 600/4-79/020. Samples shall be taken every 3 hours. When stabilized readings of these parameters, as accepted by the Contracting Officer, have been achieved for 12 consecutive hours, well development operations shall cease.

3.6 WATER FROM WELL DEVELOPMENT OPERATIONS

Water from the well development operations shall be containerized in accordance with State and local regulations. One sample shall be taken and analyzed for each required test of stored water from each well following well development operations.

3.6.1 Testing

a. The sum of benzene, toluene, ethyl benzene, and xylene (BTEX) concentrations shall be determined by using EPA 530/F-93/004, Method 8020.

b. TPH (total petroleum hydrocarbons) concentrations shall be determined by using EPA 530/F-93/004, Method 8015.

3.6.2 Disposal of Containerized Water

a. Water exhibiting TPH less than 0.5 ppm and BTEX less than 1 ppb shall be considered clean and shall be disposed of on-site as directed by the Contracting Officer.

b. If the concentration of total BTEX is greater than 1 ppb or TPH greater than 0.5 ppm, the water shall be treated and disposed of at a permitted facility.

3.7 TRANSPORTATION OF CONTAMINATED SOIL AND WATER

The Contractor shall be solely responsible for complying with Federal, State, and local requirements for transporting contaminated materials through the applicable jurisdictions and shall bear responsibility and cost for any noncompliance. In addition to those requirements, the Contractor shall do the following:

a. Inspect and document vehicles and containers for proper operation and covering.

b. Inspect vehicles and containers for proper markings, manifest documents, and other requirements for waste shipment.

c. Perform and document decontamination procedures prior to leaving the worksite and again before leaving the disposal site.

3.8 DISPOSAL OF CONTAMINATED SOIL AND WATER

Contaminated materials removed from the site shall be disposed of in a treatment/disposal facility permitted to accept such materials. All manifests for the transport and/or disposal of contaminated materials shall be signed by the Contracting Officer.

3.9 INSTALLATION SURVEY

Upon completion of well installation and development and acceptance by the Contracting Officer therefor, the vertical and horizontal position of each well shall be determined by a registered land surveyor licensed in the State of California. The survey shall document the vertical elevations of the top of the casing pipe and the ground surface elevation adjacent to each well. The survey shall also determine the horizontal location of each well based on the North American Datum of 83 (NAD 83) coordinate system. Survey shall be accurate to the nearest 0.01 foot. This data shall be submitted with a well location map as the Installation Survey Report.

3.10 CLEANUP

Upon completion of the well construction, remove debris and surplus materials from the jobsite.

-- End of Section --

SECTION 43 21 29

FLOW MEASURING EQUIPMENT - WATER
04/06

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 within the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B16.1	(2005) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME PTC 19.5	(2004) Flow Measurement

ASTM INTERNATIONAL (ASTM)

ASTM A 126	(2004) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM B 61	(2008) Standard Specification for Steam or Valve Bronze Castings

1.2 SYSTEM REQUIREMENTS

The flow measuring equipment shall be the ultrasonic meter type. The design shall permit ease of installation and shall not have any features hazardous to personnel or detrimental to the equipment. Interior parts shall be easily accessible for adjustment, repair, and replacement.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Flow measuring equipment components; G; ED

Read-out device; G; ED

; G; EDmable Logic Controller (PLC) Software

SD-06 Test Reports

Flow measuring equipment calibration

Open channel test

Dimensional inspection report

Closed channel test

SD-08 Manufacturer's Instructions

Flow measuring equipment components

Submit manufacturer's written recommendation for installation and handling.

1.4 QUALITY ASSURANCE

1.4.1 Requirements

Submit as required in paragraph entitled "Field Tests and Inspections."

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Unless otherwise specified, all materials and equipment shall be standard commercial products in regular production by the manufacturer and suitable for the required service.

2.1.1 Variable Head Meter for Closed Channel

Not used.

2.1.2 Variable Head Meter for Open Channel

Not used.

2.1.3 Variable Area Meter for Open or Closed Channel

Not used.

2.1.4 Propeller Meter

Not used.

2.1.5 Electromagnetic Meter

Not used.

2.1.6 Volumetric Meter

Not used.

2.1.7 Ultrasonic Meter

Provide an ultrasonic meter where indicated. The meter shall have a velocity range of0 to 5 feet per second through 0 to 20 feet per second for use with a 1/2 inch pipe. The flow meter shall consist of separate

transmitting and receiving transducers clamped to the outside of the pipe to measure the liquid flow without, in anyway, intruding into or altering the pipe. The transmitter shall contain all necessary circuitry enclosed in NEMA 4 outdoor housing suitable for panel mounting and connected to the transducers by [TBD]feet of cable. It shall produce an accurate 4 to 20 mA dc signal linear with flow rate. It shall provide linearity of plus of minus 0.5 percent and repeatability of 0.1 percent under simulated flow. Long term drift of the pulse rate output shall be less than 0.1 percent. It shall operate with 115 or 230 volt plus or minus 10 percent, 50 or 60 Hz electrical power. The unit shall function over an ambient temperature range of 10 degreesF to 176 F outdoor. The flow rate indicator shall be integrally mounted in the transmitter housing. Graduate 6 inch scale length ingpm.

2.2 READ-OUT DEVICE

Provide the meter with the following read-out device which shall read from 0 to 10 gpm.

2.2.1 Local Read-Out

Not used.

2.2.2 Local Read-Out and Remote Transmission

Provide an indicating, recording transmitter and an integrator for local read-out and transmission of flow data to remote read-out. The scale graduation shall be uniform. The read-out shall be visible through a shatterproof clear window. The read-out and transmission mechanism shall not be affected by the intended end use of environment. The transmission shall be impulse duration type or milliampere dc analog signal type to the remote read-out. Actuate all transmission by the output motion or the ac voltage signal of the meter. Power required shall come from the meter. When impulse duration type transmission is used, the system shall have a 15 second maximum cycle actuating a cam-operated contact. The contact shall be of the totally-enclosed type. The unit shall be non-corrosive and weatherproof or provided with a separate weatherproof housing with a sealed door for access to the mechanism, and designed to prevent the accumulation of moisture or fog inside the case. Provide a suitable mounting.

Indicator shall read the total flow in the units specified using only a whole power of 10 multiplier.

2.2.3 Remote Read-Out

Provide an indicator, a recorder, a telephone communication system, and an integrator for remote read-out of flow. The scale graduation shall be uniform. The read-out shall accept the signal output and be of the same range and flow units as the local read-out and remote transmission device. The signal shall actuate an electro-mechanical receiver in which the input duplicates the output of the remote transmission device. Ac or dc power supply shall be provided, if required. The read-out shall be visible through a shatterproof clear window. The read-out shall not be affected by the intended end use environment. The unit shall be weatherproof or provided with a separate weatherproof housing with a sealed door for access to the mechanism, and designed to prevent the accumulation of moisture or fog inside the case. Provide a suitable mounting.

shall read the total flow in the units specified using only a whole power of 10 multiplier.

2.3 ELECTRICAL REQUIREMENTS

Provide wiring for signal circuit as specified by the equipment manufacturer. The interconnecting conduit and wire (except when otherwise specified herein, or when included in factory-assembled equipment) and the electrical connection of the meters to the electrical power circuit are specified in Division 16.

2.4 SPARE PARTS

Provide all standard recommended spare parts as specified in the manufacturer's instruction manuals for each component in the system.

PART 3 EXECUTION

3.1 MATERIALS PROTECTION

Not used.

3.2 INSTALLATION

Furnish the services of an engineer representative of the manufacturer of the flow measuring equipment for checking the installation, making the necessary adjustments and calibrations, placing the equipment in operation, and performing the acceptance tests. The representative also shall be available for not less than 2 days to instruct operating personnel in the use, operation, and maintenance of the equipment during the initial operating period. Install all flow measuring equipment in accordance with the recommendations of the manufacturer.

3.3 FIELD TESTS AND INSPECTIONS

Test and calibrate in place the flow measuring equipment to demonstrate that it meets the accuracy requirements for the full range of flows specified herein. Provide all labor, equipment, and incidentals required for the tests, including electric power and water required for tests. The Contracting Officer will witness all field tests and conduct all field inspections. The Contractor shall give the Contracting Officer ample notice of the dates and times scheduled for tests. Rectify any deficiencies found and retest work affected by such deficiencies at the Contractor's expense. Record data from each field test shall be recorded and documented in a formal field test report.

-- End of Section --

3.0 HYDROGEOLOGIC REVIEW OF A-ZONE GROUNDWATER

(see next page)

Jim Van de Water, PG, CHG
Consulting Hydrogeologist
3 Bitterwood
Irvine, California 92604-3208

May 3, 2010

Mohammad Estiri, Ph.D.
Eco & Associates, Inc.
1855 West Katella Avenue, Suite 340
Orange, California 92867

Subject: Hydrogeologic Review for Planned Remediation of A-Zone Groundwater
Brown & Bryant Superfund Site
600 South Derby Street
Operable Unit No. 2
Arvin, California

Dear Dr. Estiri:

As you requested in the meeting held at your office on March 25, 2010[1], I am providing this hydrogeologic review for the Brown & Bryant Superfund Site located in Arvin, California (the Site; **Figure 1**). As discussed, this review focuses on the planned remediation by means of dewatering the "A-zone". This approach, which can be characterized as an attempt to pump a series of large diameter wells in order to dewater the A-zone, has been selected because the A-zone is of limited extent and contains relatively high concentrations of dissolved agricultural chemicals, most notably the herbicide dinoseb.[2] The intent would be to remove the source of contaminated groundwater that may migrate downward and impact deeper groundwater zones (*i.e.*, the B-zone and C-zone). It is assumed that the source of the groundwater found in the A-zone was the now-capped ponds associated with the former operation at the site. A-zone groundwater is currently monitored by means of 25 monitoring wells as shown in **Figure 2**. It is my understanding that the proposed groundwater remediation system has been documented into the Record of Decision (ROD) for the Site and is planned to consist of four, large-diameter groundwater extraction wells/sumps (**Attachment A**)[3].

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[1] Attendees at this meeting included Mohammad Estiri (Eco & Associates, Inc.), Jim Van de Water (Consulting Hydrogeologist), and David M. Henry, PG (Lexington Geoscience).

[2] This review is not a critique of the work done to date and assumes that the documents provided accurately reflect conditions at the Site.

[3] Eco & Associates, 2010. *Value Engineering Recommendation #40*. January 12-13.

This review is based on information contained in the following documents provided to me at the meeting (those in bold type are the ones most relied upon in this review):

- **Eco & Associates (E&A), 2009.** ***April 2009 Groundwater Sampling Report (Draft), Brown & Bryant Superfund Site, Arvin, California*****.**
- **E&A, 2008.** ***April 2008 Groundwater Sampling Report (Draft), Brown & Bryant Superfund Site, Arvin, California*****.**[4]
- Ecology and Environment, Inc. (EEI), 1998. *Data Needs and Recommendations Technical Memorandum, Brown & Bryant GWOU, Arvin, California*. March.
- EEI, 1993. *B-1 Aquifer Test Report, Task 11, Brown & Bryant, Arvin, California*. March 31st.
- EEI, 1993. *B-2 Aquifer Test Report, Task 11, Brown & Bryant, Arvin, California*. March 31st.
- EEI, 1992. *Final Report, Task 9 – Slug Testing, Brown & Bryant, Arvin, California*. July 17th.
- Morrison Knudsen Corporation, 1998. *Project Work Plan, Brown & Bryant, Arvin Facility, Superfund Site, First Operable Unit, Phase II*. September.
- **Panacea, Inc., 2004.** ***Remedial Investigation/Feasibility Study of Remedial Alternatives, Operable Unit No. 2, Brown & Bryant Superfund Site, Arvin, California*****. June.**
- Resource Technologies Group, Inc., 1998. *Treatability Study Work Plan, Extraction and Treatment System, Brown and Bryant, Arvin Facility, Superfund Site, First Operable Unit*. November 13th.

This review consists of a review of hydrogeologic data, an assessment of the remedial approach, and recommendations.

1 BACKGROUND[5]

The B&B Arvin facility is located at 600 South Derby Street in Arvin, California, about 18 miles southeast of the City of Bakersfield. The Site is located on the east side of Arvin in a light industrial and commercial area. Residential properties are located west of the site and agricultural fields are located north, south, and east of the Site.

Currently, the Site is vacant. A warehouse, a metal shed, and an aboveground storage tank are located on the property. The property is secured by a chain-link fence and paved with asphalt. The asphalt acts as a Resource and Conservation Recovery Act (RCRA) cap in the southern portion of the Site and a non-RCRA cap in the northern portion.

[4] Provided by David M. Henry, PG on compact disc.

[5] This section is excerpted or directly quoted from E&A 2008, 2009 unless otherwise noted.

1.1 OPERATIONAL HISTORY (USEPA, 2003)[6]

The B&B facility operated as a pesticide reformulator and custom applicator facility from 1960 to 1989. The facility formulated agricultural chemicals, including pesticides, herbicides, fumigants, and fertilizers, for sale to the local farming community between 1960 and 1968. In 1981, the facility was licensed under the Resource and Conservation Recovery Act (RCRA) as a hazardous waste transporter. Contamination of soil and groundwater resulted from inadequate procedural controls, chemical spills during operations, and leaks from a surface wastewater pond and sumps. The largest releases on Site were from the wastewater pond, a sump area, and a dinoseb spill area.

The wastewater pond located in the southwest portion of the Site was originally excavated as an unlined earthen pond in 1960. The pond was used to collect run-off water from the yard and from two sumps (since excavated). The pond was also used to collect rinse water from rinsing tanks used for fumigants. Excess pond water and rain water run-off also collected in a topographically low area to the east and south of the pond. In addition, ponded water from precipitation and irrigation from the east has occasionally breached the berm in the southeast corner of the pond and drained into the pond. The pond was double lined with a synthetic liner in November 1979. The liner and additional soil were excavated in August 1987. Approximately 640 cubic yards of soil that showed visible signs of contamination were removed from the pond at that time. The depths of this excavation ranged from approximately one and one-half feet on the sides to five feet on the bottom.

In 1960, an unlined earthen sump was constructed in the center of the Site. The sump was used to collect wash water from a pad where equipment and tanks used for liquid fertilizers and fumigants were washed. Water from the sump was drained to the pond through an underground pipeline. In 1980, the sump was replaced with two double lined sumps, and two lined sand traps were installed west of the pond. Dinoseb was stored in a smaller tank storage area along the eastern fence, just north of the pond. In 1983, there was a significant dinoseb spill in this area. As a result, the soil and groundwater underlying this portion of the Site has been reported with the highest concentrations of dinoseb. The USEPA excavated highly contaminated soil from this area in the mid 1990s.

1.2 ENVIRONMENTAL HISTORY

In 1989, the Site was listed on the National Priorities List (NPL). In the same year, all operations at the Site ceased. Subsequently, various emergency and removal actions were initiated to minimize or eliminate immediate threats to human health and the environment.

A review of the available reports, generated between 1987 through 2006, indicates that the Site has been the subject of several investigations to assess the nature and extent of contamination. Based on the available documents, the Site investigations were conducted under two separate operable units: OU-1 and OU-2.

1.2.1 OU-1

The study area for the OU-1 investigations included surface soil, the unsaturated A-zone, and the A-zone groundwater. The A-zone includes unsaturated soils below ground surface (bgs),

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[6] USEPA (Region IX), 1993. *Remedial Investigation/Feasibility Study Report, Brown & Bryant Superfund Site, Arvin, California*. May 28th.

which may vary in thickness from 65 to 85 feet, and the first water-bearing unit, the A-zone groundwater. The depth to the saturated zone generally varies between 65 and 75 feet bgs. The base of the A-zone is a thin sandy clay layer between 75 and 85 feet bgs. The A-zone groundwater occurs beneath the entire Site but pinches out between 500 and 600 feet south of the Site, 200 feet east of the Site, and 300 feet west of the Site.

1.2.2 OU-2

The study area for the OU-2 investigation includes the unsaturated zone beneath the A-zone aquifer and the B-zone aquifer. The B-zone includes unsaturated soil beneath the A-zone and the second lowest water-bearing unit (B-zone groundwater) at 140 to 165 feet bgs. The B-zone extends to at least 250 feet bgs and ends at a clay layer (known as the Corcoran Clay) that confines the drinking water aquifer (the C-zone) beneath it. The Corcoran Clay, also locally known as the "Blue Clay" or the "E-Clay" is a member of the Tulare Formation and is the predominant aquitard separating the semi-confined water-bearing layers above it and the confined aquifer beneath. It is a regionally extensive lacustrine deposit of low permeability (Johnson *et al.*, 1968)[7] ranging in thickness from 20 feet to over 100 feet. Based on the driller's log for Arvin City Well No. 1, it is estimated that the Corcoran Clay layer in the area of the Site is at least 27 feet thick.

1.3 Site Geology and Hydrogeology

The Site is underlain with an alluvial deposit of alternating layers and mixtures of unconsolidated sands, silts, and clay. Soil underlying the Site to a depth of 80 feet generally consists of silty fine sand to fine sandy silt. Clean, well-graded sand lenses and seams of silty clay occur locally within these soils. The soils are generally thinly interbedded, with textural changes occurring every few vertical inches. These textural changes are also believed to occur laterally.

The Site geology has been divided into two zones: the A-zone and the B-zone. The characteristics of these two zones are summarized below.

1.3.1 A-Zone

The A-zone includes unsaturated soil at 65 to 75 feet bgs and includes the first water bearing unit, the A-zone groundwater. The depth to the saturated zone varied between 65 and 85 feet bgs in April 2008 and between 69 and 87 feet bgs in April 2009. In April 2008, 9 of the 25 A-zone wells were reported to be dry (Table 1 of E&A, 2008); in April 2009, 10 of the 25 A-zone wells were reported to be dry (Table 1 of E&A, 2009). The base of the A-zone is a thin sandy clay layer between 75 and 85 feet bgs. The clay layer and the A-zone groundwater extends beneath the entire Site but its off-site extent is limited to an area extending 640 feet south, 560 feet east, and 500 feet west of the Site.[8] The clay layer and A-zone groundwater are reportedly absent beyond these distances from the Site.

Groundwater in the A-zone flows is reported to flow in a generally southern direction with some mounding of the water table observed extending southward from the southwest corner of the

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[7] Johnson, A.I., R.P. Moston, and D.A. Davis, 1968. *Physical and Hydrologic Properties of Water-Bearing Materials in Subsiding Areas in Central California*. U.S. Geol. Surv. Prof. Paper.

[8] The approximate limits of the A-zone Aquifer are shown in Figure I-7 of Panacea (2004).

Site.[9] The saturated thickness of the A-zone groundwater ranges from 0 to 10 feet. The groundwater velocity in the A-zone has been estimated at 53 feet per year. Slug test results suggest that a yield of less than 100 gallons per day can be expected for wells in the A-zone. Aquifer testing of three of the on-site extraction wells showed a groundwater yield of approximately ¼ gallon per minute (gpm).

1.3.2 B-Zone

The B-zone includes unsaturated soil beneath the A-zone and the second lowest water-bearing unit (B-zone groundwater) at 140 to 165 feet bgs. The B-zone extends to at least 250 feet bgs and ends at a clay layer known as the Corcoran Clay that confines the drinking water aquifer beneath it. The thickness of this clay layer beneath the Site is unknown.

The B-zone groundwater comprises a series of water-bearing units. Wells in the B-zone were installed in the water-bearing units located at approximately 145 feet bgs and 170 feet bgs. The direction of flow in the water-bearing unit at 170 feet bgs is to the south, and the gradient is 0.0004 feet per foot. Permeabilities are much higher than for the A-zone. Past pump tests for the water-bearing unit at 170 feet bgs indicated that wells could be pumped at 7 gpm for an extended period.

1.3.3 Groundwater Monitoring Well Network

The groundwater monitoring well network is shown in **Figure 2**. It consists of 44 groundwater monitoring wells[10]. Twenty-five of these wells are screened within the A-zone aquifer; the remaining 19 wells are screened in the B-zone aquifer.

1.3.4 A-Zone and B-Zone Groundwater Contamination

Subsurface investigations conducted on Site to date have confirmed the presence of a number of potentially hazardous substances in the groundwater. In general, the A-zone groundwater contains more analytes and at higher concentrations than the B-zone groundwater. The primary chemicals of concern (COCs) in groundwater include:

- Chloroform;
- 1,2-Dibromo-3-chloropropane (DBCP);
- 1,2-Dichloropropane (1,2-DCP);
- 1,3-Dichloropropane (1,3-DCP);
- 1,2,3-Trichloropropane (1,2,3-TCP);
- Ethylene dibromide (EDB); and
- Dinoseb.

Dinoseb has been detected at concentrations above 1,000,000 micrograms per liter (ug/L) in groundwater samples collected from monitoring wells completed in the A-zone. Dinoseb is a contact herbicide commonly used for post-emergence weed control in a variety of crops. The maximum contaminant level (MCL) for dinoseb in drinking water is 7 ug/L.

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[9] No clearly-defined groundwater flow direction in the A-zone could be determined during this review of available documents. This review also suggests the presence of two sinks (as opposed to mounds) southwest and southeast of the Site. These sinks are described in further detail in Section 2 below.

[10] E&A 2008 and 2009 also refers to "… 9 unused groundwater extraction wells…" as being part of the Site well network. These reports also refer to City Well CW-1, which is not sampled as it does not contain a pump.

The contamination in the perched aquifer poses a potential threat to the underlying unconfined regional aquifer (B-zone) and the C-zone aquifer that is used for municipal drinking water. Public and private wells within 3 miles of the Site provide drinking water to 7,200 people and irrigate 19,600 acres of cropland. City of Arvin Well #1 (CW-1) is located approximately 1,500 feet from the Site (USEPA, 1993)[11]. This well is currently out of operation.

2 REVIEW OF HYDROGEOLOGIC DATA

There are two areas of low groundwater elevations ('sinks') depicted on **Figure 3** (E&A, 2008); these sinks are also present on Figure 3 of E&A (2009)[12] and Figure I-11 of Panacea (2004). Groundwater is depicted as flowing into these sinks on these figures. One sink is located southwest of the Site in the vicinity of A-zone monitoring wells EPAS-1 and PWA-4 and the other is located southeast of the Site near A-zone monitoring well PWA-2. Using the groundwater elevation contours in **Figure 3**, the southwest sink is characterized as a roughly 100 x 200 foot area. Using the groundwater elevation contours in **Figure 3**, the southeast sink appears to be centered on PWA-2 but its extent is not discernable. In general, the highest concentrations of dissolved contaminants in A-zone groundwater are now found in the vicinity of these sinks, particularly the southeast sink.[13] Possible explanations for any groundwater sink include but are not limited to:

- operation of one or more extraction wells,
- the presence of a natural breach (absence or increased sand content) of the underlying sandy clay aquitard.

Based on information provided by E&A's client, no extraction wells currently operating. The presence of a breach is plausible given that the aquitard (a) is known to be generally limited in lateral extent and (b) contains sand.

The exact nature and extent(s) of the aquitard breach(es) that are assumed to create the sinks is unknown but may be interpreted as creating a "zone of capture" into which impacted groundwater may be flowing. There is insufficient data available to estimate the zone of capture for the proposed large diameter groundwater recovery wells given the limited information provided by the slug and aquifer test data, the irregular hydraulic gradient, and – most importantly - the limited information regarding the presence and nature of the sinks southwest and southeast of the Site. It is important to keep in mind that the ultimate goal is dewatering of the A-zone; therefore, A-zone groundwater elevations – not the capture zone - is of primary importance. However, it may be assumed that the installation and testing of a large diameter extraction well would provide approximately ¼-gallon per minute (gpm) reported from aquifer testing of three of the on-site extraction wells. Even if testing of the large diameter extraction wells does not indicate a zone of capture that extends entirely under the capped area, it is expected that such wells may be beneficial in reducing the flow of impacted groundwater into sinks where it may impact deeper zones.

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[11] USEPA (Region IX), 1993. *Remedial Investigation/Feasibility Study Report, Brown & Bryant Superfund Site, Arvin, California*. May 28th.

[12] Due to the generally irregular groundwater gradient and presence of these sinks, a capture zone analysis was deemed intractable. The magnitude of the A-zone groundwater gradient is not quantified in E&A 2008 and 2009, presumably due to its irregular nature.

[13] The highest A-zone dinoseb concentration in April 2009 was reported in the southeast sink area.

3 RECOMMENDED APPROACH FOR DESIGN OF GROUNDWATER DEWATERING WELLFIELD

Two recommended approaches are outlined below. The first assumes that no additional data can be collected (*i.e.*, the wellfield is to be designed based solely on the existing data); the second assumes that additional data can be collected.

3.1 IF NO ADDITIONAL DATA CAN BE COLLECTED

As stated above in the introductory paragraph of this report, it is my understanding that the proposed groundwater remediation system has been documented into the ROD for the Site and is planned to consist of four, large-diameter groundwater extraction wells/sumps. If no additional data are to be collected (*i.e.*, the wellfield is to be designed based solely on the existing data), it is recommended that two wells be installed in the southeast sink area and the other two wells be installed in the southwest sink area. The sink areas are recommended locations because:

- the sinks generally contain the highest contaminant concentrations in A-zone groundwater,
- A-zone groundwater and any dissolved contaminants therein will flow naturally toward the wells regardless of whether they are pumping or not, and
- extraction wells located in the sinks should have a reasonable chance of being continuously 'pumpable' compared to other areas of the Site.

The screened interval of the wells should extend to the top of the aquitard separating the A-zone from the B-zone (approximately 85 feet bgs) with a sediment trap/sump and pump set a foot or two below the top of the aquitard (as shown in **Attachment A**) with caution taken to ensure the well is not screened and/or gravel packed across the aquitard in such a way as to inadvertently provide a conduit for contaminants to migrate downward from the A-zone into the B-zone and deeper zones.[14] Based on information provided by E&A's client, the wells will not be pumped continuously because there are no plans to plumb them to a continuously-operating treatment and discharge system. Given the propensity for wells to go dry in the A-zone, it is recommended that the wells be equipped with a water level sensor so that the pump shuts off when the well goes dry.

3.2 IF ADDITIONAL DATA CAN BE COLLECTED

As stated above in Section 2, the nature of the sinks which appear to govern groundwater flow in the A-zone is unknown. Given this uncertainty, it is recommended that additional data be collected prior to installing any dewatering wells. In order to obtain the data needed to evaluate the parameters involved in designing and fully implementing a dewatering program for the A-zone it is expected that a single test well would need to be installed and operated for some extended period of time. As above, the initial large diameter extraction well should be constructed in such a way as to fully access the A-zone and not inadvertently breach the aquitard and thus inadvertently provide a potential pathway for contaminants to migrate to deeper groundwater zones.

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[14] It is recommended that the boreholes be continuously cored over their entire length or, at a minimum, between approximately 60 feet bgs and the bottom of the borehole.

The two data collection tasks outlined below (*i.e.*, Task 1 and Task 2) are recommended to assist in the final design of the groundwater dewatering wellfield. Given the anticipated low and intermittent pumping rates, minimal saturated thickness of the A-zone[15], and the objective of the remedial effort (*i.e.*, dewatering the A-zone), groundwater modeling (*e.g.*, using a numerical flow/capture zone model such as MODFLOW/MODPATH) is not included among these two tasks. If delineation of a capture zone is deemed necessary, it is anticipated that the best way to do so would be direct measurement of groundwater elevations (as opposed to modeling). If groundwater modeling is deemed necessary, it is expected that the usefulness of any such model would hinge on a thorough understanding of the nature of the sinks and the aquitard separating the A-zone from the B-zone.

3.2.1 Task 1 – Identify Location for Test Well and Monitoring Wells

It is recommended that cone penetrometer testing (CPT) be conducted in and around the sink areas to better understand the nature and extent of the A-zone and underlying aquitard to identify an appropriate location, total depth, and screened interval[16] for the test well and additional A-zone groundwater monitoring wells. Specifically, groundwater extraction may be most sustainable if the extraction well(s) are located in depressions in the upper surface of the aquitard and/or areas consisting of comparatively coarser-grained soils. Since the objective is to dewater the A-zone, the additional A-zone monitoring wells will be needed to assess the degree to which the objective is ultimately met. The additional monitoring wells should be minimum 2-inch diameter PVC – and ideally, 4-inch PVC[17] - and extend to the top of the aquitard separating the A-zone from the B-zone.

3.2.2 Task 2 – Step-Drawdown Testing

Following development of the test well and additional monitoring wells, the maximum sustainable pumping rate should be established by sequentially increasing the pumping rate through a "step-drawdown" test. It is recommended that the step-drawdown test consist of a minimum of three to four 1- to 2-hour "steps" (*i.e.*, pumping rates). For example, the steps could be attempted as follows:

- Step 1: Pump test well at constant rate of 0.1 gpm for 2 hours;
- Step 2: Pump test well at constant rate of 0.25 gpm for 2 hours;
- Step 3: Pump test well at constant rate of 0.5 gpm for 2 hours.

It is recognized that (a) these pumping rates and durations may not be achievable and (b) maintaining a "constant" pumping rate at such low levels may prove difficult and that the well may pump dry fairly quickly despite data collected as part of Task 1.[18] The step-drawdown test

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[15] Groundwater flow models generally work best when there is a reasonably large quantity of groundwater flowing through reasonably homogeneous and permeable materials.

[16] Water-bearing A-zone soils generally consist of silty fine sand to fine sandy silt with clean, well-graded sand lenses and seams of silty clay occuring locally. Given the generally fine-grained nature of these soils, it is recommended that a sieve analysis be performed to properly select the screen slot size and gravel pack. Proper slot size and filter pack selection should increase the likelihood that the well will perform its intended function and reduce the potential for clogging of the well screen.

[17] If necessary, the monitoring wells could be used (a) to empirically define the capture zone(s) and (b) as dewatering wells in the latter stages of remediation.

[18] Because it is anticipated that the wells will run dry fairly quickly, a constant rate / recovery test will not be attempted at this time. If the wells can be pumped continuously at some point, a constant rate / recovery test may be considered.

would provide the sustainable pumping rate for longer term testing/pumping. Analysis of the step-drawdown test data may also allow for an estimation of well efficiency and hydraulic conductivity.

4 CLOSING

Thank you for providing me the opportunity to provide consulting services to E&A. If you have any questions, please contact me at (949) 795-0855 or jimvdw@cox.net.

Sincerely,

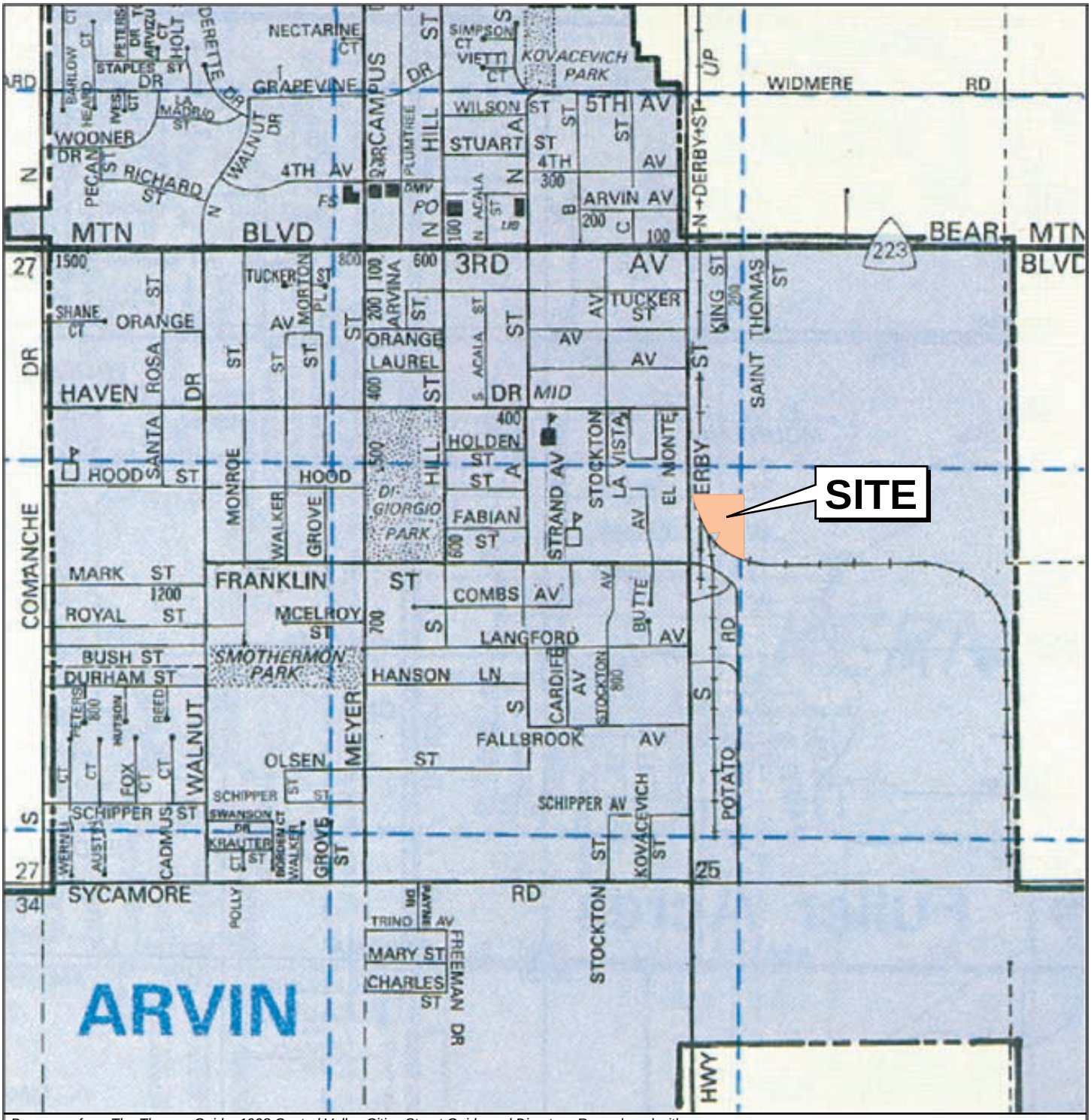
Jim Van de Water, CHG
Consulting Hydrogeologist

Cc: David M. Henry, PG (Lexington Geoscience)

Attachments

Figure 1:	Site Location Map (E&A, 2008)
Figure 2:	Site Plan and Well Locations (E&A, 2008)
Figure 3:	Piezometric Surface A-Zone (E&A, 2008)
Attachment A:	E&A Value Engineering Recommendation #40

FIGURES



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Environmental Excellence

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SITE LOCATION MAP
Brown & Bryant Superfund Site
600 South Derby Street
Arvin, California

Project No.: Eco-10-409 | May 2010

FIGURE: 1

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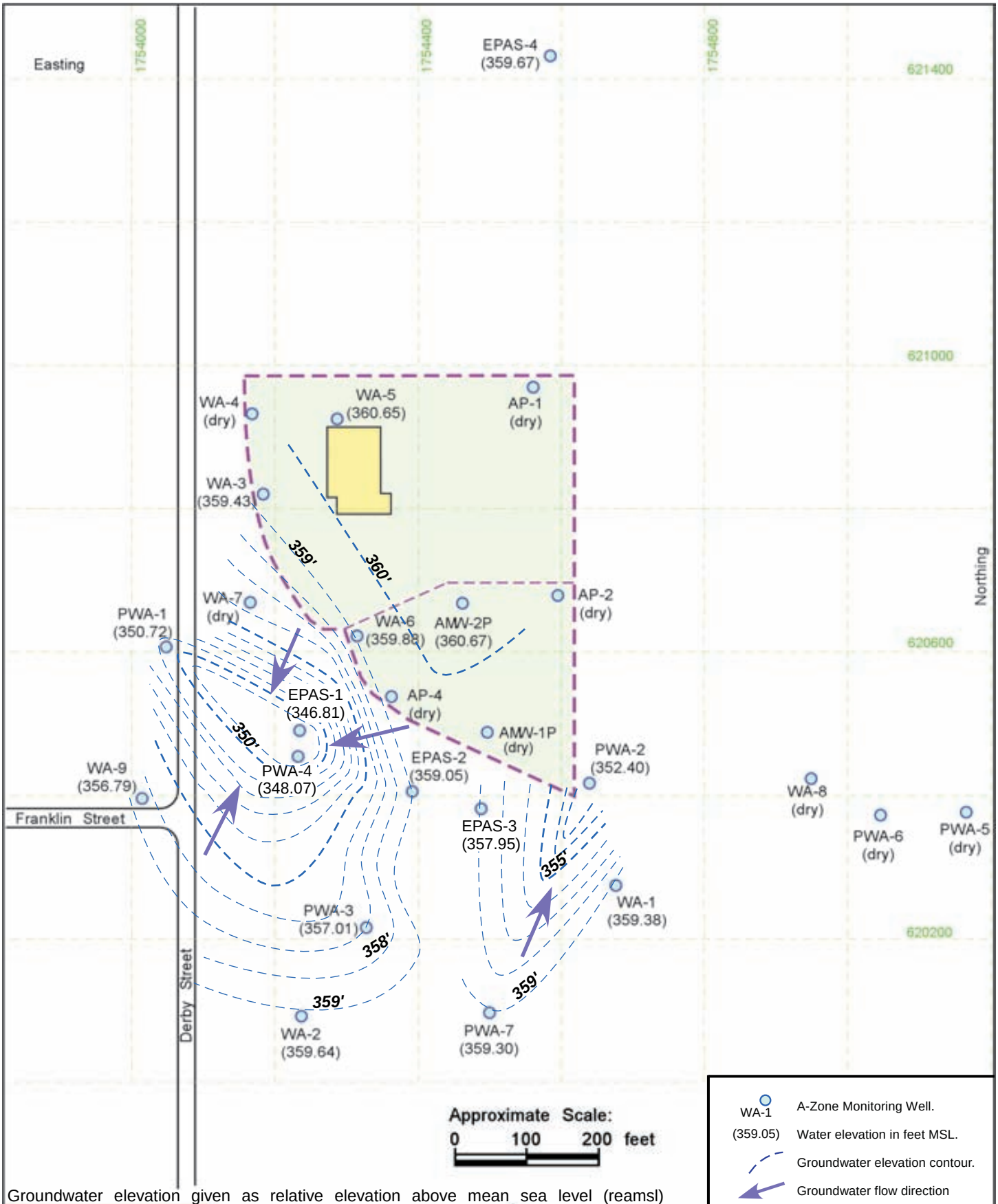
SITE PLAN AND WELL LOCATIONS
Brown & Bryant Superfund Site
600 South Derby Street
Arvin CA

Project No.: Eco-10-409 | May 2010

FIGURE: 2



Groundwater elevation given as relative elevation above mean sea level (reamsl)

Environmental Excellence
Eco & Associates, Inc.
1855 W. Katella Avenue, Suite 340
Orange, California 92867
Phone: 714.289.0995 FAX: 714.289.0965

PIEZOMETRIC SURFACE
A-ZONE
Brown & Bryant Superfund Site

Project No.: Eco-10-409 | May 2010

FIGURE: 3

ATTACHMENT A

VALUE ENGINEERING RECOMMENDATION # 40

PROJECT: Brown and Bryant Superfund Site
LOCATION: Arvin, California
STUDY DATE: January 12-13, 2010

DESCRIPTIVE TITLE OF RECOMMENDATION:
Belled-out caisson to reduce volume of excavated soil.

Creative Idea #: 40 **Sequence #** 7

ORIGINAL DESIGN:

The proposed design is to provide eight foot diameter wells approximately 85 feet below ground surface. The bottom 20 feet have a pea gravel filter pack. The wells will have a 2 inch PVC discharge pipe and an approximate 10 gallon per minute submersible discharge pump. See attached drawing "Groundwater Extraction Well Construction detail by Eco & Associates, Inc., Figure 1.

RECOMMENDED CHANGE:

Use a much small diameter well with a belled bottom similar to a belled bottom structural caisson. The belled portion could be eight foot in diameter and be gravel packed similar to the proposed design.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$361,000		$361,000
RECOMMENDED DESIGN	$64,000		$64,000
ESTIMATED SAVINGS OR (COST)	$297,000	$0	$297,000

VALUE ENGINEERING RECOMMENDATION # 40

ADVANTAGES:

- Significantly reduces amount of excavated materials.
- Significantly increases constructability relative to current design.
- Uses known construction methods, established technology.

DISADVANTAGES:

- Potential bell hole collapse during construction.

JUSTIFICATION:

This recommended change is consistent with the current ROD.
It is assumed that the reason for the large proposed diameter is to obtain the circumference area for the filter pack area. Using a smaller diameter bore but belling the bottom produces the same results. The stability of the soil during the belling process could be an issue but due to the minimum water content of the soils, this problem is not anticipated with this design solution. This recommendation provides all of the benefits of the larger well with a significant cost savings and considerably less soil disposal problems. See attached sketch.

The limited research done into caisson construction found that up to 84 inch (7 feet) diameter caisson could be drilled and belled out up to 14 feet. The soil condition and depth would be critical factors. 24 inch caissons can be belled out up to 4 feet in diameter. 36 inch caisson can be belled out up to 8 feet in diameter. For structural caissons, the bell depth would not typically be as deep as the proposed depth for a groundwater extraction well. Not withstanding the soil conditions stability, there should not be any constructability limitations on the bell depths.

Recommend that a 36 inch caisson be used belled to an eight foot diameter. The bell depth could be 20 to 22 feet deep as proposed, packed with gravel, etc.

The need to case the entire length during construction and/or permanently would be the same for either a 36 inch diameter or an eight foot diameter. In fact, a 36 inch may hold during construction and packing the entire height better than an eight foot diameter. The proposed plan does not indicate casing for the entire length. Cost for casing would be less for a 36 inch than for eight foot well.

For cost estimating purposes, an 84 inch caisson belled to eight foot was used as the original design. The actual construction method planned for the eight foot diameter well was unknown, but could be assumed to be considerably higher than the 84 inch belled caisson. Therefore the cost estimate for the “original” designed well could be much higher than estimated.

The potential savings for this recommendation could be far greater than estimated.

VALUE ENGINEERING RECOMMENDATION # 40

COST ESTIMATE – First Cost

Cost Item	Units	$/Unit	Original Design		Recommended Design	
			Num of Units	Total $	Num of Units	Total $
84 inch well, belled to eight foot	l ft	850.00	340	$289,000		
36 inch caisson belled to 8 foot	l ft	150.00			340	$51,000
Assume 4 wells, 85 foot deep						
Construction Cost				$289,000		$51,000
CWE 125%				$361,250		$63,750

Figure 1 Well Drawing

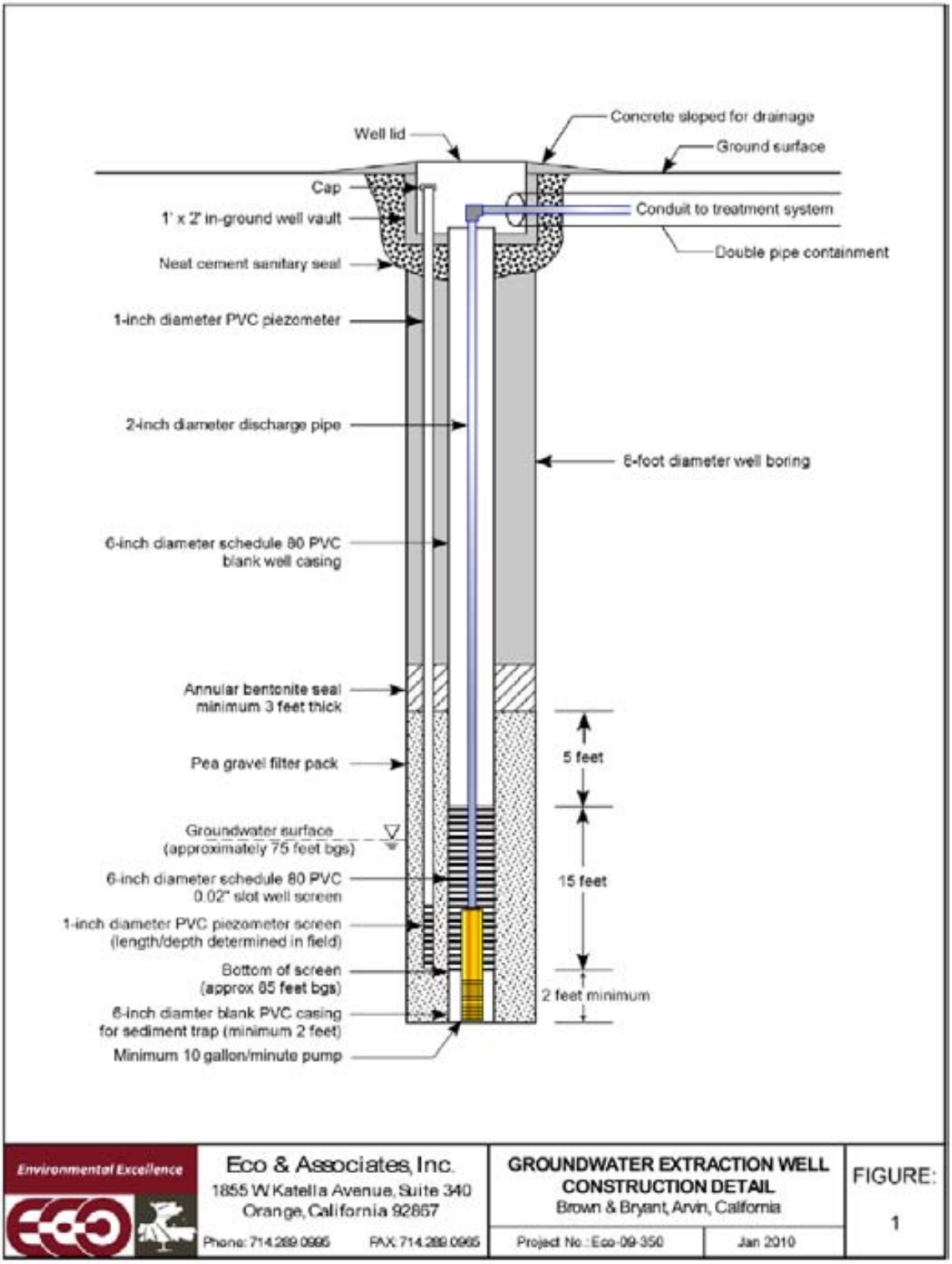
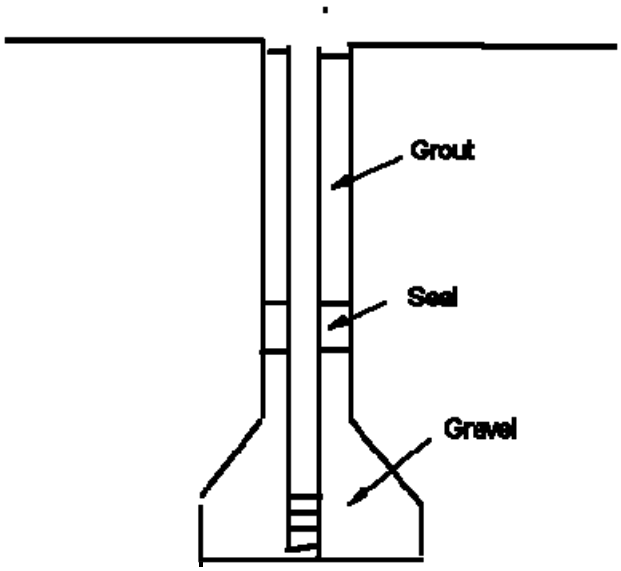


Figure 2

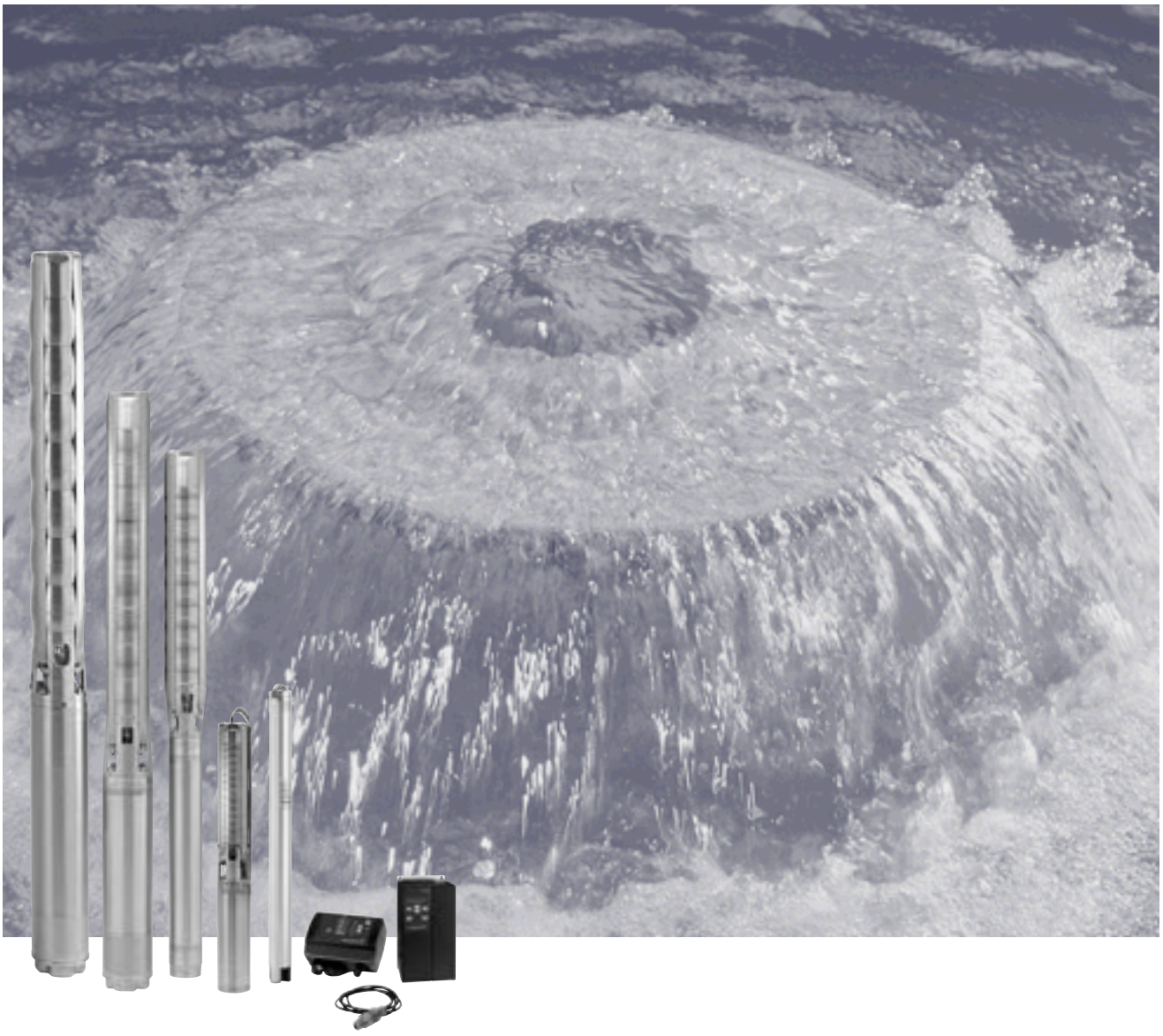


4.0 PRODUCT CUT SHEETS

(see next page)

SQ, SQE, SP

Stainless steel submersible pumps and accessories
60 Hz



Mission

- to successfully develop, produce, and sell high quality pumps and pumping systems worldwide, contributing to a better quality of life and healthier environment

Bjerringbro, Denmark

Fresno, California

Olathe, Kansas

Monterrey, Mexico

Allentown, Pennsylvania

Oakville, Ontario

- One of the 3 largest pump companies in the world with over 11,000 employees worldwide
- World headquarters in Denmark
- North American headquarters in Kansas City - Manufacturing in Fresno, California
- 60 companies in 40 countries
- More than 10 million pumps produced annually worldwide
- North American companies operating in USA, Canada and Mexico
- Continuous reinvestment in growth and development enables the company to

  BE responsible, **THINK** ahead, and **INNOVATE**

Submittal Data Sheet

GRUNDFOS

Company name: _____
Prepared by: _____
Phone number: ( ) -
Fax number: ( ) -
Date: _____ Page 1 of: _____
Quote number: _____

Client Information

Project title:		Client name:	
Reference number:		Client number:	
Client contact:		Client phone no: ( ) -	

Location Information

For:		Unit:	
Site:		Service:	
Address:		City:	State: Zip Code:

Technical Data

Flow (GPM) _____
Head (Ft) _____
Motor _____
Max Fluid Temp _____
Min Fluid Temp _____
Max Working Pressure _____
Min Required Inlet Pressure _____
Connection Type and Size _____

Motor Information

HP: _____
Phase: _____
Voltage: _____
Enclosure: _____

Pump Information

Model Information from Type Key and Codes: _____
Quantity Required: _____ Example: SP 150S
Minimum required flow: _____ NPSH required at duty point: _____

Product Guide additional information pages

Materials page number: _____ Performance curve page number: _____
Technical data page number: Motor data page number:

Custom-built pump information (optional): _____

Additional Information _____

TABLE OF CONTENTS

STAINLESS STEEL CONSTRUCTION

Grundfos submersibles feature rugged and durable stainless steel construction for all vital pump components. Impellers, diffusers, shafts, vanes, cable guards, couplings...even the nuts and bolts are stainless steel. Grundfos' 4-inch pump systems include the stainless steel pump, motor, and control box and are delivered ready to install.

Computer-aided design and manufacturing techniques ensure that each *pump* is built to exacting tolerance and performs to industry-leading standards. Grundfos state-of-the-art production equipment includes extensive use of robotics and advanced quality assurance procedures. You can rely on quality Grundfos' groundwater products for outstanding pump performance and best value.

SUBMERSIBLES

4-INCH and LARGER WELLS
The 4-inch submersibles line covers all flow requirements from 1.2 to 95 gpm and heads to 2000 feet. This broad range ensures proper pump selection for all domestic groundwater system applications.

6, 8, & 10-INCH and LARGER WELLS
For high flow requirements, this submersible line includes 6, 8, and 10-inch models for flows up to 1,400 gpm and heads to 2100 feet.

Grundfos offers 18 models of submersible pumps designed for domestic and industrial applications with flow rates from five to 1,400 gpm. Horsepower range extends from 1/3 hp to 250 hp. These pumps are marketed through more than 300 distributors and nearly 2,000 dealers nationwide.

THE STAINLESS STEEL ADVANTAGE

TOP PUMP PERFORMANCE
Grundfos pumps are built to work hard with every component designed for maximum hydraulic efficiency. With the inherently smooth surfaces of fabricated stainless steel, peak performance is maintained over many years of service.

RELIABLE OPERATION
Highly advanced design and manufacturing techniques minimize the number of moving parts. This, plus Grundfos' use of rugged stainless steel construction, make GRUNDFOS groundwater pumps the toughest, most reliable pumps on the market. With Grundfos you can rely on getting the water you need, when you need it.

LONG PUMP LIFE
Stainless steel is the best available material to resist wear and corrosion in water system applications. Compare Grundfos' stainless steel construction to the best the other manufactures have to offer. Grundfos stainless steel pumps are designed to operate efficiently and effectively for a long, long time.

SQ/SQE SUBMERSIBLE PUMPS

3-Inch SQ/SQE Submersible Well Pumps
3-Inch and Larger Wells

SQ/SQE pumps are suitable for both continuous and intermittent operation for a variety of applications:

- Domestic water supply
- Small waterworks
- Irrigation
- Tank applications

SQ, SQE pumps offer the following features:

- Dry-Run protection
- High efficiency pump and motor
- Protection against up-thrust
- Soft-start
- Over-voltage and under-voltage protection
- Overload protection
- Over-temperature protection
- High starting torque

Additionally, the SQE pumps offer:

- Constant pressure control
- Variable speed
- Electronic control and communication

The SQ and SQE pump models incorporate an innovative motor design. With the use of permanent-magnet technology within the motor, the SQ/SQE pumps deliver unmatched performance. By combining permanent-magnet motors and Grundfos's own micro frequency converter, we are now able to control and communicate with the pump in ways never before possible. A few of the features that come out of this combination are Constant Pressure Control, Soft-Start, and integrated Dry-Run protection. These are just a few of the many features that the SQ/SQE pumps can offer.

The SQ pump models operate at a constant speed much like today's conventional pumps. The difference between it and traditional pumps is you get all the benefits of an electronically controlled permanent-magnet motor that cannot be accomplished with a conventional induction motor. The SQ pumps are available for single phase power. They use a simple 2-wire design making installation easy.

The SQE uses the Grundfos "Smart Motor". Like the SQ model, we still use the high efficiency permanent magnet motor, but we give this motor the ability to communicate. The "Smart Motor" communicates via the CU301 status box through the power leads. It is not necessary to run any additional wires down the well. By being able to communicate with the pump you can have Constant Pressure Control and the ability to change the pump performance while the pump is installed in the well. Like the SQ motor, this is also a 2-wire motor designed for single-phase operation.

TYPE KEYS

SP Example 10 S 05 - 9

- 10 — Rated gallons per minute
- S — Material of construction
- 05 — Horsepower
- 9 — Number of pump stages

SQ/SQE Example 10 SQ E 05 - 160

- 10 — Rated gallons per minute
- SQ — Basic version (without communication)
- E — Electronic communication
- 05 — Horsepower
- 160 — Total Dynamic Head in (ft) at rated flow

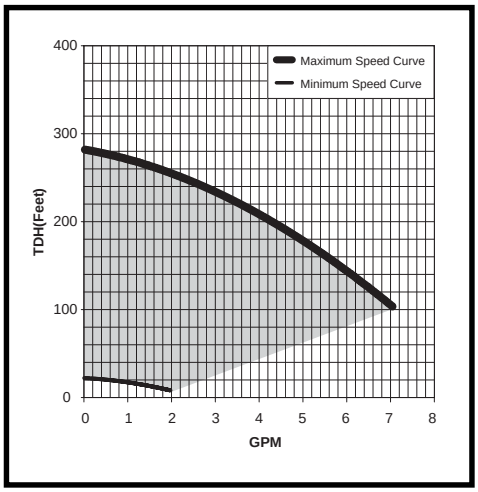
Performance Curves and Technical Data

For 3-Inch & larger well applications

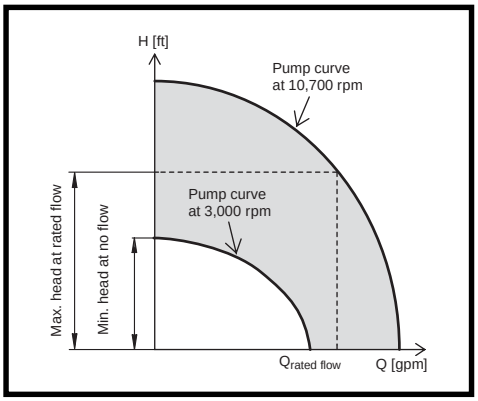
SP (4") SQE (3")

CU 321 CU 301

PRESSURE SENSOR



Performance Curves

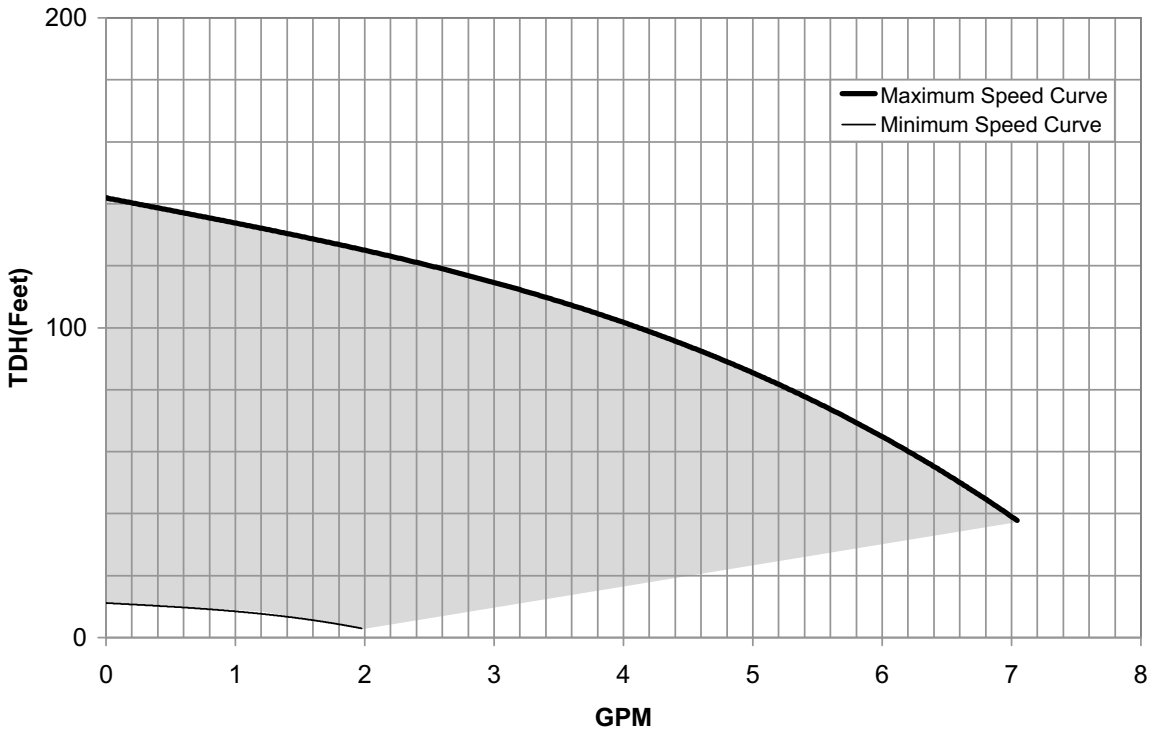


System Sizing Guide

WATER TANK

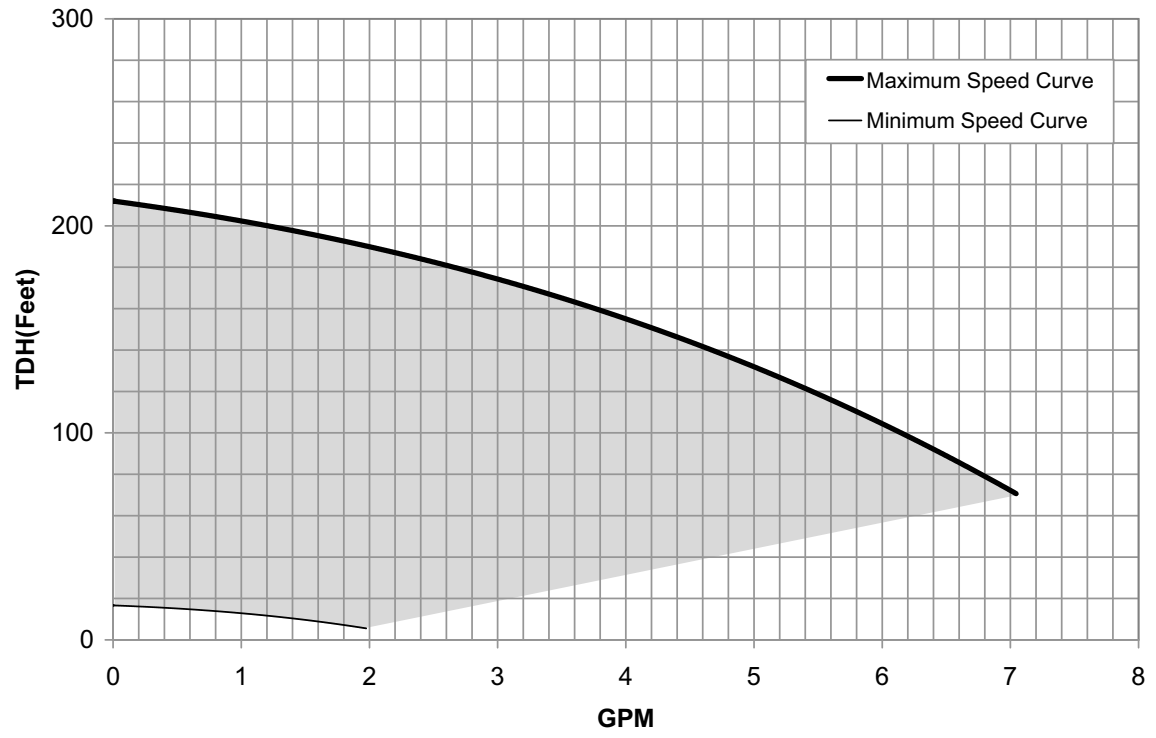
2 gallon tank min. for SQE
4 gallon tank min. for CU 321

5 GPM • MODEL 5SQE05-90



OUTLET SIZE: 1" NPT **NOMINAL DIA. 3"**

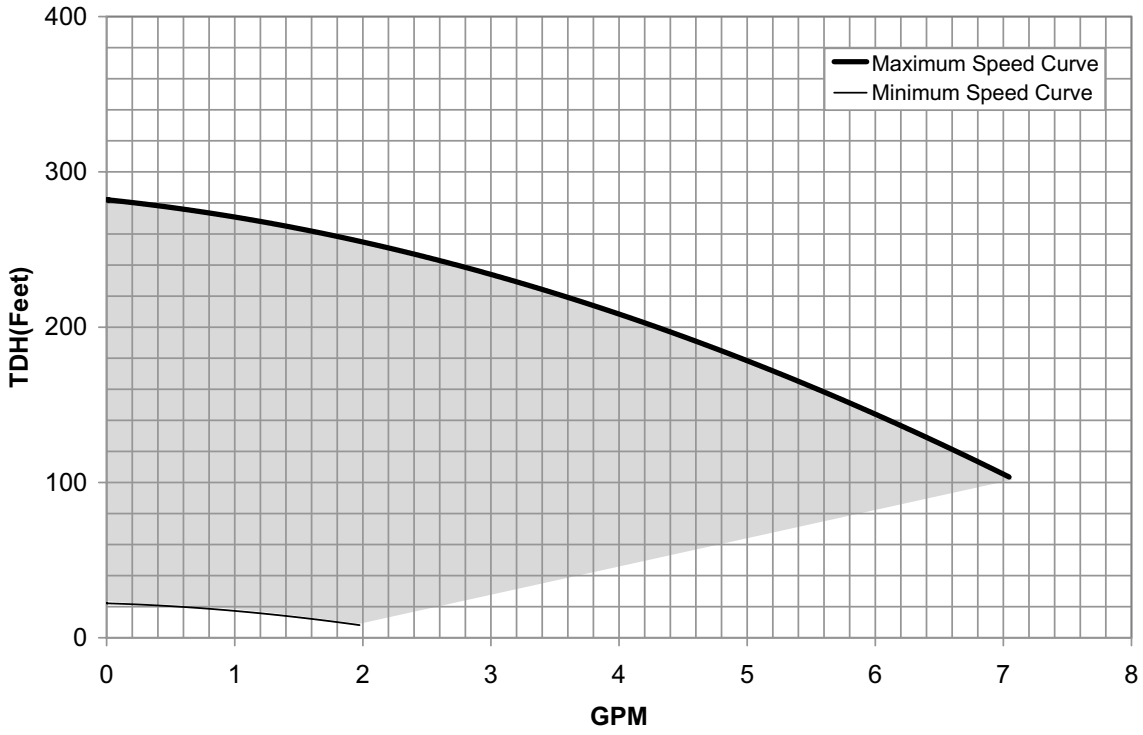
5 GPM • MODEL 5SQE05-140



OUTLET SIZE: 1" NPT **NOMINAL DIA. 3"**

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

5 GPM • MODEL 5SQE05-180



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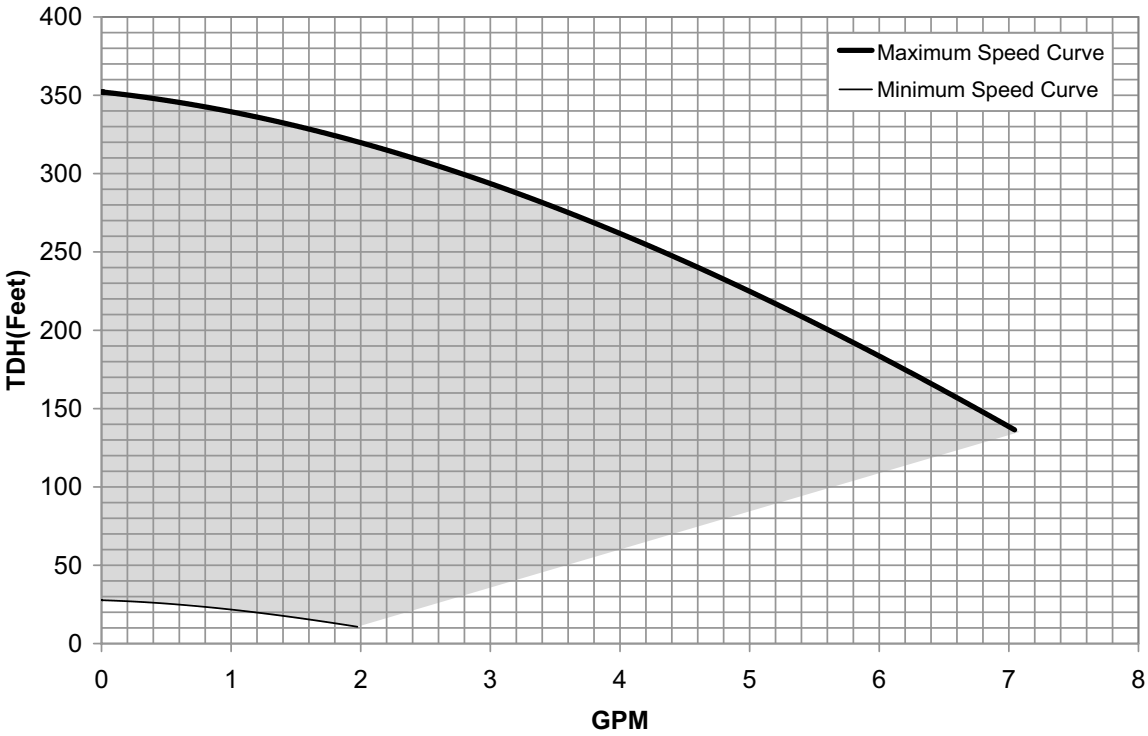
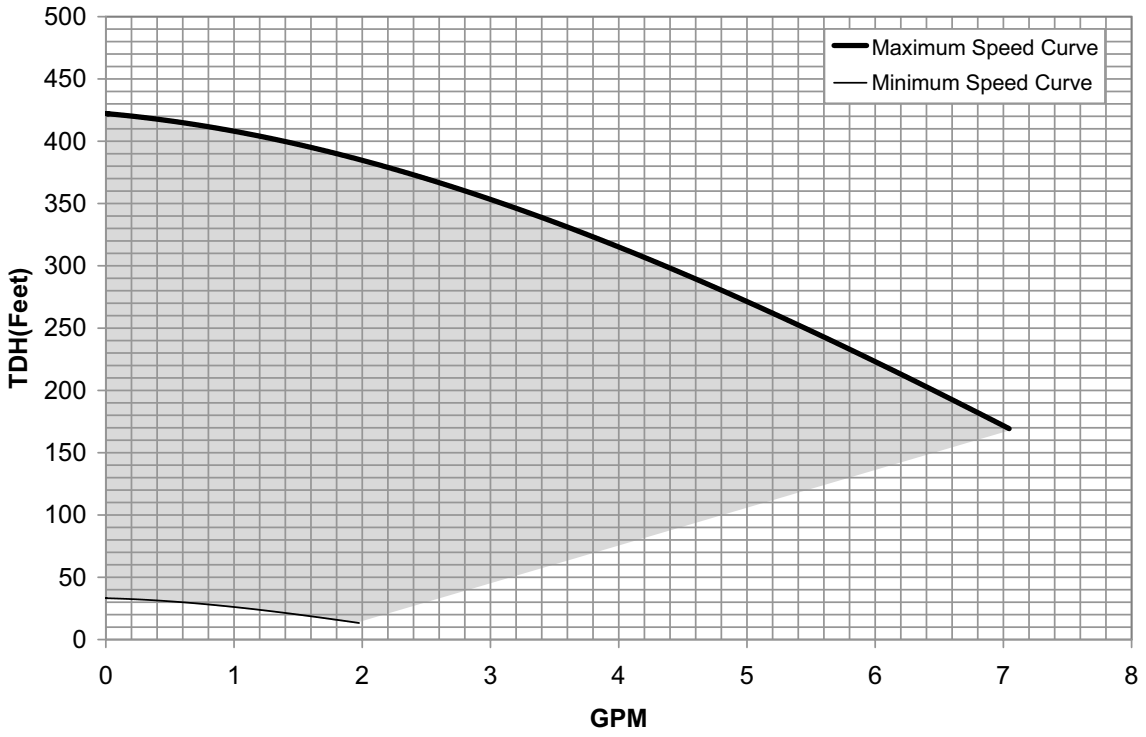
5 GPM • MODEL 5SQE07-230



OUTLET SIZE: 1" NPT **NOMINAL DIA. 3"**

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

5 GPM • MODEL 5SQE07-270



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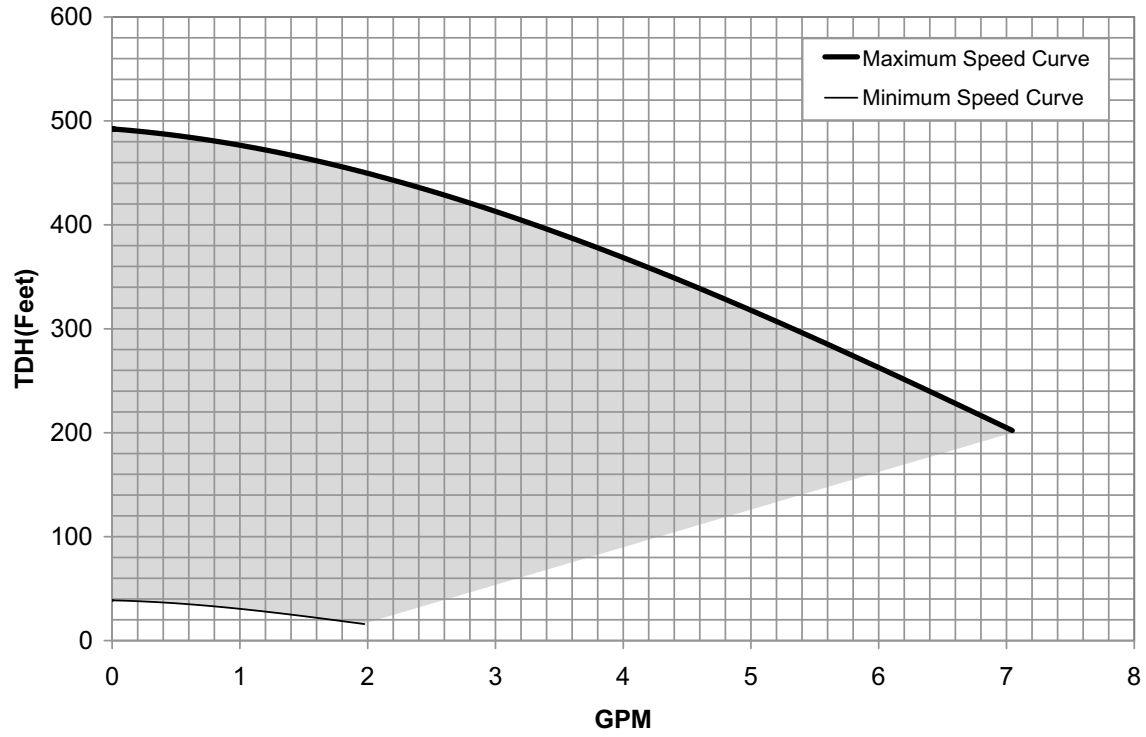
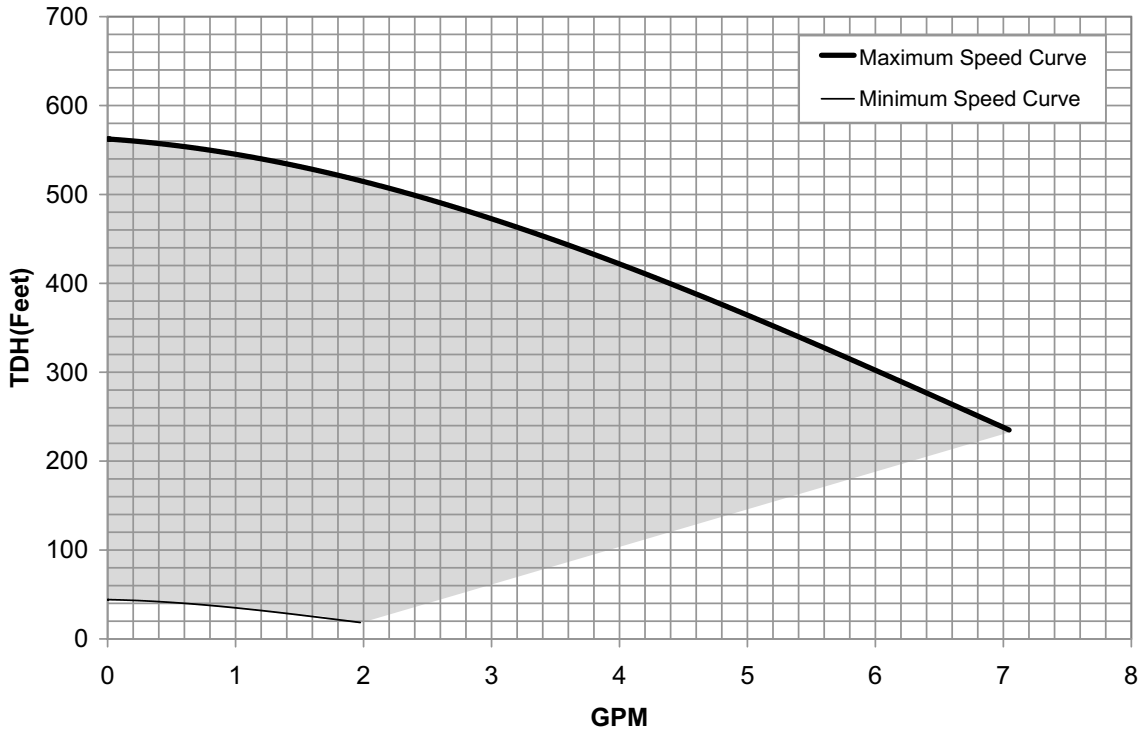
5 GPM • MODEL 5SQE07-320



OUTLET SIZE: 1" NPT **NOMINAL DIA. 3"**

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

5 GPM • MODEL 5SQE10-360



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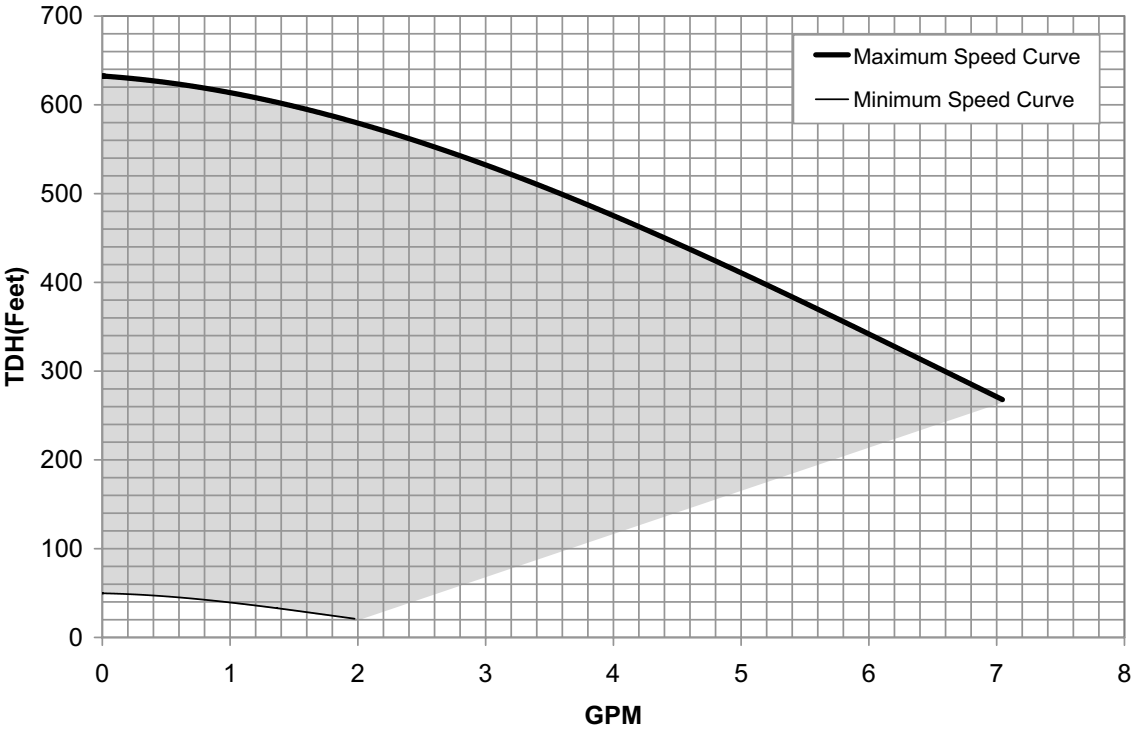
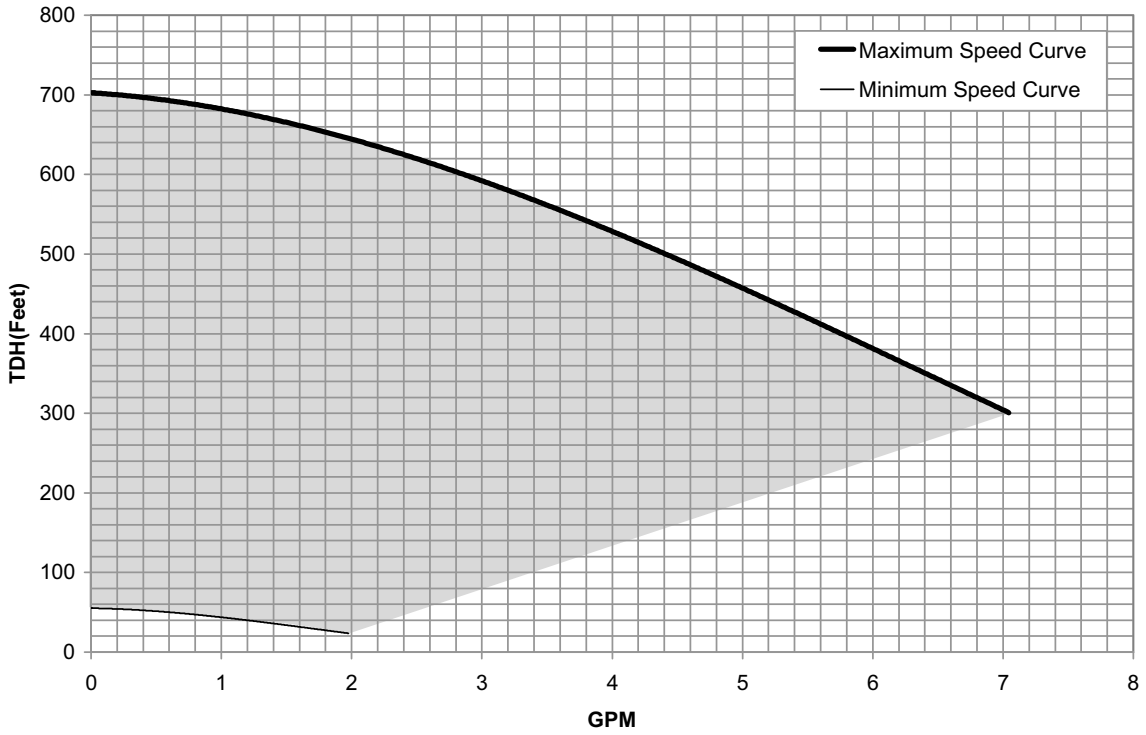
5 GPM • MODEL 5SQE10-410



OUTLET SIZE: 1" NPT **NOMINAL DIA. 3"**

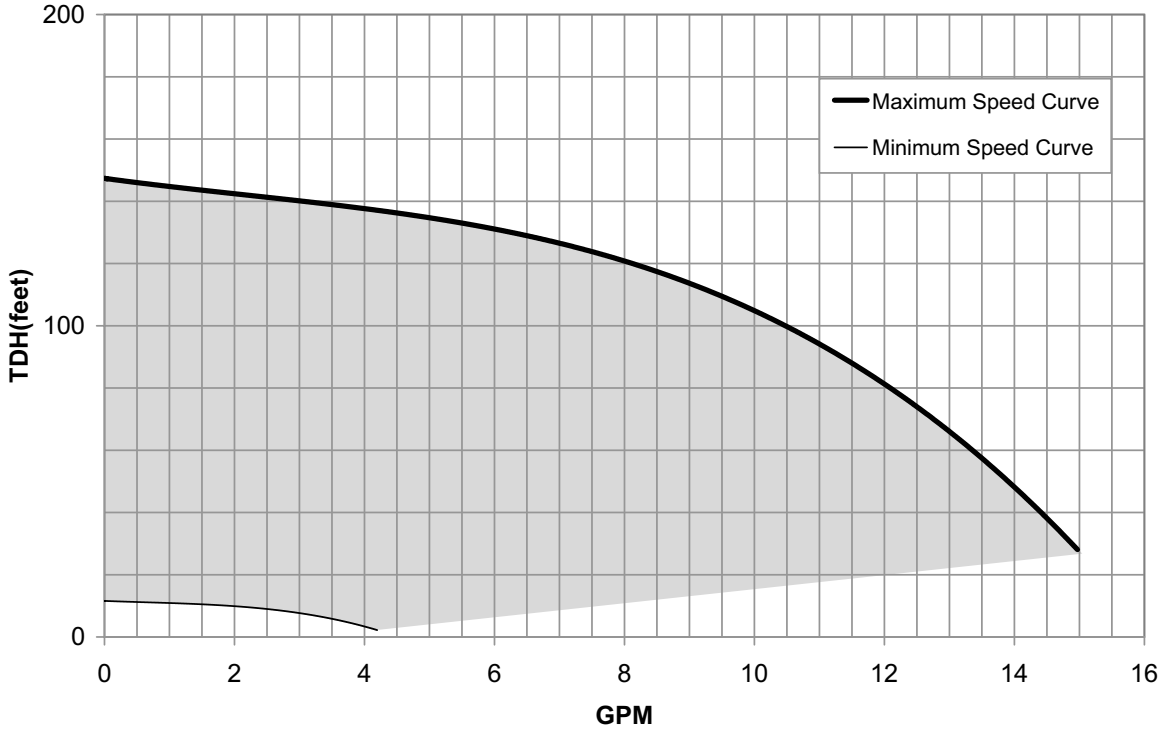
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

5 GPM • MODEL 5SQE15-450



OUTLET SIZE: 1" NPT **NOMINAL DIA. 3"**

10 GPM • MODEL 10SQE05-110



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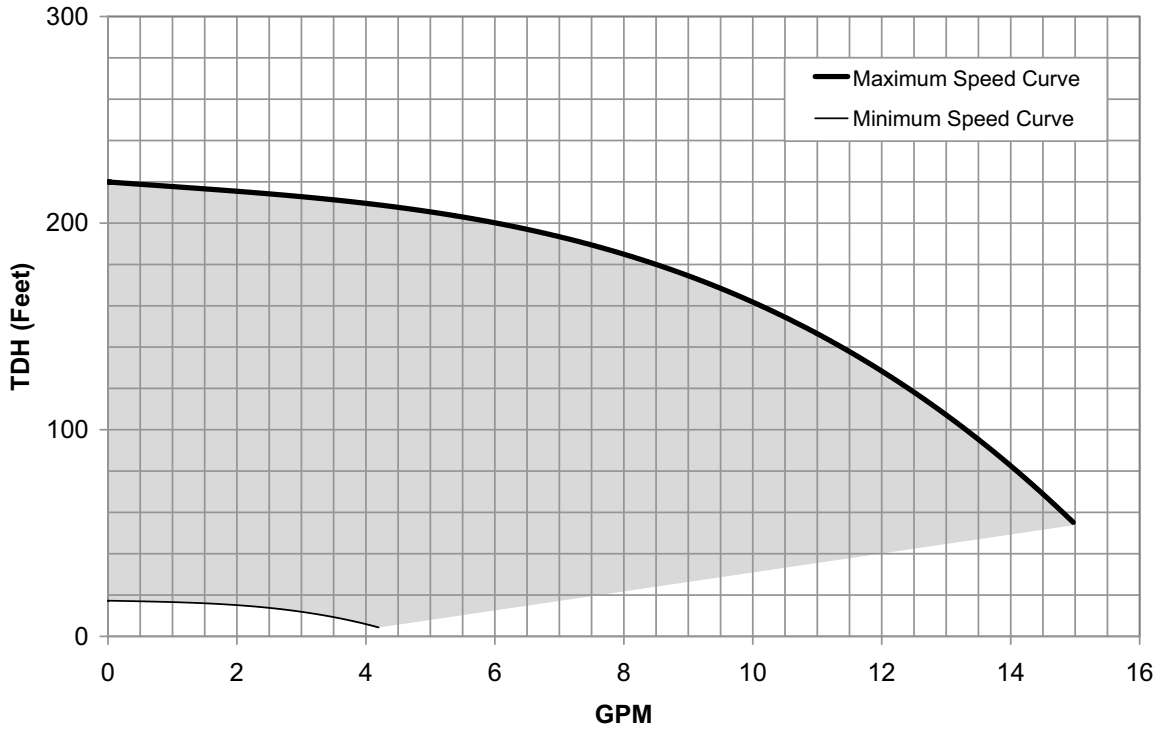
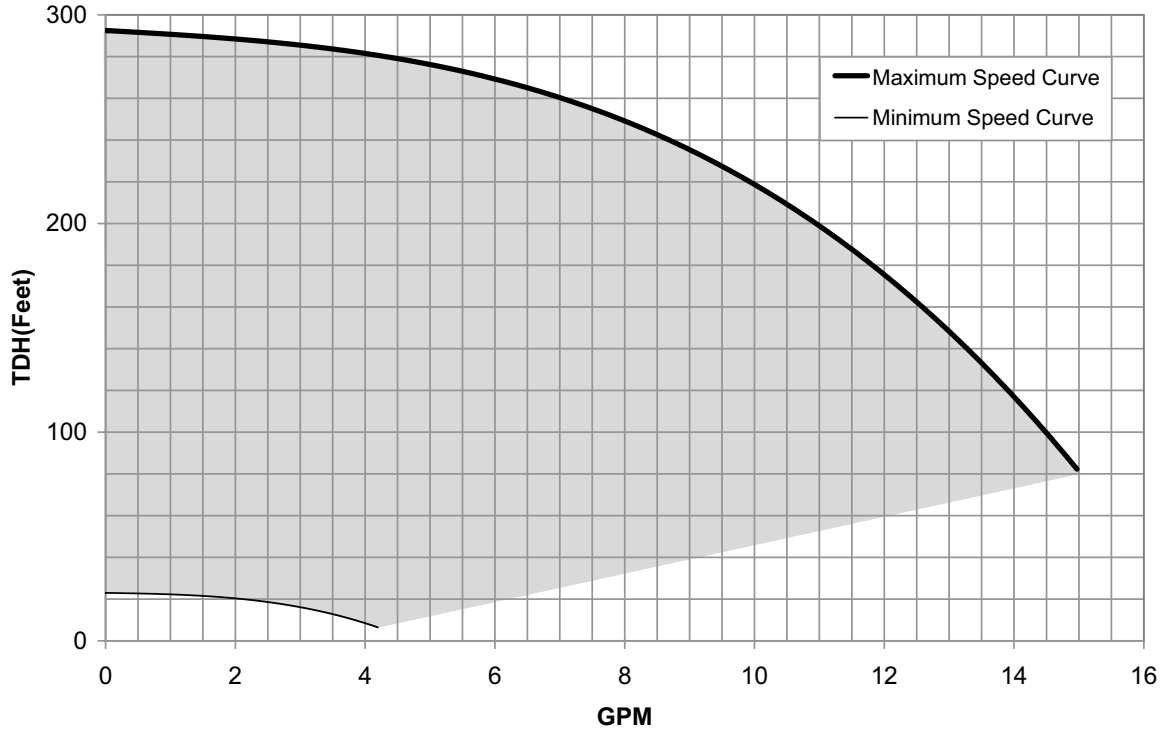
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

10 GPM • MODEL 10SQE05-160



OUTLET SIZE: 1 1/4" NPT **NOMINAL DIA. 3"**

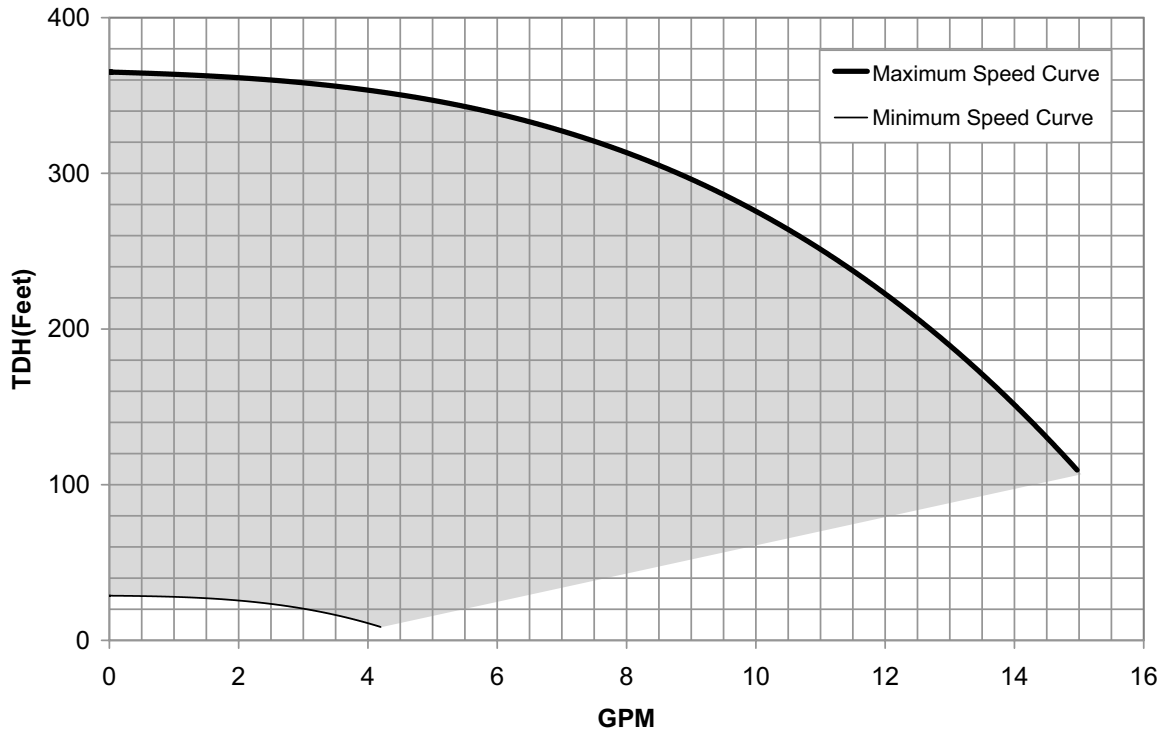
10 GPM • MODEL 10SQE07-200



OUTLET SIZE: 1 1/4" NPT **NOMINAL DIA. 3"**

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

10 GPM • MODEL 10SQE07-240



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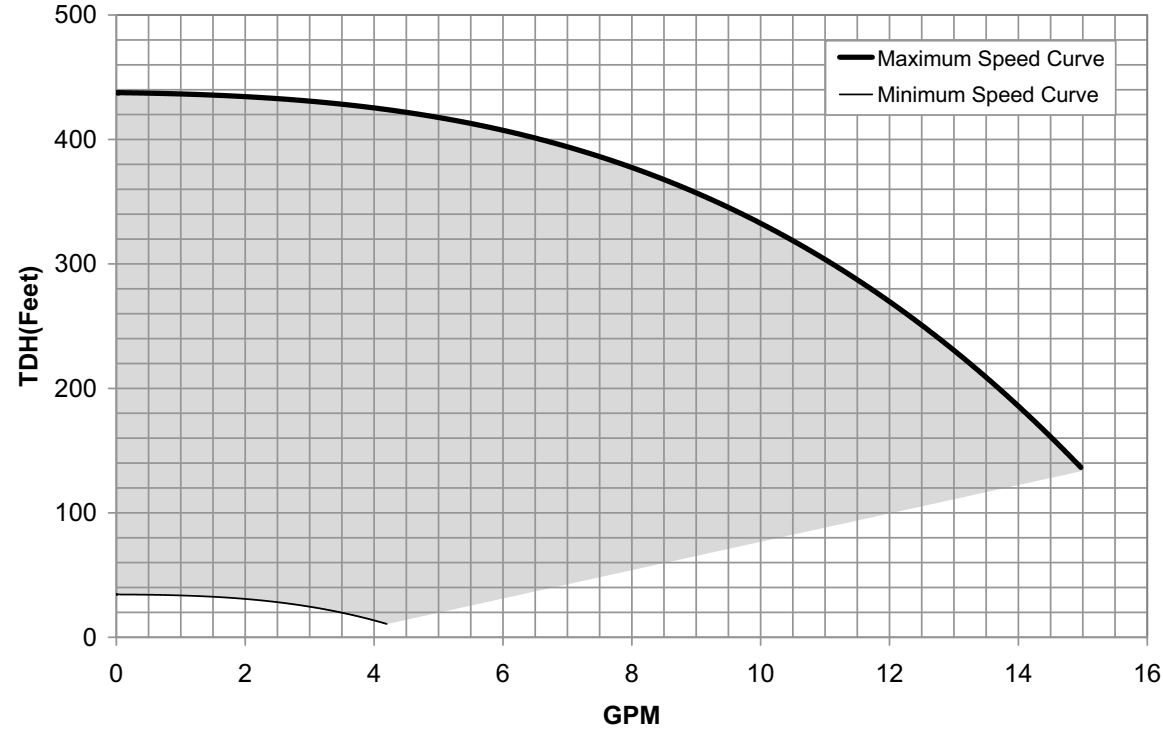
10 GPM • MODEL 10SQE10-290



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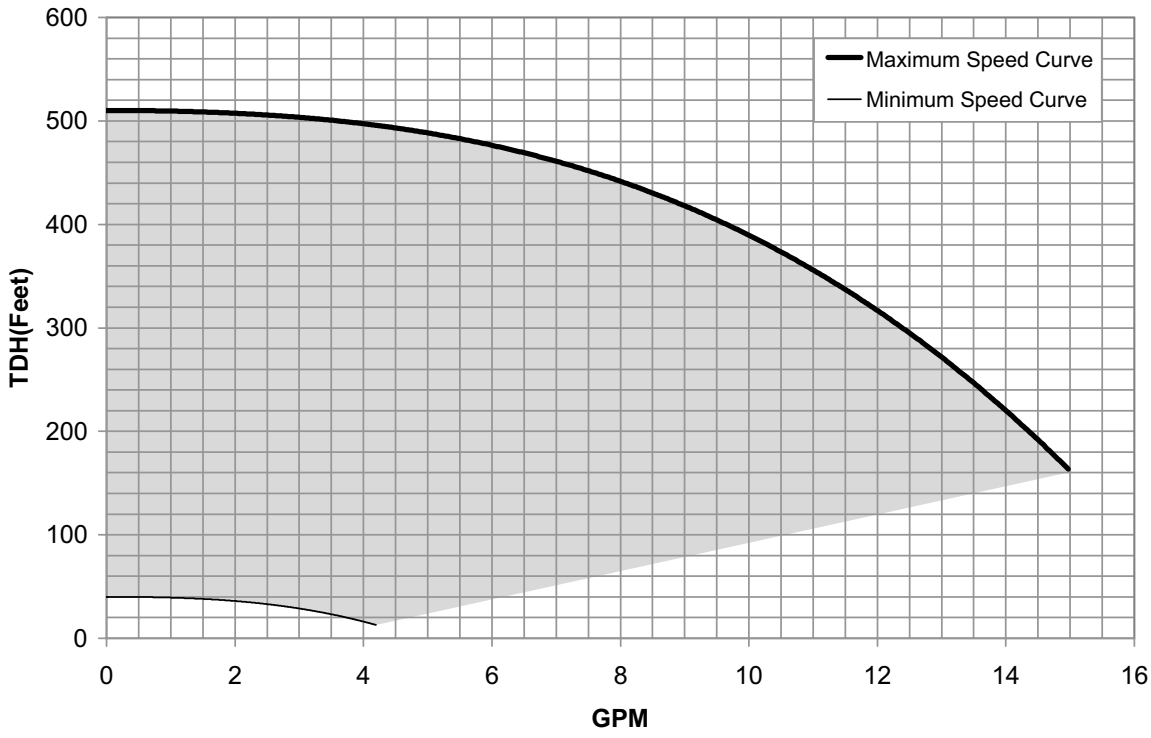
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

10 GPM • MODEL 10SQE15-330



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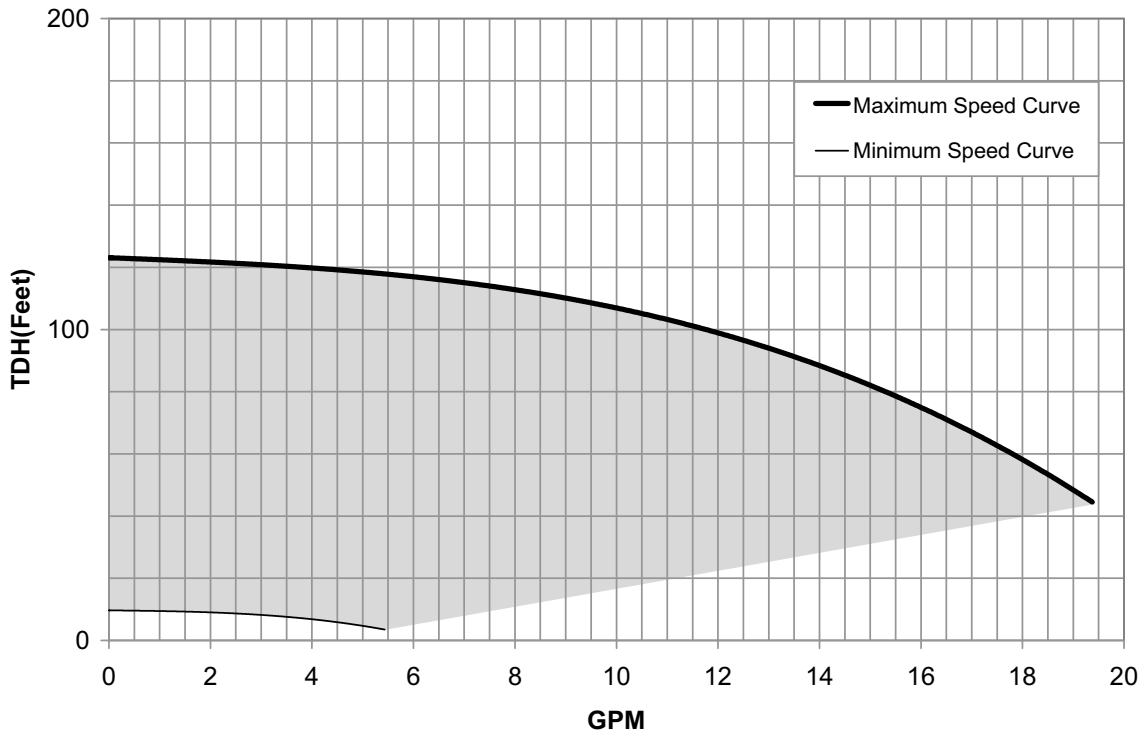
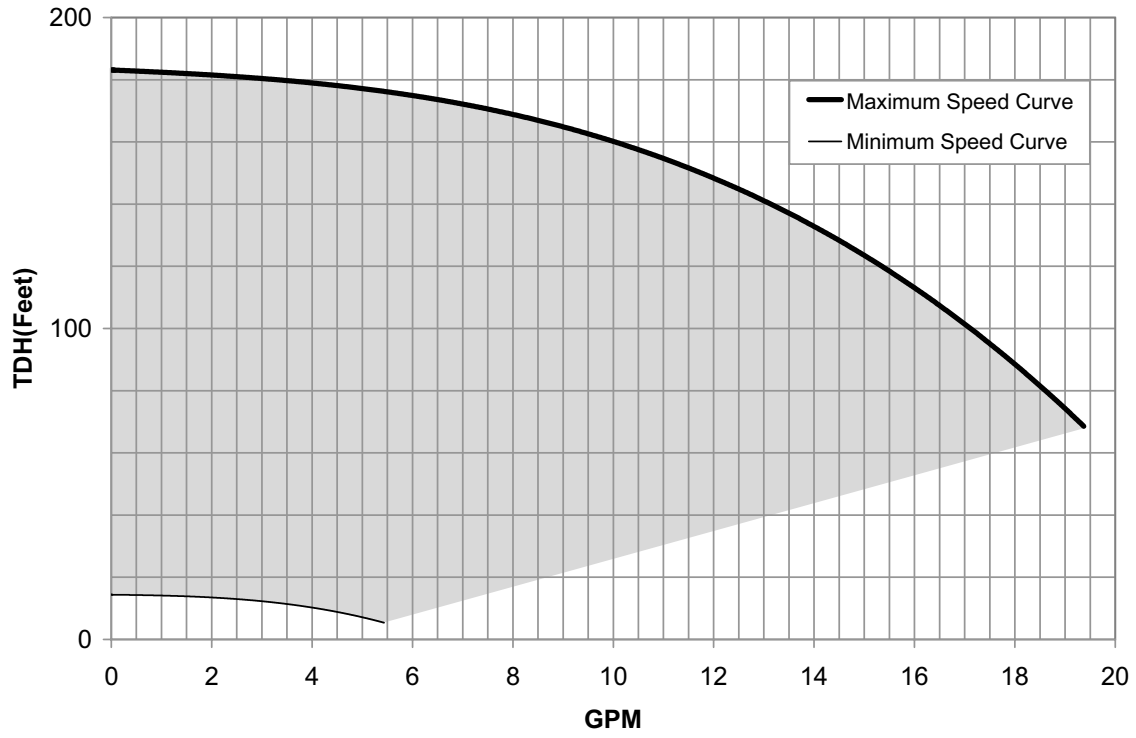
15 GPM • MODEL 15SQE05-70



OUTLET SIZE: 1 1/4" NPT **NOMINAL DIA. 3"**

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

15 GPM • MODEL 15SQE05-110



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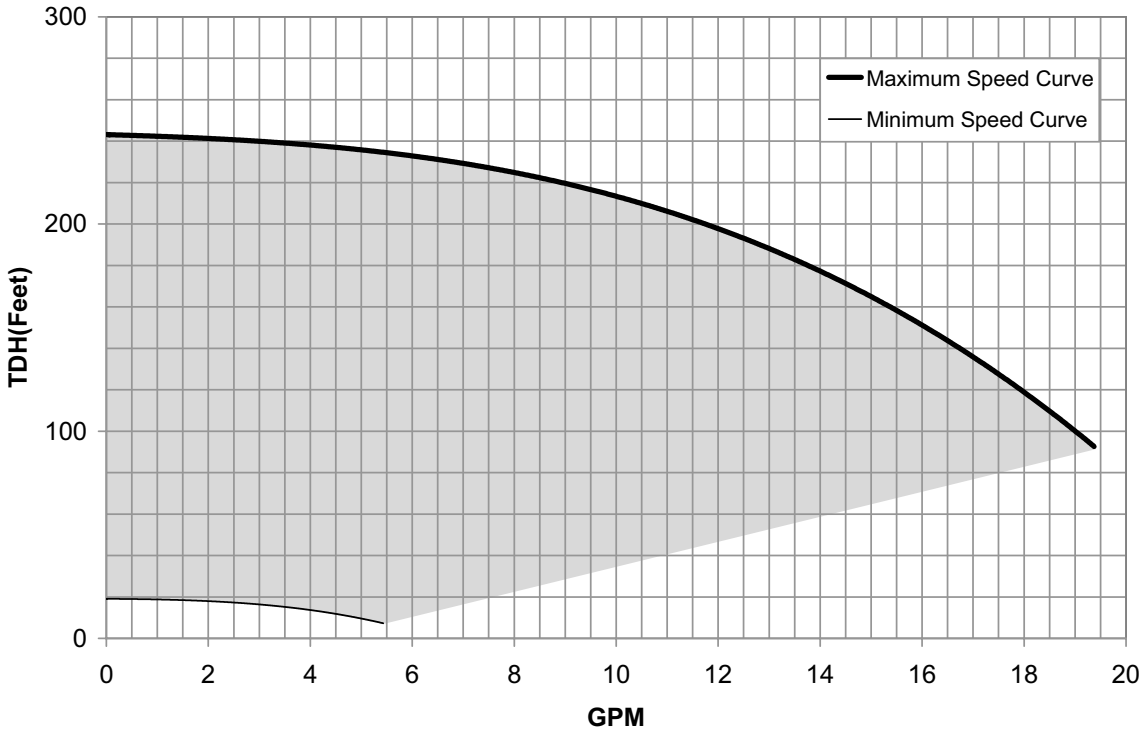
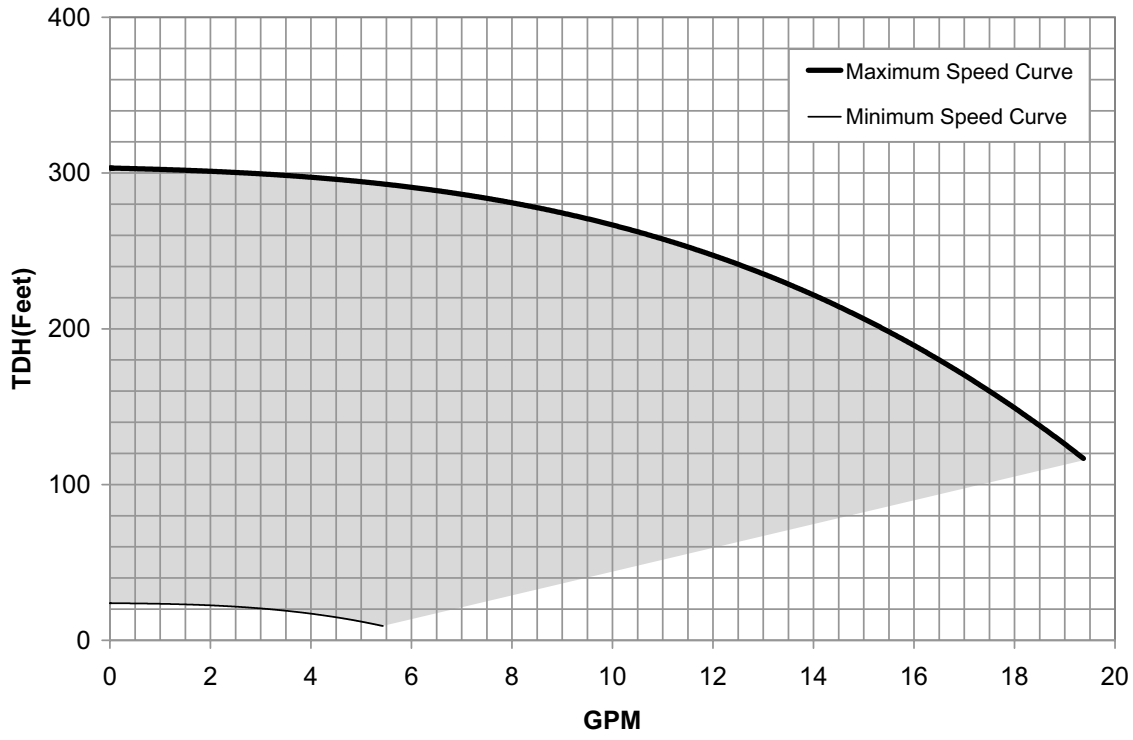
15 GPM • MODEL 15SQE07-150



OUTLET SIZE: 1 1/4" NPT **NOMINAL DIA. 3"**

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

15 GPM • MODEL 15SQE07-180



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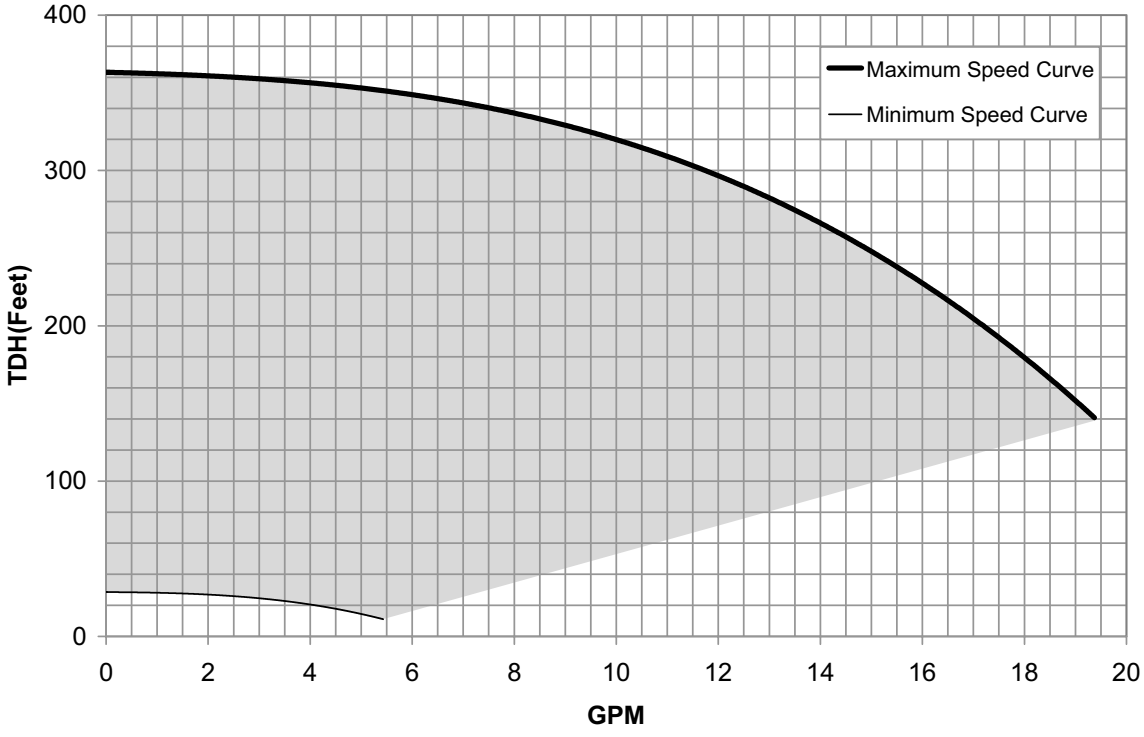
15 GPM • MODEL 15SQE10-220



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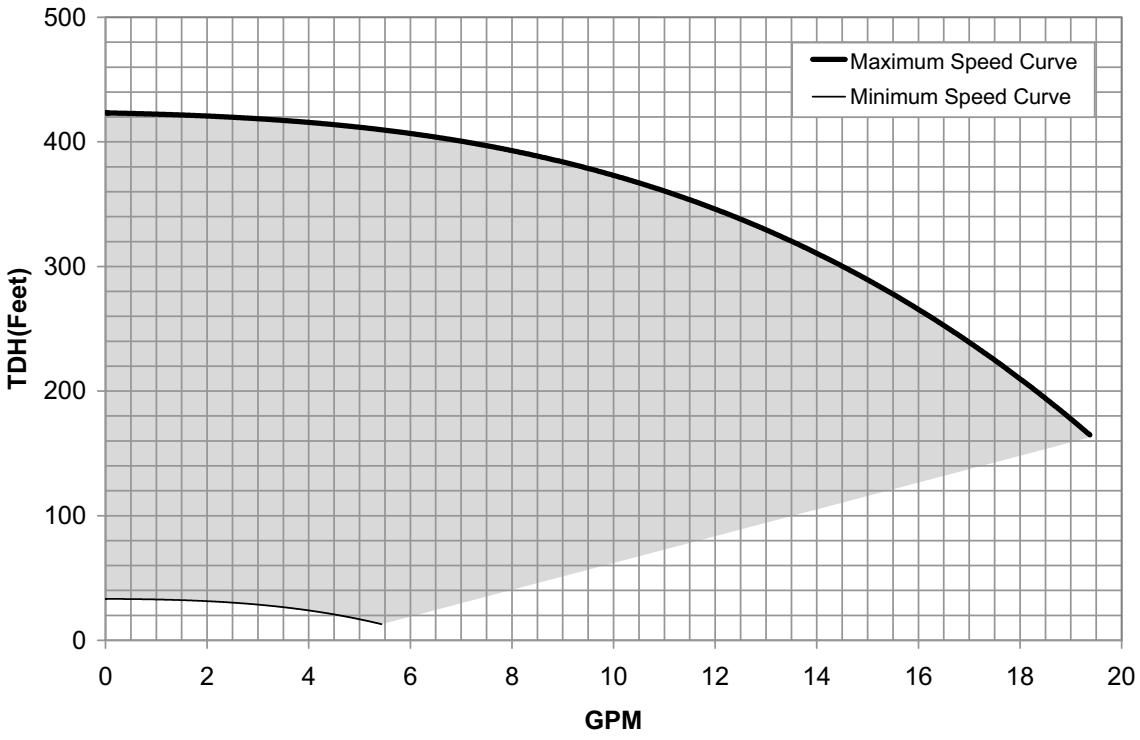
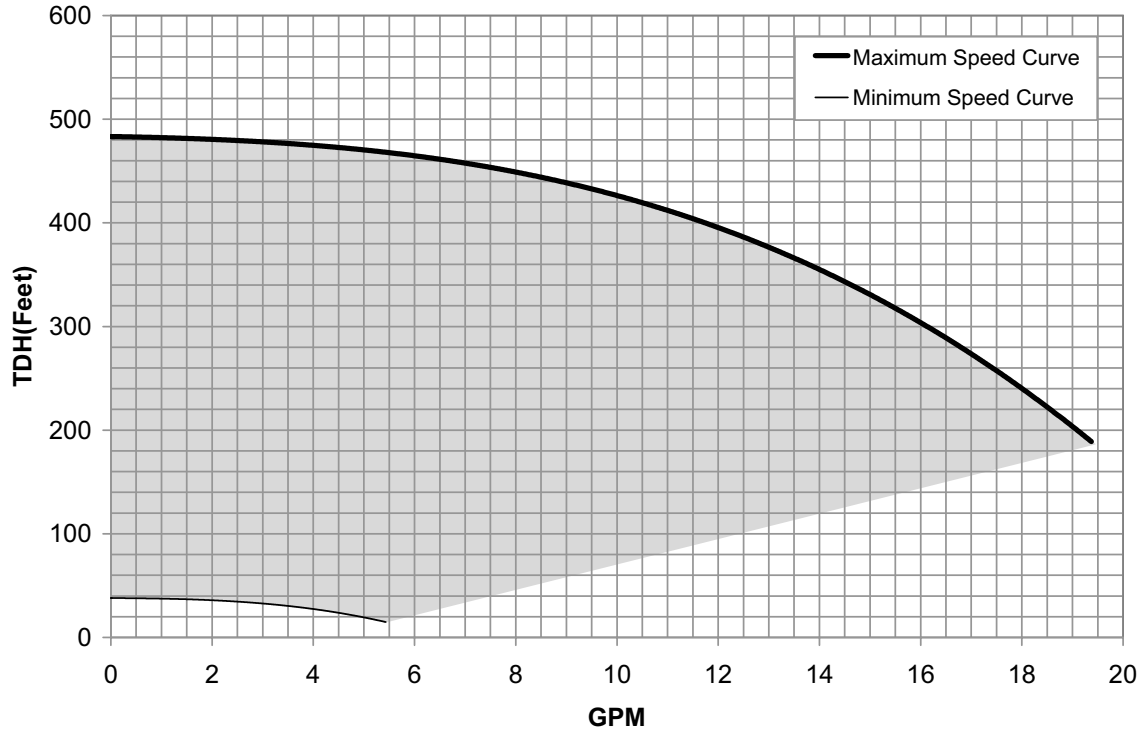
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

15 GPM • MODEL 15SQE10-250



OUTLET SIZE: 1 1/4" NPT **NOMINAL DIA. 3"**

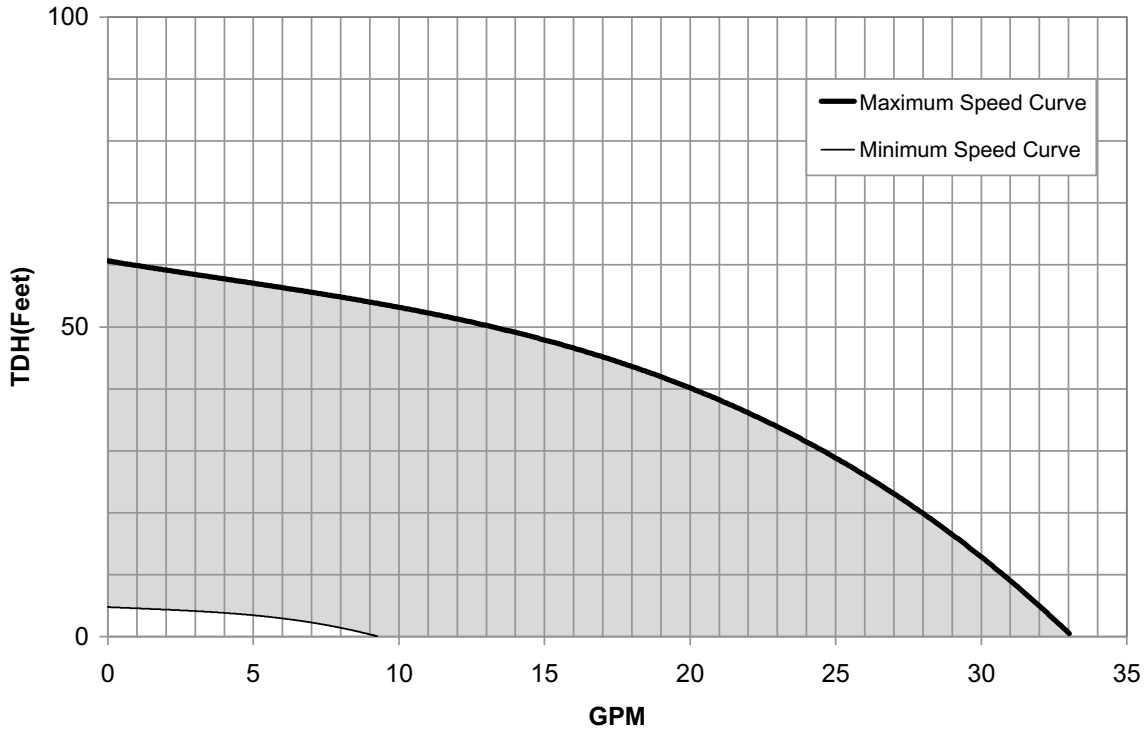
15 GPM • MODEL 15SQE15-290



OUTLET SIZE: 1 1/4" NPT **NOMINAL DIA. 3"**

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

22 GPM • MODEL 22SQE05-40



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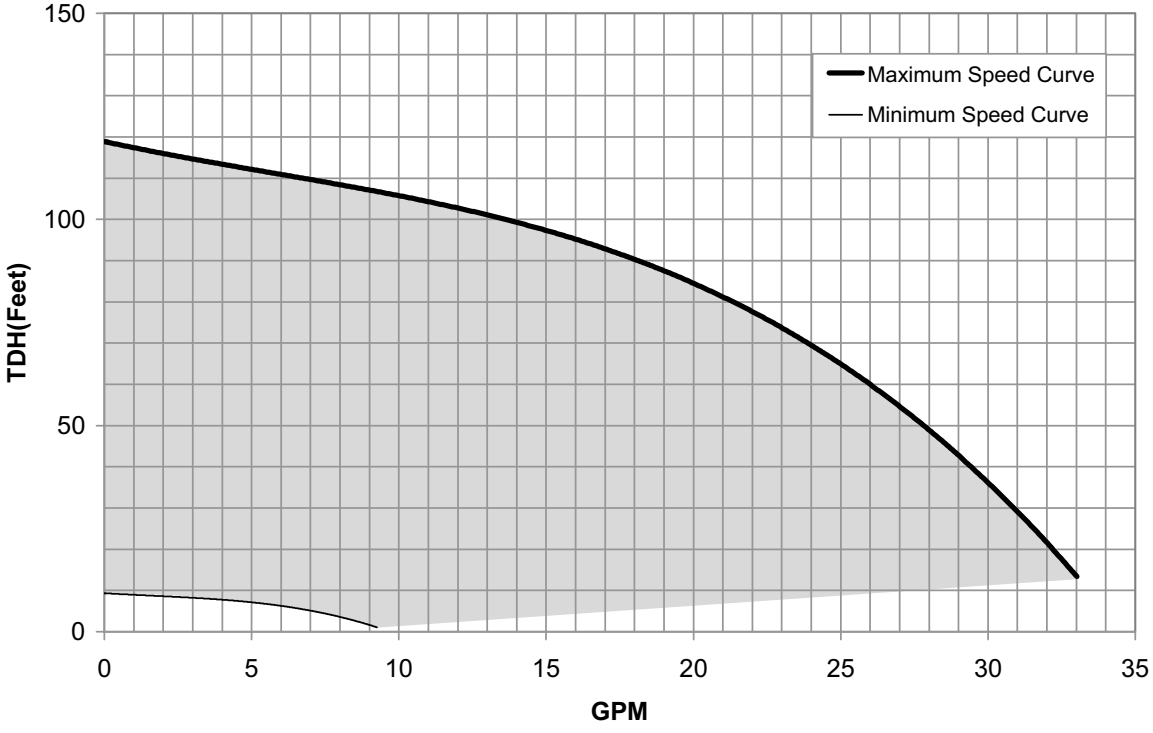
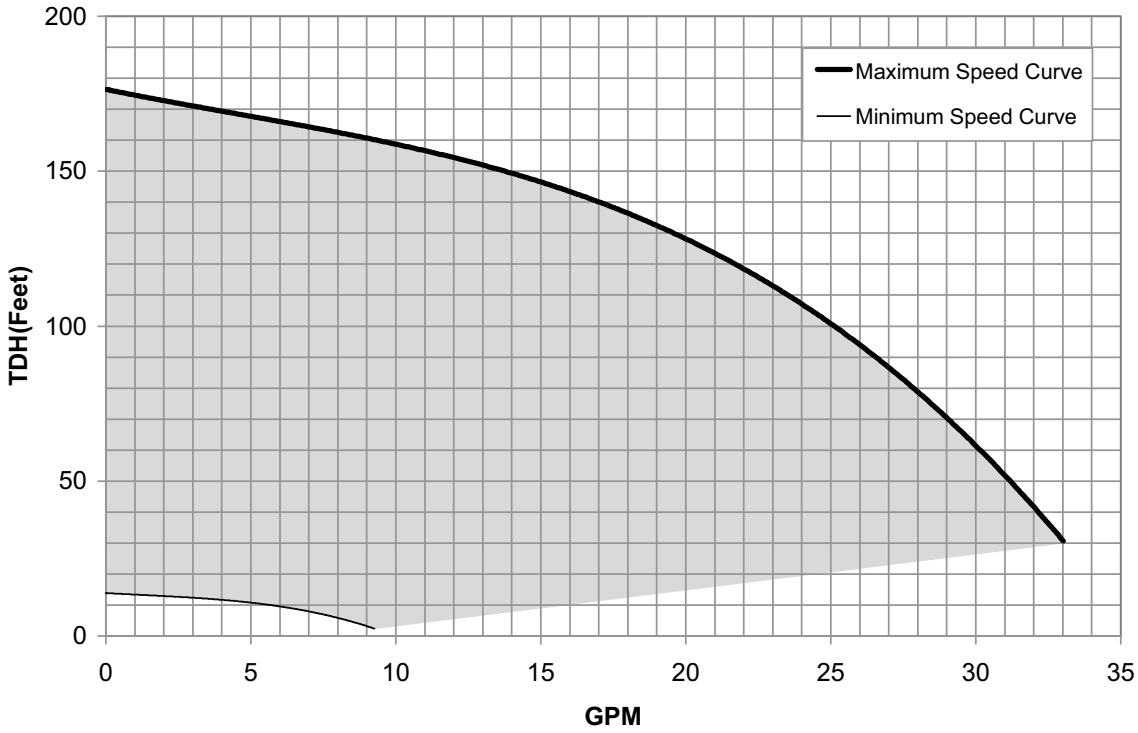
22 GPM • MODEL 22SQE05-80



OUTLET SIZE: 1 1/2" NPT **NOMINAL DIA. 3"**

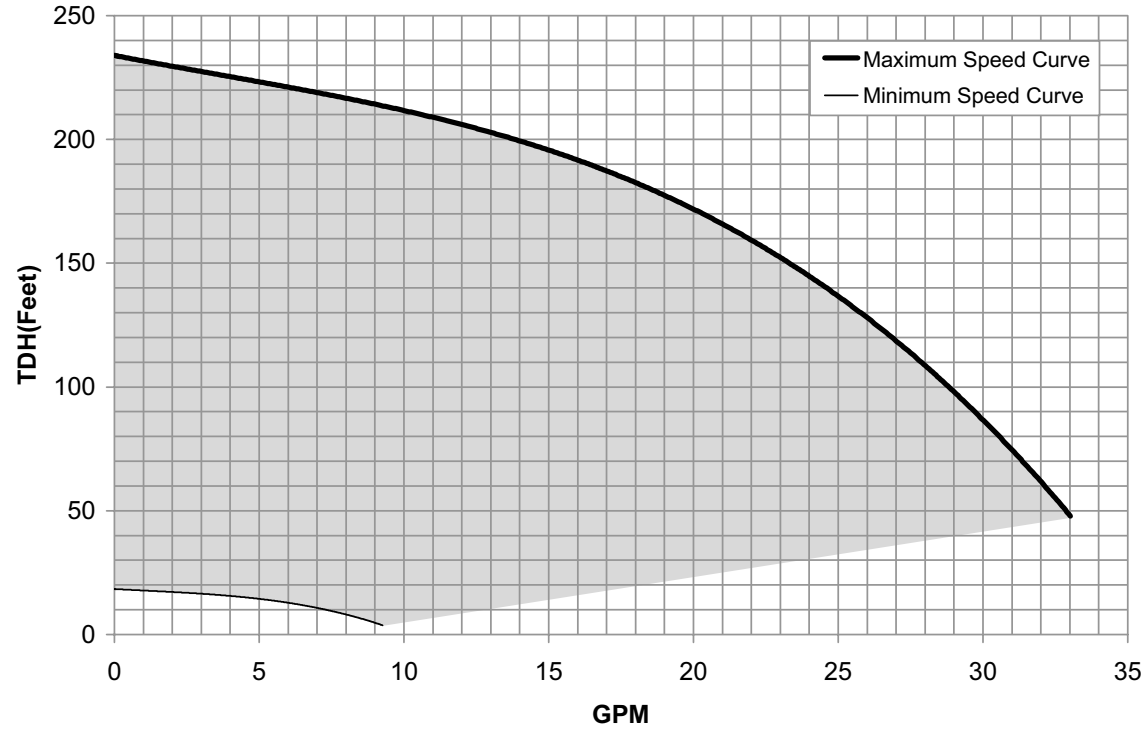
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

22 GPM • MODEL 22SQE07-120



OUTLET SIZE: 1 1/2" NPT **NOMINAL DIA. 3"**

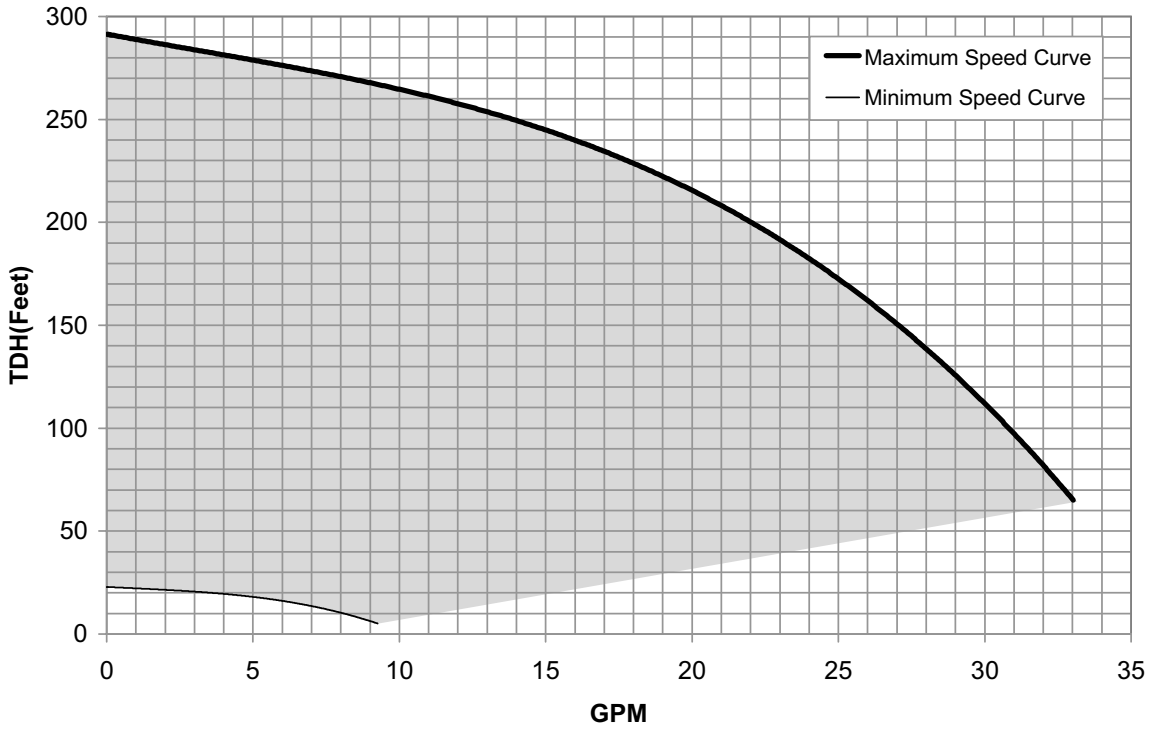
22 GPM • MODEL 22SQE07-160



OUTLET SIZE: 1 1/2" NPT **NOMINAL DIA. 3"**

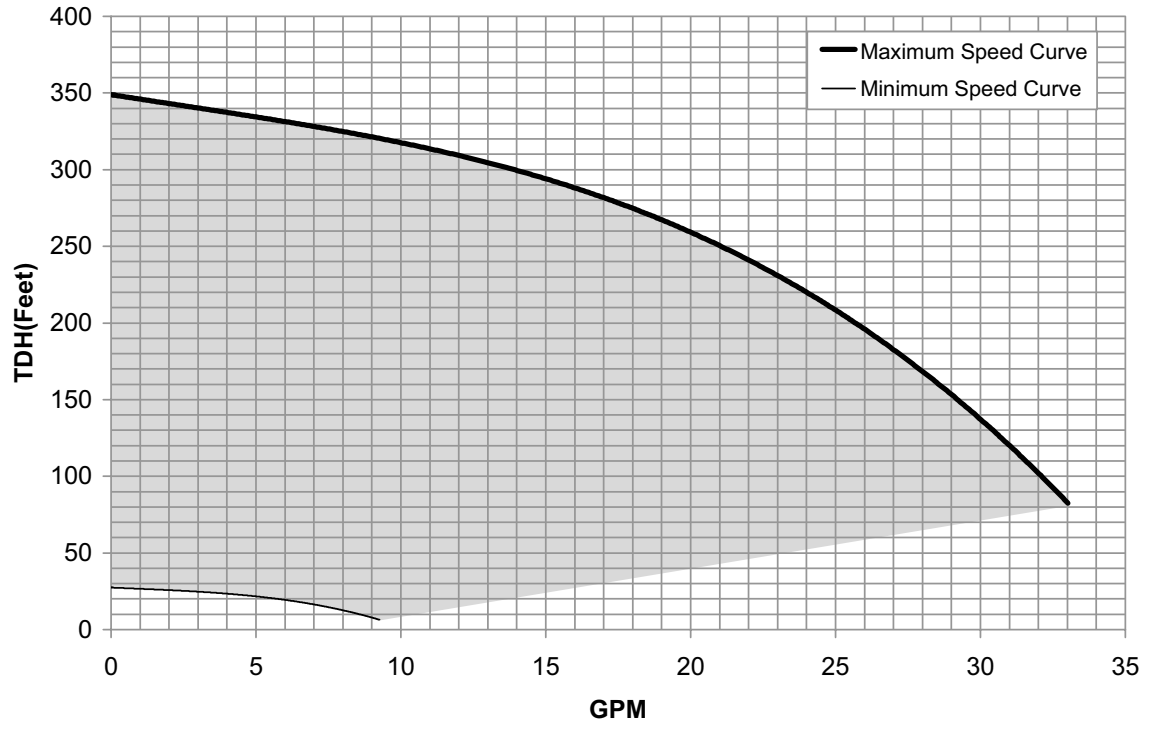
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

22 GPM • MODEL 22SQE10-190



OUTLET SIZE: 1 1/2" NPT **NOMINAL DIA. 3"**

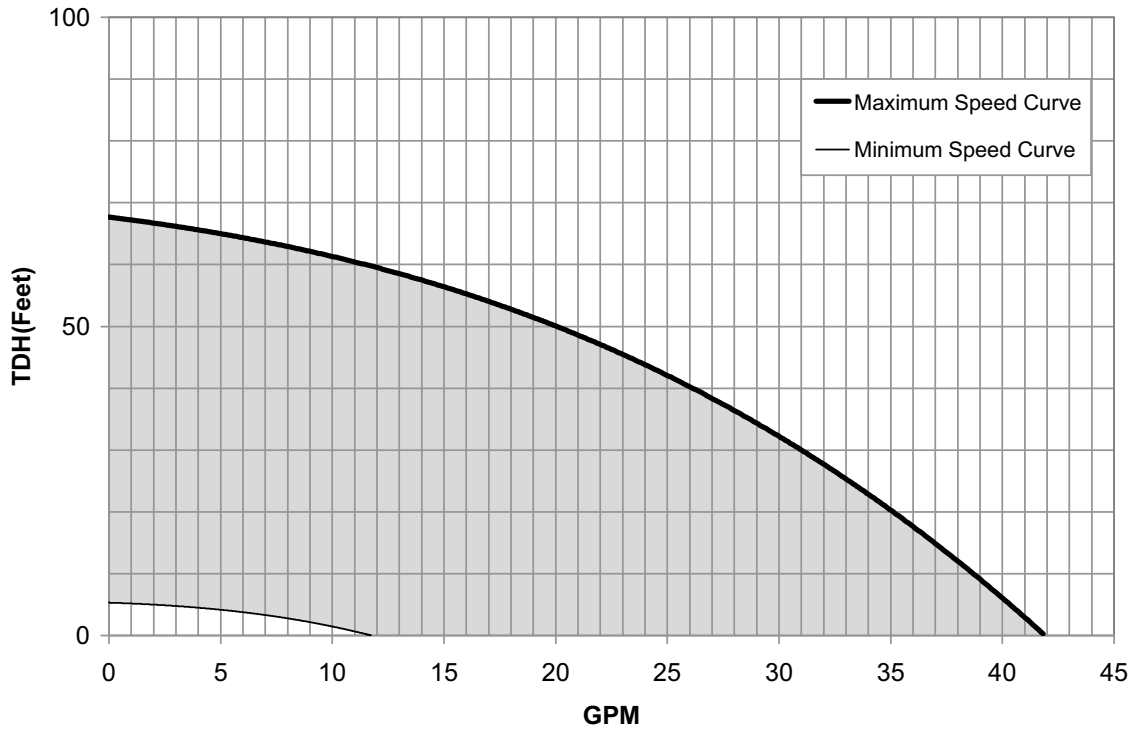
22 GPM • MODEL 22SQE15-220



OUTLET SIZE: 1 1/2" NPT **NOMINAL DIA. 3"**

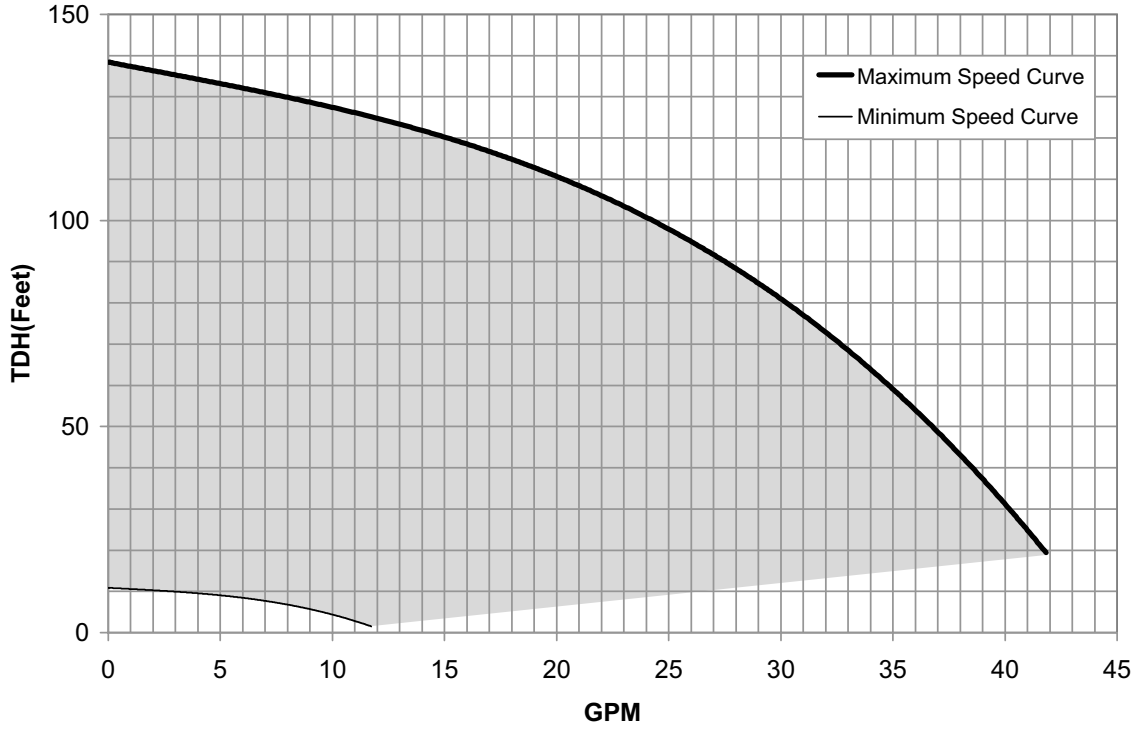
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

30GPM • MODEL 30SQE05-40



OUTLET SIZE: 1 1/2" NPT **NOMINAL DIA. 3"**

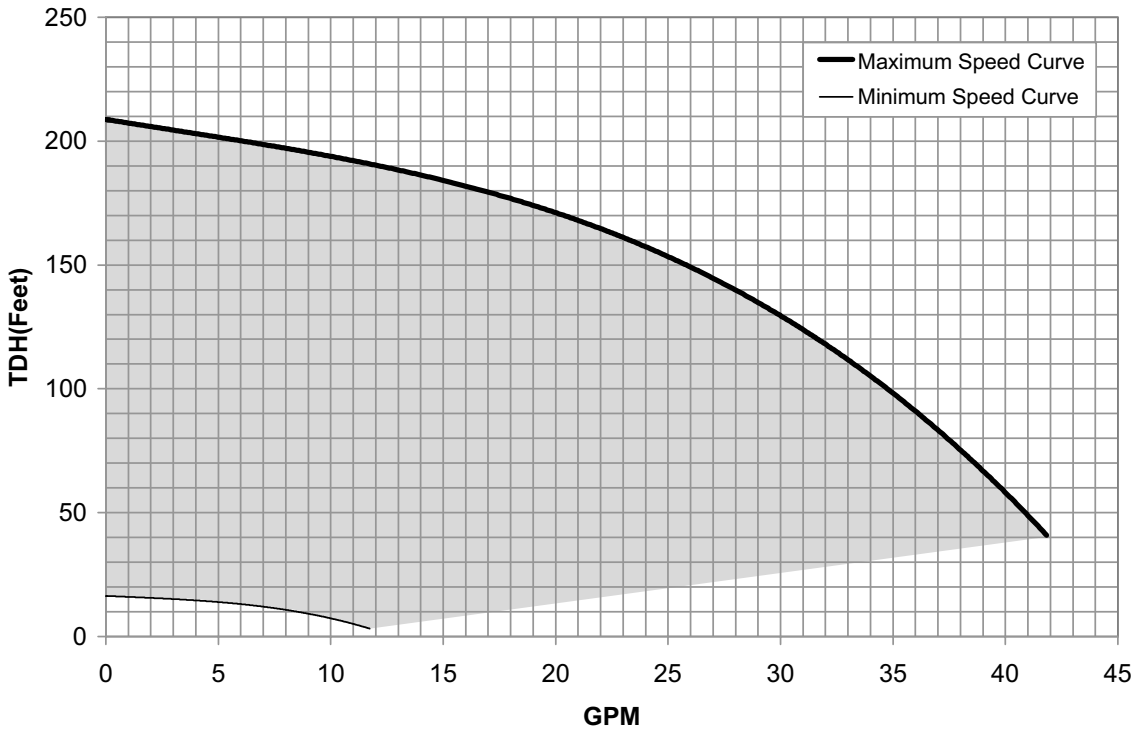
30 GPM • MODEL 30SQE07-90



OUTLET SIZE: 1 1/2" NPT **NOMINAL DIA. 3"**

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

30 GPM • MODEL 30SQE10-130



OUTLET SIZE: 1 1/2" NPT **NOMINAL DIA. 3"**

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

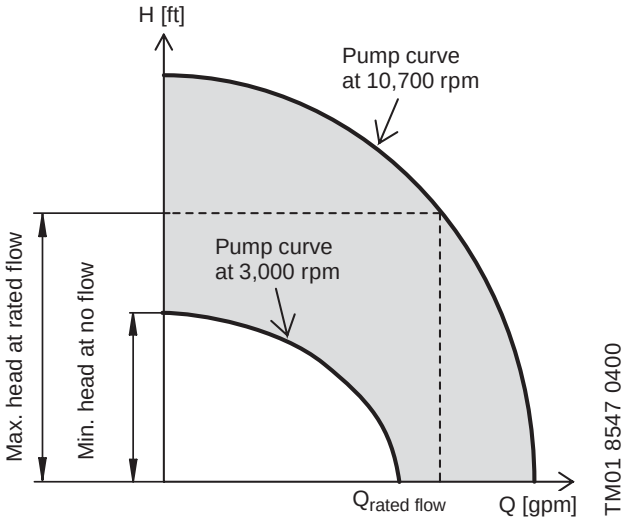
Step 1
Calculate minimum head requirements at no flow conditions:

Hmax (required) = dynamic head + system pressure (in feet) + above grade elevation + friction loss.

Step 2
Select pump from chart as follows:

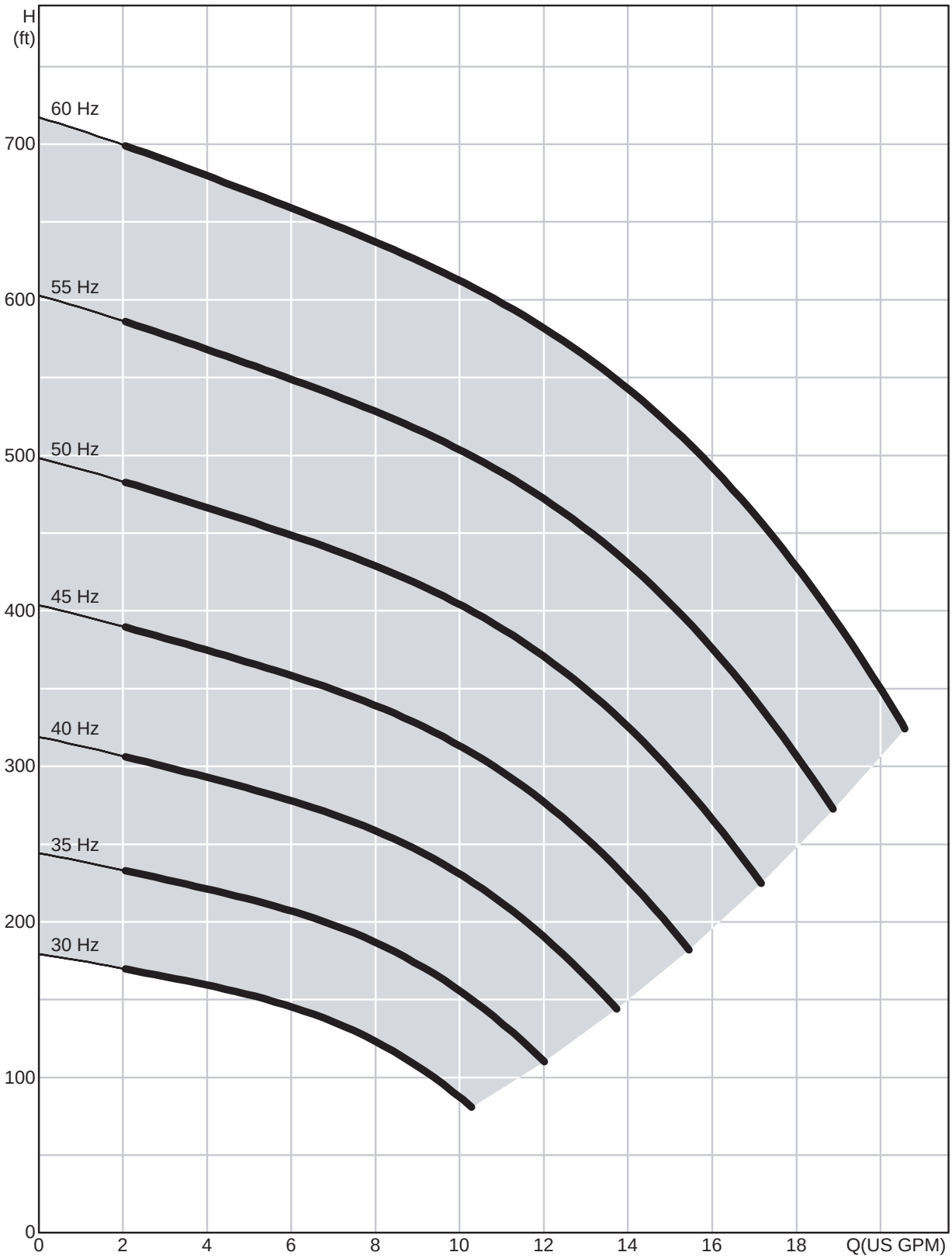
- Choose model family based on the desired flow rate. i.e. 15SQE for a flow rate of 15gpm
- Select the first model with a value in Column 2 greater than the Hmax calculated in Step 1
- For example: the choice for a 22gpm model with an Hmax of 140' would be the 22SQE-160. Double check your selection in the performance curves found in the previous pages of this book.

	Col. 1	Col. 2
System Sizing Matrix		
Pump Type Model B	Shutoff Head (0 GPM) @ 3000 RPM Min. Speed	Head @ Rated GPM @ 10700 RPM Max. Speed
	TDH(Feet)	TDH(Feet)
5SQE-90	11	86
5SQE-140	17	131
5SQE-180	22	177
5SQE-230	28	222
5SQE-270	34	270
5SQE-320	39	315
5SQE-360	45	360
5SQE-410	51	405
5SQE-450	56	450
10SQE-110	12	105
10SQE-160	17	164
10SQE-200	23	215
10SQE-240	29	267
10SQE-290	34	328
10SQE-330	40	390
15SQE-70	10	75
15SQE-110	14	123
15SQE-150	19	164
15SQE-180	24	205
15SQE-220	29	246
15SQE-250	33	287
15SQE-290	38	328
22SQE-40	5	36
22SQE-80	9	77
22SQE-120	14	117
22SQE-160	18	159
22SQE-190	23	200
22SQE-220	27	240
30SQE-40	5	33
30SQE-90	11	82
30SQE-130	16	126



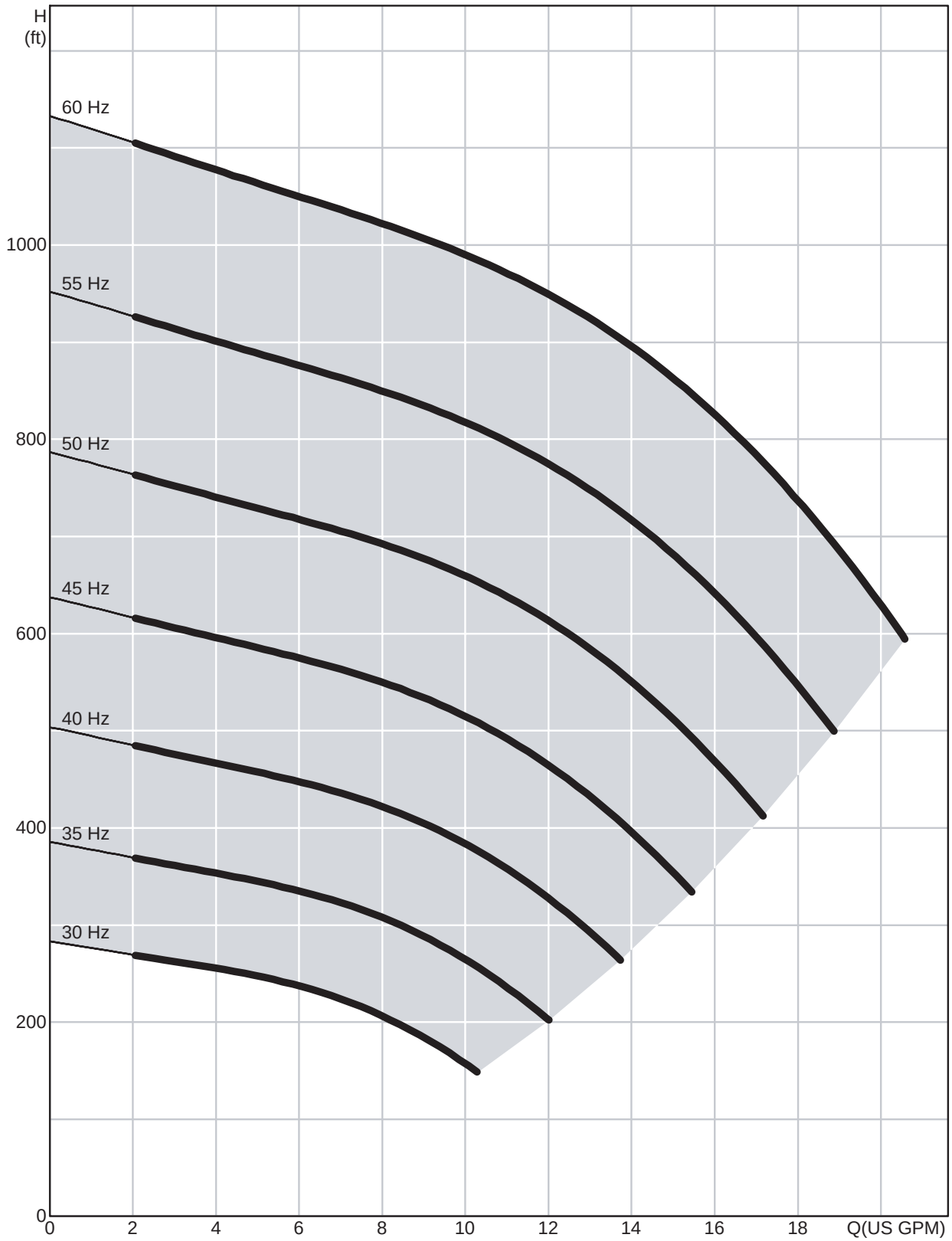
Note: All calculated head requirements must lie between the selected pump models minimum and maximum speed curves.

16 GPM • MODEL 16S30-24



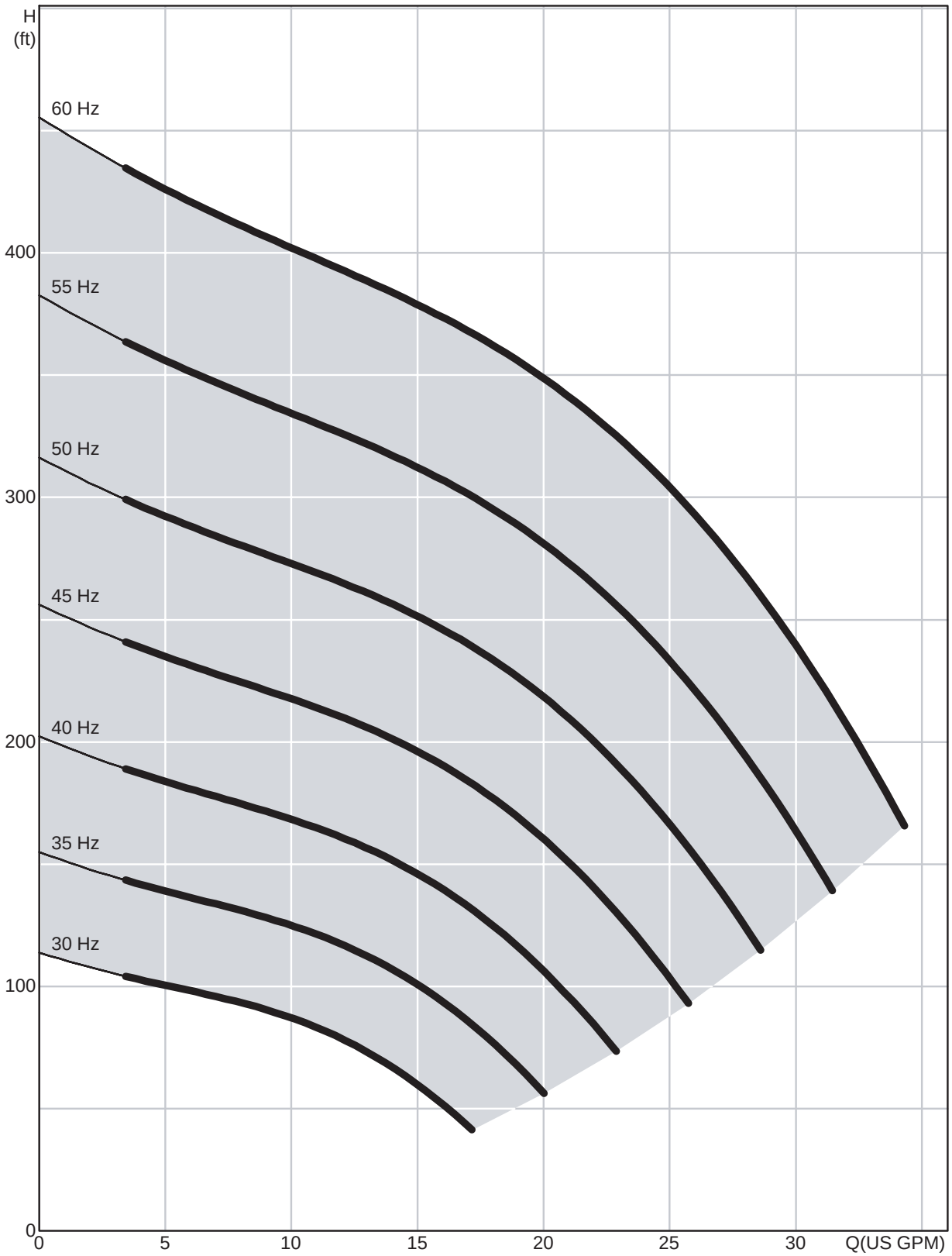
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

16 GPM • MODEL 16S50-38



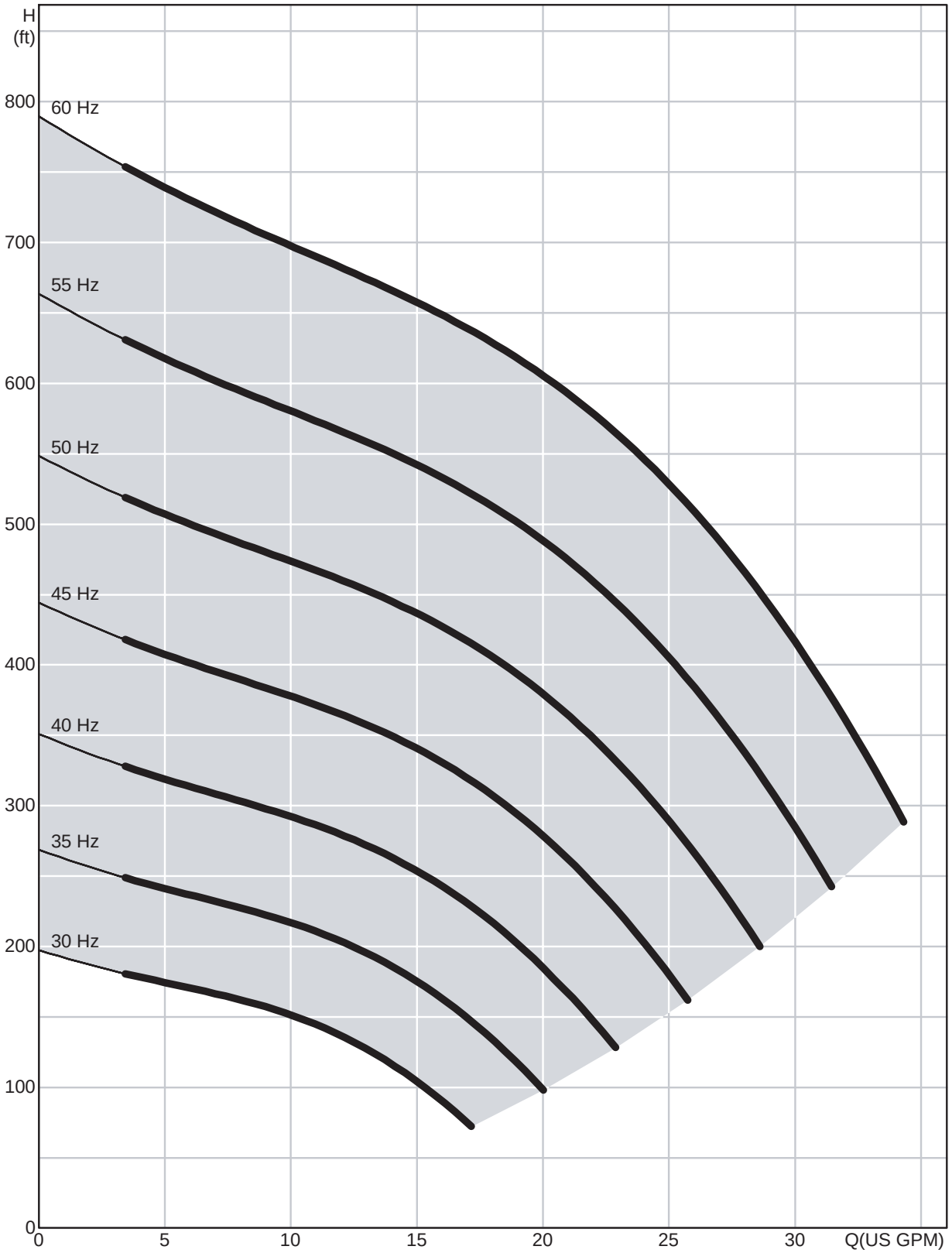
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

25 GPM • MODEL 25S30-15



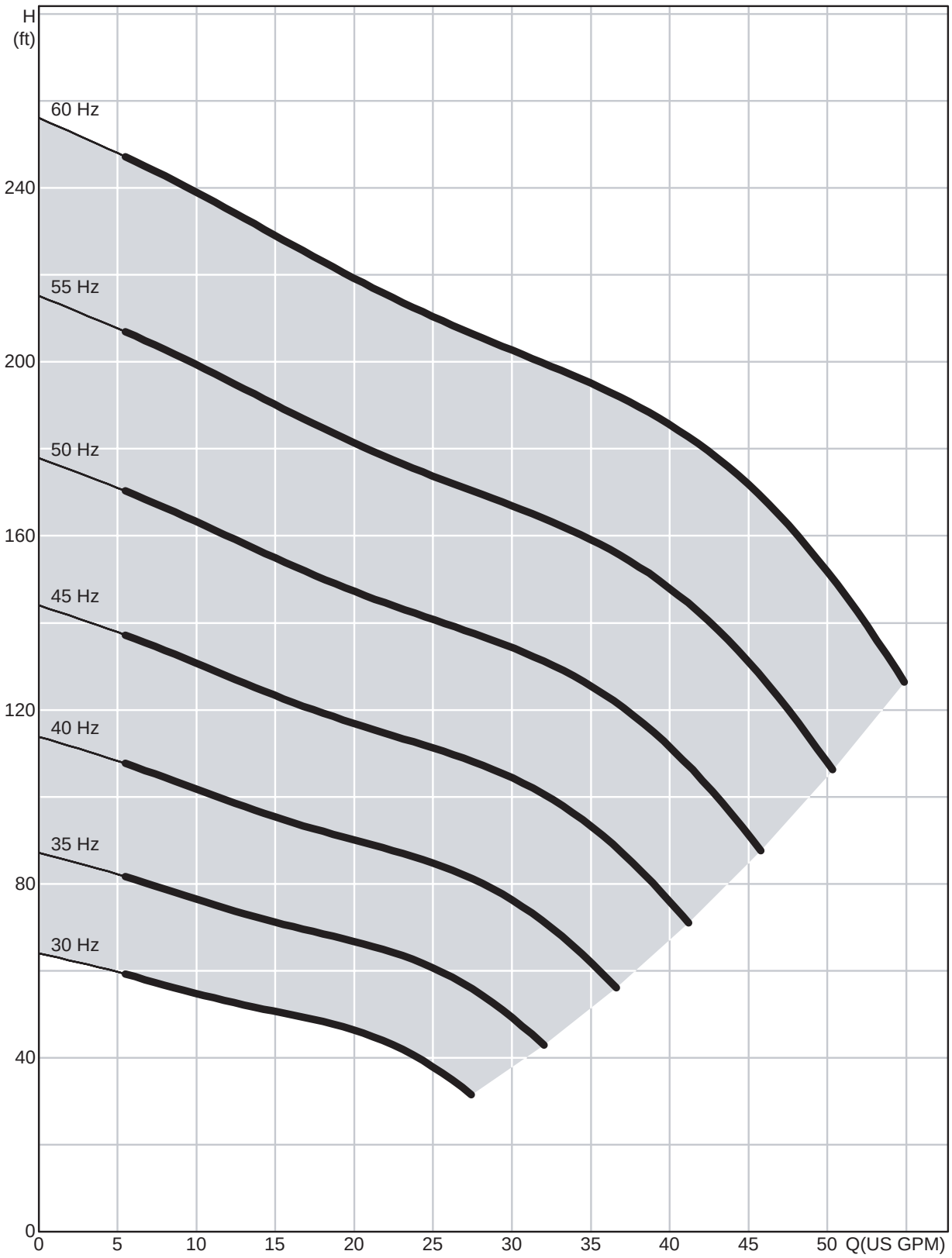
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

25 GPM • MODEL 25S50-26



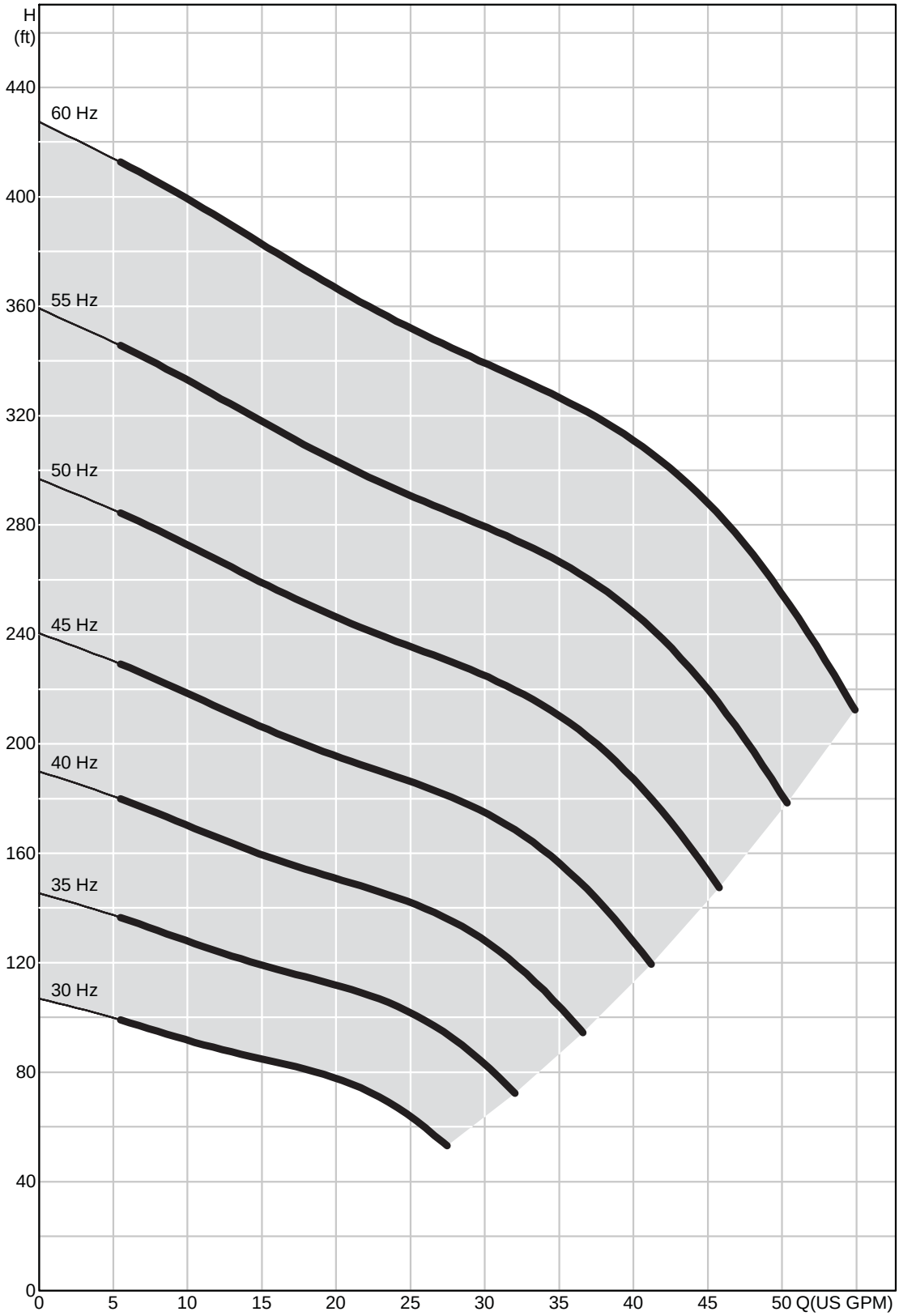
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

40 GPM • MODEL 40S30-9



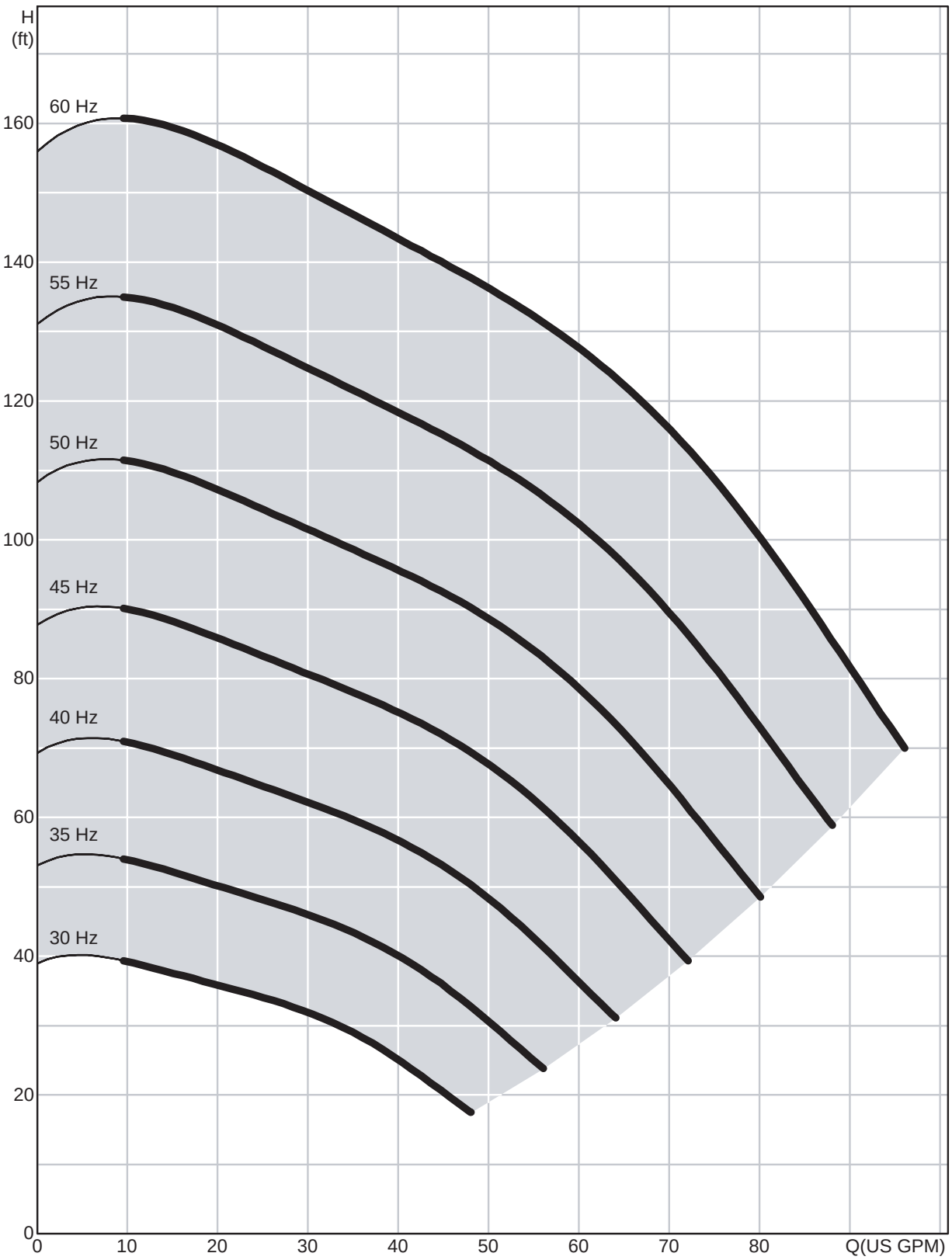
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

40 GPM • MODEL 40S50-15



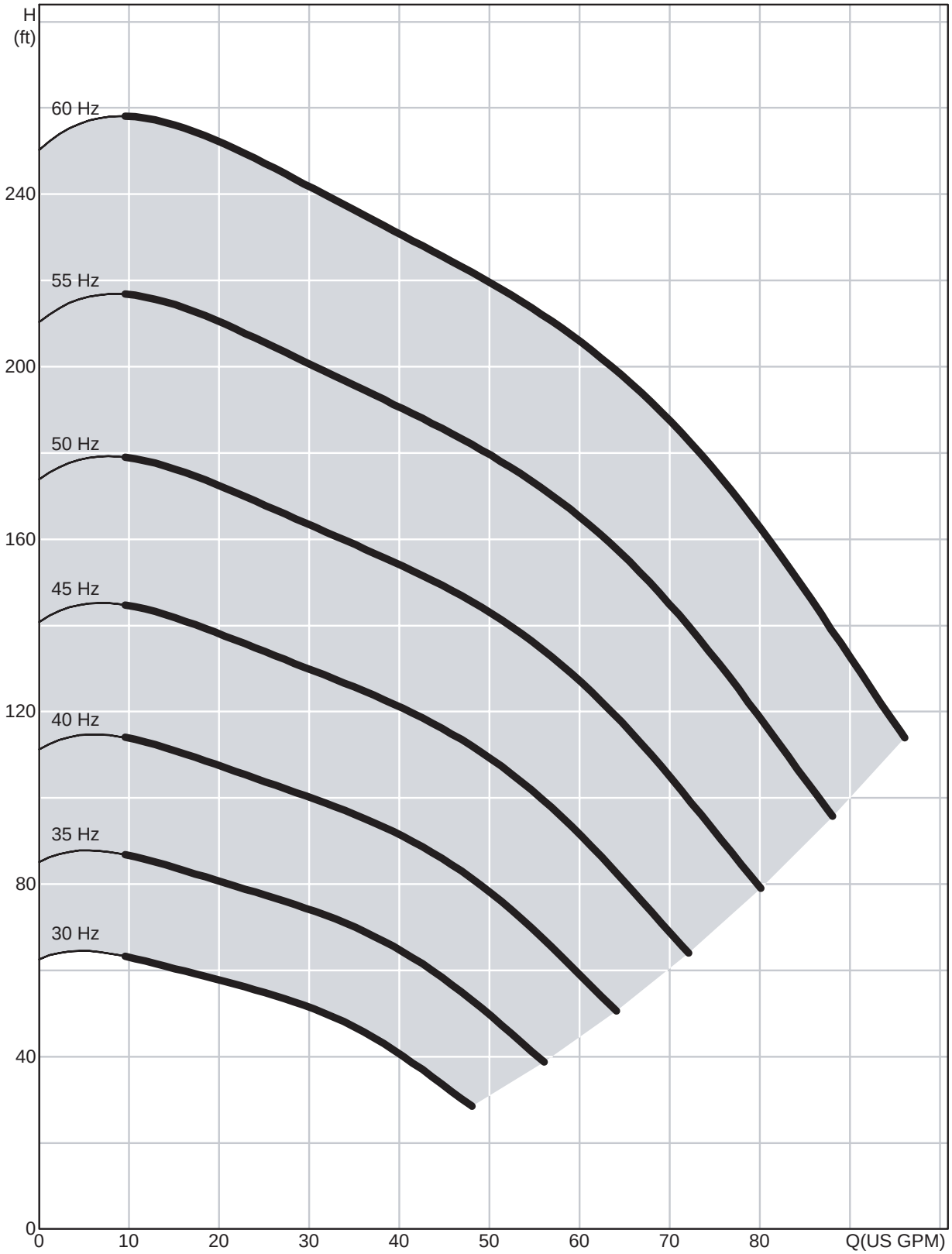
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

75 GPM • MODEL 75S30-5



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

75 GPM • MODEL 75S50-8



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

Step 1
Calculate maximum head requirements at rated flow conditions:

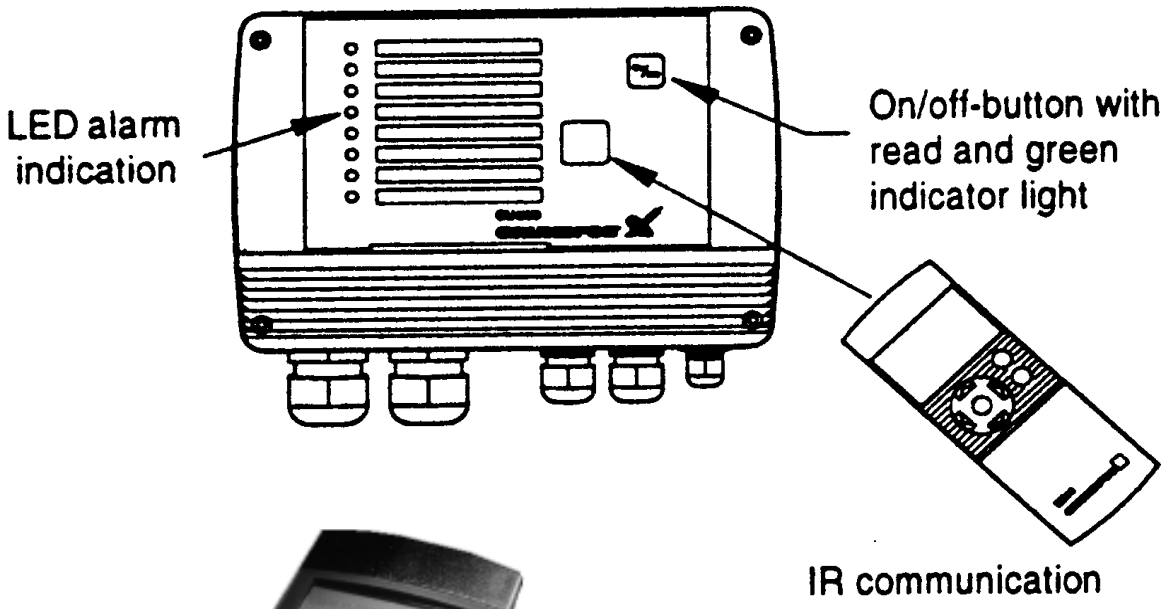
Hmax = dynamic head + system psi (in feet) + friction loss + above grade elevation

Step 2
Select pump from chart as follows:

- Select a model in which the calculated value of Hmax is below the value in columns 2
- For example: the choice for a 40gpm model with an Hmax of 150 would be the 40S30-9

	Col. 1	Col. 2
System Sizing Matrix		
Pump Type	**Shutoff Head (0 GPM) @ 1500 RPM Min. Speed**	**Head @ Rated GPM @ 3600 RPM Max. Speed**
3HP	**TDH(Feet)**	**TDH(Feet)**
16S30-24	128	490
25S30-15	80	305
40S30-9	45	185
75S30-5	30	105
5HP		
16S50-38	200	825
25S50-26	105	530
40S50-15	75	310
75S50-8	45	175

SmartFlo™ Accessories



CU301 SQE 3" Constant Pressure System "SmartFlo"

Description	Product no.
"SmartFlo" Constant Pressure Kit (Includes CU301 and Transducer)	96438895

CU321 SP 4" Constant Pressure System "SmartFlo"

Description	HP	Input PH	Input VOLTS	Product no.
CU321 Constant Pressure Kit	3	1	200-240	96581690
CU321 Constant Pressure Kit	5	3	200-240	96581691
Pressure Sensor	_	_	_	96437852

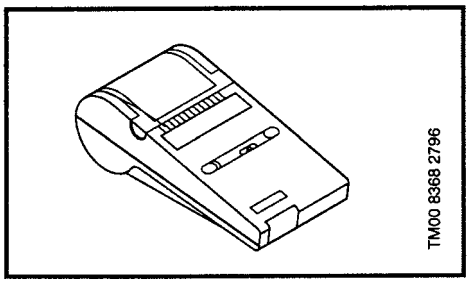
Note: Kits include CU321 and pressure sensor

CU300 Status Box & R100

Description	Product no.
CU300 Status Box	96422776

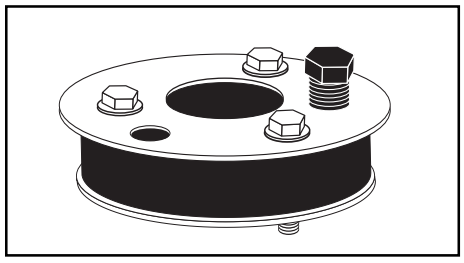
Description	Product no.
The R100 is used for wireless infrared communication with the CU300	625333

Printer



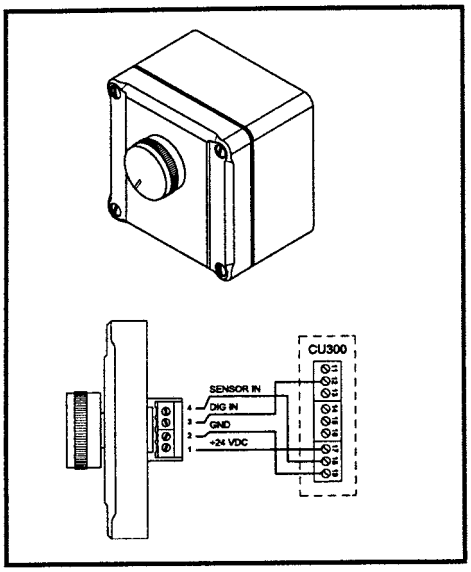
Description	Product no.
Printer for R100, infrared communication Type: Hewlett Packard, HP 82240B	620480
Paper Roll	620481

3" Well Seal



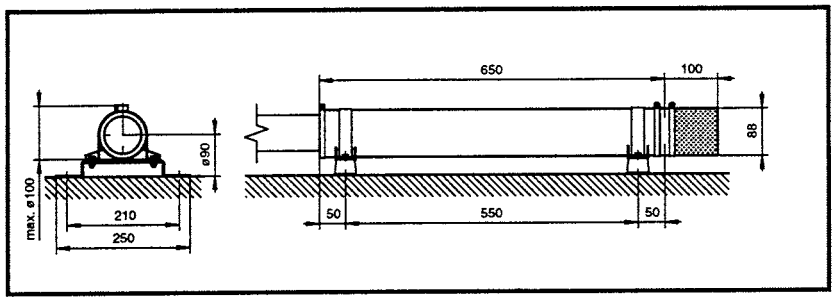
Description	Product no.
3" Sanitary Well Seal	1B5102

Potentiometer



Description	Version	Product no.
External potentiometer with cabinet for wall mounting. Screened cables, 4-wire cable, max. length of cable: 100m	Grundfos potentiometer, SPP1 Enclosure class: IP 55	625468

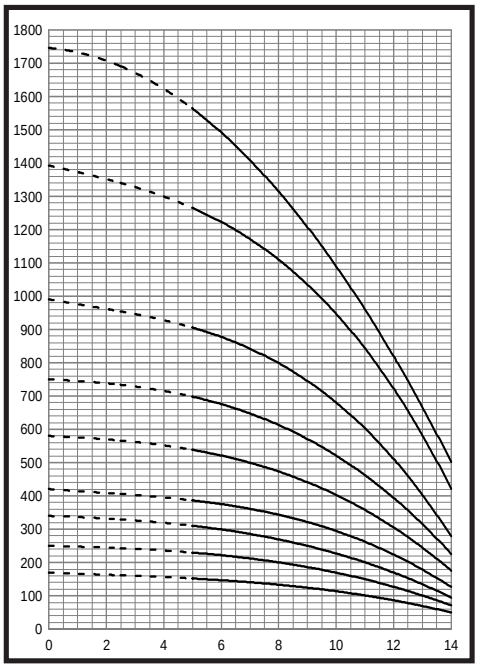
SQ/SQE - Flow sleeve



Description	Product no.
Flow Sleeve Complete	96037505

Performance Curves and Technical Data

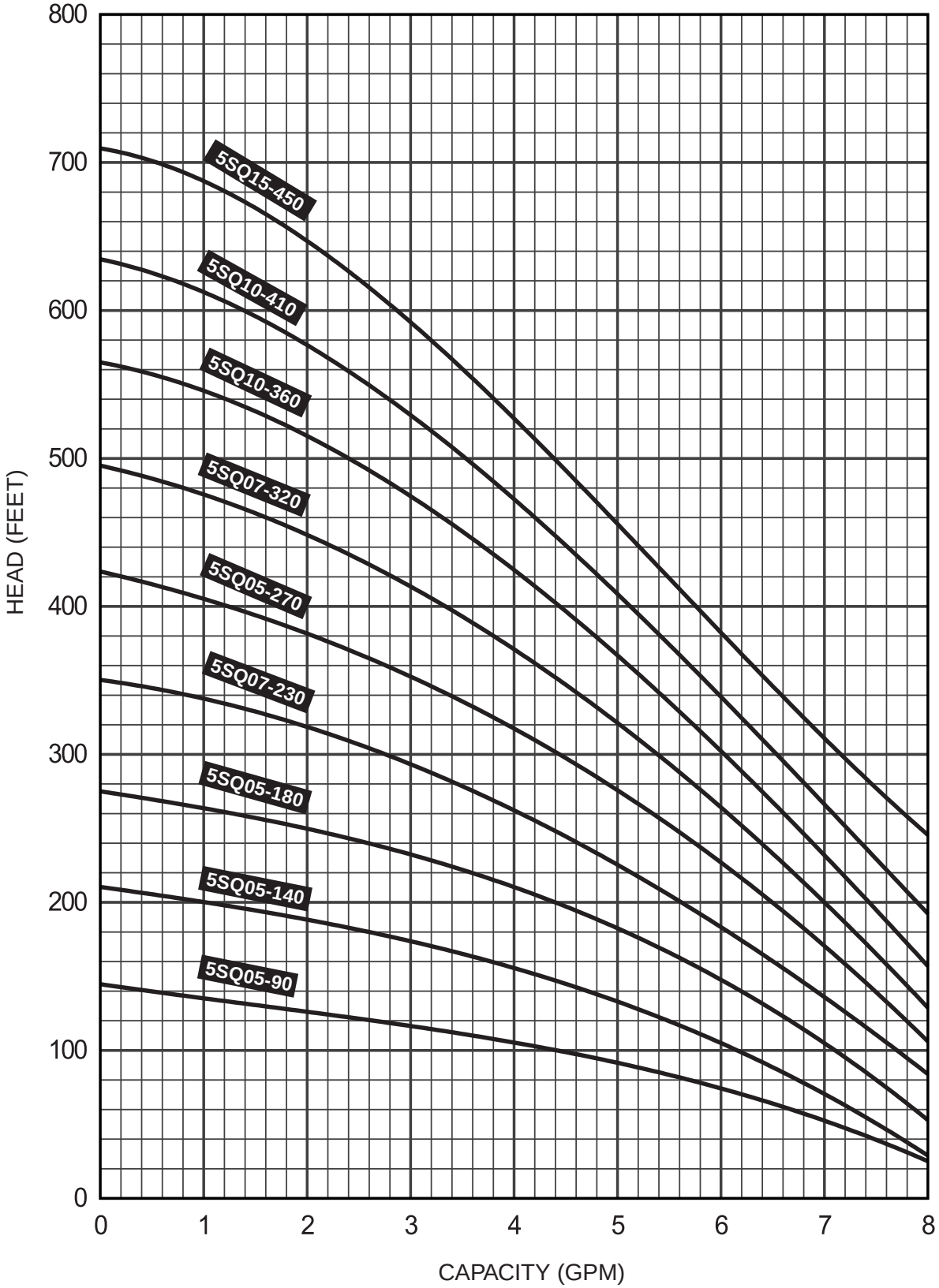
For 3-Inch & larger well applications



Performance Curves

Materials of Construction

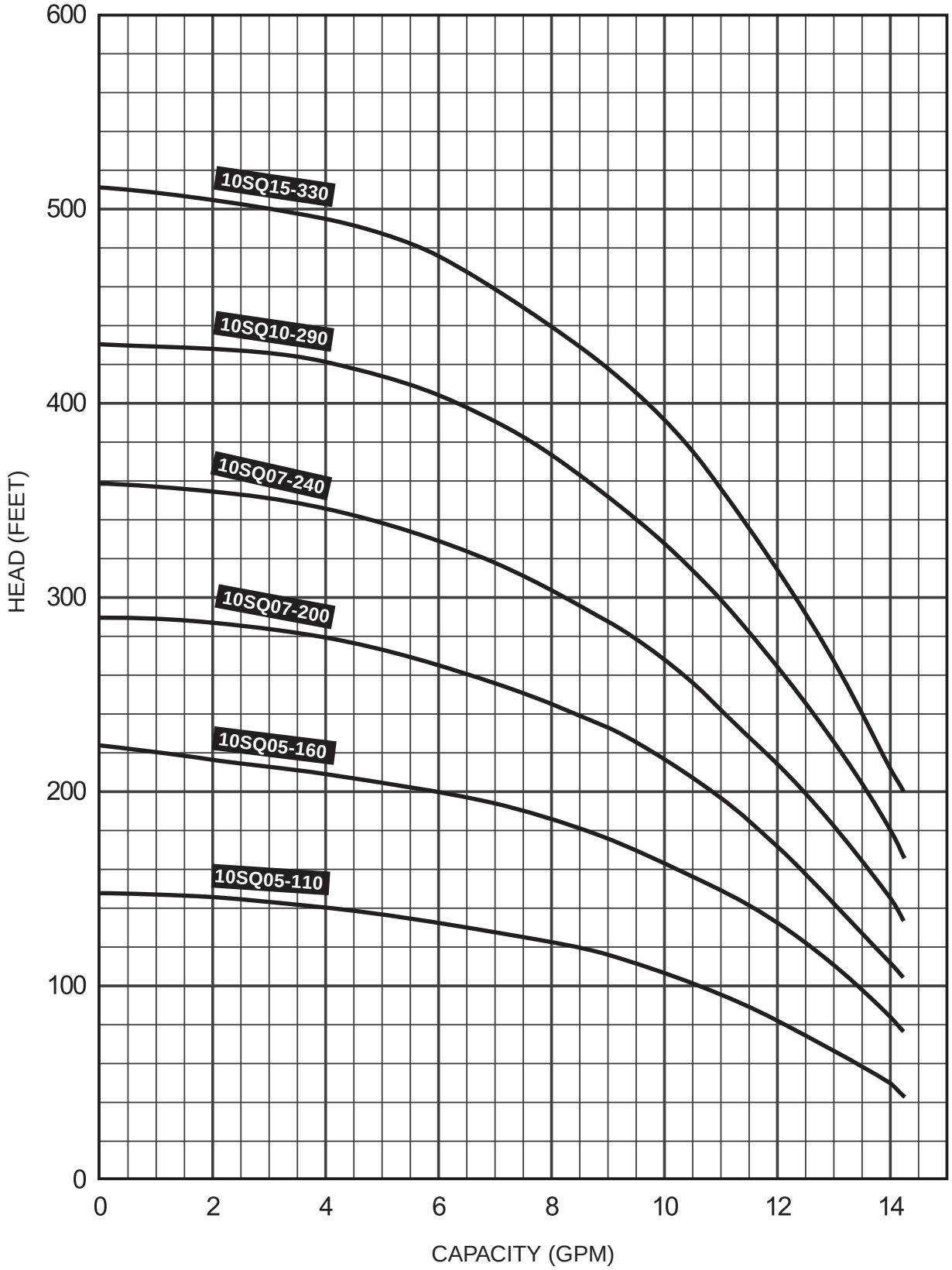
OUTLET SIZE: 1" NPT **NOMINAL DIA. 3"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

PERFORMANCE CONFORMS TO ISO 9906 ANNEX A

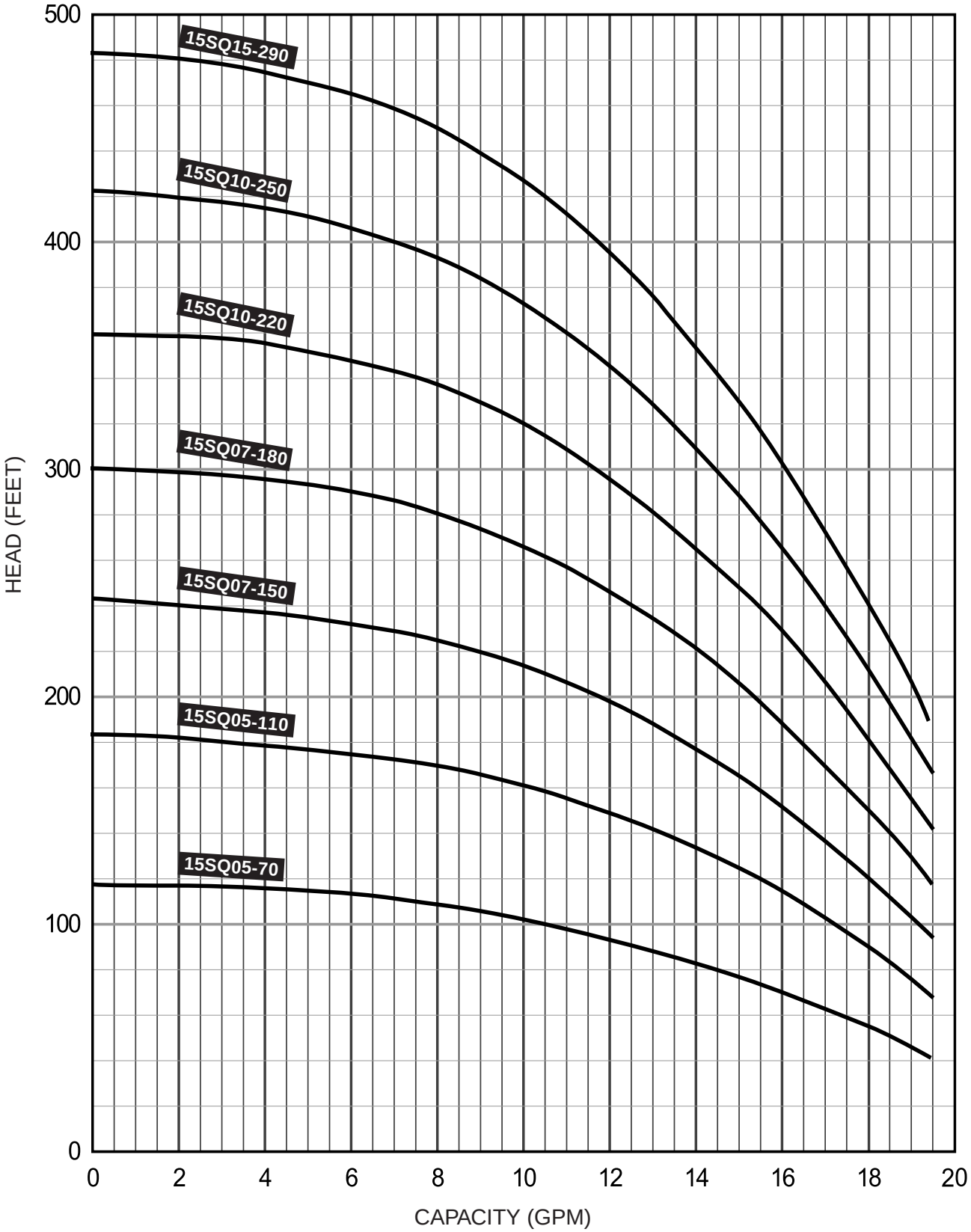
OUTLET SIZE: 1 1/4" NPT **NOMINAL DIA. 3"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

PERFORMANCE CONFORMS TO ISO 9906. (E) ANNEX A

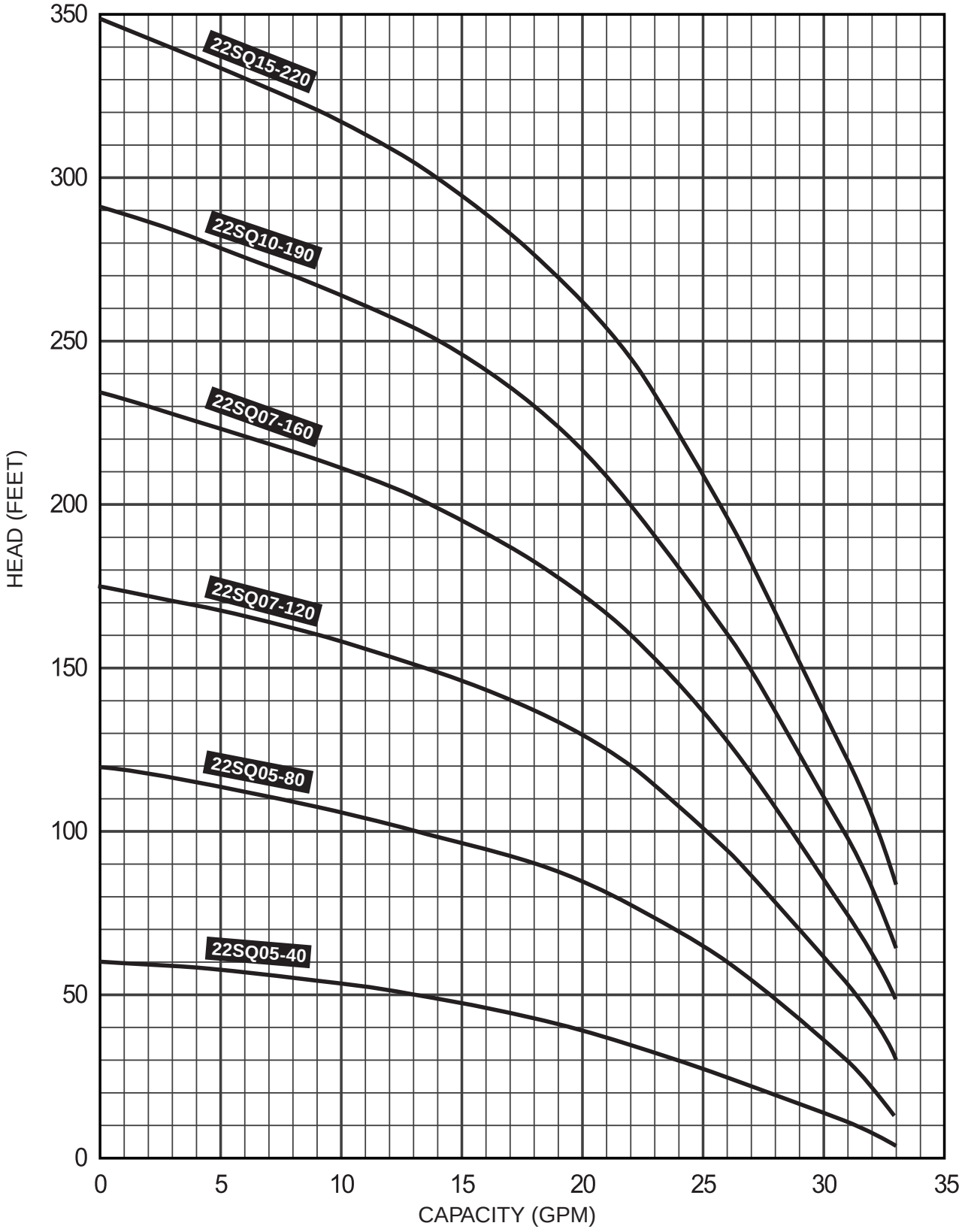
OUTLET SIZE: 1 1/4" NPT **NOMINAL DIA. 3"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

PERFORMANCE CONFORMS TO ISO 9906. (E) ANNEX A

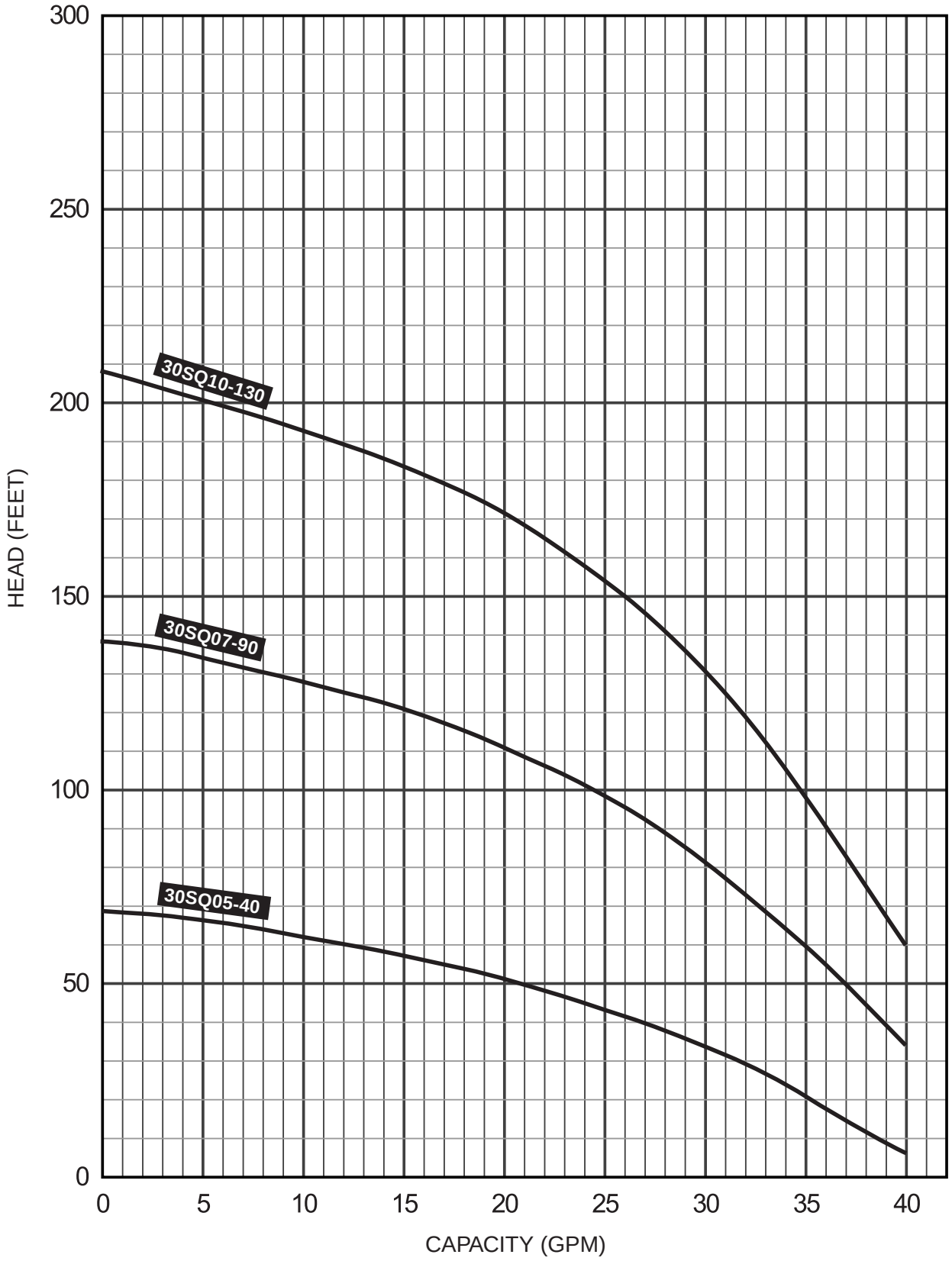
OUTLET SIZE: 1 1/2" NPT **NOMINAL DIA. 3"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

PERFORMANCE CONFORMS TO ISO 9906. (E) ANNEX A

OUTLET SIZE: 1 1/2" NPT **NOMINAL DIA. 3"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

PERFORMANCE CONFORMS TO ISO 9906. (E) ANNEX A

Dimensions and Weights

MODEL	FIG.	HP	MOTOR SIZE	DISCHARGE SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
5SQ/SQE05-90	A	1/2	3"	1" NPT	30.4	19.8	10.6	2.6	2.9	12
5SQ/SQE05-140	A	1/2	3"	1" NPT	30.4	19.8	10.6	2.6	2.9	12
5SQ/SQE05-180	A	1/2	3"	1" NPT	31.5	19.8	11.6	2.6	2.9	12
5SQ/SQE07-230	A	3/4	3"	1" NPT	33.6	19.8	13.7	2.6	2.9	13
5SQ/SQE07-270	A	3/4	3"	1" NPT	33.6	19.8	13.7	2.6	2.9	13
5SQ/SQE07-320	A	3/4	3"	1" NPT	34.6	19.8	14.8	2.6	2.9	13
5SQ/SQE10-360	A	1	3"	1" NPT	38.2	21.3	16.9	2.6	2.9	16
5SQ/SQE10-410	A	1	3"	1" NPT	38.2	21.3	16.9	2.6	2.9	16
5SQ/SQE15-450	A	1 1/2	3"	1" NPT	39.3	21.3	18.0	2.6	2.9	16
10SQ/SQE05-110	A	1/2	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
10SQ/SQE05-160	A	1/2	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
10SQ/SQE07-200	A	3/4	3"	1 1/4" NPT	31.5	19.8	11.6	2.6	2.9	13
10SQ/SQE07-240	A	3/4	3"	1 1/4" NPT	33.6	19.8	13.7	2.6	2.9	13
10SQ/SQE10-290	A	1	3"	1 1/4" NPT	35.0	21.3	13.7	2.6	2.9	16
10SQ/SQE15-330	A	1 1/2	3"	1 1/4" NPT	36.14	21.3	14.8	2.6	2.9	16
15SQ/SQE05-70	A	1/2	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
15SQ/SQE05-110	A	1/2	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
15SQ/SQE07-150	A	3/4	3"	1 1/4" NPT	31.5	19.8	11.6	2.6	2.9	13
15SQ/SQE07-180	A	3/4	3"	1 1/4" NPT	33.6	19.8	13.7	2.6	2.9	13
15SQ/SQE10-220	A	1	3"	1 1/4" NPT	35.0	21.3	13.7	2.6	2.9	16
15SQ/SQE10-250	A	1	3"	1 1/4" NPT	36.1	21.3	14.8	2.6	2.9	16
15SQ/SQE15-290	A	1 1/2	3"	1 1/4" NPT	38.2	21.3	16.9	2.6	2.9	16
22SQ/SQE05-40	A	1/2	3"	1 1/2" NPT	30.4	19.8	10.6	2.6	2.9	12
22SQ/SQE05-80	A	1/2	3"	1 1/2" NPT	30.4	19.8	10.6	2.6	2.9	12
22SQ/SQE07-120	A	3/4	3"	1 1/2" NPT	31.5	19.8	11.6	2.6	2.9	13
22SQ/SQE07-160	A	3/4	3"	1 1/2" NPT	33.6	19.8	13.7	2.6	2.9	13
22SQ/SQE10-190	A	1	3"	1 1/2" NPT	38.2	21.3	16.9	2.6	2.9	16
22SQ/SQE15-220	A	1 1/2	3"	1 1/2" NPT	38.2	21.3	16.9	2.6	2.9	16
30SQ/SQE05-40	A	1/2	3"	1 1/2" NPT	30.4	19.8	10.6	2.6	2.9	12
30SQ/SQE07-90	A	3/4	3"	1 1/2" NPT	30.4	19.8	10.6	2.6	2.9	13
30SQ/SQE10-130	A	1	3"	1 1/2" NPT	35.0	21.3	13.7	2.6	2.9	13

DISCHARGE SIZES
1" NPT 5SQ/SQE
1 1/4" NPT 10-15SQ/SQE
1 1/2" NPT 22-30 SQ/SQE

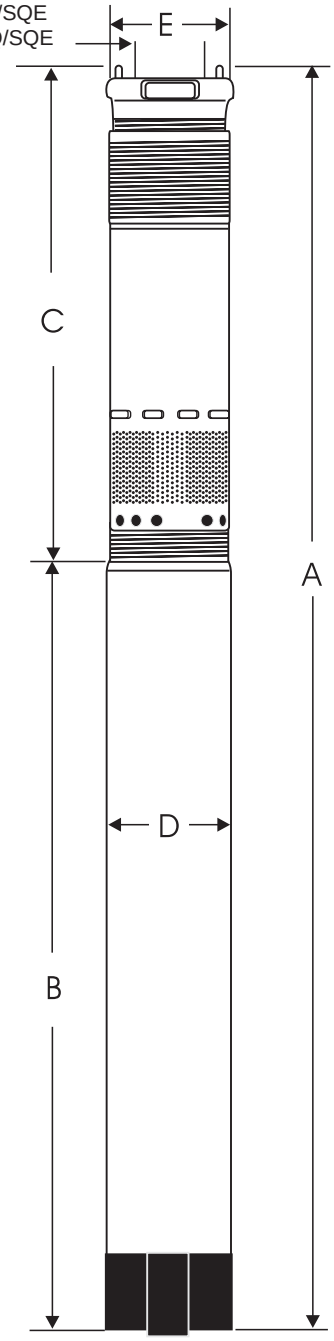


Fig. A

MATERIALS OF CONSTRUCTION

COMPONENT	SPLINED SHAFT
Valve Casing	Polyamide
Discharge Chamber	304 Stainless Steel
Valve Guide	Polyamide
Valve Spring	316LN Stainless Steel
Valve Cone	Polyamide
Valve Seat	NBR Rubber
O-ring	NBR Rubber
Lock Ring	310 Stainless Steel
Top Bearing	NBR Rubber
Top Chamber	Polyamide
Guide Vanes	Polyamide
Impeller	Polyamide w/tungsten carbide bearings
Bottom Chamber	Polyamide
Neck Ring	TPU/PBT
Bearing	Aluminum Oxide
Suction Interconnector	Polyamide
Ring	304 Stainless Steel
Pump Sleeve	304 Stainless Steel
Cone for Pressure Equalization	Polyamide
Spacer	Polyamide
Sand Trap	316 Stainless Steel
Shaft w/Coupling	304 Stainless Steel
Cable Guard	304 Stainless Steel

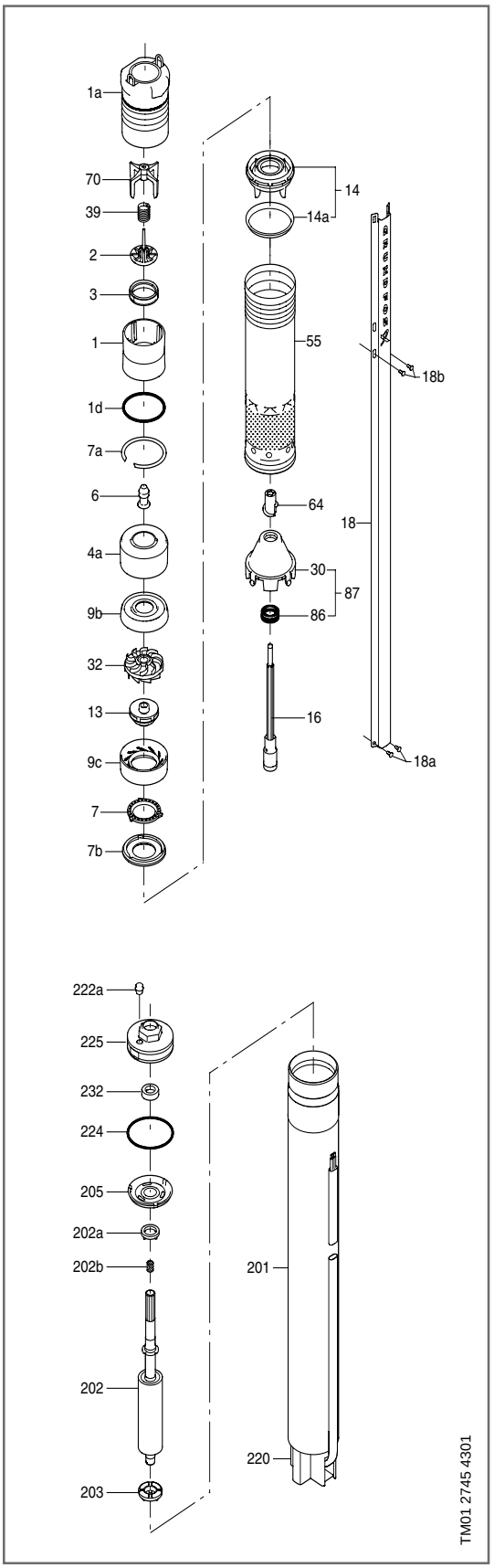
NOTES: Specifications subject to change without notice.

Material specification (Pump)

Pos.	Component	Material	DIN W.-Nr. SQ/SQE	AISI	DIN W.-Nr. SQ-N	AISI
1	Valve casing	Polyamide				
1a	Discharge chamber	Stainless steel	1.4301	304	1.4401	316
1d	O-ring	NBR rubber				
2	Valve cup	Polyamide				
3	Valve seat	NBR rubber				
4a	Empty chamber	Polyamide				
6	Top bearing	NBR rubber				
7	Neck ring	TPU/PBT				
7a	Lock ring	Stainless spring steel	1.4310	310	1.4401	316
7b	Neck ring retainer	Polyamide				
9b	Chamber top	Polyamide				
9c	Chamber bottom	Polyamide				
13	Impeller with tungsten carbide bearing	Polyamide				
14	Suction inter-connector	Polyamide				
14a	Ring	Stainless steel	1.4301	304	1.4401	316
16	Shaft with coupling	Stainless steel	1.4301	304	1.4401	316
		Sintered steel				
18	Cable guard	Stainless steel	1.4301	304	1.4401	316
18a 18b	Screws for cable guard	Stainless steel	1.4401	316	1.4401	316
30	Cone for pressure equalisation	Polyamide				
32	Guide vanes	Polyamide				
39	Spring	Stainless spring steel	1.4406	316LN	1.4406	316LN
55	Pump sleeve	Stainless steel	1.4301	304	1.4401	316
64	Priming screw	Polyamide				
70	Valve guide	Polyamide				
86	Lip seal ring	NBR rubber				
87	Cone for pressure equalization complete	Polyamide/ NBR rubber				

Material specification (Motor)

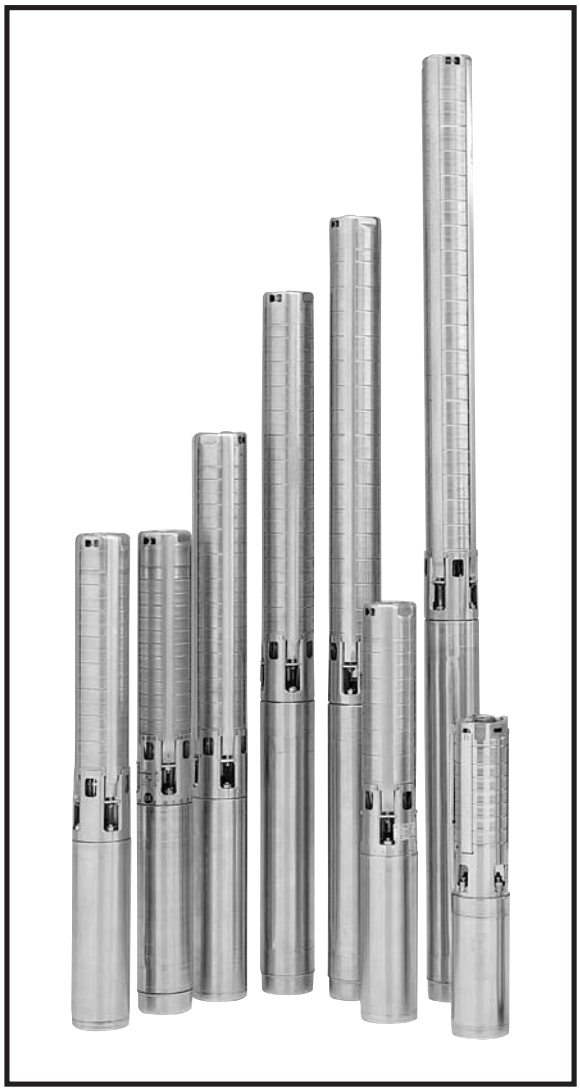
Pos.	Component	Material	DIN W.-Nr. MS 3/ MSE 3	AISI	DIN W.-Nr. MS 3-NE	AISI
201	Stator	Stainless steel	1.4301	304	1.4401	316
202	Rotor	Stainless steel	1.4301	304	1.4401	316
202a	Stop ring	PP				
202b	Filter	Polyester				
203	Thrust bearing	Carbon				
205	Radial bearing	Ceramic/ tungsten carbide				
220	Motor cable with plug	EPR				
222a	Filling plug	MS 3: NBR MSE 3: FKM				
224	O-ring	FKM				
225	Top cover	PPS				
232	Shaft seal	MS 3: NBR MSE 3: FKM				
	Motor liquid	SML-2				

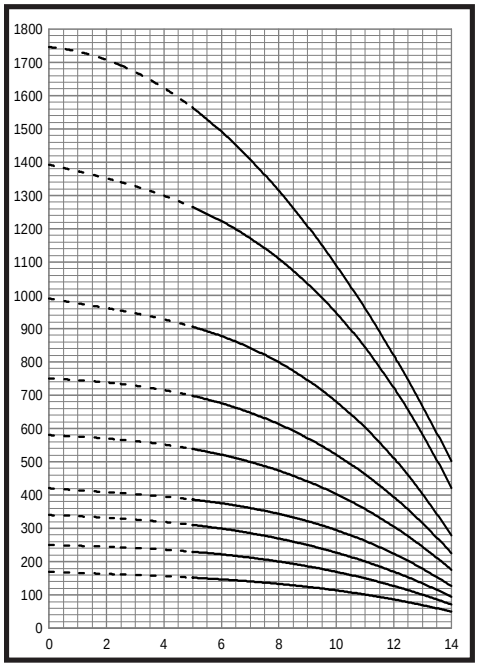


ELECTRIC	
Supply Voltage:	1x200-240V +6%/-10%, 50/60 Hz, PE 1x100-115V +6%/-10%, 50/60 Hz, PE
Operation Via Generator:	As a minimum, the generator output must be equal to the motor P1[kw] + 10%
Starting Current:	The motor starting current is equal to the highest value stated on the motor nameplate
Starting:	Soft Start
Run-up Time:	Maximum: 2-seconds
Motor Protection:	Motor is protected against: Dry running, overvoltage, undervoltage, overload, overtemperature
Power Factor:	PF=1
Motor Cable:	3 Wire, 14AWG XLPE
Motor Liquid:	Type SML 2
pH Values:	SQ and SQE: 5 to 9
Liquid Temperature:	The temperature of the pumped liquid must not exceed 104°F
Note: If liquids with a viscosity higher than that of water are to be pumped, please contact Grundfos	
PIPING CONNECTION	
Discharge Port:	5SQ/SQE - 1” NPT 10-15SQ/SQE - 1-1/4” NPT 22-30SQ/SQE - 1-1/2” NPT
STORAGE CONDITIONS	
Minimum Ambient Temperature:	-4°F
Maximum Ambient Temperature:	+140°F
Frost Protection:	If the pump has to be stored after use, it must be stored at a frost-free location or it must be ensured that the motor liquid is frost proof.
OPERATING CONDITIONS	
Minimum Ambient Fluid Temperature:	+ 34°F
Maximum Ambinet Fluid Temperature:	+140°F
APPROXIMATE DIMENSIONS AND WEIGHT	
Motor Dimensions (MS 3 & MSE 3):	
0.50 [Hp]	20.9” length x 2.68 diameter
0.75 [Hp]	20.9” length x 2.68 diameter
1.0 - 1.5 [Hp]	22.3” length x 2.68 diameter
Motor Weights (MS3 & MSE3)	
0.50 [Hp]	6.0 lbs
0.75 [Hp]	7.1 lbs
1.0 - 1.5 [Hp]	8.2 lbs
Pump End Dimensions:	
Pump Diameter:	2.68
Pump Diameter, incl cable guard	2.91
Pump End Dimensions (min. and max.):	
5SQ/SQE	10.6” to 18.0”
10SQ/SQE	10.6” to 14.8”
15SQ/SQE	10.6” to 16.9”
22SQ/SQE	10.6” to 13.7”
30SQ/SQE	10.6" to 13.7"
Pump End Weights (min. and max.):	
All SQ/SQE Models	2.2 lbs to 3.5 lbs
Well Diameter:	3-inch or larger
Installation Depth (maximum)	500 feet below static water level

Easy Selection Chart
Performance Curves and Technical Data

4-Inch Submersible Pumps





Performance Curves

Materials of Construction

Grundfos Stainless Steel Submersible Pumps

4" Submersible
Easy Selection Charts.

5 GPM

SELECTION CHARTS

FLOW RANGE (1.2 TO 7 GPM)

PUMP OUTLET 1 " NPT

(Ratings are in GALLONS PER MINUTE-GPM)

			DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET																										
PUMP MODEL	**HP**	**PSI**	**20**	**40**	**60**	**80**	**100**	**120**	**140**	**160**	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**340**	**400**	**460**	**520**	**600**	**700**	**800**	**900**	**1000**	**1100**
5S03-9	**1/3**	0				7.1	6.7	6.2	5.8	5.3	4.8	4.3	3.2	2.1													
		20		7.0	6.6	6.1	5.7	5.2	4.6	4.0	2.8	1.6															
		30		6.5	6.0	5.6	5.1	4.6	3.8	2.9	1.5																
		40	6.7	6.0	5.5	5.1	4.4	3.8	2.4																		
		50	6.2	5.5	4.9	4.4	3.4	2.5	1.3																		
		60	5.6	4.9	4.2	3.5	1.9																				
SHUT-OFF PSI:			102	94	85	76	68	59	50	42	33	24	16	7													
5S05-13	**1/2**	0						7.1	6.8	6.4	6.1	5.8	5.5	5.2	4.8	4.5	3.9	2.3									
		20			7.3	7.0	6.7	6.3	6.0	5.7	5.4	5.1	4.7	4.3	3.7	3.1	2.0										
		30		7.2	6.9	6.6	6.3	6.0	5.7	5.4	5.0	4.7	4.2	3.7	2.8	2.0											
		40	7.2	6.9	6.6	6.3	5.9	5.6	5.3	5.0	4.6	4.2	3.5	2.8	1.6												
		50	6.8	6.5	6.2	5.9	5.6	5.3	4.9	4.6	4.0	3.5	2.6	1.6													
		60	6.5	6.2	5.8	5.5	5.2	4.9	4.5	4.0	3.3	2.6	1.3														
SHUT-OFF PSI:			152	143	134	126	117	108	100	91	82	74	65	56	48	39	30	13									
5S07-18	**3/4**	0								7.1	6.9	6.7	6.4	6.2	6.0	5.8	5.6	5.1	4.2	2.7							
		20						7.1	6.8	6.6	6.4	6.2	5.9	5.7	5.5	5.3	5.0	4.5	3.2								
		30					7.0	6.8	6.6	6.3	6.1	5.9	5.7	5.5	5.2	5.0	4.7	4.0	2.5								
		40			7.2	7.0	6.8	6.5	6.3	6.1	5.9	5.6	5.4	5.2	4.9	4.7	4.4	3.5	1.5								
		50		7.2	7.0	6.7	6.5	6.3	6.1	5.8	5.6	5.4	5.1	4.9	4.6	4.3	3.9	2.9									
		60	7.1	6.9	6.7	6.5	6.2	6.0	5.8	5.6	5.3	5.1	4.9	4.6	4.3	3.9	3.4	2.1									
SHUT-OFF PSI:			213	204	195	187	178	169	161	152	143	135	126	117	109	100	91	74	48	22							
5S10-22	**1**	0										7.1	6.9	6.7	6.6	6.4	6.2	5.8	5.3	4.7	3.8	1.7					
		20								7.1	6.9	6.7	6.5	6.3	6.1	6.0	5.8	5.4	4.8	4.0	2.8						
		30							7.0	6.8	6.7	6.5	6.3	6.1	5.9	5.7	5.6	5.2	4.6	3.6	2.1						
		40						7.0	6.8	6.6	6.5	6.3	6.1	5.9	5.7	5.5	5.4	5.0	4.3	3.1	1.3						
		50				7.2	7.0	6.8	6.6	6.4	6.2	6.1	5.9	5.7	5.5	5.3	5.1	4.7	3.9	2.5							
		60			7.1	6.9	6.8	6.6	6.4	6.2	6.0	6.0	5.7	5.5	5.3	5.1	4.9	4.4	3.5	1.7							
SHUT-OFF PSI:					245	237	228	219	211	202	194	185	176	168	159	150	142	124	98	72	46	12					
5S15-26	**1 1/2**	0												7.1	7.0	6.8	6.7	6.4	5.9	5.4	4.9	4.1	2.1				
		20										7.1	6.9	6.8	6.6	6.5	6.3	6.0	5.5	5.1	4.5	3.4					
		30									7.1	6.9	6.7	6.6	6.4	6.3	6.1	5.8	5.4	4.8	4.2	2.9					
		40								7.0	6.9	6.7	6.6	6.4	6.3	6.1	6.0	5.6	5.2	4.6	5.6	2.4					
		50							7.0	6.9	6.7	6.5	6.4	6.2	6.1	5.9	5.8	5.5	5.0	4.4	3.6	1.7					
		60						7.0	6.8	6.7	6.5	6.4	6.2	6.1	5.9	5.8	5.6	5.3	4.8	4.1	3.1						
SHUT-OFF PSI:								269	260	252	243	234	226	217	208	200	191	174	148	122	96	61	18				
5S15-31	**1 1/2**	0														7.1	7.0	6.7	6.3	5.9	5.5	6.7	4.1	2.6			
		20												7.1	6.9	6.8	6.7	6.4	6.0	5.6	5.2	4.6	3.5	1.6			
		30											7.0	6.9	6.8	6.6	6.5	6.2	5.9	5.5	5.1	4.4	3.2	0.9			
		40										7.0	6.9	6.8	6.6	6.5	6.4	6.1	5.7	5.3	4.9	4.2	2.8				
		50								7.1	7.0	6.9	6.7	6.6	6.5	6.3	6.2	6.0	5.6	5.2	4.7	4.0	2.3				
		60							7.1	7.0	6.8	6.7	6.6	6.5	6.3	6.2	6.1	5.8	5.4	5.0	4.5	3.7	1.7				
SHUT-OFF PSI:									320	311	303	294	285	277	268	259	251	233	207	181	155	121	77	34			

See 5S performance curves for higher head models.
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

7S EASY SELECTION CHART

7 GPM

SELECTION CHARTS

(Ratings are in GALLONS PER MINUTE-GPM)

FLOW RANGE
(3 TO 10 GPM)

PUMP OUTLET
1 " NPT

			DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET																									
PUMP MODEL	**HP**	**PSI**	**20**	**40**	**60**	**80**	**100**	**120**	**140**	**160**	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**340**	**400**	**460**	**520**	**600**	**700**	**800**	**900**	**1000**	**1100**
7S03-8	**1/3**	20	10.0	9.5	8.7	8.0	7.2	6.4	5.0	3.7	1.8																
		30	9.3	8.7	7.9	7.1	6.1	5.1	2.6																		
		40	8.5	7.8	7.0	6.1	4.5	2.9	1.5																		
		50	7.6	6.9	5.8	4.7	2.3																				
		60	6.7	5.8	3.9	2.0																					
SHUT-OFF PSI:			86	77	69	60	52	43	34	26	17	8															
7S05-11	**1/2**	0					9.9	9.5	8.9	8.4	7.8	7.3	6.7	6.0	5.0	4.0											
		20			9.8	9.3	8.8	8.2	7.7	7.1	6.5	5.8	4.7	3.5	1.8												
		30	10.1	9.7	9.2	8.7	8.1	7.6	7.0	6.4	5.6	4.7	2.9														
		40	9.6	9.2	8.6	8.1	7.5	6.9	6.2	5.6	4.3	3.0	1.5														
		50	9.1	8.5	8.0	7.4	6.8	6.2	5.3	4.3	2.2																
		60	8.4	7.9	7.3	6.8	6.0	5.3	3.8	2.3																	
SHUT-OFF PSI:			122	113	105	96	87	79	70	61	53	44	35	27	18	10											
7S07-15	**3/4**	0						10.2	9.9	9.5	9.2	8.8	8.4	8.0	7.6	7.1	6.7	5.6	2.9								
		20				10.1	9.8	9.4	9.0	8.6	8.2	7.8	7.4	7.0	6.5	6.1	5.4	3.6									
		30			10.0	9.7	9.4	9.0	8.6	8.2	7.8	7.4	6.9	6.5	5.9	5.4	4.5	1.8									
		40		10.0	9.7	9.3	8.9	8.5	8.1	7.7	7.3	6.9	6.4	5.9	5.2	4.5	3.2	1.0									
		50	9.9	9.6	9.2	8.9	8.5	8.1	7.6	7.2	6.8	6.4	5.8	5.2	4.2	3.2	1.6										
		60	9.5	9.2	8.8	8.4	8.0	7.6	7.2	6.7	6.2	5.7	4.9	4.2	2.8	1.4											
SHUT-OFF PSI:			170	101	153	144	135	127	118	110	101	92	84	75	66	58	49	32	6								
7S10-19	**1**	0								10.1	9.8	9.6	9.3	9.0	8.7	8.4	8.0	7.4	6.4	4.8							
		20						10.0	9.8	9.5	9.2	8.9	8.6	8.3	7.9	7.6	7.3	6.6	5.3	2.8							
		30					10.0	9.7	9.5	9.2	8.9	8.5	8.2	7.9	7.6	7.3	6.9	6.2	4.6	1.4							
		40				10.0	9.7	9.4	9.1	8.8	8.5	8.2	7.8	7.5	7.2	6.9	6.5	5.6	3.7								
		50		10.2	9.9	9.7	9.4	9.1	8.8	8.4	8.1	7.8	7.5	7.2	6.8	6.5	6.0	5.0	2.4								
		60	10.1	9.9	9.6	9.3	9.0	8.7	8.4	8.1	7.8	7.4	7.1	6.8	6.4	6.0	5.5	4.2									
SHUT-OFF PSI:			218	209	200	192	183	174	166	157	148	140	131	123	114	105	97	79	53	27							
7S15-26	**1 1/2**	0											10.1	9.9	9.7	9.5	9.3	8.8	8.1	7.4	6.7	5.5					
		20									10.0	9.8	9.6	9.4	9.2	9.0	8.8	8.3	7.6	6.9	6.1	4.4					
		30								10.0	9.8	9.6	9.4	9.2	9.0	8.7	8.5	8.0	7.3	6.6	5.7	3.7					
		40						10.1	10.0	9.8	9.6	9.4	9.1	8.9	8.7	8.5	8.2	7.8	7.1	6.3	5.2	2.9					
		50					10.1	9.9	9.7	9.6	9.3	9.1	8.9	8.7	8.4	8.2	8.0	7.5	6.8	5.9	4.7	1.9					
		60				10.1	9.9	9.7	9.5	9.3	9.1	8.9	8.6	8.4	8.2	7.9	7.7	7.2	6.5	5.5	4.1						
SHUT-OFF PSI:						274	265	257	248	239	231	222	213	205	196	187	179	161	135	110	84	49					
7S20-32	**2**	0	0										10.6	10.5	10.4	10.4	10.3	10.1	9.6	9.1	8.4	7.3	5.7				
		20	46.2								10.5	10.5	10.4	10.3	10.3	10.2	10.0	9.8	9.2	8.6	7.8	6.6	4.8				
		30	69.3							10.5	10.5	10.4	10.3	10.2	10.1	10.0	9.9	9.6	9.0	8.3	7.5	6.2	4.3				
		40	92.4						10.5	10.5	10.4	10.3	10.2	10.1	10.0	9.9	9.7	9.4	8.8	8.0	7.2	5.8	3.9				
		50	116						10.5	10.4	10.3	10.2	10.1	10.0	9.8	9.7	9.5	9.1	8.5	7.7	6.8	5.4	3.3				
		60	139					10.5	10.4	10.3	10.2	10.1	10.0	9.8	9.7	9.5	9.3	8.9	8.2	7.4	6.4	5.0					
SHUT-OFF PSI:							343	334	326	317	308	300	291	282	274	265	256	239	213	187	161	126	83				

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

10 GPM

SELECTION CHARTS

FLOW RANGE (5 TO 14 GPM)

PUMP OUTLET 1 1/4" NPT

(Ratings are in GALLONS PER MINUTE-GPM)

			DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET																									
PUMP MODEL	**HP**	**PSI**	**20**	**40**	**60**	**80**	**100**	**120**	**140**	**160**	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**340**	**400**	**460**	**520**	**600**	**700**	**800**	**900**	**1000**	**1100**
10S03-6	**1/3**	20	14.0	13.2	12.4	10.6	8.9	5.3																			
		30	13.2	11.8	10.4	8.4																					
		40	11.9	10.1	8.3																						
		50	9.8	7.5																							
		60	7.7	3.9																							
SHUT-OFF PSI:			64	55	47	38	29	21	12	3																	
10S05-9	**1/2**	0				14.1	13.4	12.4	11.4	10.4	9.5	8.3	6.6	3.5													
		20		13.9	13.1	12.1	11.1	10.1	9.2	7.9	5.8	2.0															
		30	13.8	13.0	12.0	11.0	10.0	9.0	7.6	5.3	1.2																
		40	12.8	11.8	10.8	9.8	8.8	7.3	4.8																		
		50	11.7	10.7	9.7	8.6	7.0	4.3																			
		60	10.5	9.5	8.4	6.7	3.7																				
SHUT-OFF PSI:			100	92	83	74	66	57	48	40	31	23	14	5													
10S07-12	**3/4**	0					14.3	13.8	13.2	12.5	11.7	11.0	10.2	9.5	8.7	7.6	6.0										
		20			14.2	13.6	12.9	12.2	11.5	10.7	10.0	9.3	8.4	7.2	5.4	2.6											
		30		14.1	13.5	12.9	12.1	11.4	10.6	9.9	9.2	8.2	7.0	5.0	2.0												
		40	14.0	13.4	12.8	12.0	11.3	10.5	9.8	9.0	8.1	6.7	4.7	1.4													
		50	13.3	12.6	11.9	11.1	10.4	9.7	8.9	7.9	6.5	4.2															
		60	12.5	11.8	11.0	10.3	9.6	8.8	7.7	6.2	3.8																
SHUT-OFF PSI:			137	129	120	111	103	94	85	77	68	59	51	42	33	25	16										
10S10-15	**1**	0							14.1	13.6	13.1	12.5	11.9	11.3	10.7	10.1	9.6	8.2	3.8								
		20					13.9	13.5	12.9	12.3	11.7	11.1	10.5	10.0	9.4	8.7	7.9	5.2									
		30				13.9	13.4	12.8	12.2	11.6	11.0	10.5	9.9	9.3	8.6	7.7	6.6	2.6									
		40		14.2	13.8	13.3	12.7	12.1	11.5	10.9	10.4	9.8	9.2	8.5	7.6	6.3	4.6										
		50	14.1	13.7	13.2	12.6	12.1	11.4	10.9	10.3	9.7	9.1	8.3	7.4	6.1	4.3	1.7										
		60	13.6	13.1	12.6	12.0	11.4	10.8	10.2	9.6	9.0	8.2	7.2	5.9	3.9												
SHUT-OFF PSI:			174	165	157	148	139	131	122	113	105	96	87	79	70	61	53	35	10								
10S15-21	**1 1/2**	0									14.2	13.9	13.6	13.3	12.9	12.5	12.0	11.2	9.9	8.5	6.3						
		20							14.1	13.9	13.5	13.1	12.7	12.3	11.9	11.5	11.0	10.2	8.9	6.9	2.9						
		30						14.1	13.8	13.5	13.1	12.7	12.3	11.8	11.4	11.0	10.5	9.7	8.3	5.7							
		40					14.1	13.8	13.4	13.0	12.6	12.2	11.8	11.3	10.9	10.5	10.1	9.2	7.5	4.1							
		50				14.0	13.7	13.3	13.0	12.5	12.1	11.7	11.3	10.8	10.4	10.0	9.6	8.7	6.5	2.0							
		60		14.2	14.0	13.6	13.3	12.9	12.5	12.1	11.6	11.2	10.8	10.4	9.9	9.5	9.1	8.0	5.1								
SHUT-OFF PSI:				237	229	220	211	203	194	185	177	168	159	151	142	133	125	107	81	55	29						
10S20-27	**2**	0												14.1	13.9	13.7	13.4	12.8	11.8	10.8	9.8	8.3	4.7				
		20										14.1	13.8	13.6	13.3	13.0	12.7	12.0	11.0	10.0	9.0	7.1	1.5				
		30									14.0	13.8	13.5	13.3	12.9	12.6	12.3	11.6	10.6	9.7	8.6	6.2					
		40							14.2	14.0	13.8	13.5	13.2	12.9	12.6	12.2	11.9	11.2	10.3	9.3	8.1	5.2					
		50						14.2	14.0	13.7	13.5	13.2	12.8	12.5	12.2	11.9	11.5	10.9	9.9	8.9	7.4	3.8					
		60					14.1	13.9	13.7	13.4	13.1	12.8	12.5	12.1	11.8	11.5	11.1	10.5	9.5	8.4	6.6	2.1					
SHUT-OFF PSI:							285	276	268	259	250	242	233	224	216	207	198	181	155	129	103	68	25				
10S30-34	**3**	0																13.8	13.2	12.5	11.9	10.9	9.6	7.9	4.8		
		20														13.9	13.7	13.3	12.7	12.0	11.3	10.3	8.9	6.7	2.7		
		30													13.9	13.7	13.5	13.1	12.4	11.7	11.0	10.0	8.5	6.0	1.3		
		40											14.0	13.8	13.7	13.5	13.3	12.8	12.2	11.5	10.8	9.7	8.0	5.1			
		50										14.0	13.8	13.6	13.4	13.2	13.0	12.6	11.9	11.2	10.5	9.4	7.5	4.2			
		60										13.8	13.6	13.4	13.2	13.0	12.8	12.3	11.6	10.9	10.2	9.0	6.9	3.1			
SHUT-OFF PSI:												332	324	315	306	298	289	272	246	220	194	159	116	73	29		

See 10S performance curves for higher head models.
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

16S EASY SELECTION CHART

16 GPM

SELECTION CHARTS

(Ratings are in GALLONS PER MINUTE-GPM)

FLOW RANGE
(10 TO 20 GPM)

PUMP OUTLET
1 1/4 " NPT

DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET

PUMP MODEL	HP	PSI	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100
16S05-5	1/2	20	20.3	18.2	14.1	10.0	5.0																				
		30	17.3	14.4	8.0	1.6																					
		40	12.7	8.0	4.0																						
		50	6.5																								
		60	2.9																								
SHUT-OFF PSI:			58	49	40	32	23	14																			
16S07-8	3/4	0					20.5	19.2	17.5	15.8	12.8	9.8	5.2														
		20			20.1	18.8	16.9	15.2	11.8	8.5	4.3																
		30	21.2	19.9	18.4	16.9	14.3	11.8	7.5	3.2	1.6																
		40	19.7	18.3	16.3	14.3	10.8	7.2	3.6																		
		50	17.9	16.3	13.5	10.7	6.2	1.7																			
		60	15.7	13.5	9.6	5.8	2.9																				
SHUT-OFF PSI:			97	88	80	71	62	54	45	36	28	19	10														
16S10-10	1	0						20.8	19.8	18.8	17.3	15.9	13.7	11.4	8.0	4.7											
		20				20.5	19.4	18.3	16.8	15.3	12.9	10.5	7.0	3.5	1.8												
		30			20.3	19.3	18.1	16.8	14.8	12.8	9.8	6.7	3.3														
		40		20.2	19.1	18.0	16.4	14.8	12.2	9.6	5.9	2.3															
		50	20.0	19.0	17.7	16.3	14.2	12.0	8.8	5.6	2.8																
		60	18.8	17.6	15.8	14.1	11.3	8.6	4.8																		
SHUT-OFF PSI:			123	115	106	97	89	80	71	63	54	45	37	28	19	11											
16S15-14	1 1/2	0								21.0	20.3	19.6	18.8	18.0	16.9	15.8	14.3	10.7	3.3								
		20							20.1	19.3	18.5	17.7	16.6	15.4	13.8	12.2	10.0	5.1									
		30					20.7	20.0	19.2	18.4	17.4	16.5	15.1	13.7	11.8	9.8	7.3	2.4									
		40				20.6	19.8	19.1	18.3	17.4	16.0	15.0	13.3	11.6	9.3	7.0	4.3										
		50			20.4	19.8	18.9	18.2	17.2	16.1	14.7	13.2	11.2	9.1	6.5	3.9	2.0										
		60		20.3	19.6	18.8	18.0	17.1	15.8	14.5	12.8	11.0	8.6	6.3	3.4												
SHUT-OFF PSI:				167	158	149	141	132	123	115	106	97	89	80	71	63	54	37	28								
16S20-18	2	0										21.2	20.6	20.0	19.5	18.9	18.2	16.7	13.5	8.8	2.7						
		20									20.4	19.8	19.3	18.7	18.0	17.3	16.4	14.3	10.0	4.2							
		30								20.3	19.8	19.2	18.6	17.9	17.2	16.3	15.3	12.8	7.9	1.9							
		40							20.3	19.7	19.1	18.5	17.8	17.1	16.1	15.2	13.9	11.1	5.7								
		50						20.2	19.6	19.0	18.3	17.7	16.8	16.0	14.9	13.8	12.3	9.2	3.2								
		60					20.1	19.5	18.9	18.3	17.5	16.8	15.8	14.8	13.5	12.3	10.6	7.0									
SHUT-OFF PSI:							194	186	177	168	160	151	142	134	125	116	108	90	65	39	13						
16S30-24	3	0																19.6	18.3	16.5	14.2	9.8	2.1				
		20													20.3	19.9	19.5	18.6	17.0	14.8	11.8	6.5					
		30												20.3	19.8	19.4	19.0	18.0	16.3	13.7	10.4	4.7					
		40											20.2	19.8	19.3	18.9	18.4	17.3	15.3	12.5	8.9	2.8					
		50										20.2	19.8	19.3	18.8	18.3	17.8	16.7	14.3	11.3	7.3						
		60									20.1	19.7	19.2	18.8	18.3	17.8	17.2	15.8	13.3	9.8	5.5						
SHUT-OFF PSI:											239	230	221	213	204	195	187	169	143	117	91	57	13				
16S50-38	5	0																			21.5	20.4	18.7	16.5	13.4	8.9	2.1
		20																			20.9	19.6	17.7	15.2	11.5	6.1	
		30																		21.4	20.5	19.2	17.2	14.5	10.5	4.5	
		40																		21.1	20.2	18.8	16.7	13.7	9.3	2.7	
		50																	21.6	20.7	19.8	18.4	16.1	12.8	8.0	0.8	
		60																	21.3	20.4	19.4	17.9	15.4	11.9	6.6		
SHUT-OFF PSI:																			314	288	262	227	184	141	98	54	11

See 16S performance curves for higher head models.
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

25 GPM

SELECTION CHARTS

FLOW RANGE (18 TO 32 GPM)

PUMP OUTLET 1 1/2" NPT

(Ratings are in GALLONS PER MINUTE-GPM)

			DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET																										
PUMP MODEL	**HP**	**PSI**	**20**	**40**	**60**	**80**	**100**	**120**	**140**	**160**	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**340**	**400**	**460**	**520**	**600**	**700**	**800**	**900**	**1000**	**1100**
25S05-3	**1/2**	20	18.6	6.5	3.3																						
		30	10.5																								
		40																									
		50																									
		60																									
SHUT-OFF PSI:			31	22	13	5																					
25S07-5	**3/4**	0			34.5	29.8	23.9	18.1																			
		20	32.9	28.6	21.8	15.1	7.5																				
		30	27.1	22.5	12.3	2.0																					
		40	19.5	11.8	5.8																						
		50	10.1																								
		60	4.1																								
SHUT-OFF PSI:			57	48	39	31	22	13																			
25S10-7	**1**	0					31.3	28.5	24.3	20.2	12.7	5.1															
		20		33.2	30.3	27.6	22.9	18.3	10.4	2.5	1.3																
		30	33.0	29.9	26.5	23.1	13.0	9.6	4.8																		
		40	29.4	26.6	21.3	16.2	8.2																				
		50	25.3	21.5	14.3	7.0	3.5																				
		60	19.7	13.9	7.0																						
SHUT-OFF PSI:			83	74	65	57	48	39	31	22	13	5															
25S15-9	**1 1/2**	0						32.2	30.0	27.9	24.8	21.6	16.3	10.8													
		20				31.5	29.3	27.2	23.7	20.3	14.5	8.8	4.4														
		30			31.3	29.1	26.4	23.7	18.9	14.2	7.8	1.5															
		40		30.8	28.6	26.3	22.6	18.8	12.8	6.8	3.4																
		50	30.6	28.4	25.5	22.5	17.4	12.3	6.2																		
		60	27.8	25.5	21.3	17.2	11.0	4.8	2.4																		
SHUT-OFF PSI:			109	100	91	83	74	65	57	48	39	31	22	13													
25S20-11	**2**	0						33.1	31.1	29.3	27.6	25.1	22.5	18.5	14.5	9.3											
		20					32.5	30.6	28.8	27.0	24.3	21.5	17.3	13.0	7.8	2.5											
		30				32.0	30.3	28.7	26.4	24.2	20.6	16.9	12.0	7.0	3.5												
		40			31.8	30.1	28.2	26.3	23.3	20.4	15.9	11.4	6.3														
		50		31.5	29.8	28.1	25.7	23.3	19.4	15.6	10.4	5.3	2.7														
		60	31.3	29.6	27.6	25.6	22.4	19.3	14.5	9.8	4.9																
SHUT-OFF PSI:			135	126	118	109	100	92	83	74	66	57	48	40	31	23											
25S30-15	**3**	0										32.3	31.0	29.8	28.4	27.1	25.2	20.7									
		20								31.8	30.6	29.3	28.0	26.6	24.6	22.7	19.8	13.5									
		30						33.0	31.7	30.4	29.2	27.8	26.2	24.5	22.1	19.7	16.4	9.3									
		40					32.8	31.5	30.3	29.0	27.5	26.0	24.0	21.9	19.0	16.1	12.4	4.9									
		50				32.6	31.3	30.0	28.7	27.4	25.7	23.8	21.3	18.8	15.3	12.0	8.2	2.2									
		60			32.4	31.1	29.8	28.6	27.0	25.5	23.3	21.2	18.1	15.0	11.3	7.6	3.8										
SHUT-OFF PSI:					170	161	152	144	135	126	118	109	100	92	83	74	66	48									
25S50-26	**5**	0																32.5	30.3	28.0	25.3	19.9	10.2				
		20															32.3	30.8	28.6	25.9	22.5	15.8	5.0				
		30														32.1	31.3	29.9	27.7	24.7	20.8	13.5	2.5				
		40													32.0	31.3	30.5	29.1	26.7	23.3	18.9	11.0					
		50											32.7	31.8	31.2	30.4	29.7	28.2	25.5	21.8	16.8	8.5					
		60										32.5	31.8	31.0	30.3	29.6	28.8	27.3	24.3	20.0	14.6	5.8					
SHUT-OFF PSI:												253	245	236	227	219	210	193	167	141	115	80	37				

See 25S performance curves for higher head models.
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

40S EASY SELECTION CHART

40 GPM

SELECTION CHARTS

FLOW RANGE

(24 TO 55 GPM)

PUMP OUTLET
2 " NPT

(Ratings are in GALLONS PER MINUTE-GPM)

PUMP MODEL	HP	PSI		DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET																									
				20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100
40S10-3	1	20	46.2	33.0																								
		30	69.3																									
		40	92.4																									
		50	116																									
		60	139																									
SHUT-OFF PSI:		0		28	19	11	2																					
40S15-5	1 1/2	0	0				52.0	41.0	24.0																			
		20	46.2	57.0	50.0	37.0	18.0																					
		30	69.3	48.0	34.0	15.0																						
		40	92.4	31.0	11.0																							
		50	116	7.0																								
		60	139																									
SHUT-OFF PSI:		0		52	44	35	26	18	9																			
40S20-7	2	0	0					54.0	49.0	40.0	29.0	15.0																
		20	46.2			53.0	46.0	37.0	25.0	10.0																		
		30	69.3		52.0	45.0	35.0	23.0	8.0																			
		40	92.4	51.0	44.0	33.0	21.0	5.0																				
		50	116	42.0	32.0	18.0	2.0																					
		60	139	30.0	16.0																							
SHUT-OFF PSI:		0		77	68	59	51	42	33	25	16	7																
40S30-9	3	0	0							53.0	47.0	41.0	32.0	22.0														
		20	46.2					51.0	45.0	38.0	29.0	19.0																
		30	69.3				50.0	44.0	37.0	28.0	17.0																	
		40	92.4		54.0	50.0	43.0	35.0	26.0	15.0																		
		50	116	54.0	49.0	42.0	34.0	24.0	13.0																			
		60	139	48.0	41.0	33.0	23.0	11.0																				
SHUT-OFF PSI:		0		102	94	85	76	68	59	50	42	33	24	16	7													
40S50-12	5	0	0									53.0	49.0	44.0	39.0	32.0	25.0	16.0										
		20	46.2							52.0	48.0	43.0	37.0	30.0	22.0	13.0												
		30	69.3						51.0	47.0	42.0	36.0	29.0	21.0	12.0													
		40	92.4					51.0	46.0	41.0	35.0	28.0	20.0	11.0														
		50	116			54.0	50.0	45.0	40.0	34.0	26.0	18.0	9.0															
		60	139		53.0	49.0	45.0	39.0	33.0	25.0	17.0	8.0																
SHUT-OFF PSI:		0			130	122	113	104	96	87	78	70	61	52	44	35	26	18										
40S50-15	5	0	0											52.0	49.0	46.0	42.0	37.0	26.0									
		20	46.2									51.0	48.0	45.0	40.0	35.0	30.0	24.0										
		30	69.3								51.0	48.0	44.0	40.0	35.0	29.0	23.0	16.0										
		40	92.4							51.0	47.0	43.0	39.0	34.0	28.0	21.0	14.0											
		50	116						50.0	47.0	43.0	38.0	33.0	27.0	20.0	13.0												
		60	139					50.0	46.0	42.0	37.0	32.0	26.0	19.0	12.0													
SHUT-OFF PSI:		0						141	132	124	115	107	98	89	81	72	63	55	37	11								
40S75-21	7 1/2	0	0																49.0	41.0	29.0	15.0						
		20	46.2													53.0	51.0	48.0	43.0	32.0	19.0							
		30	69.3												52.0	50.0	48.0	45.0	39.0	27.0	13.0							
		40	92.4											52.0	50.0	48.0	45.0	42.0	35.0	22.0	6.0							
		50	116										52.0	50.0	47.0	44.0	41.0	38.0	30.0	16.0								
		60	139									51.0	49.0	47.0	44.0	41.0	38.0	34.0	25.0	10.0								
SHUT-OFF PSI:		0										181	172	163	155	146	137	129	111	85	59	33						
40S75-25	7 1/2	0	0																	51.0	45.0	37.0	23.0					
		20	46.2																52.0	47.0	39.0	29.0	14.0					
		30	69.3															54.0	50.0	44.0	35.0	25.0						
		40	92.4														54.0	52.0	48.0	41.0	32.0	21.0						
		50	116													53.0	52.0	50.0	45.0	38.0	28.0							
		60	139												53.0	51.0	49.0	47.0	43.0	34.0	24.0							
SHUT-OFF PSI:		0													203	194	186	177	160	134	108	82	47					
*40S100-30 40S100-30	10	0	0																		53.0	49.0	41.0	27.0				
		20	46.2																	54.0	50.0	44.0	35.0	20.0				
		30	69.3																	52.0	48.0	42.0	32.0	16.0				
		40	92.4																	51.0	46.0	39.0	28.0	12.0				
		50	116																	49.0	43.0	36.0	25.0	8.0				
		60	139																52.0	47.0	41.0	33.0	21.0					
SHUT-OFF PSI:																			222	196	170	144	110	66	23			

*** 6" Motor**

See 40S performance curves for higher head models.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

60 GPM

SELECTION CHARTS

(Ratings are in GALLONS PER MINUTE-GPM)

FLOW RANGE
(40 TO 75 GPM)

PUMP OUTLET
2 " NPT

DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET

PUMP MODEL	HP	PSI	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100
60S20-4	2	20	72.3	64.5	38.6	12.7	6.3																				
		30	58.6	44.9	22.4																						
		40	30.4																								
		50	17.9																								
		60																									
SHUT-OFF PSI:			46	37	29	20	11	3																			
60S30-5	3	0				74.8	66.8	58.8	34.3																		
		20	77.8	72.9	63.8	54.8	27.4																				
		30	76.0	64.3	47.3	30.0	15.0																				
		40	60.4	49.9	25.0																						
		50	40.4	19.4	9.8																						
		60	22.0																								
SHUT-OFF PSI:			60	51	42	34	25	16	8																		
60S50-7	5	0					77.5	73.8	68.4	63.1	52.2	41.3															
		20			76.3	72.4	66.6	61.1	48.3	35.8	17.9																
		30		76.0	71.3	66.5	57.8	49.2	24.6																		
		40	75.1	71.0	64.6	58.2	43.8	29.4	14.8																		
		50	69.7	64.6	54.8	44.9	22.5																				
		60	62.3	55.3	38.7	22.0	11.0																				
SHUT-OFF PSI:			88	80	71	62	54	45	36	28	19	10															
60S50-9	5	0							74.8	71.7	67.3	63.0	55.6	48.2	32.8	17.3											
		20					73.8	70.5	65.9	61.3	53.0	44.8	27.5	10.2	5.1												
		30			76.5	73.5	69.6	65.7	59.4	53.2	40.7	28.1	14.0														
		40		76.2	72.8	69.3	64.3	59.4	50.3	41.0	20.5																
		50	75.5	72.5	68.3	64.2	57.3	50.4	36.3	22.2	11.1																
		60	71.7	68.1	62.7	57.3	47.1	36.8	18.4																		
SHUT-OFF PSI:			115	106	98	89	81	72	63	55	46	37	29	20	11	3											
*60S75-13	7 1/2	0									77.3	75.4	73.1	70.7	67.8	64.8	60.7	50.0	21.5								
		20							76.8	74.8	72.3	69.9	66.8	63.8	59.3	55.0	47.9	28.9									
		30						76.6	74.3	72.1	69.3	66.6	62.8	59.2	53.3	47.7	38.2	14.3									
		40					76.2	74.1	71.6	69.1	65.8	62.7	57.9	53.3	45.6	37.9	25.0	6.0									
		50				75.9	73.6	71.3	68.4	65.6	61.7	57.7	51.6	45.4	35.0	24.7	12.3										
		60			75.5	73.3	70.8	68.2	64.8	61.4	56.3	51.3	43.1	34.8	20.8	6.8											
SHUT-OFF PSI:					152	143	134	126	117	108	100	91	82	74	65	56	48	30	4								
*60S100-18	10	0													76.5	75.0	73.3	69.8	63.1	52.6	35.8						
		20											76.1	74.6	72.8	71.2	69.2	64.7	55.8	40.0	14.2						
		30										75.9	74.3	72.7	70.8	68.9	66.7	61.6	50.9	31.5							
		40									75.7	74.1	72.3	70.6	68.5	66.5	63.9	58.0	45.0	20.7							
		50								75.4	73.8	72.1	70.2	68.3	66.0	63.7	60.7	53.6	37.5	10.0							
		60							75.2	73.6	71.8	70.0	67.8	65.8	63.1	60.5	56.8	48.2	28.3								
SHUT-OFF PSI:									186	177	169	160	152	143	134	126	117	100	74	46	22						

*** 6" Motor**

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

75S EASY SELECTION CHART

75 GPM

SELECTION CHARTS
(Ratings are in GALLONS PER MINUTE-GPM)

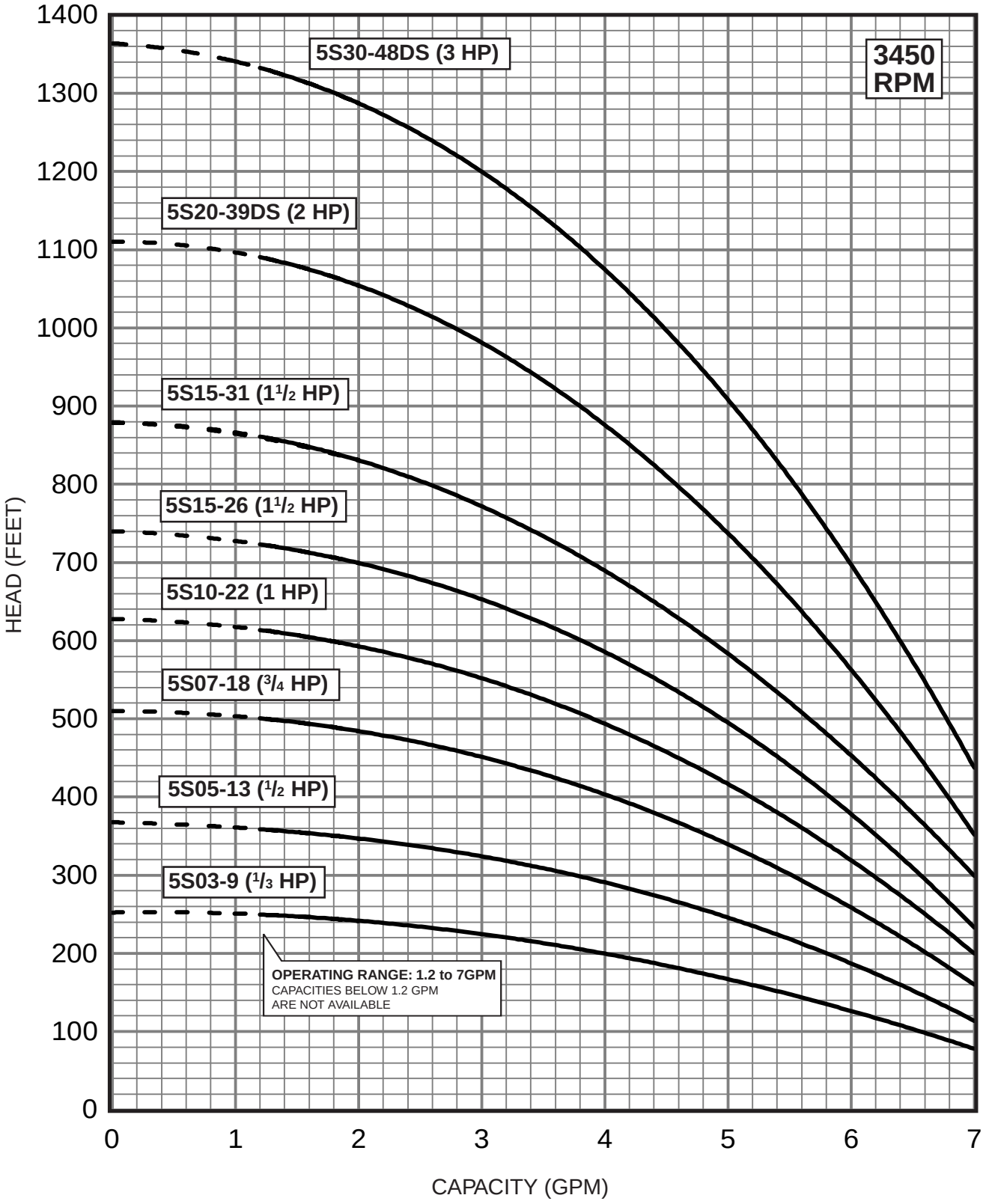
FLOW RANGE
(45 TO 95 GPM)

PUMP OUTLET
2" NPT

			DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET																									
PUMP MODEL	**HP**	**PSI**	**20**	**40**	**60**	**80**	**100**	**120**	**140**	**160**	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**340**	**400**	**460**	**520**	**600**	**700**	**800**	**900**	**1000**	**1100**
75S20-3	**2**	20	69.6	45.8	22.9																						
		30	36.2																								
		40	12.4																								
		50																									
		60																									
SHUT-OFF PSI:			32	23	14	6																					
75S30-5	**3**	0			89.8	90.2	78.8	67.6																			
		20	96.3	86.8	74.8	62.9	31.5																				
		30	85.8	74.2	51.8	29.5	14.8																				
		40	70.2	57.1	28.6																						
		50	35.3																								
		60	24.2																								
SHUT-OFF PSI:			58	49	41	32	23	15																			
75S50-8	**5**	0						93.3	86.5	79.6	72.0	64.5	46.9	29.4													
		20			97.4	91.3	84.7	77.5	69.4	61.3	40.3	19.4	9.8														
		30		96.9	90.1	83.3	76.3	69.3	56.3	43.1	21.6																
		40	95.5	89.1	82.3	75.4	66.5	57.5	28.8																		
		50	88.0	81.2	73.9	66.7	51.2	35.8	17.9																		
		60	80.2	73.3	63.2	53.0	26.5																				
SHUT-OFF PSI:			98	90	81	72	64	55	46	38	29	20	12	3													
***75S75-11**	**7 1/2**	0								97.8	93.3	88.8	84.3	79.8	75.1	70.4	63.7	43.4									
		20						96.5	92.0	87.4	82.9	78.3	73.5	68.8	61.4	54.0	38.8	11.8									
		30					95.7	91.3	86.8	82.2	77.6	73.1	67.3	61.4	50.3	39.3	19.7										
		40				95.2	90.6	86.0	81.5	77.0	72.0	67.0	58.9	50.8	33.5	16.3	8.2										
		50			94.3	89.9	85.3	80.8	76.2	71.6	65.3	59.0	46.6	34.2	17.1												
		60	97.9	93.8	89.2	84.6	80.1	75.6	70.3	65.2	56.1	47.0	23.5														
SHUT-OFF PSI:			151	142	133	125	116	107	99	90	81	73	64	55	47	38	29	12									
***75S100-15**	**10**	0											96.7	93.4	90.0	86.5	83.2	76.3	64.7	40.9							
		20									95.7	92.4	88.9	85.5	82.1	78.7	75.2	67.4	49.3	12.5							
		30								95.3	91.8	88.4	85.0	81.5	78.2	74.8	70.9	61.6	37.1								
		40						98.0	94.7	91.3	87.8	84.4	81.0	77.7	74.1	70.6	66.0	54.0	19.9								
		50					97.3	94.3	90.8	87.3	83.9	80.5	77.1	73.7	69.7	65.8	59.8	43.5									
		60				97.0	93.7	90.3	86.8	83.3	80.0	76.6	73.0	69.3	64.5	59.6	51.5	21.7									
SHUT-OFF PSI:						178	170	161	152	144	135	126	118	109	100	92	83	66	40	14							

*** 6" Motor** Performance is the same at Best Efficiency Point only, consult factory for actual performance.
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

FLOW RANGE: 1.2 - 7 GPM **OUTLET SIZE: 1" NPT** **NOMINAL DIA. 4"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 3450 RPM.

Performance conforms to ISO 9906. 1999 (E) Annex A
Minimum submergance is 2 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
5S03-9	A	1/3	4"	1" NPT	22.3	8.8	13.5	3.8	3.9	27
5S05-13	A	1/2	4"	1" NPT	26.4	9.5	16.9	3.8	3.9	31
5S07-18	A	3/4	4"	1" NPT	31.7	10.7	21.0	3.8	3.9	34
5S10-22	A	1	4"	1" NPT	36.1	11.8	24.3	3.8	3.9	42
5S15-26	A	1 1/2	4"	1" NPT	41.2	13.6	27.6	3.8	3.9	46
5S15-31	A	1 1/2	4"	1" NPT	47.1	13.6	33.5	3.8	3.9	58
5S20-39DS	A	2	4"	1" NPT	55.2	15.1	40.1	3.8	3.9	65
5S30-48DS	A	3	4"	1" NPT	70.0	20.6	45.8	3.8	3.9	90

NOTES: All models suitable for use in 4" wells.
Weights include pump end with motor in lbs.

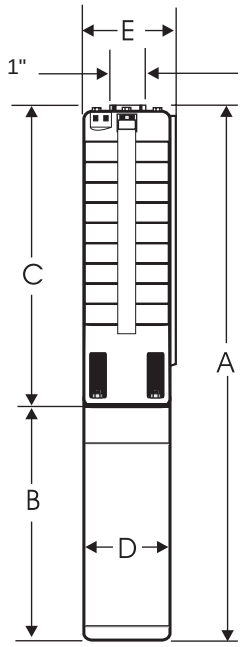


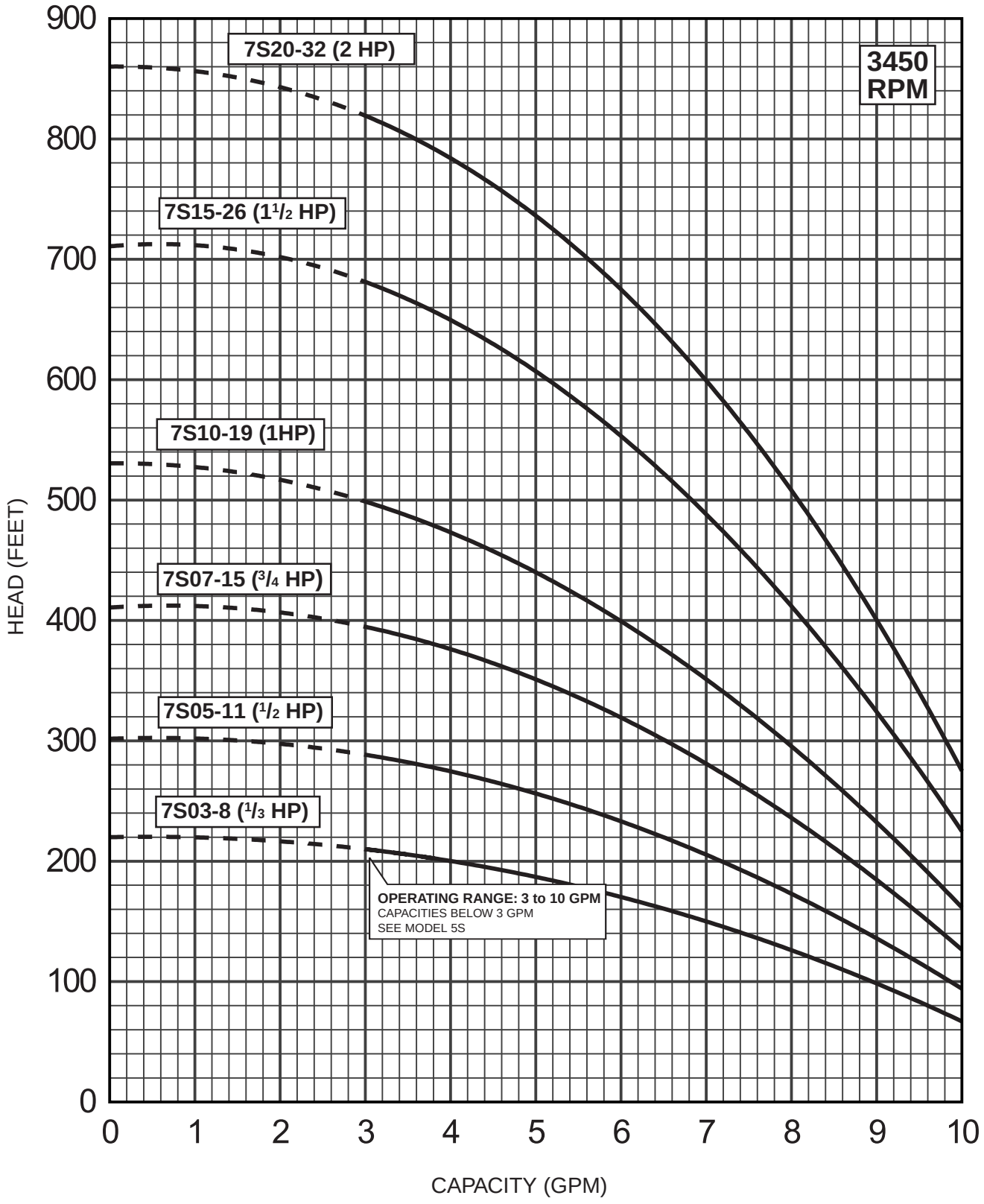
Fig. A

MATERIALS OF CONSTRUCTION

COMPONENT	SPLINED SHAFT (9-26 Stgs.)	CYLINDRICAL SHAFT (31-48 Stgs.)
Check Valve Housing	304 Stainless Steel	304 Stainless Steel
Check Valve	304 Stainless Steel	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel	304 Stainless Steel
Impeller	304 Stainless Steel	304 Stainless Steel
Suction Interconnector	304 Stainless Steel	304 Stainless Steel
Inlet Screen	304 Stainless Steel	304 Stainless Steel
Pump Shaft	304 Stainless Steel	431 Stainless Steel
Straps	304 Stainless Steel	304 Stainless Steel
Cable Guard	304 Stainless Steel	304 Stainless Steel
Priming Inducer	304 Stainless Steel	316 Stainless Steel
Coupling	329/420/431 Stainless Steel	329/420/431 Stainless Steel
Check Valve Seat	NBR/304 Stainless Steel	NBR/316 Stainless Steel
Top Bearing	NBR/304 Stainless Steel	NBR/316 Stainless Steel
Impeller Seal Ring	NBR/PBT (Valox®)	NBR/PPS (Ryton®)
Intermediate Bearings	NBR	304 Stainless Steel
Shaft Washer	Not Required	LCP (Vectra®)
Split Cone	Not Required	304 Stainless Steel
Split Cone Nut	Not Required	316 Stainless Steel

NOTES: Specifications subject to change without notice.
Valox® is a registered trademark of General Electric Co.
Vectra® is a registered trademark of Hoechast Calanese Corporation.
Ryton® is a registered trademark of Phillips 66.

FLOW RANGE: 3 -10 GPM **OUTLET SIZE: 1" NPT** **NOMINAL DIA. 4"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 3450 RPM.

Performance conforms to ISO 9906. 1999 (E) Annex A
Minimum submergance is 2 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
7S03-8	A	1/3	4"	1" NPT	21.5	8.8	12.7	3.8	3.9	27
7S05-11	A	1/2	4"	1" NPT	24.7	9.5	15.2	3.8	3.9	30
7S07-15	A	3/4	4"	1" NPT	29.2	10.7	18.5	3.8	3.9	33
7S10-19	A	1	4"	1" NPT	33.6	11.8	21.8	3.8	3.9	36
7S15-26	A	1 1/2	4"	1" NPT	41.2	13.6	27.6	3.8	3.9	46
7S20-32	A	2	4"	1" NPT	48.5	14.0	34.5	3.8	3.9	59

NOTES: All models suitable for use in 4" wells.
Weights include pump end with motor in lbs.

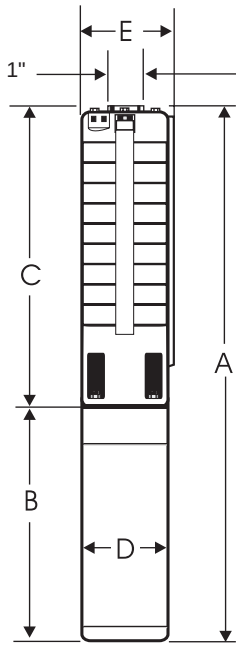


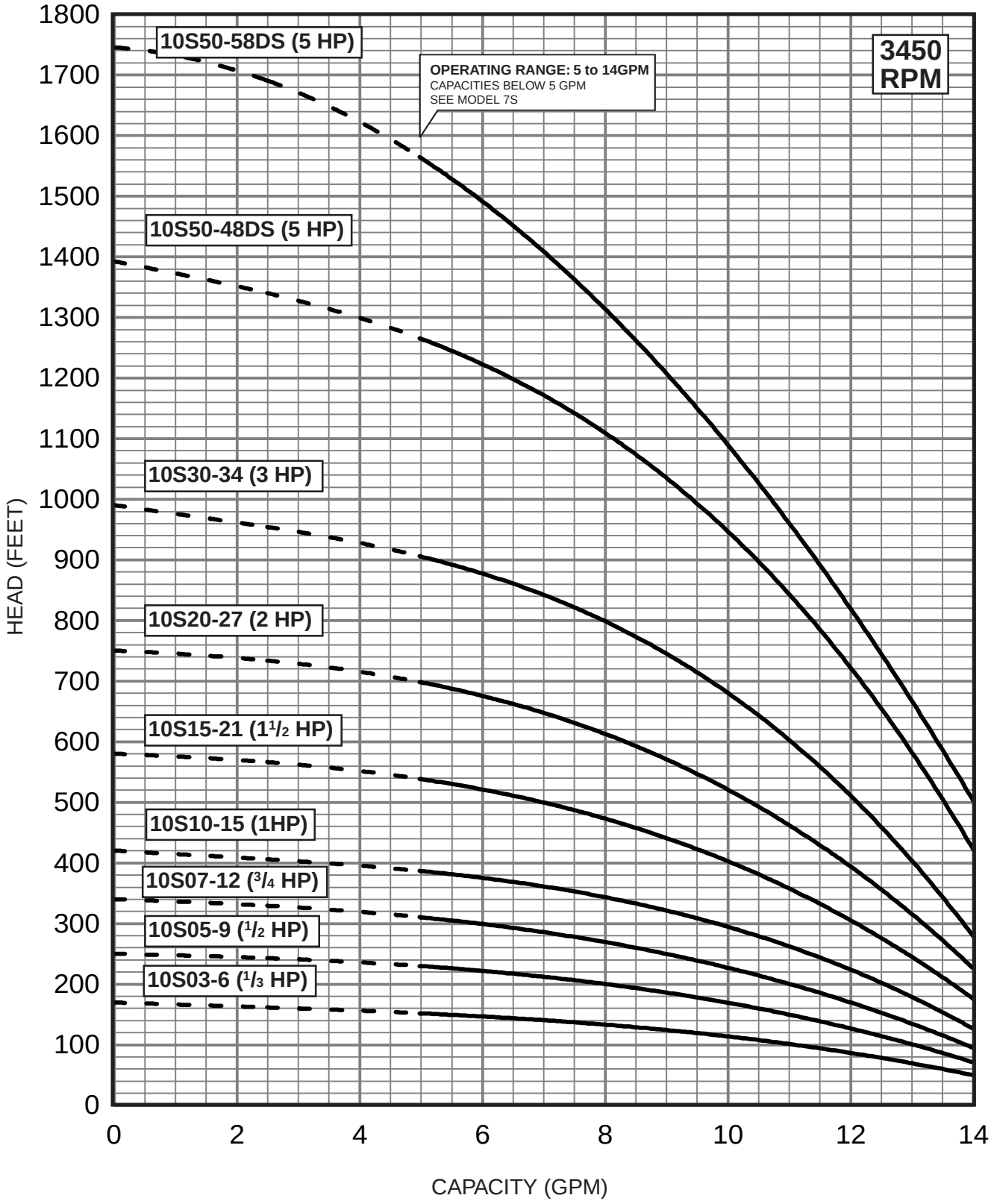
Fig. A

MATERIALS OF CONSTRUCTION

COMPONENT	SPLINE SHAFT
Check Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Pump Shaft	304 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	304 Stainless Steel
Priming Inducer	304 Stainless Steel
Coupling	316/431 Stainless Steel
Check Valve Seat	NBR/304 Stainless Steel
Top Bearing	NBR
Impeller Seal Ring	NBR/PBT (Valox ®)
Intermediate Bearings	NBR

NOTES: Specifications subject to change without notice.
Valox® is a registered trademark of General Electric Co.

FLOW RANGE: 5 -14 GPM **OUTLET SIZE: 1 1/4 " NPT** **NOMINAL DIA. 4"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 3450 RPM.

Performance conforms to ISO 9906. 1999 (E) Annex A
Minimum submergance is 2 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES A	B	C	D	E	APPROX. SHIP WT.
10S03-6	A	1/3	4"	1 1/4" NPT	19.9	8.8	11.1	3.8	3.9	26
10S05-9	A	1/2	4"	1 1/4" NPT	23.0	9.5	13.5	3.8	3.9	29
10S07-12	A	3/4	4"	1 1/4" NPT	26.7	10.7	16.0	3.8	3.9	32
10S10-15	A	1	4"	1 1/4" NPT	30.3	11.8	18.5	3.8	3.9	34
10S15-21	A	1 1/2	4"	1 1/4" NPT	37.1	13.6	23.5	3.8	3.9	44
10S20-27	A	2	4"	1 1/4" NPT	43.5	15.1	28.4	3.8	3.9	49
10S30-34	A	3	4"	1 1/4" NPT	54.7	20.6	34.1	3.8	3.9	83
10S50-48DS	A	5	4"	1 1/4" NPT	71.3	23.6	47.7	3.8	3.9	115
10S50-58DS*	B	5	4"	1 1/4" MPT	88.2	23.6	64.5	3.8	4.3	142

NOTES: All models suitable for use in 4" wells, unless otherwise noted.
Weights include pump end with motor in lbs.
* Built into sleeve 1¼" MPT discharge, 5" min. well dia.

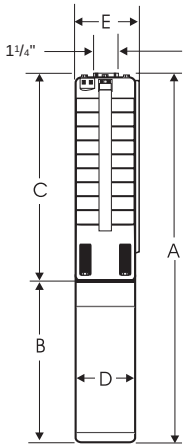


Fig. A

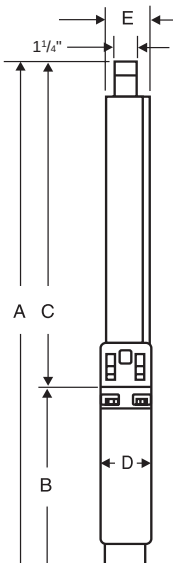


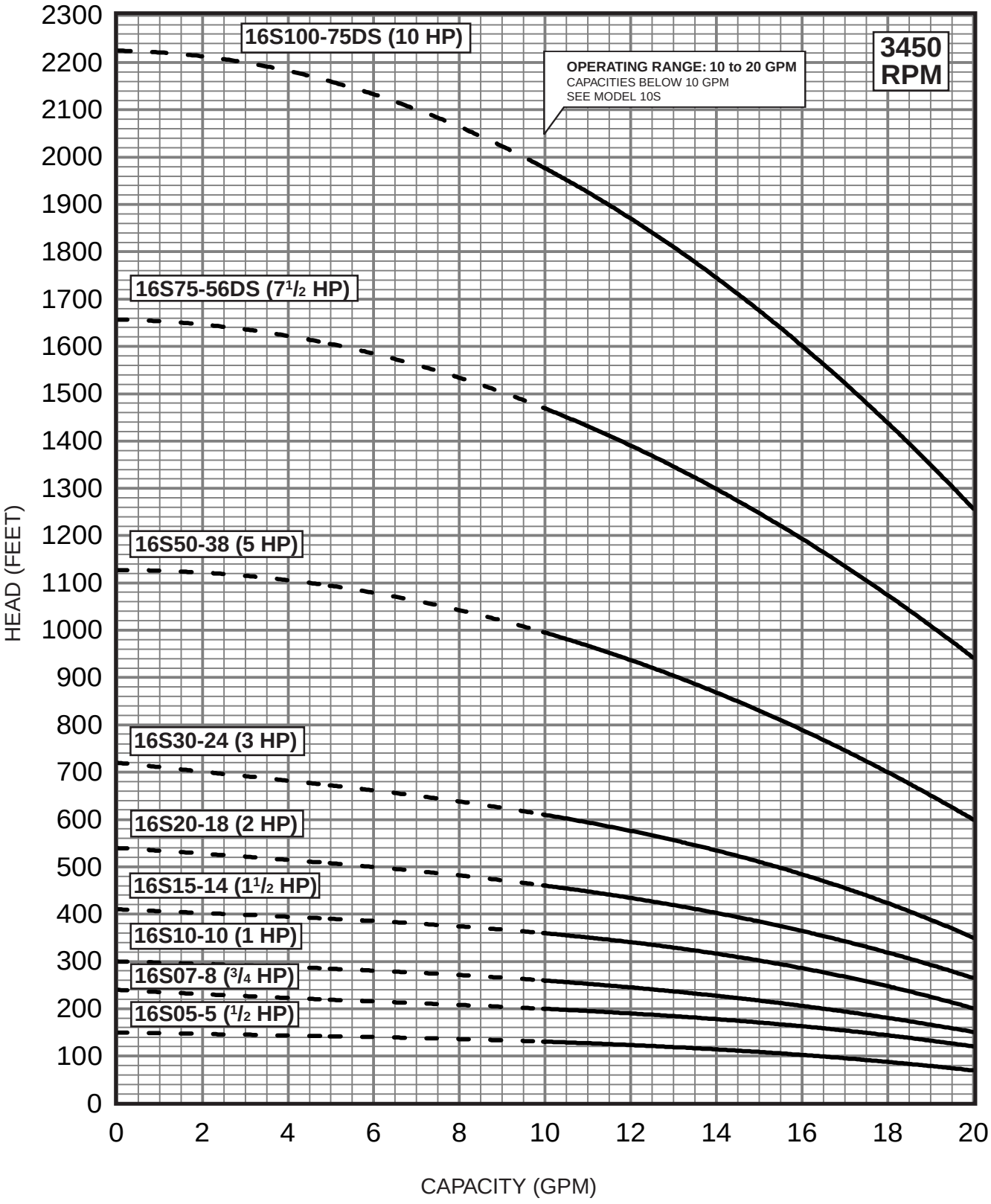
Fig. B

MATERIALS OF CONSTRUCTION

COMPONENT	SPLINED SHAFT (6-27 Stgs.)	CYLINDRICAL SHAFT (34-48 Stgs.)	DEEP SET (58 Stgs.)
Check Valve Housing	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Check Valve	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Impeller	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Suction Interconnector	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Inlet Screen	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Pump Shaft	304 Stainless Steel	431 Stainless Steel	431 Stainless Steel
Straps	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Cable Guard	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Priming Inducer	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Coupling	316/431 Stainless Steel	316/431 Stainless Steel	316/431 Stainless Steel
Check Valve Seat	NBR/304 Stainless Steel	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Top Bearing	NBR	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Impeller Seal Ring	NBR/PBT (Valox®)	NBR/PPS (Ryton®)	NBR/PPS (Ryton®)
Intermediate Bearings	NBR	304 Stainless Steel	NBR/316 Stainless Steel
Shaft Washer	Not Required	LCP (Vectra®)	LCP (Vectra®)
Split Cone	Not Required	304 Stainless Steel	304 Stainless Steel
Split Cone Nut	Not Required	316 Stainless Steel	304 Stainless Steel
Sleeve	Not Required	Not Required	316 Stainless Steel
Sleeve Flange	Not Required	Not Required	Zincless Bronze*

NOTES: Specifications subject to change without notice.
Valox® is a registered trademark of General Electric Co.
Vectra® is a registered trademark of Hoechast Calanese Corporation.
Ryton® is a registered trademark of Phillips 66.
*** Stainless Steel option available.**

FLOW RANGE: 10 -20 GPM **OUTLET SIZE: 1 1/4 " NPT** **NOMINAL DIA. 4"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, .5 -5 HP/3450 RPM.
6" MOTOR STANDARD,7.5 -10HP/3450 RPM.

Performance conforms to ISO 9906. 1999 (E) Annex A
Minimum submergance is 2 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
16S05-5	A	1/2	4"	1 1/4" NPT	19.7	9.5	10.2	3.8	3.9	27
16S07-8	A	3/4	4"	1 1/4" NPT	23.4	10.7	12.7	3.8	3.9	29
16S10-10	A	1	4"	1 1/4" NPT	26.2	11.8	14.4	3.8	3.9	32
16S15-14	A	1 1/2	4"	1 1/4" NPT	32.8	15.1	17.7	3.8	3.9	36
16S20-18	A	2	4"	1 1/4" NPT	36.0	15.1	20.9	3.8	3.9	40
16S30-24	A	3	4"	1 1/4" NPT	46.5	20.6	25.9	3.8	3.9	64
16S50-38	A	5	4"	1 1/4" NPT	61.1	23.6	37.5	3.8	3.9	94
16S75-56DS*	B	7 1/2	6"	1 1/4" MPT	93.0	24.2	68.8	5.4	4.6	220
16S100-75DS*	B	10	6"	1 1/4" MPT	109.9	25.4	84.5	5.4	4.6	245

NOTES: All models suitable for use in 4" wells, unless otherwise noted.
Weights include pump end with motor in lbs..
* Built into sleeve 1¼" MPT discharge, 6" min. well dia.

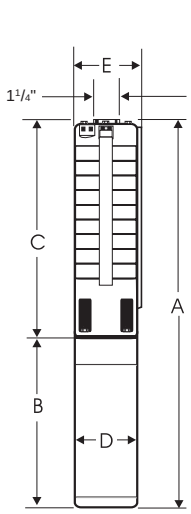


Fig. A

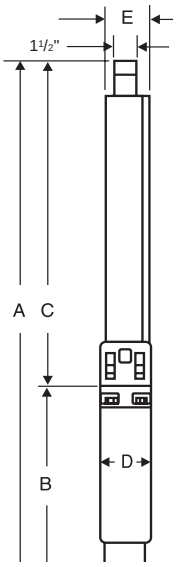


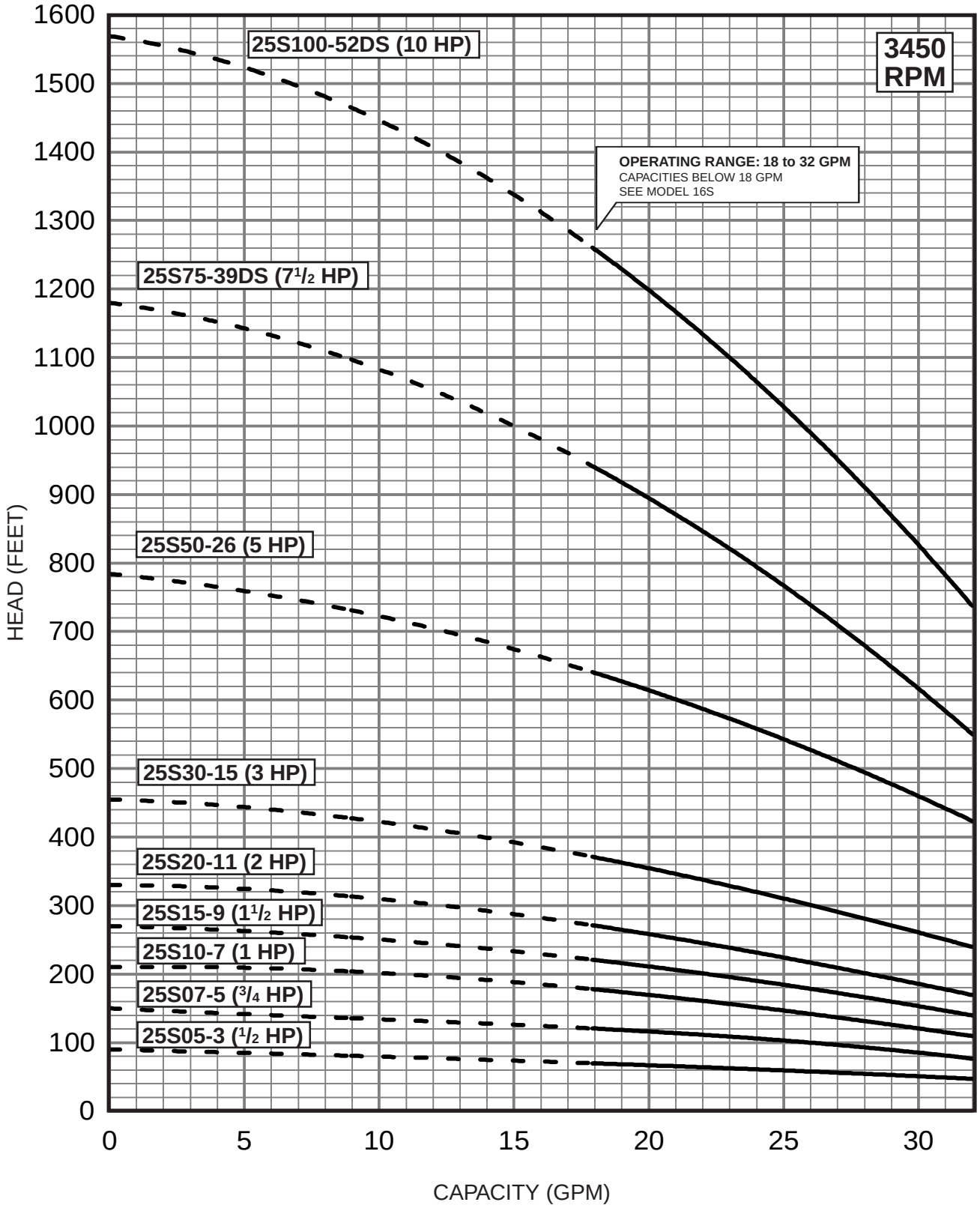
Fig. B

MATERIALS OF CONSTRUCTION

COMPONENT	SPLINED SHAFT (5-24 Stgs.)	CYLINDRICAL SHAFT (38 Stgs.)	DEEP SET (56-75 Stgs)
Check Valve Housing	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Check Valve	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Impeller	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Suction Interconnector	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Inlet Screen	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Pump Shaft	304 Stainless Steel	431 Stainless Steel	431 Stainless Steel
Straps	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Cable Guard	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Priming Inducer	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Coupling	316/431 Stainless Steel	316/431 Stainless Steel	329/416 Stainless Steel**
Check Valve Seat	NBR/304 Stainless Steel	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Top Bearing	NBR	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Impeller Seal Ring	NBR/PBT (Valox®)	NBR/PPS (Ryton®)	NBR/PPS (Ryton®)
Intermediate Bearings	NBR	304 Stainless Steel	NBR/316 Stainless Steel
Shaft Washer	Not Required	LCP (Vectra®)	LCP (Vectra®)
Split Cone	Not Required	304 Stainless Steel	304 Stainless Steel
Split Cone Nut	Not Required	316 Stainless Steel	304 Stainless Steel
Sleeve	Not Required	Not Required	316 Stainless Steel
Sleeve Flange	Not Required	Not Required	304 Stainless Steel
Coupling Key	Not Required	Not Required	302/304 Stainless Steel**

NOTES: Specifications are subject to change without notice.
Valox® is a registered trademark of General Electric Co.
Vectra® is a registered trademark of Hoechast Calanese Corporation.
Ryton® is a registered trademark of Phillips 66.
***Stainless Steel option available.**
** If using 4" non-standard motors, refer to 329/420/431 Stainless Steel for coupling.
A coupling key is not required.

FLOW RANGE: 18 -32 GPM **OUTLET SIZE: 1 1/2 " NPT** **NOMINAL DIA. 4"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, .5 -5 HP/3450 RPM.
6" MOTOR STANDARD,7.5 -10HP/3450 RPM.

Performance conforms to ISO 9906. 1999 (E) Annex A
Minimum submergance is 2 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
25S05-3	A	1/2	4"	1 1/2" NPT	18.1	9.5	8.6	3.8	3.9	26
25S07-5	A	3/4	4"	1 1/2" NPT	20.9	10.7	10.2	3.8	3.9	28
25S10-7	A	1	4"	1 1/2" NPT	23.7	11.8	11.9	3.8	3.9	29
25S15-9	A	1 1/2	4"	1 1/2" NPT	27.1	13.6	13.5	3.8	3.9	34
25S20-11	A	2	4"	1 1/2" NPT	30.3	15.1	15.2	3.8	3.9	37
25S30-15	A	3	4"	1 1/2" NPT	39.1	20.6	18.5	3.8	3.9	59
25S50-26	A	5	4"	1 1/2" NPT	51.2	23.6	27.6	3.8	3.9	76
25S75-39DS	A	7 1/2	6"	1 1/2" NPT	66.8	24.2	42.6	5.4	4.6	168
25S100-52DS*	B	10	6"	1 1/2" MPT	90.9	25.4	65.5	5.4	5.4	226

NOTES: All models suitable for use in 4" wells, unless otherwise noted.
Weights include pump end with motor in lbs.
* Built into sleeve 1 1/2" MPT discharge, 6" min. well dia.

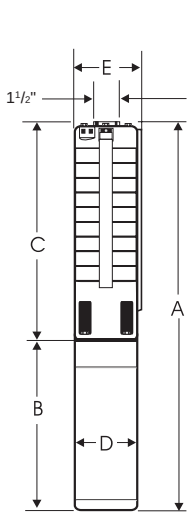


Fig. A

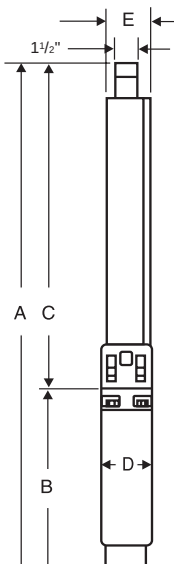


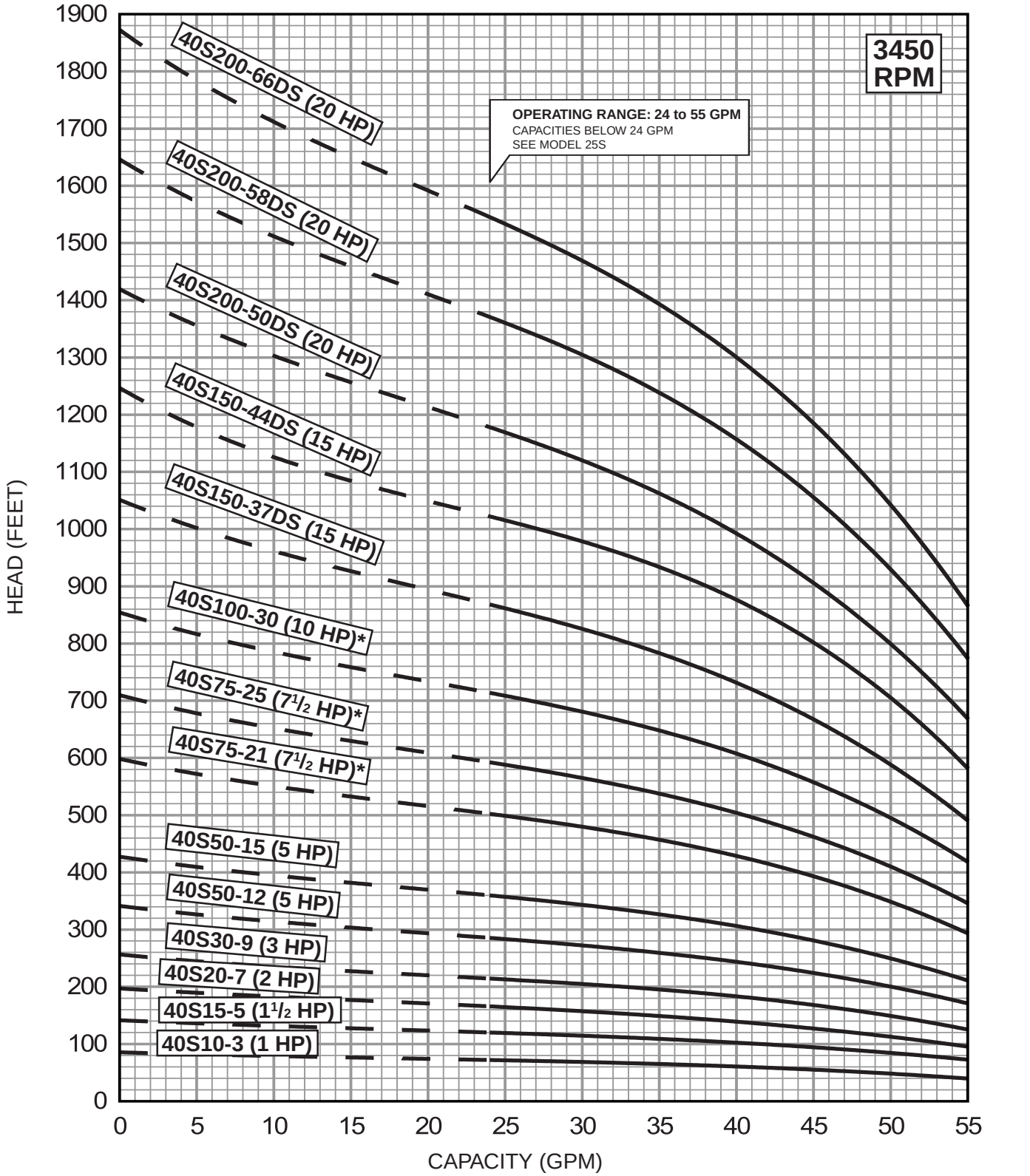
Fig. B

MATERIALS OF CONSTRUCTION

COMPONENT	SPLINED SHAFT (3-26 Stgs.)	CYLINDRICAL SHAFT (39 Stgs.)	DEEP SET (52 Stgs)
Check Valve Housing	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Check Valve	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Impeller	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Suction Interconnector	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Inlet Screen	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Pump Shaft	304 Stainless Steel	431 Stainless Steel	431 Stainless Steel
Straps	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Cable Guard	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Priming Inducer	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Coupling	316/431 Stainless Steel	316/431 Stainless Steel	329/416 Stainless Steel**
Check Valve Seat	NBR/304 Stainless Steel	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Top Bearing	NBR	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Impeller Seal Ring	NBR/PBT (Valox®)	NBR/PPS (Ryton®)	NBR/PPS (Ryton®)
Intermediate Bearings	NBR	304 Stainless Steel	NBR/316 Stainless Steel
Shaft Washer	Not Required	LCP (Vectra®)	LCP (Vectra®)
Split Cone	Not Required	304 Stainless Steel	304 Stainless Steel
Split Cone Nut	Not Required	316 Stainless Steel	304 Stainless Steel
Sleeve	Not Required	Not Required	316 Stainless Steel
Sleeve Flange	Not Required	Not Required	304 Stainless Steel
Coupling Key	Not Required	Not Required	302/304 Stainless Steel**

NOTES: Specifications are subject to change without notice.
Valox® is a registered trademark of General Electric Co.
Vectra® is a registered trademark of Hoechast Calanese Corporation.
Ryton® is a registered trademark of Phillips 66.
***Stainless Steel option available.**
** If using 4" non-standard motors, refer to 329/420/431 Stainless Steel for coupling.
A coupling key is not required.

FLOW RANGE: 24 - 55 GPM **OUTLET SIZE: 2 " NPT** **NOMINAL DIA. 4"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 1-10 HP/3450 RPM.
6" MOTOR STANDARD,15-20 HP/3450 RPM.
* Also available with 6" motor.

Performance conforms to ISO 9906. 1999 (E) Annex A
Minimum submergance is 5 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
40S10-3	A	1	4"	2" NPT	24.6	11.8	12.8	3.8	3.9	32
40S15-5	A	1 1/2	4"	2" NPT	29.7	13.6	16.1	3.8	3.9	37
40S20-7	A	2	4"	2" NPT	34.5	15.1	19.4	3.8	3.9	41
40S30-9	A	3	4"	2" NPT	43.3	20.6	22.7	3.8	3.9	65
40S50-12	A	5	4"	2" NPT	51.3	23.6	27.7	3.8	3.9	78
40S50-15	A	5	4"	2" NPT	56.2	23.6	32.6	3.8	3.9	84
40S75-21*	A	7 1/2	4"	2" NPT	74.6	29.6	45.0	3.8	3.9	120
40S75-25*	A	7 1/2	4"	2" NPT	81.2	29.6	51.6	3.8	3.9	124
40S100-30*	A	10	4"	2" NPT	103.7	43.9	59.8	3.8	3.9	181
40S150-37DS	A	15	6"	2" NPT	99.5	28.0	71.5	5.4	5.4	244
40S150-44DS	A	15	6"	2" NPT	111.0	28.0	83.0	5.4	5.4	340
40S200-50DS**	B	20	6"	2" MPT	136.0	30.6	105.4	5.4	5.5	319
40S200-58DS**	B	20	6"	2" MPT	149.2	30.6	118.6	5.4	5.5	334
40S200-66DS**	B	20	6"	2" MPT	162.4	30.6	131.8	5.4	5.5	394

NOTES: All models suitable for use in 4" wells, unless otherwise noted.
Weights include pump end with motor in lbs.
* Also available with 6" motor.
** Built into sleeve 2" MPT discharge, 6" min. well dia.

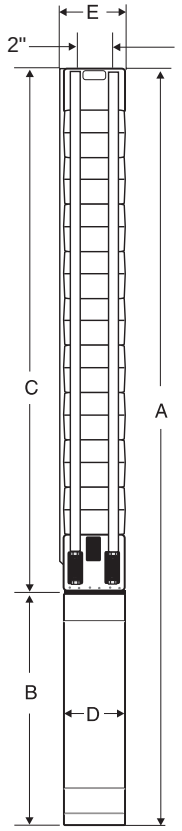


Fig. A

MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT (3-44 Stgs.)	DEEP SET (50-66 Stgs.)
Check Valve Housing	304 Stainless Steel	304 Stainless Steel
Check Valve	304 Stainless Steel	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel	304 Stainless Steel
Impeller	304 Stainless Steel	304 Stainless Steel
Suction Interconnector	304 Stainless Steel	304 Stainless Steel
Inlet Screen	304 Stainless Steel	304 Stainless Steel
Pump Shaft	431 Stainless Steel	431 Stainless Steel
Straps	304 Stainless Steel	304 Stainless Steel
Cable Guard	304 Stainless Steel	304 Stainless Steel
Priming Inducer	304 Stainless Steel	304 Stainless Steel
Coupling	316/431 Stainless Steel **	329/ 416 Stainless Steel
Check Valve Seat	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Top Bearing	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Impeller Seal Ring	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Intermediate Bearings	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Shaft Washer	LCP (Vectra®)	LCP (Vectra®)
Split Cone	304 Stainless Steel	304 Stainless Steel
Split Cone Nut	304 Stainless Steel	304 Stainless Steel
Sleeve	Not Required	316 Stainless Steel
Sleeve Flange	Not Required	304 Stainless Steel

NOTES: Specifications are subject to change without notice.
Vectra® is a registered trademark of Hoechast Calanese Corporation.
***Stainless Steel option available.**

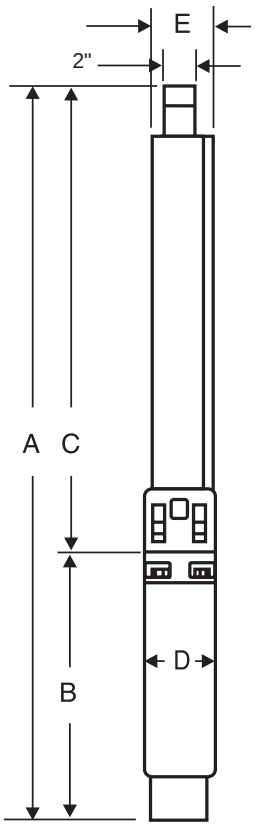
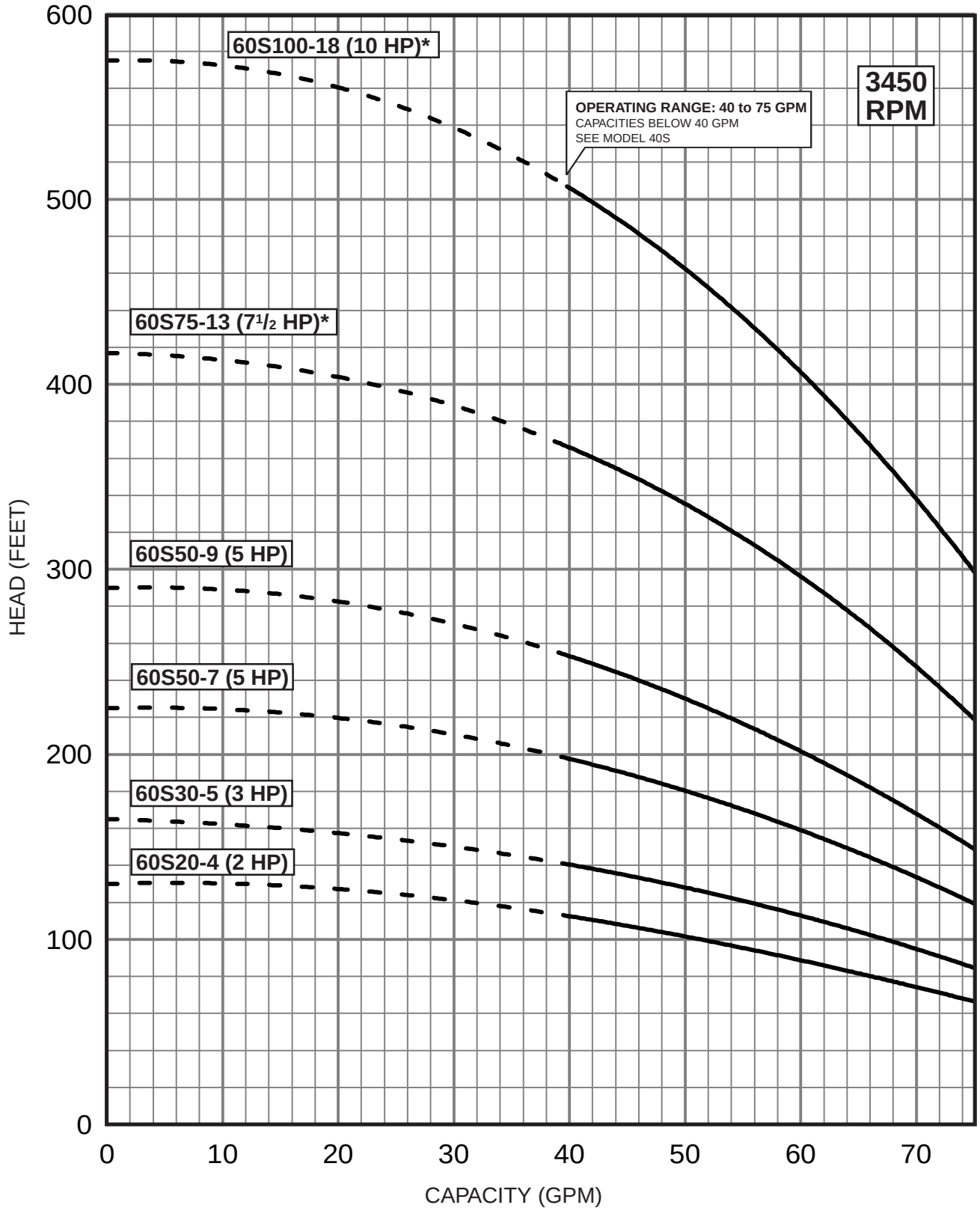


Fig. B

FLOW RANGE: 40 -75 GPM **OUTLET SIZE: 2 " NPT** **NOMINAL DIA. 4"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 3450 RPM.
* Also available with 6" motor.

Performance conforms to ISO 9906. 1999 (E) Annex A
Minimum submergance is 5 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
60S20-4	A	2	4"	2" NPT	32.6	15.1	17.5	3.8	3.9	39
60S30-5	A	3	4"	2" NPT	40.7	20.6	20.1	3.8	3.9	64
60S50-7	A	5	4"	2" NPT	48.8	23.6	25.2	3.8	3.9	75
60S50-9	A	5	4"	2" NPT	53.9	23.6	30.3	3.8	3.9	80
60S75-13*	A	7 1/2	4"	2" NPT	70.1	29.6	40.5	3.8	3.9	105
60S100-18*	A	10	4"	2" NPT	97.3	43.9	53.4	3.8	3.9	160

NOTES: All models suitable for use in 4" wells, unless otherwise noted.
Weights include pump end with motor in lbs..
* Also available with 6" motor.

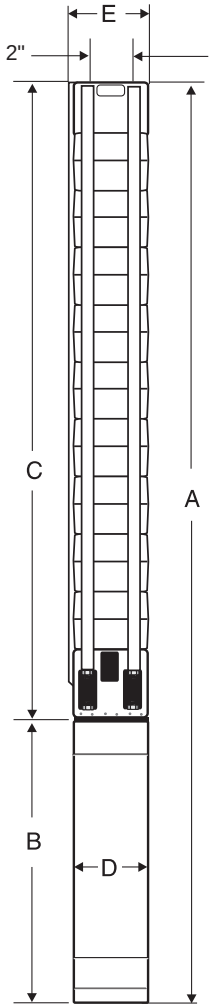


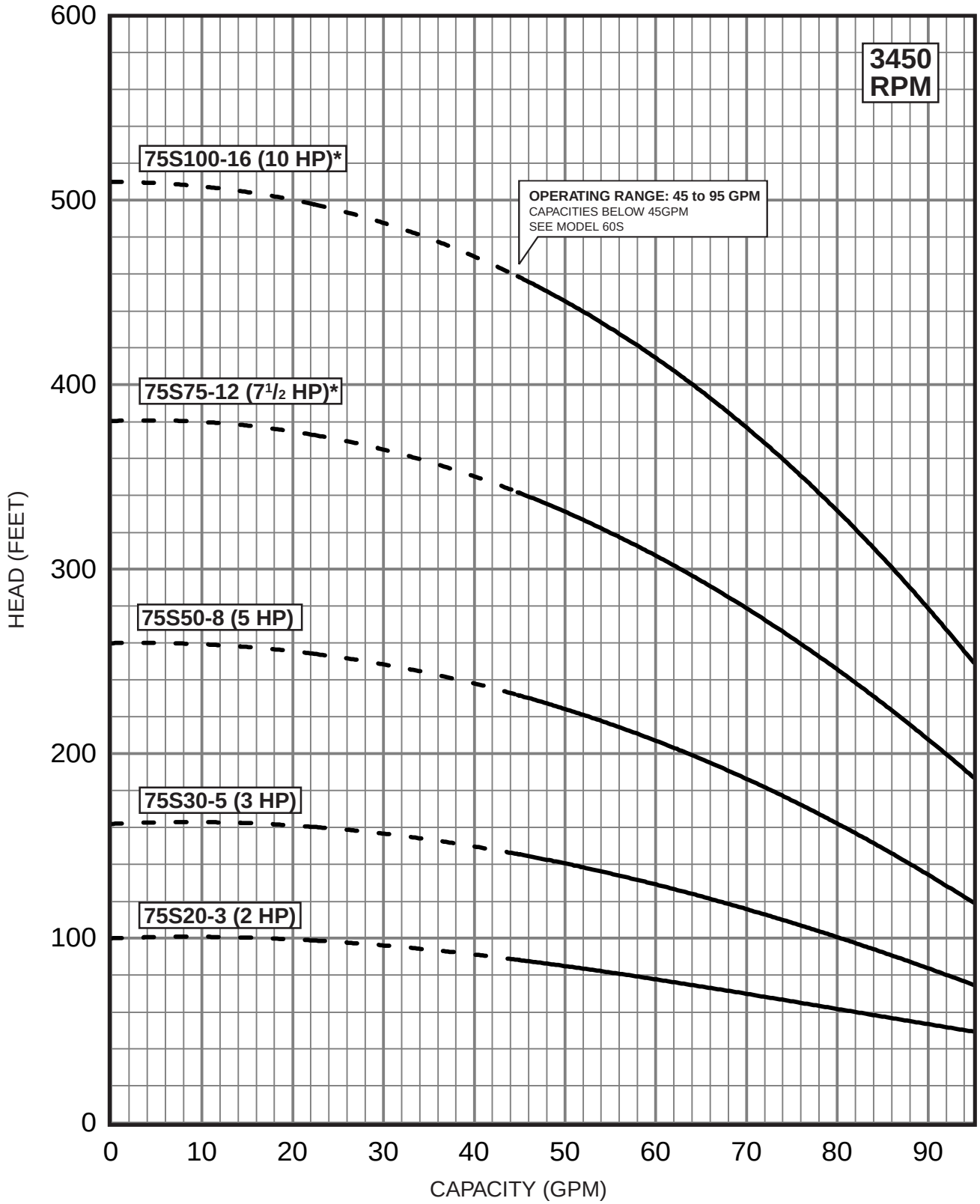
Fig. A

MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT (4-18 Stgs.)
Check Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Pump Shaft	431 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	304 Stainless Steel
Priming Inducer	304 Stainless Steel
Coupling	316/431 Stainless Steel**
Check Valve Seat	NBR/316 Stainless Steel
Top Bearing	NBR/316 Stainless Steel
Impeller Seal Ring	NBR/316 Stainless Steel
Intermediate Bearings	NBR/316 Stainless Steel
Shaft Washer	LCP (Vectra®)
Split Cone	304 Stainless Steel
Split Cone Nut	304 Stainless Steel

NOTES: Specifications are subject to change without notice.
Vectra® is a registered trademark of Hoechast Calanese Corporation.

FLOW RANGE: 45 - 95 GPM **OUTLET SIZE: 2" NPT** **NOMINAL DIA.: 4"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD,2-10 Hp 3450 RPM.
* Also available with 6" motor, performance is the same only at Best Effeciency point.
Consult factory for actual performance.

Performance conforms to ISO 9906. 1999 (E) Annex A
Minimum submergance is 5 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
75S20-3	A	2	4"	2" NPT	30.0	15.1	14.9	3.8	3.9	38
75S30-5	A	3	4"	2" NPT	40.7	20.6	20.1	3.8	3.9	64
75S50-8	A	5	4"	2" NPT	51.4	23.6	27.8	3.8	3.9	78
75S75-12*	A	7 1/2	4"	2" NPT	67.5	29.6	37.9	3.8	3.9	100
75S100-16*	A	10	4"	2" NPT	92.1	43.9	48.2	3.8	3.9	155

NOTES: All models suitable for use in 4" wells, unless otherwise noted.
Weights include pump end with motor in lbs.
* Also available with 6" motor, performance is the same only at Best Efficiency point. Consult factory for actual performance.

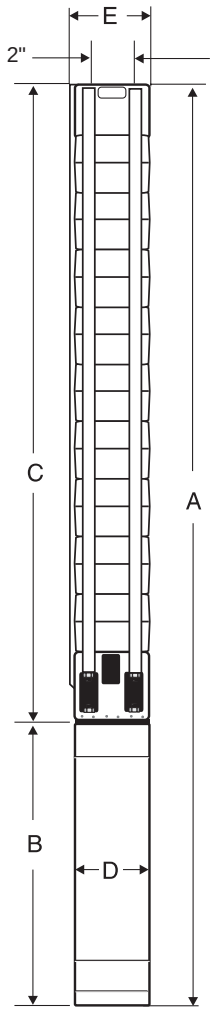


Fig. A

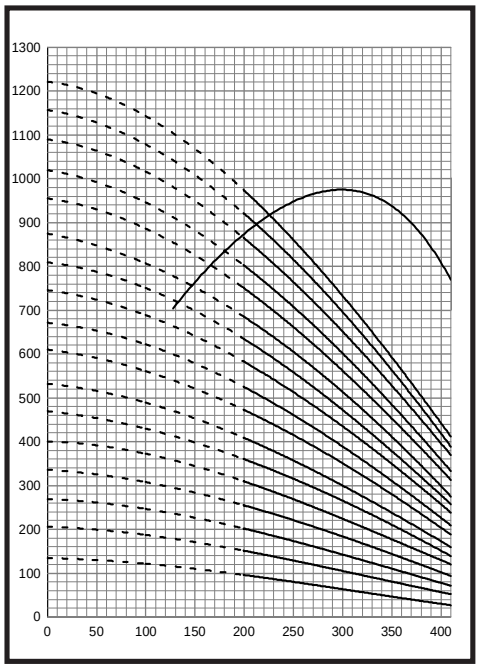
MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT (3-16 Stgs.)
Check Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Pump Shaft	431 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	304 Stainless Steel
Priming Inducer	304 Stainless Steel
Coupling	316/431 Stainless Steel**
Check Valve Seat	NBR/316 Stainless Steel
Top Bearing	NBR/316 Stainless Steel
Impeller Seal Ring	NBR/316 Stainless Steel
Intermediate Bearings	NBR/316 Stainless Steel
Shaft Washer	LCP (Vectra®)
Split Cone	304 Stainless Steel
Split Cone Nut	304 Stainless Steel

NOTES: Specifications are subject to change without notice.
Vectra® is a registered trademark of Hoechast Calanese Corporation.

Performance Curves and Technical Data

6-Inch, 8-Inch & 10-Inch Submersible Pumps



Performance Curves

Materials of Construction

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
85S15-1	A	1 1/2	4"	3" NPT	25.9	13.6	12.3	3.75	5.2	37
85S30-2	A	3	4"	3" NPT	35.3	20.6	14.7	3.75	5.2	61
85S50-3	A	5	4"	3" NPT	40.7	23.6	17.1	3.75	5.2	75
85S50-4	A	5	4"	3" NPT	43.1	23.6	19.5	3.75	5.2	77
85S75-5	A	7 1/2	4"	3" NPT	51.5	29.6	21.9	3.75	5.2	95
85S75-6	A	7 1/2	4"	3" NPT	53.9	29.6	24.3	3.75	5.2	97
85S100-7	A	10	4"	3" NPT	70.5	43.9	26.6	3.75	5.2	151
85S100-8	A	10	4"	3" NPT	72.9	43.9	29.0	3.75	5.2	154
85S100-9	A	10	4"	3" NPT	75.3	43.9	31.4	3.75	5.2	156
85S75-5	A	7 1/2	6"	3" NPT	46.7	24.2	22.5	5.38	5.6	135
85S75-6	A	7 1/2	6"	3" NPT	49.1	24.2	24.9	5.38	5.6	137
85S100-7	A	10	6"	3" NPT	52.7	25.4	27.3	5.38	5.6	148
85S100-8	A	10	6"	3" NPT	55.0	25.4	29.6	5.38	5.6	151
85S100-9	A	10	6"	3" NPT	57.4	25.4	32.0	5.38	5.6	153
85S150-10	A	15	6"	3" NPT	62.4	28.0	34.4	5.38	5.6	170
85S150-11	A	15	6"	3" NPT	64.8	28.0	36.8	5.38	5.6	174
85S150-12	A	15	6"	3" NPT	67.2	28.0	39.2	5.38	5.6	176
85S150-13	A	15	6"	3" NPT	69.6	28.0	41.6	5.38	5.6	178
85S200-14	A	20	6"	3" NPT	74.5	30.6	43.9	5.38	5.6	193
85S200-15	A	20	6"	3" NPT	76.9	30.6	46.3	5.38	5.6	198
85S200-16	A	20	6"	3" NPT	79.3	30.6	48.7	5.38	5.6	200
85S200-17	A	20	6"	3" NPT	81.7	30.6	51.1	5.38	5.6	202
85S200-18	A	20	6"	3" NPT	84.1	30.6	53.5	5.38	5.6	204
85S250-19	A	25	6"	3" NPT	88.9	33.1	55.8	5.38	5.6	240
85S250-20	A	25	6"	3" NPT	91.9	33.1	58.8	5.38	5.6	244
85S250-21	A	25	6"	3" NPT	94.3	33.1	61.2	5.38	5.6	246
85S250-22	A	25	6"	3" NPT	96.7	33.1	63.6	5.38	5.6	249
85S300-23	A	30	6"	3" NPT	101.9	35.7	66.2	5.38	5.6	264
85S300-24	A	30	6"	3" NPT	104.1	35.7	68.4	5.38	5.6	266
85S300-25	A	30	6"	3" NPT	106.4	35.7	70.7	5.38	5.6	271
85S300-26	A	30	6"	3" NPT	108.8	35.7	73.1	5.38	5.6	273
85S300-27	A	30	6"	3" NPT	116.3	40.8	75.5	5.38	5.6	278
85S400-28	A	40	6"	3" NPT	118.7	40.8	77.9	5.38	5.6	281
85S400-29	A	40	6"	3" NPT	121.1	40.8	80.3	5.38	5.6	283
85S400-30	A	40	6"	3" NPT	123.4	40.8	82.6	5.38	5.6	287
85S400-33*	B	40	6"	3" NPT	139.7	40.8	98.9	5.38	6.9	343
85S400-36*	B	40	6"	3" NPT	146.9	40.8	106.1	5.38	6.9	354
85S500-39*	B	50	6"	3" NPT	171.0	57.8	113.2	5.38	6.9	448
85S400-33*	B	40	8"	3" NPT	134.7	35.8	98.9	7.5	6.9	377
85S400-36*	B	40	8"	3" NPT	141.9	35.8	106.1	7.5	6.9	390
85S500-39*	B	50	8"	3" NPT	152.0	38.8	113.2	7.5	6.9	498

NOTES: All models suitable for use in 6" wells, unless otherwise noted.
Weights include pump end with motor in lbs.
* Built into sleeve 3" NPT discharge, 8" min. well dia.

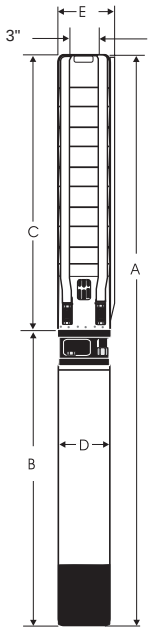


Fig. A

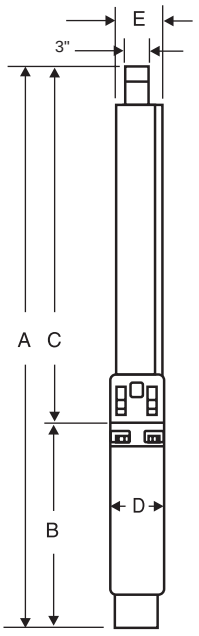
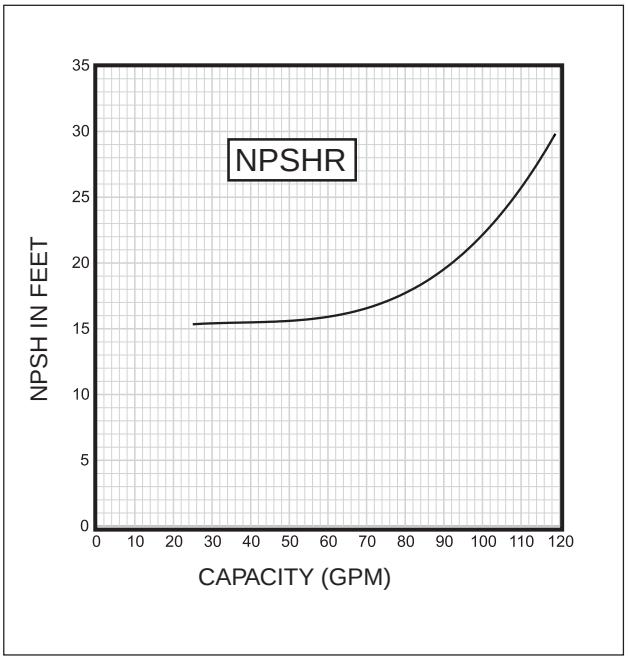


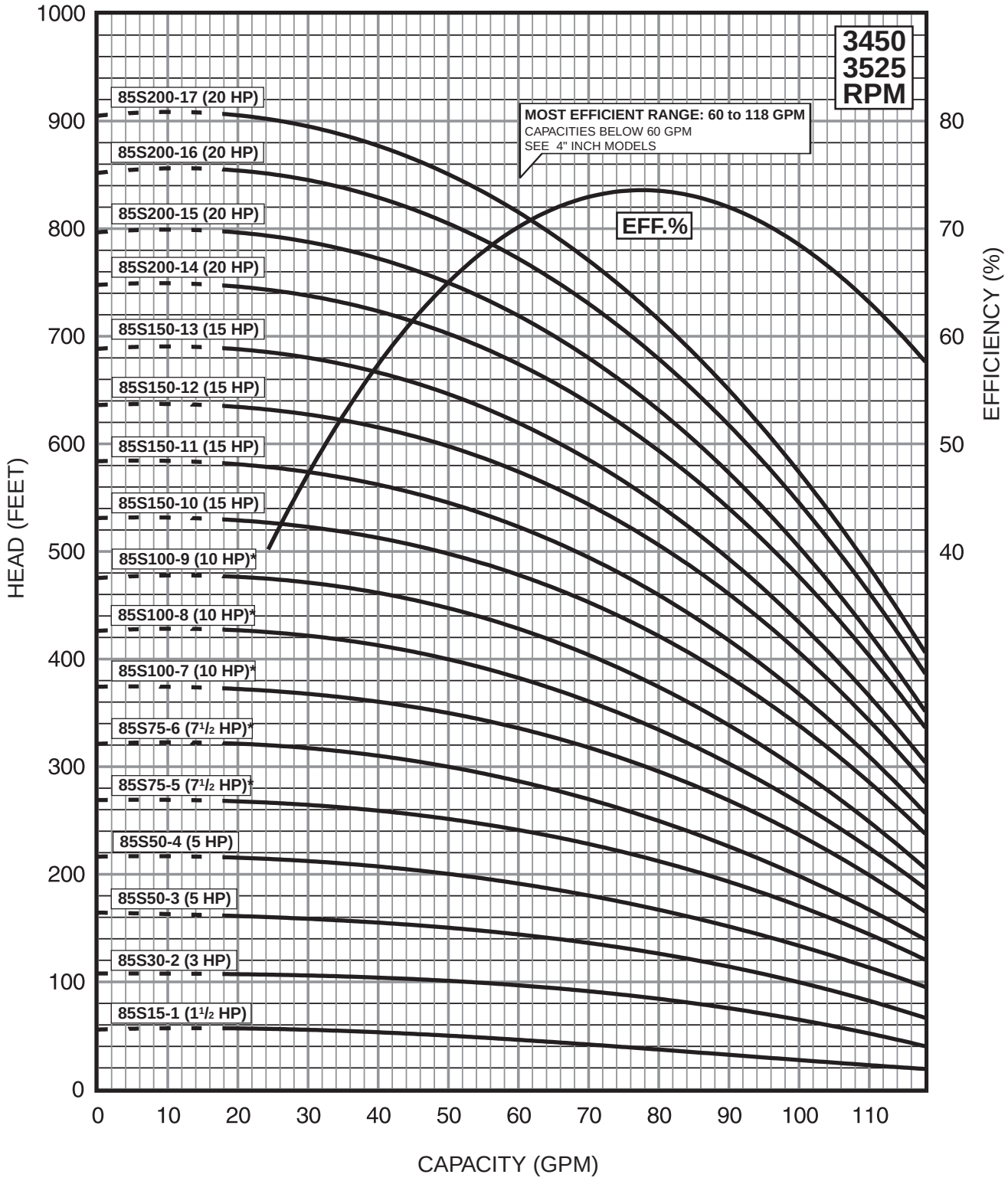
Fig. B

MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT (1- 39 Stgs.)
Check Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Split Cone Nut	304 Stainless Steel
Split Cone	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Seal Ring Support	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	304 Stainless Steel
Priming Inducer	304 Stainless Steel
Coupling	316/329 Stainless Steel**
Pump Shaft	431 Stainless Steel
Intermediate Bearings	NBR
Impeller Seal Ring	NBR/PPS
Check Valve Seat	NBR/316 Stainless Steel
Upthrust Disc	Carbon/Graphite
Upthrust Stop Washer	304 Stainless Steel
8" Motor Adaptor Plate	304 Stainless Steel
Sleeve *	316 Stainless Steel
Sleeve Flange *	316 Stainless Steel
NOTES: Specifications are subject to change without notice. * Required for 33-39 stages. ** 4" Coupling made of 316 Stainless Steel	



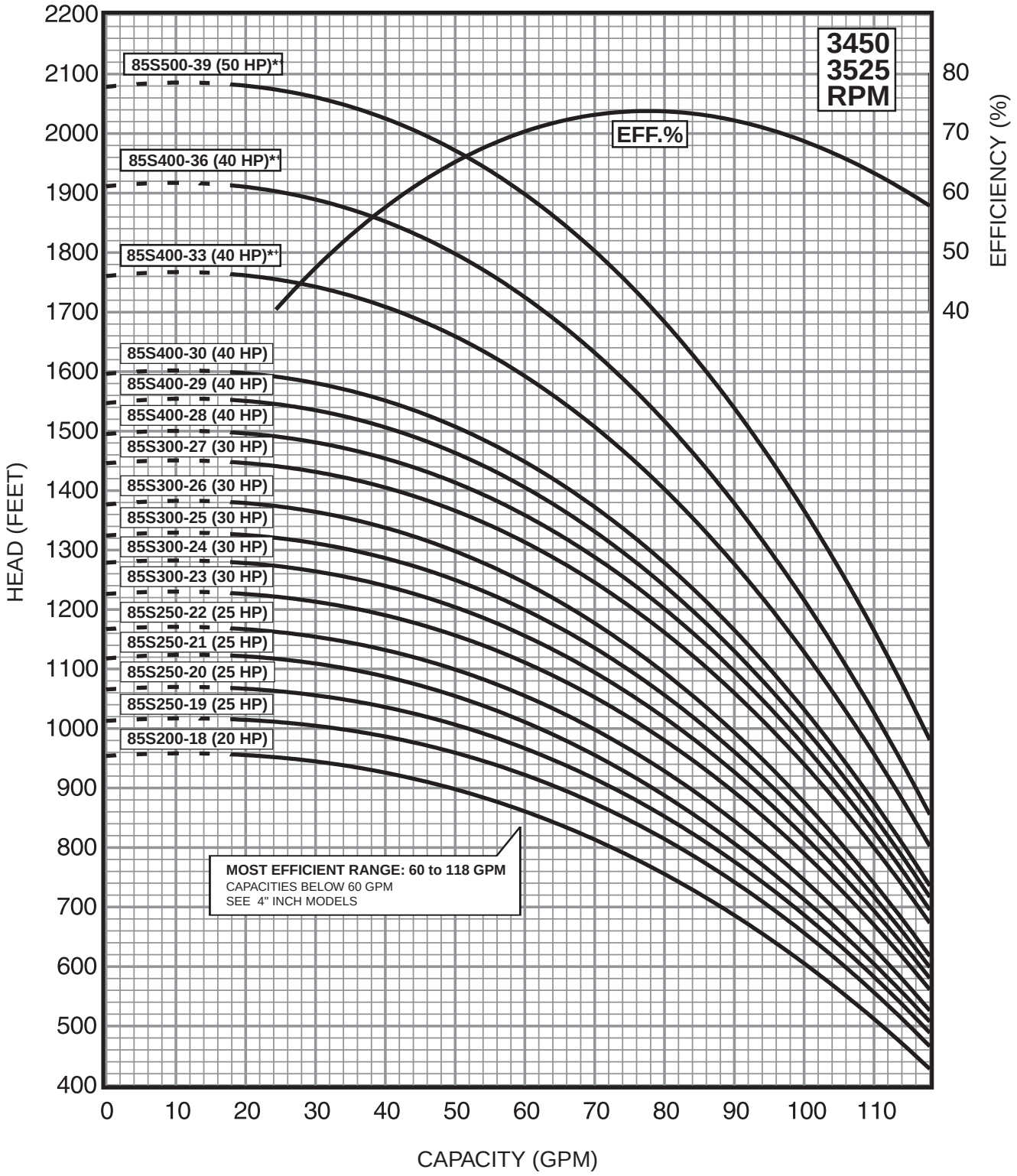
FLOW RANGE: 18 -118 GPM **OUTLET SIZE: 3" NPT** **NOMINAL DIA. 6"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 1.5-5 HP/3450 RPM
6" MOTOR STANDARD, 7.5-50 HP/3450 RPM.
* Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 5 ft. min. submergence.

FLOW RANGE: 18 -118 GPM **OUTLET SIZE: 3" NPT** **NOMINAL DIA. 6"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
* Built into sleeve 3" male NPT discharge/ 8" min. well diameter.
6" MOTOR STANDARD, 7.5-50 HP/3450 RPM.
+Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 5 ft. min. submergence.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
150S20-1	A	2	4"	3" NPT	27.3	13.6	13.7	3.75	5.2	55
150S50-2	A	5	4"	3" NPT	41.1	23.6	17.5	3.75	5.2	75
150S75-3	A	7 1/2	4"	3" NPT	50.9	29.6	21.3	3.75	5.2	92
150S75-4	A	7 1/2	4"	3" NPT	54.7	29.6	25.1	3.75	5.2	97
150S100-5	A	10	4"	3" NPT	72.8	43.9	28.9	3.75	5.2	151
150S75-4	A	7 1/2	6"	3" NPT	49.9	24.2	25.7	5.38	5.6	135
150S100-5	A	10	6"	3" NPT	54.9	25.4	29.5	5.38	5.6	148
150S150-6	A	15	6"	3" NPT	61.3	28.0	33.3	5.38	5.6	167
150S150-7	A	15	6"	3" NPT	65.0	28.0	37.0	5.38	5.6	169
150S150-8	A	15	6"	3" NPT	68.8	28.0	40.8	5.38	5.6	174
150S200-9	A	20	6"	3" NPT	75.2	30.6	44.6	5.38	5.6	191
150S200-10	A	20	6"	3" NPT	79.0	30.6	48.4	5.38	5.6	193
150S200-11	A	20	6"	3" NPT	82.8	30.6	52.2	5.38	5.6	198
150S250-12	A	25	6"	3" NPT	89.0	33.1	55.9	5.38	5.6	235
150S250-13	A	25	6"	3" NPT	92.8	33.1	59.7	5.38	5.6	238
150S250-14	A	25	6"	3" NPT	96.6	33.1	63.5	5.38	5.6	242
150S300-15	A	30	6"	3" NPT	103.0	35.7	67.3	5.38	5.6	260
150S300-16	A	30	6"	3" NPT	106.8	35.7	71.1	5.38	5.6	262
150S300-17	A	30	6"	3" NPT	110.5	35.7	74.8	5.38	5.6	266
150S400-18	A	40	6"	3" NPT	119.4	40.8	78.6	5.38	5.6	306
150S400-19	A	40	6"	3" NPT	123.2	40.8	82.4	5.38	5.6	308
150S400-20	A	40	6"	3" NPT	127.0	40.8	86.2	5.38	5.6	323
150S400-21	A	40	6"	3" NPT	130.8	40.8	90.0	5.38	5.7	334
150S400-22	A	40	6"	3" NPT	134.5	40.8	93.7	5.38	5.7	338
150S400-23	A	40	6"	3" NPT	138.3	40.8	97.5	5.38	5.7	340
150S500-24	A	50	6"	3" NPT	162.2	57.8	104.4	5.38	6.1	442
150S500-25	A	50	6"	3" NPT	166.0	57.8	108.2	5.38	6.1	444
150S500-26	A	50	6"	3" NPT	169.8	57.8	112.0	5.38	6.1	446
150S500-27	A	50	6"	3" NPT	173.6	57.8	115.8	5.38	6.1	448
150S500-28	A	50	6"	3" NPT	183.4	63.8	119.6	5.38	7.1	450
150S600-29	A	60	6"	3" NPT	193.7	63.8	129.9	5.38	7.1	448
150S600-31	A	60	6"	3" NPT	201.3	63.8	137.5	5.38	7.1	452
150S600-33	A	60	6"	3" NPT	208.8	63.8	145.0	5.38	7.1	456
150S500-24	A	50	8"	3" NPT	143.2	38.8	104.4	7.50	7.5	492
150S500-25	A	50	8"	3" NPT	147.0	38.8	108.2	7.50	7.5	495
150S500-26	A	50	8"	3" NPT	150.8	38.8	112.0	7.50	7.5	497
150S500-27	A	50	8"	3" NPT	154.6	38.8	115.8	7.50	7.5	499
150S500-28	A	50	8"	3" NPT	158.4	38.8	119.6	7.50	7.5	501
150S600-29*	B	60	8"	3" NPT	169.7	41.8	127.9	7.50	7.5	539
150S600-31*	B	60	8"	3" NPT	177.3	41.8	135.5	7.50	7.5	543
150S600-33*	B	60	8"	3" NPT	184.8	41.8	143.0	7.50	7.5	547
150S750-36*	B	75	8"	3" NPT	201.8	47.4	154.4	7.50	7.5	592
150S750-39*	B	75	8"	3" NPT	213.1	47.4	165.7	7.50	7.5	598

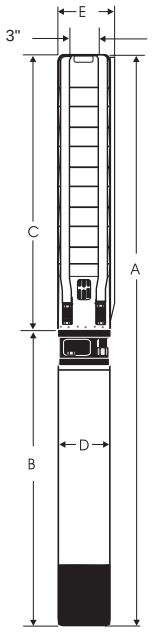


Fig. A

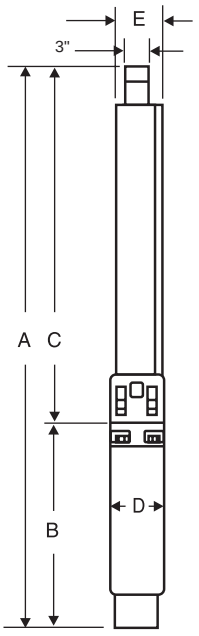


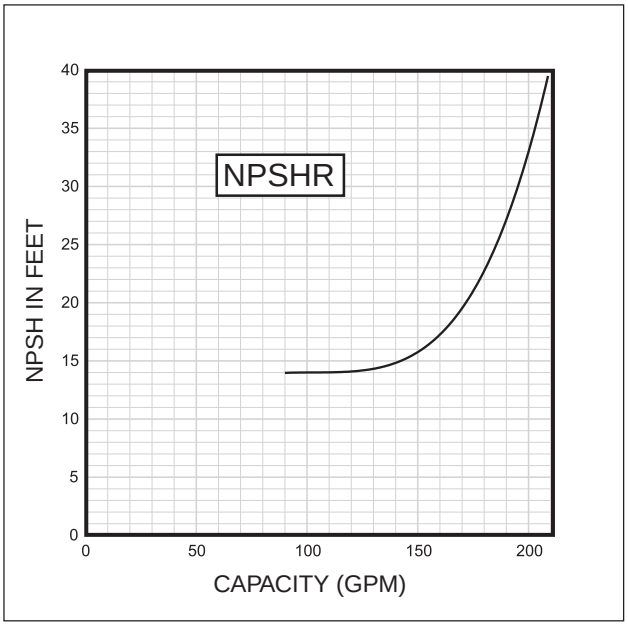
Fig. B

NOTES: All models suitable for use in 6" wells, unless otherwise noted.
Weights include pump end with motor in lbs.
* Built into sleeve 3" NPT discharge, 8" min. well dia.

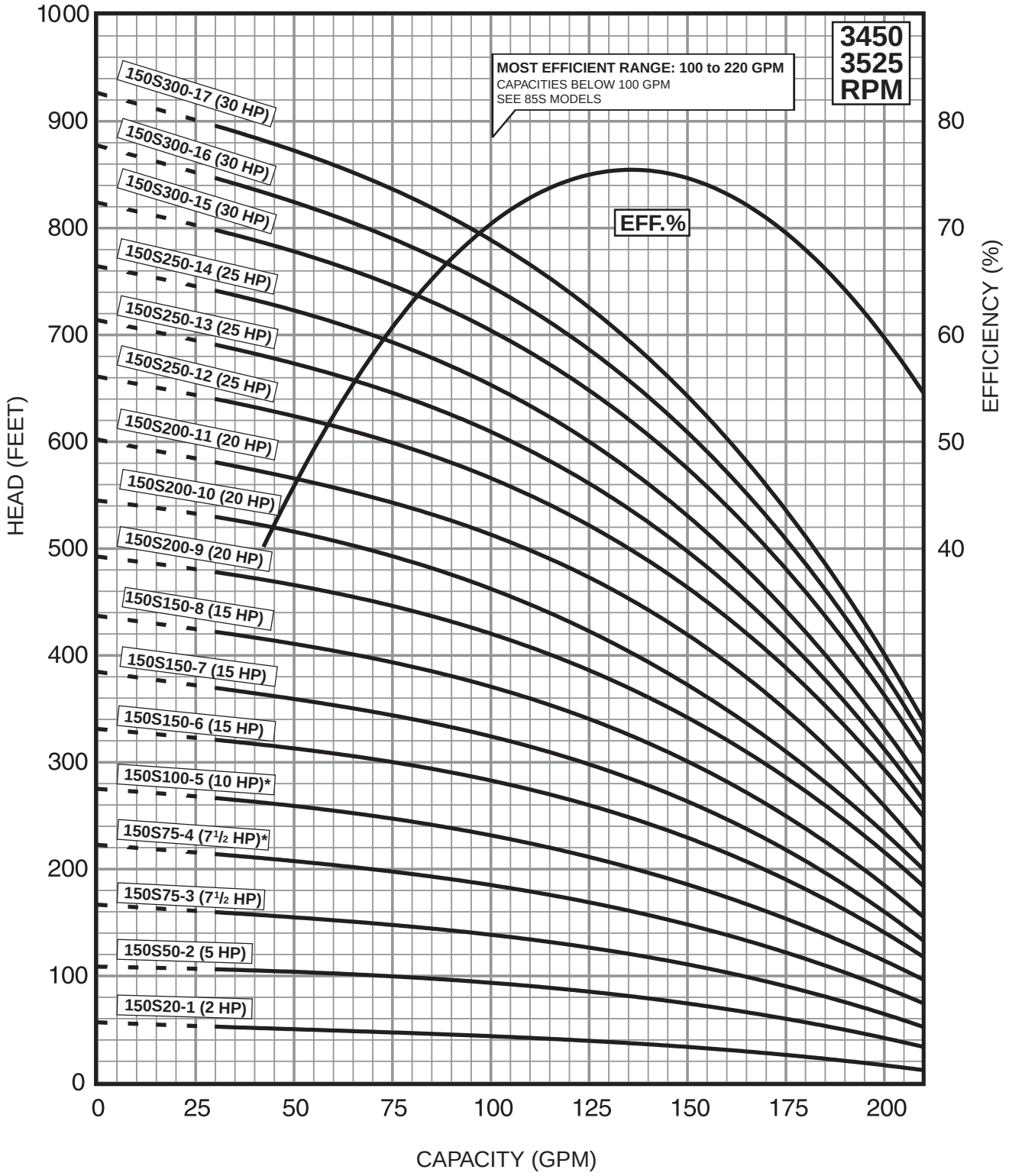
MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT (1-39 Stgs.)
Check Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Split Cone Nut	304 Stainless Steel
Split Cone	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Seal Ring Support Plate	304 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	304 Stainless Steel
Priming Inducer	304 Stainless Steel
Coupling	316/329 Stainless Steel**
Pump Shaft	431 Stainless Steel
Intermediate Bearings	NBR
Impeller Seal Ring	NBR/PPS
Check Valve Seat	NBR/316 Stainless Steel
Top Bearing	NBR/304 Stainless Steel
Upthrust Disc	Carbon/Graphite
Upthrust Stop Washer	304 Stainless Steel
8" Motor Adaptor Plate	304 Stainless Steel
Sleeve*	316 Stainless Steel
Sleeve Flange	304 Stainless Steel

NOTES: Specifications are subject to change without notice.
***Required for 29-39 stage models.**
** 4" Coupling made of 316 Stainless Steel.



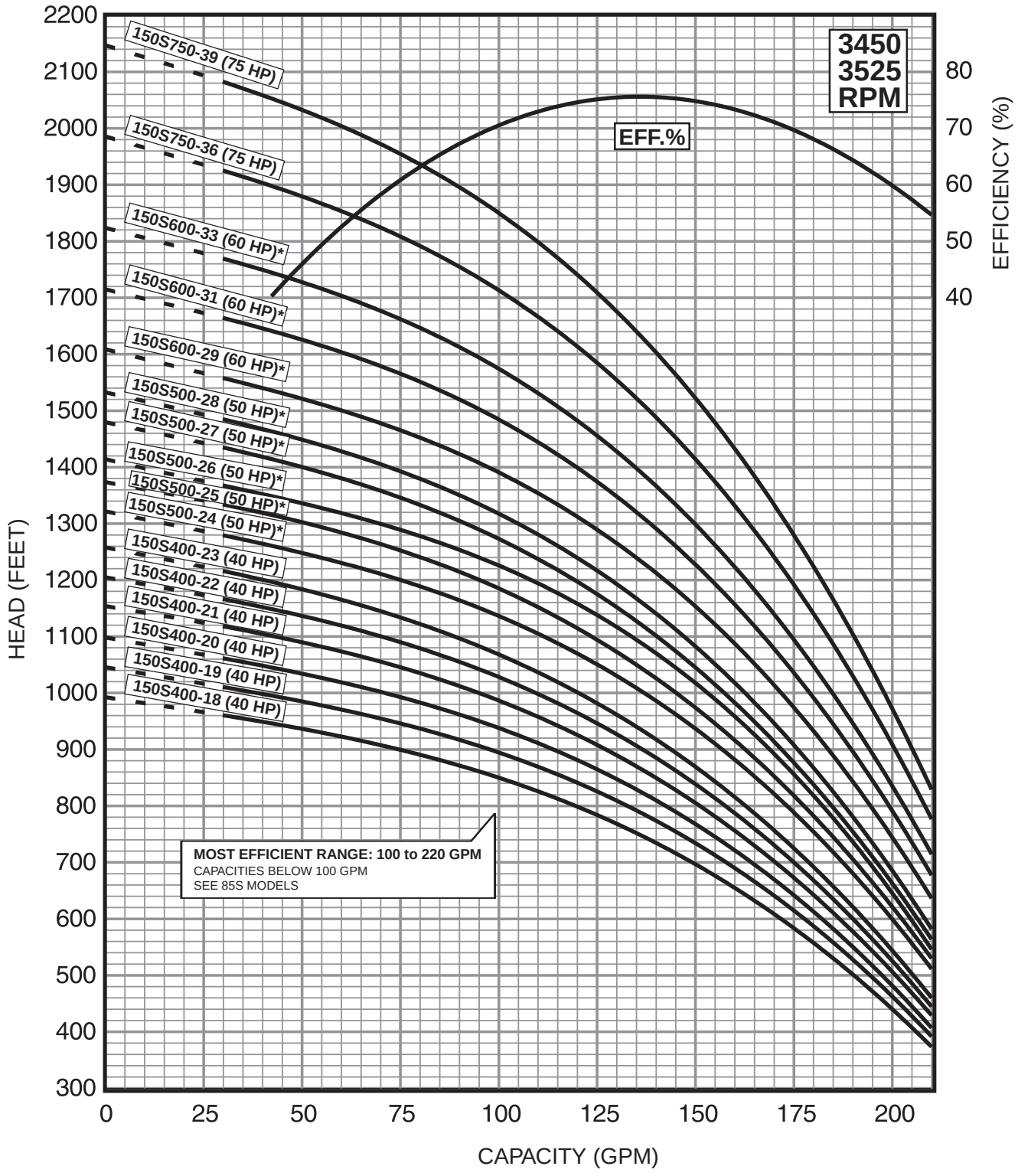
FLOW RANGE: 30 -220 GPM **OUTLET SIZE: 3" NPT** **NOMINAL DIA. 6"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 2-10 HP/3450 RPM
6" MOTOR STANDARD, 7.5-60 HP/3450 RPM.
8" MOTOR STANDARD, 75 HP/3525 RPM.
* Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 5 ft. min. submergence.

FLOW RANGE: 30 -220 GPM **OUTLET SIZE: 3" NPT** **NOMINAL DIA. 6"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
6" MOTOR STANDARD, 7.5-60 HP/3450 RPM.
8" MOTOR STANDARD, 75 HP/3525 RPM.
* Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 5 ft. min. submergence.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES A	B	C	D	E	APPROX. SHIP WT.
230S20-1B	A	2	4"	3" NPT	29.7	15.1	14.6	3.8	5.7	44
230S30-1A	A	3	4"	3" NPT	38.2	23.6	14.6	3.8	5.7	55
230S50-1	A	5	4"	3" NPT	44.2	29.6	14.6	3.8	5.7	65
230S50-2AB	A	5	4"	3" NPT	48.5	29.6	18.9	3.8	5.7	71
230S75-2	A	7.5	4"	3" NPT	48.5	29.6	18.9	3.8	5.7	88
230S75-2	A	7.5	6"	3" NPT	43.0	24.2	18.9	5.4	5.7	124
230S75-3BB	A	7.5	4"	3" NPT	53.5	29.6	23.9	3.8	5.7	96
230S75-3BB	A	7.5	6"	3" NPT	48.1	24.2	23.9	5.4	5.7	96
230S100-3	A	10	4"	3" NPT	67.8	43.9	23.9	3.8	5.7	146
230S100-3	A	10	6"	3" NPT	49.3	25.4	23.9	5.4	5.7	140
230S100-4BC	A	10	4"	3" NPT	72.3	43.9	28.4	3.8	5.7	147
230S100-4BC	A	10	6"	3" NPT	53.8	25.4	28.4	5.4	5.7	147
230S150-4	A	15	6"	3" NPT	56.4	28.0	28.4	5.4	5.7	161
230S150-5B	A	15	6"	3" NPT	60.8	28.0	32.8	5.4	5.7	165
230S200-5	A	20	6"	3" NPT	63.4	30.6	32.8	5.4	5.7	167
230S200-6	A	20	6"	3" NPT	67.8	30.6	37.3	5.4	5.7	186
230S200-7C	A	20	6"	3" NPT	67.8	30.6	37.3	5.4	5.7	202
230S250-7	A	25	6"	3" NPT	74.9	33.1	41.7	5.4	5.7	202
230S250-8B	A	25	6"	3" NPT	79.3	33.1	46.2	5.4	5.7	209
230S250-8	A	25	6"	3" NPT	79.3	33.1	46.2	5.4	5.7	209
230S250-9BB	A	25	6"	3" NPT	83.8	33.1	50.6	5.4	5.7	228
230S300-9	A	30	6"	3" NPT	86.3	35.7	50.6	5.4	5.7	228
230S400-10*	A	40	6"	3" NPT	95.9	40.81	55.1	5.4	5.7	234
230S400-11*	A	40	6"	3" NPT	100.3	40.81	59.5	5.4	5.7	273
230S400-12*	A	40	6"	3" NPT	104.8	40.81	64.0	5.4	5.7	279
230S400-13*	A	40	6"	3" NPT	109.2	40.81	68.4	5.4	5.7	284
230S500-14*	A	50	6"	3" NPT	130.7	57.83	72.9	5.4	5.7	388
230S500-15*	A	50	6"	3" NPT	135.2	57.83	77.3	5.4	5.7	393
230S500-16*	A	50	6"	3" NPT	139.6	57.83	81.8	5.4	5.7	399
230S600-17*	A	60	6"	3" NPT	151.2	63.83	87.4	5.4	5.7	438
230S600-18*	A	60	6"	3" NPT	155.6	63.83	91.8	5.4	5.7	445
230S600-19*	A	60	6"	3" NPT	160.1	63.83	96.3	5.4	5.7	449
230S600-17	A	60	8"	3" NPT	129.2	41.79	87.4	7.5	7.6	544
230S600-18	A	60	8"	3" NPT	133.6	41.79	91.8	7.5	7.6	551
230S600-19	A	60	8"	3" NPT	138.0	41.79	96.3	7.5	7.6	555
230S750-20**	B	75	8"	4" M-NPT	154.7	47.41	107.3	7.5	7.6	634
230S750-22**	B	75	8"	4" M-NPT	163.6	47.41	116.2	7.5	7.6	681

NOTES: All models suitable for use in 6" wells, unless equipped with 8" motor.
Weights include pump end with motor in lbs.
* Alternate motor sizes available.
** Built into sleeve, 4" NPT, 8" motor required.

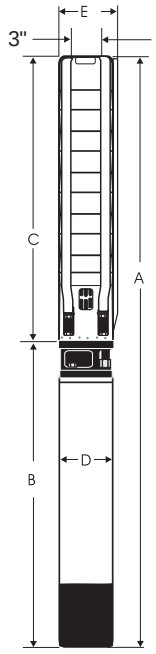


Fig. A

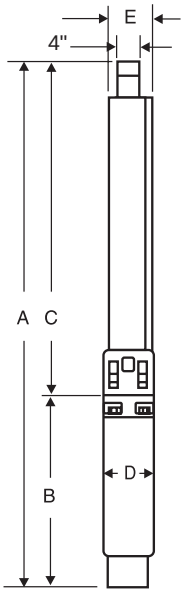
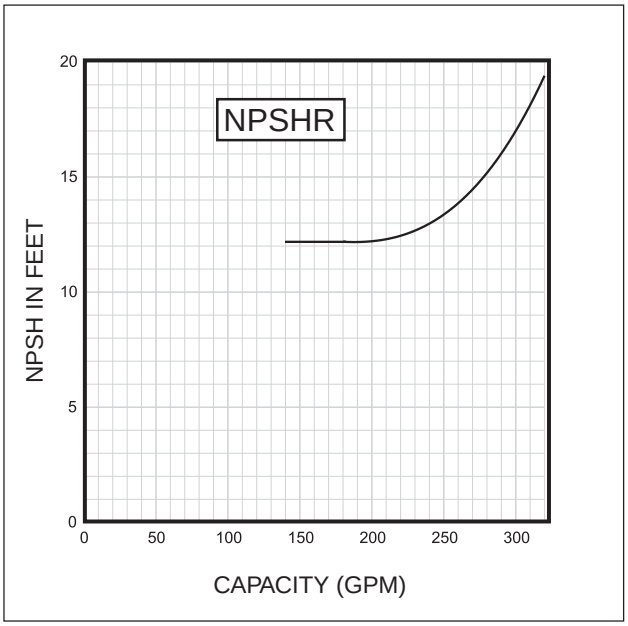


Fig. B

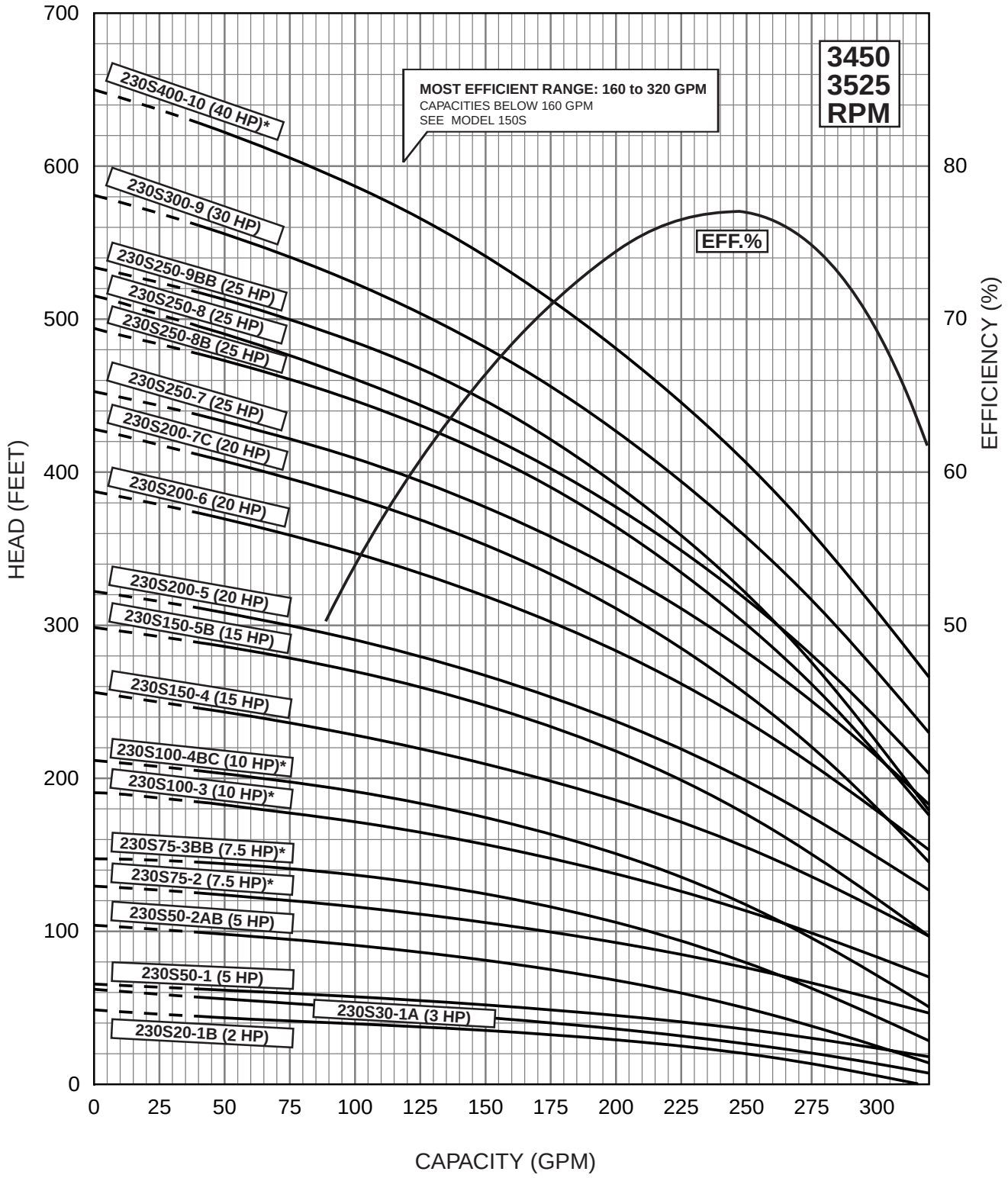
MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT (2-18 Stgs.)
Check Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Split Cone Nut	304 Stainless Steel
Split Cone	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	304 Stainless Steel
Coupling	316/329 Stainless Steel**
Pump Shaft	431 Stainless Steel
Intermediate Bearings	NBR
Impeller Seal Ring	NBR/304 Stainless Steel
Check Valve Seat	NBR/316 Stainless Steel
Top/Lower Bearing	NBR/316 Stainless Steel
8" Motor Adaptor Plate	304 Stainless Steel
Upthrust Washer	Carbon/Graphite HY22
Upthrust stop ring	304 S.S./Tungsten Carbide
Sleeve*	304 Stainless Steel
Sleeve Flange*	304 Stainless Steel

NOTES: Specifications subject to change without notice.
* Required for 20-22 stage only.
** 4" Coupling made of 316 Stainless Steel.



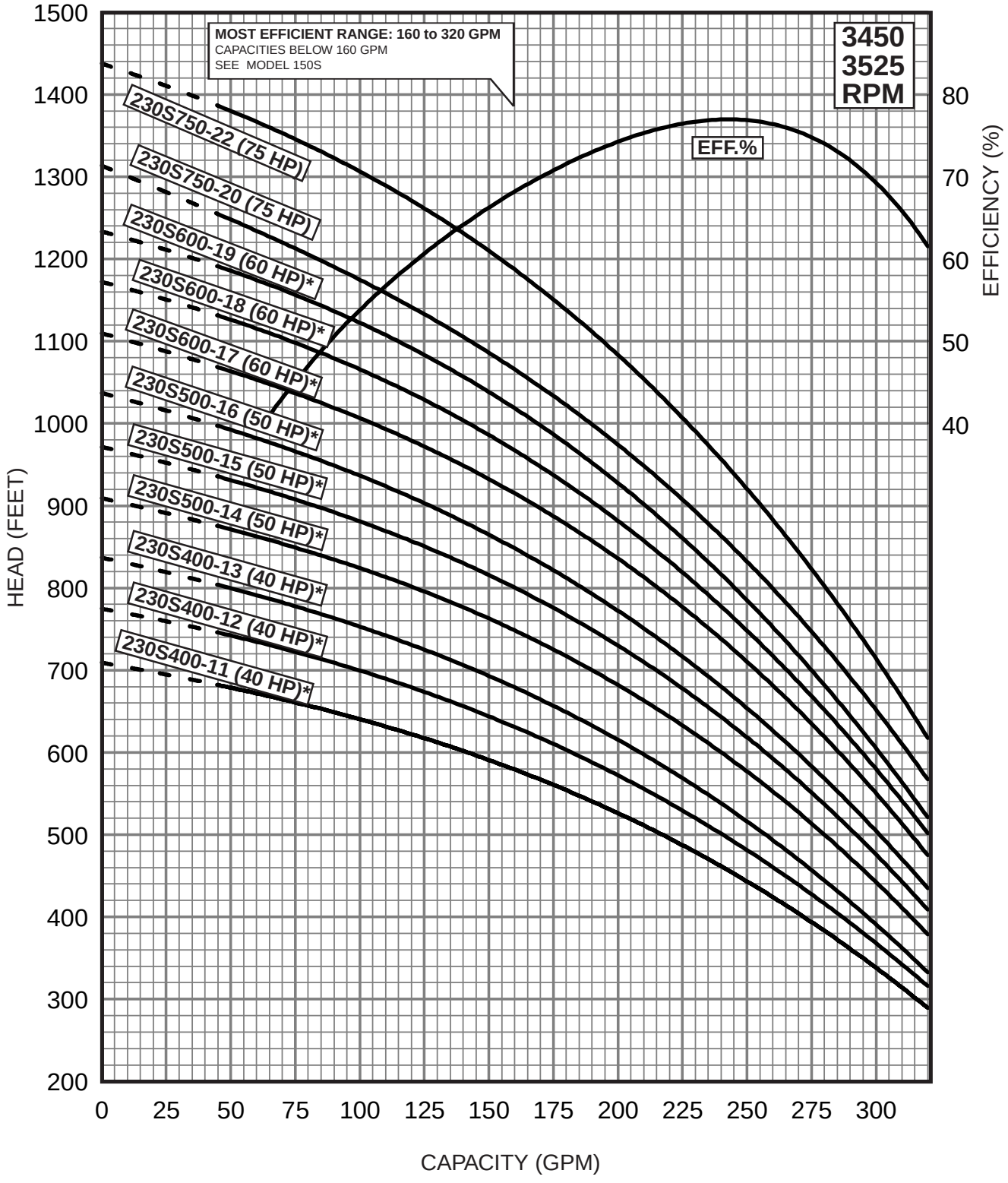
FLOW RANGE: 160 -320 GPM **OUTLET SIZE: 3" NPT** **NOMINAL DIA. 6"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 7.5 HP/3450 RPM
6" MOTOR STANDARD, 10-60 HP/3450 RPM.
8" MOTOR STANDARD, 75 HP/3525 RPM.
* Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 8 ft. min. submergence.

FLOW RANGE: 160 -320 GPM **OUTLET SIZE: 3" NPT** **NOMINAL DIA. 6"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 7.5 HP/3450 RPM
6" MOTOR STANDARD, 10-60 HP/3450 RPM.
8" MOTOR STANDARD, 75 HP/3525 RPM.
* Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 8 ft. min. submergence.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
300S30-1B	A	3	4"	3" NPT	38.1	23.6	14.5	3.8	5.7	65
300S50-1	A	5	4"	3" NPT	44.1	29.6	14.5	3.8	5.7	82
300S50-2BB	A	5	4"	3" NPT	49.1	29.6	19.5	3.8	5.7	87
300S75-2	A	7 1/2	4"	3" NPT	43.5	24.0	19.5	3.8	5.7	113
300S75-2*	A	7 1/2	6"	3" NPT	49.1	29.6	19.5	5.4	5.7	104
300S100-3A	A	10	4"	3" NPT	67.8	43.9	23.9	3.8	5.7	154
300S100-3A	A	10	6"	3" NPT	49.3	25.4	23.9	5.4	5.7	130
300S150-3	A	15	6"	3" NPT	51.9	28.0	23.9	5.4	5.7	146
300S150-4AA	A	15	6"	3" NPT	56.4	28.0	28.4	5.4	5.7	161
300S150-4	A	15	6"	3" NPT	56.4	28.0	28.4	5.4	5.7	161
300S200-5AA	A	20	6"	3" NPT	63.4	30.6	32.8	5.4	5.7	172
300S200-5	A	20	6"	3" NPT	63.4	30.6	32.8	5.4	5.7	172
300S200-6B	A	20	6"	3" NPT	67.9	30.6	37.3	5.4	5.7	177
300S250-6	A	25	6"	3" NPT	70.4	33.1	37.3	5.4	5.7	192
300S250-7AA	A	25	6"	3" NPT	74.8	33.1	41.7	5.4	5.7	201
300S300-7	A	30	6"	4" NPT	74.8	33.1	41.7	5.4	5.7	220
300S300-8	A	30	6"	4" NPT	81.9	35.7	46.2	5.4	5.7	241
300S300-9B	A	30	6"	4" NPT	81.9	35.7	46.2	5.4	5.7	246
300S400-9*	A	40	6"	4" NPT	91.4	40.8	50.6	5.4	5.7	281
300S400-10*	A	40	6"	4" NPT	95.9	40.8	55.1	5.4	5.7	286
300S500-11*	A	50	6"	4" NPT	117.3	57.8	59.5	5.4	5.7	292
300S500-12*	A	50	6"	4" NPT	116.8	57.8	63.9	5.4	5.7	396
300S500-13*	A	50	6"	4" NPT	126.2	57.8	68.4	5.4	5.7	402
300S600-14*	A	60	6"	4" NPT	135.3	61.3	74.0	5.4	7.1	447
300S600-15*	A	60	8"	4" NPT	120.3	41.8	78.5	7.5	7.1	484
300S750-16	A	75	8"	4" NPT	130.3	47.4	82.9	7.5	7.1	540
300S750-17	A	75	8"	4" NPT	134.8	47.4	87.4	7.5	7.1	544
300S750-18	A	75	8"	4" NPT	139.2	47.4	91.8	7.5	7.1	626

NOTES: Models 2-15 Stgs. are suitable for use in 6" wells, 16-18 Stgs. are suitable for use in 8" wells.
Weights include pump end with motor in lbs.
* Alternate motor sizes available.

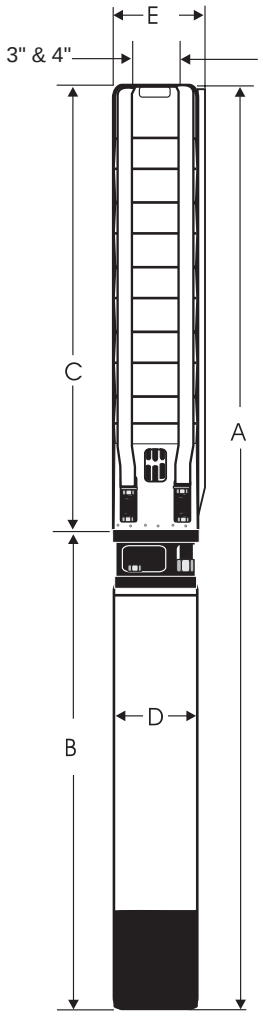
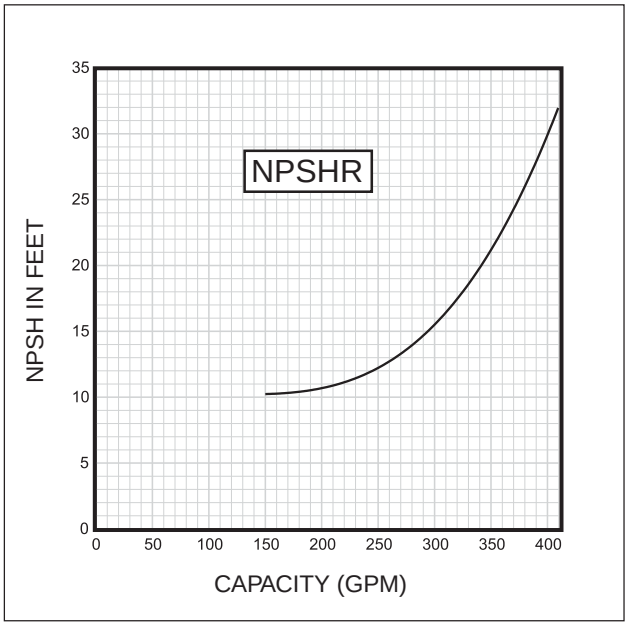


Fig. A

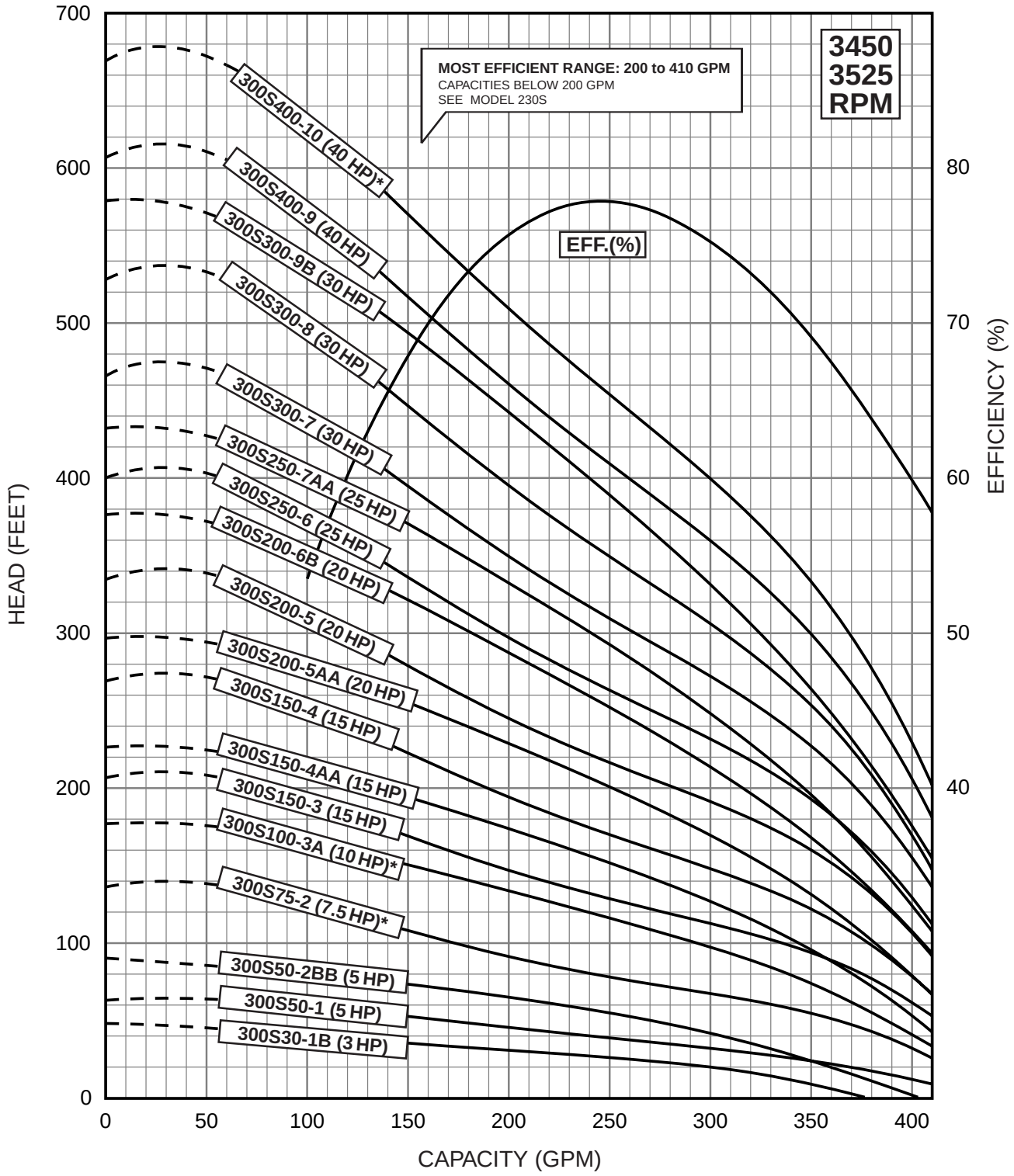
MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT (2-18 Stgs.)
Check Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Split Cone Nut	304 Stainless Steel
Split Cone	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	304 Stainless Steel
Coupling	316/329 Stainless Steel**
Pump Shaft	431 Stainless Steel
Intermediate Bearings	NBR
Impeller Seal Ring	NBR/304 Stainless Steel
Check Valve Seat	NBR/316 Stainless Steel
Top/Lower Bearing	NBR/316 Stainless Steel
8" Motor Adaptor Plate	304 Stainless Steel
Upthrust Washer	Carbon/Graphite HY22
Upthrust stop ring	304 S.S./Tungsten Carbide
NOTES: Specifications are subject to change without notice. ***Stainless Steel options available.** ** 4" Coupling made of 316 Stainless Steel.	



PERFORMANCE CURVES 300 GPM MODEL 300S

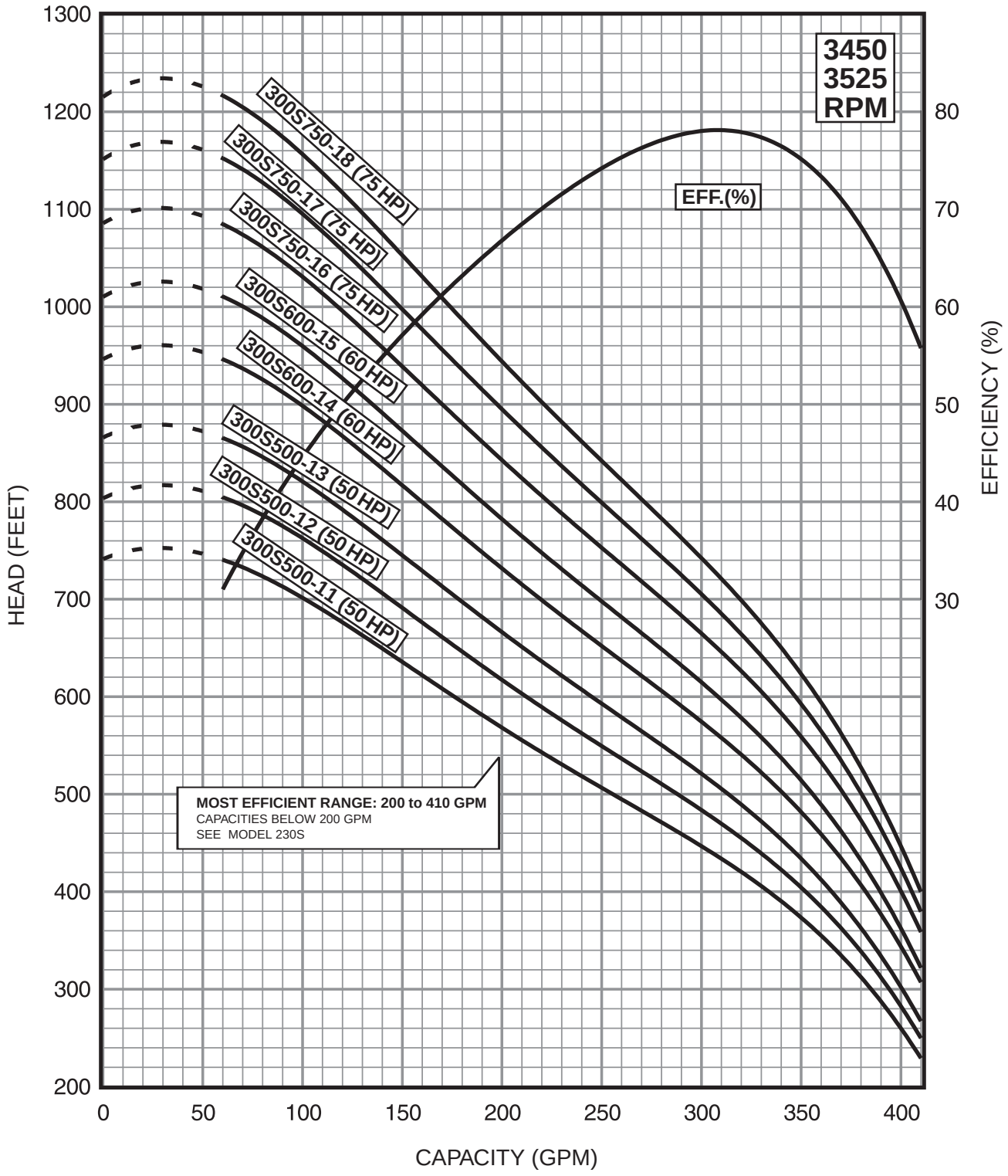
FLOW RANGE: 60 -410 GPM **OUTLET SIZE: 3"& 4" NPT*** **NOMINAL DIA. 6"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 7.5 HP/3450 RPM.
6" MOTOR STANDARD,15-60 HP/3450 RPM.
8" MOTOR STANDARD, 75 HP/3525 RPM.
* 3" NPT 2-6 STAGES, 4" NPT 7-18 STAGES.

Performance conforms to ISO 9906 Annex A
@ 8 ft. min. submergence.

FLOW RANGE: 60 -410 GPM **OUTLET SIZE: 3"& 4" NPT*** **NOMINAL DIA. 6"**



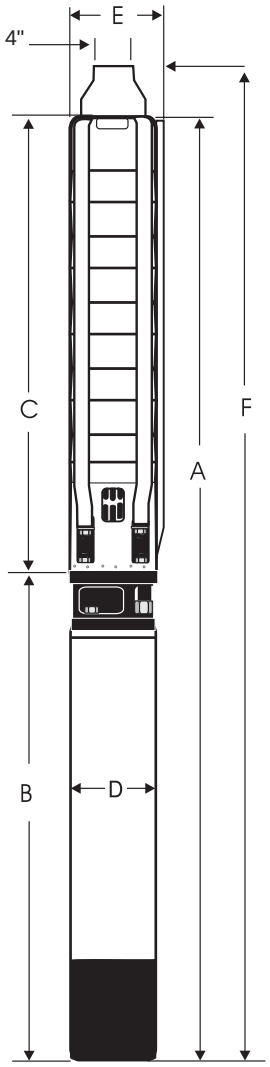
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 7.5 HP/3450 RPM.
6" MOTOR STANDARD,15-60 HP/3450 RPM.
8" MOTOR STANDARD, 75 HP/3525 RPM.
* 3" NPT 2-6 STAGES, 4" NPT 7-18 STAGES.

Performance conforms to ISO 9906 Annex A
@ 8 ft. min. submergence.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES						APPROX. SHIP WT.
					A	B	C	D	E	F	
385S75-1	A	7.5	6"	4" NPT	48.3	24.0	24.3	5.4	7.0	53.1	148
385S100-2BA	A	10	6"	4" NPT	54.8	25.4	29.4	5.4	7.0	59.6	178
385S150-2	A	15	6"	4" NPT	57.4	28.0	29.4	5.4	7.0	62.2	192
385S200-3A	A	20	6"	4" NPT	65.0	30.6	34.4	5.4	7.0	69.8	223
385S250-3	A	25	6"	4" NPT	67.5	33.1	34.4	5.4	7.0	72.3	210
385S250-4B	A	25	6"	4" NPT	72.6	33.1	39.5	5.4	7.0	77.4	210
385S300-4	A	30	6"	4" NPT	75.2	35.7	39.5	5.4	7.0	80.0	243
385S300-5BB	A	30	6"	4" NPT	80.2	35.7	44.5	5.4	7.0	85.0	252
385S400-5*	A	40	6"	4" NPT	85.3	40.8	44.5	5.4	7.0	90.1	276
385S400-6B	A	40	6"	4" NPT	90.4	40.8	49.6	5.4	7.0	95.2	285
385S500-6*	A	50	6"	4" NPT	107.4	57.8	49.6	5.4	7.0	112.2	285
385S500-7A	A	50	6"	4" NPT	113.0	57.8	55.2	5.4	7.0	117.8	450
385S600-7*	A	60	6"	4" NPT	119.0	63.8	55.2	5.4	7.0	123.8	450
385S600-8*	A	60	6"	4" NPT	124.0	63.8	60.2	5.4	7.0	128.8	459
385S750-9	A	75	8"	4" NPT	112.7	47.4	65.3	7.6	7.7	117.5	577
385S750-10	A	75	8"	4" NPT	117.7	47.4	70.3	7.6	7.7	122.5	586
385S1000-11	A	100	8"	4" NPT	130.3	54.91	75.4	7.6	7.7	135.1	672
385S1000-12	A	100	8"	4" NPT	135.3	54.91	80.4	7.6	7.7	140.1	701
385S1000-13	A	100	8"	4" NPT	140.3	54.91	85.4	7.6	7.7	145.1	709
Pipe Adapter	A									4.8	

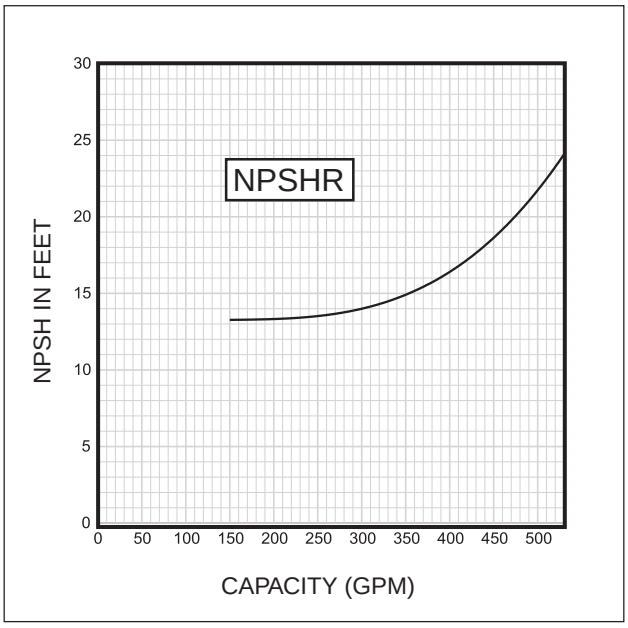
NOTES: All models suitable for use in 8" wells, unless otherwise noted.
Weights include pump end with motor in lbs.
*Alternate motor sizes available.
All models come with a standard 5"-4" Pipe Adapter. Refer to chart for dimensions.



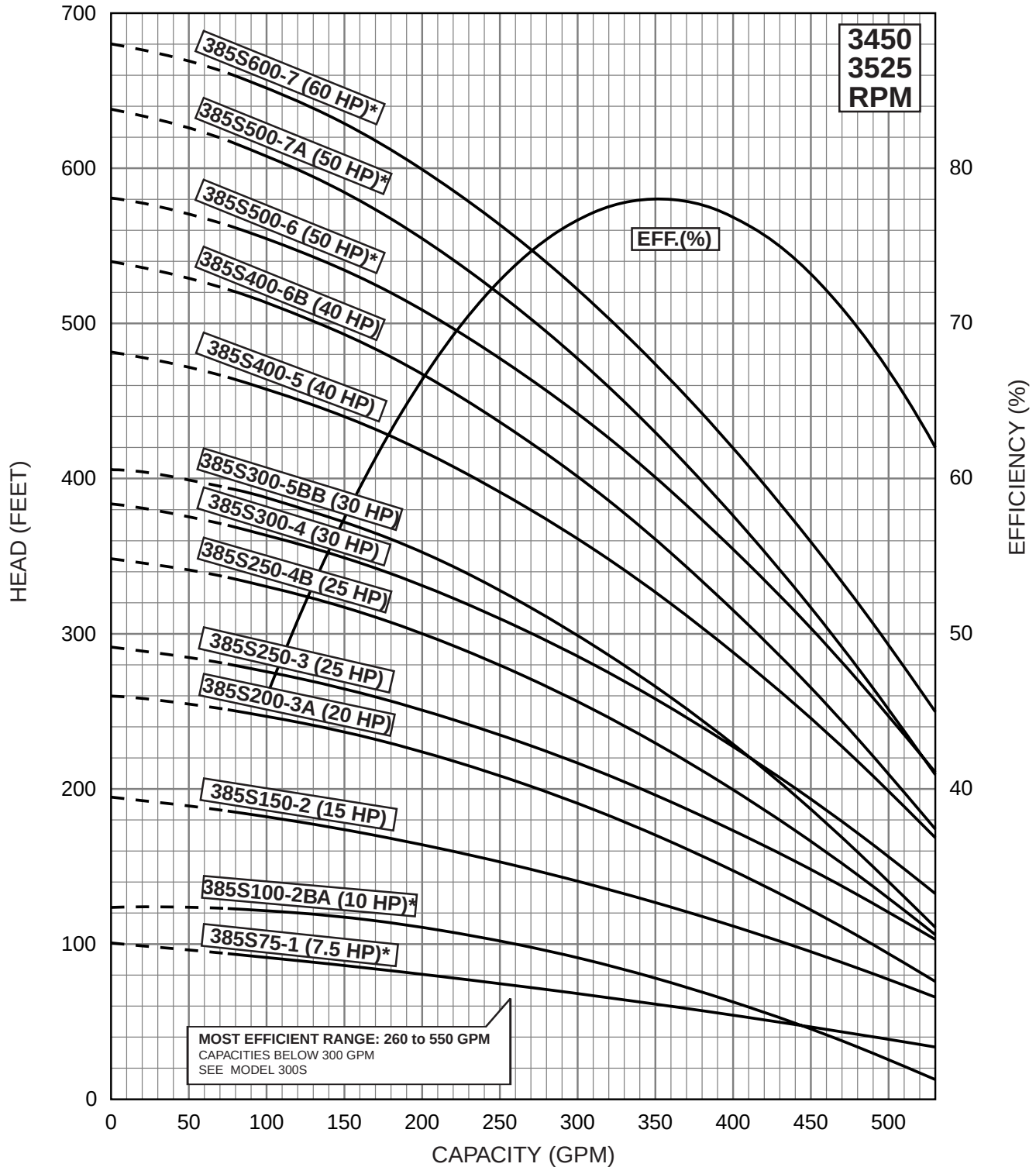
MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT (1-13 Stgs.)
Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Split Cone Nut	304 Stainless Steel
Split Cone	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	304 Stainless Steel
Coupling	316/329 Stainless Steel
Pump Shaft	431 Stainless Steel
Intermediate Bearings	NBR
Impeller Seal Ring	NBR/PPS
Lower Bearing	NBR/316 Stainless Steel
Upthrust Washer	Carbon/Graphite HY22
Upthrust stop ring	304 S.S./Tungsten Carbide
O-Ring	NBR
Valve Seat	304 Stainless Steel
Lower Valve Seat Retainer	316 Stainless Steel
Upper Valve Seat Retainer	304 Stainless Steel
Valve Guide	304 Stainless Steel
Valve Cup Spring	304 Stainless Steel

NOTES: Specifications are subject to change without notice.



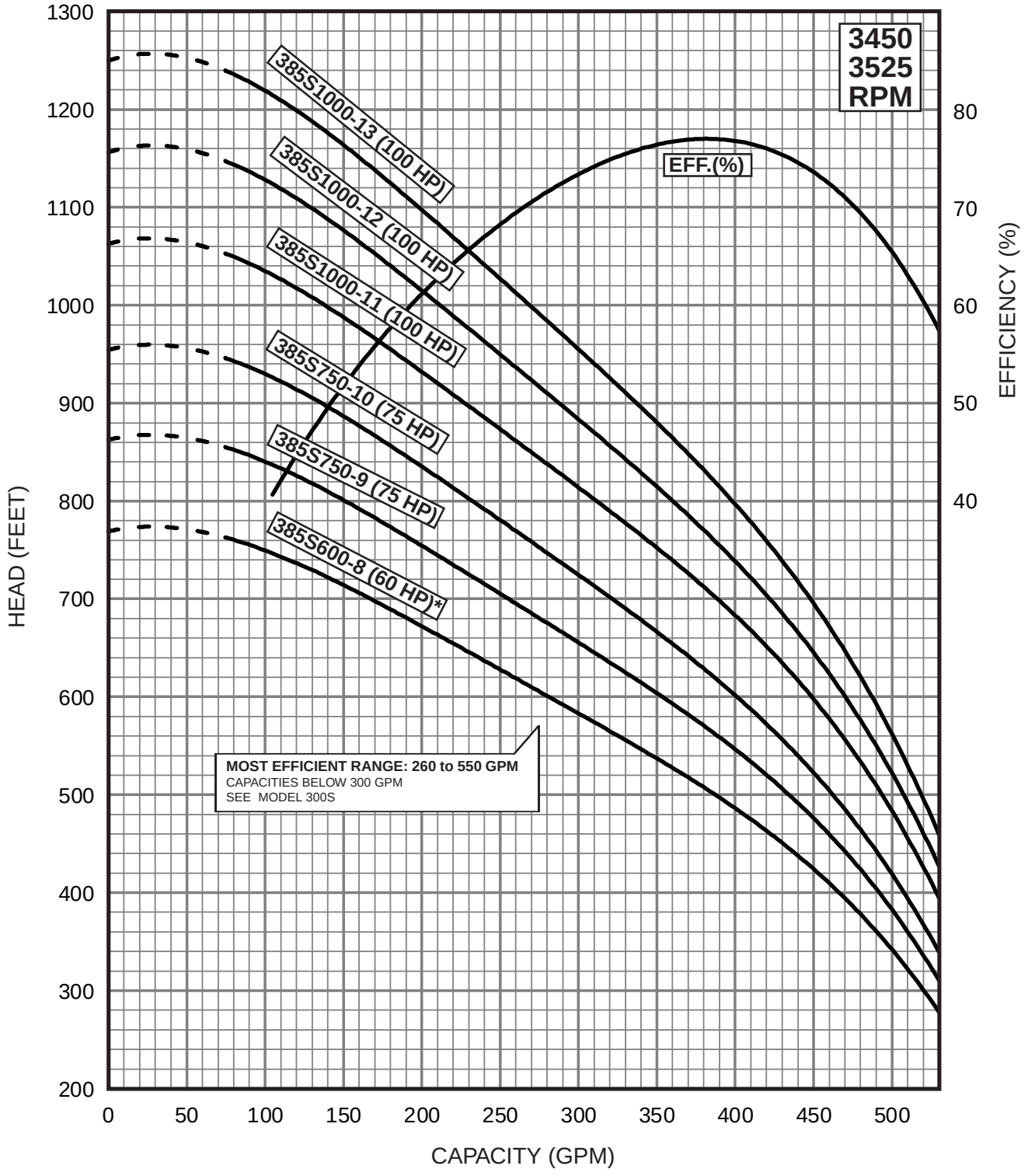
FLOW RANGE: 75 - 550 GPM **OUTLET SIZE: 4" NPT** **NOMINAL DIA. 8"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
6" MOTOR STANDARD, 7.5-60 HP/3450 RPM.
8" MOTOR STANDARD,75-100 HP/3525 RPM.
* Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 8 ft. min. submergence.

FLOW RANGE: 75 - 550 GPM **OUTLET SIZE: 4" NPT** **NOMINAL DIA. 8"**



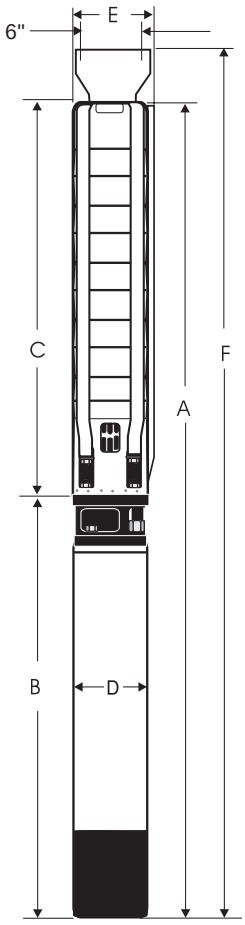
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
6" MOTOR STANDARD, 7.5-60 HP/3450 RPM.
8" MOTOR STANDARD,75-100 HP/3525 RPM.
* Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 8 ft. min. submergence.

DIMENSIONS AND WEIGHTS

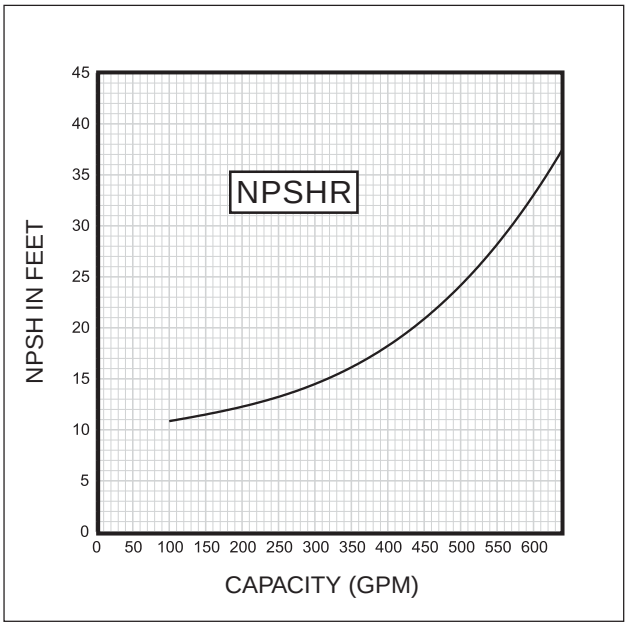
MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES						APPROX. SHIP WT.
					A	B	C	D	E	F	
475S75-1A	A	7.5	6"	6" NPT	48.5	24.2	24.3	5.4	7	54.6	161
475S100-1	A	10	6"	6" NPT	49.7	25.4	24.3	5.4	7	55.8	171
475S150-2B	A	15	6"	6" NPT	57.4	28.0	29.4	5.4	7	63.5	195
475S200-2	A	20	6"	6" NPT	60.0	30.6	29.4	5.4	7	66.1	210
475S250-3A	A	25	6"	6" NPT	67.5	33.1	34.4	5.4	7	73.6	230
475S300-3	A	30	6"	6" NPT	70.1	35.7	34.4	5.4	7	76.2	230
475S300-4AB	A	30	6"	6" NPT	75.2	35.7	39.5	5.4	7	81.3	295
475S400-4*	A	40	6"	6" NPT	80.3	40.8	39.5	5.4	7	86.4	328
475S500-5B*	A	40	6"	6" NPT	85.3	40.8	44.5	5.4	7	91.4	336
475S500-5*	A	50	6"	6" NPT	102.5	58.0	44.5	5.4	7	108.6	428
475S500-6A*	A	50	6"	6" NPT	108.1	58.0	50.1	5.4	7	114.2	437
475S600-6*	A	60	6"	6" NPT	111.8	61.7	50.1	5.4	7.0	117.9	403
475S600-7*	A	60	6"	6" NPT	116.9	61.7	55.2	5.4	7.0	123.0	467
475S750-8	A	75	8"	6" NPT	107.6	47.4	60.2	7.5	7.7	113.6	547
475S1000-9	A	100	8"	6" NPT	120.1	54.9	65.2	7.5	7.7	126.2	641
475S1000-10	A	100	8"	6" NPT	125.2	54.9	70.3	7.5	7.7	131.2	648
475S1000-11	A	100	8"	6" NPT	130.3	54.9	75.4	7.5	7.7	136.4	654
475S1250-12	A	125	8"	6" NPT	149.2	68.8	80.4	7.5	7.7	155.3	862
475S1250-13	A	125	8"	6" NPT	154.3	68.8	85.5	7.5	7.7	160.4	868
Pipe Adapter	A									6.1	

NOTES: All models suitable for use in 8" wells, unless otherwise noted.
Weights include pump end with motor in lbs.
*Alternate motors sizes available.
All models come with a standard 5"-6" Pipe Adapter refer to chart for dimensions.

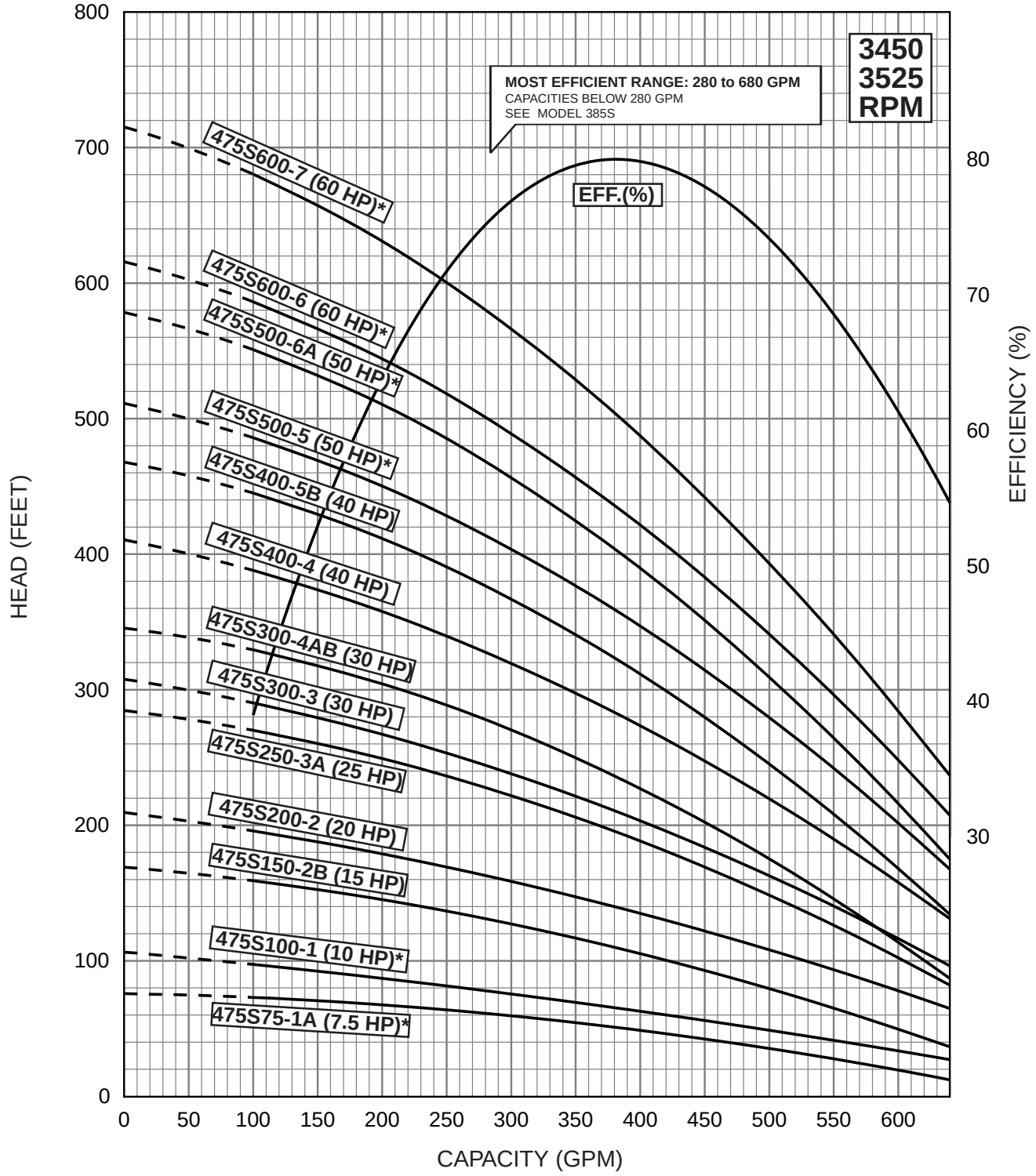


MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT (1-13 Stgs.)
Check Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Split Cone Nut	304 Stainless Steel
Split Cone	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	304 Stainless Steel
Coupling	316/329 Stainless Steel
Pump Shaft	431 Stainless Steel
Intermediate Bearings	NBR
Impeller Seal Ring	NBR/PPS
Check Valve Seat	NBR/316 Stainless Steel
Lower Bearing	NBR/316 Stainless Steel
Upthrust Washer	Carbon/Graphite HY22
Upthrust stop ring	304 S.S./Tungsten Carbide
O-Ring	NBR
Valve Seat	304 Stainless Steel
Lower Valve Seat Retainer	316 Stainless Steel
Upper Valve Seat Retainer	304 Stainless Steel
Valve Guide	304 Stainless Steel
Valve Cup Spring	304 Stainless Steel
NOTES: Specifications are subject to change without notice.	



FLOW RANGE: 95 - 680 GPM **OUTLET SIZE: 6" NPT** **NOMINAL DIA. 8"**

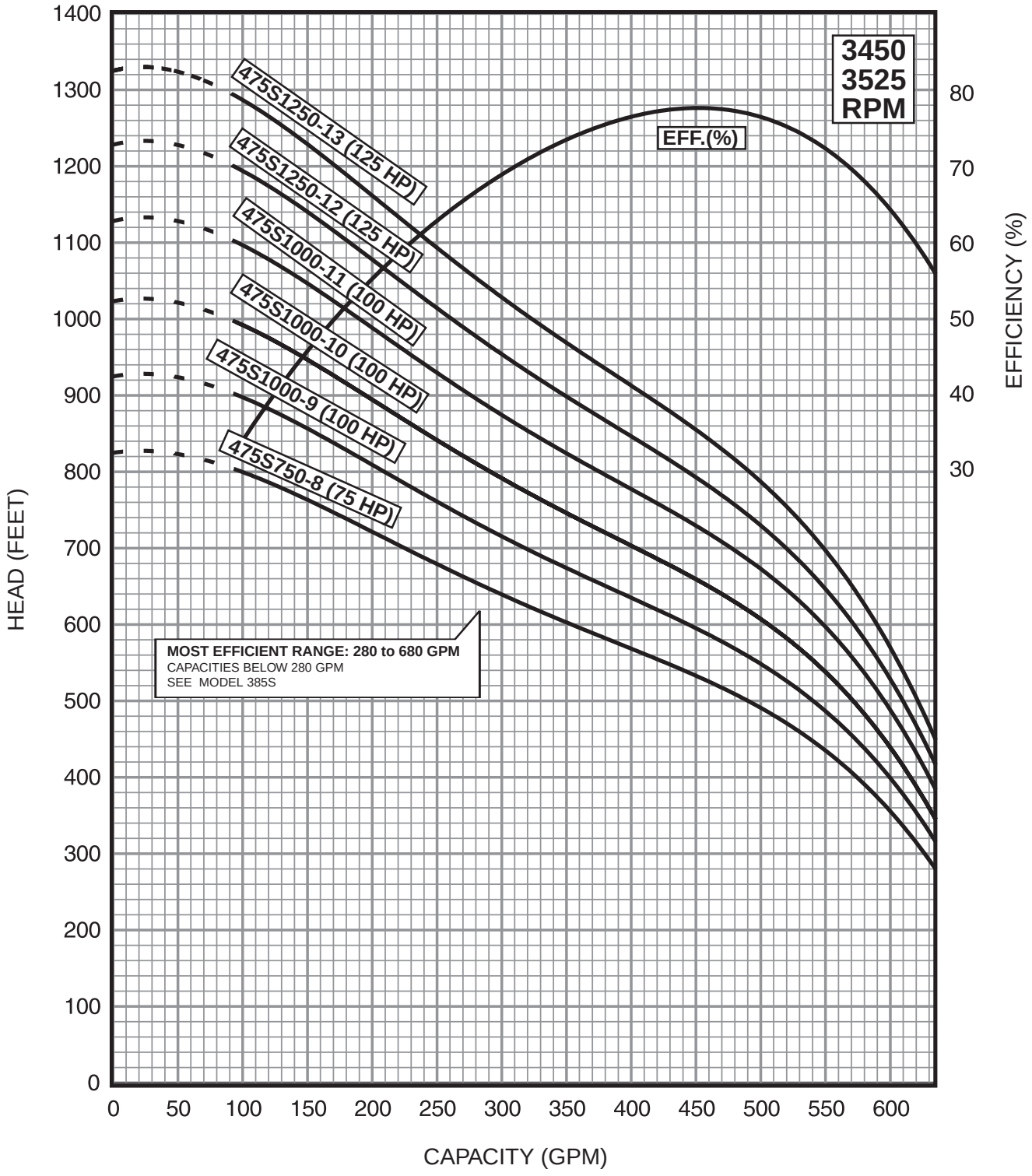


SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
6" MOTOR STANDARD, 10-60 HP/3450 RPM.
8" MOTOR STANDARD,75-125 HP/3525 RPM.
* Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 8 ft. min. submergence.

MODEL 475S 475 GPM PERFORMANCE CURVES

FLOW RANGE: 95 - 680 GPM **OUTLET SIZE: 6" NPT** **NOMINAL DIA. 8"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
6" MOTOR STANDARD, 10-60 HP/3450 RPM.
8" MOTOR STANDARD,75-125 HP/3525 RPM.
* Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 8 ft. min. submergence.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
625S150-1A	A	15	6"	6" NPT	50.6	25	25.6	5.4	8.3	208
625S250-1	A	25	6"	6" NPT	58.7	33.1	25.6	5.4	8.3	235
625S300-2AA	A	30	6"	6" NPT	63.8	32	31.8	5.4	8.3	296
625S400-2A	A	40	6"	6" NPT	66.2	34.4	31.8	5.4	8.3	307
625S400-2*	A	40	6"	6" NPT	66.2	34.4	31.8	5.4	8.3	320
625S500-3AA*	A	50	6"	6" NPT	93.6	55.7	37.9	5.4	8.3	415
625S600-3A*	A	60	6"	6" NPT	99.6	61.7	37.9	5.4	8.3	448
625S600-3*	A	60	6"	6" NPT	99.6	61.7	37.9	5.4	8.3	448
625S750-4AA	A	75	8"	6" NPT	91.4	47.4	44.0	7.5	8.6	560
625S750-4A	A	75	8"	6" NPT	91.4	47.4	44.0	7.6	8.6	560
625S1000-4	A	100	8"	6" NPT	98.9	54.9	44.0	7.6	8.6	638
625S1000-5AA	A	100	8"	6" NPT	105.0	54.9	50.1	7.6	8.6	661
625S1000-5A	A	100	8"	6" NPT	105.0	54.9	50.1	7.6	8.6	661
625S1000-5	A	100	8"	6" NPT	105.0	54.9	50.1	7.6	8.6	661
625S1250-6AA	A	125	8"	6" NPT	125.0	68.8	56.2	7.7	8.6	855
625S1250-6A	A	125	8"	6" NPT	125.0	68.8	56.2	7.7	8.6	855
625S1250-6	A	125	8"	6" NPT	125.0	68.8	56.2	7.7	8.6	855
625S1250-7AA	A	125	8"	6" NPT	131.2	68.8	62.4	7.7	8.6	890
625S1500-7A	A	150	8"	6" NPT	140.2	77.8	62.4	7.7	8.6	983
625S1500-7	A	150	8"	6" NPT	140.2	77.8	62.4	7.7	8.6	983

NOTES: All models suitable for use in 10" wells unless otherwise noted.
Weights include pump end with motor in lbs.
*Alternate motor sizes available.

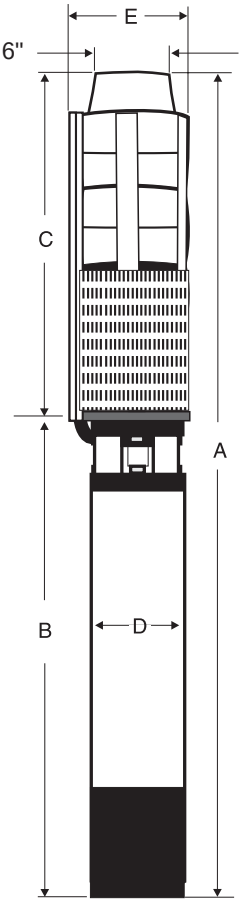
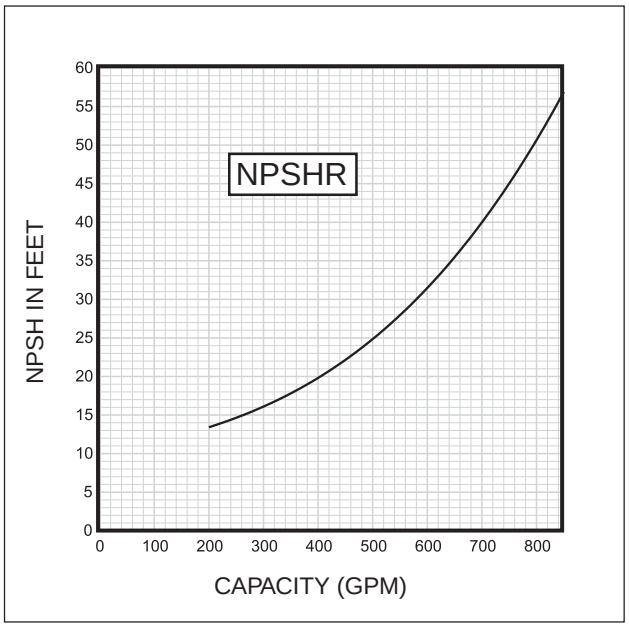


Fig. A

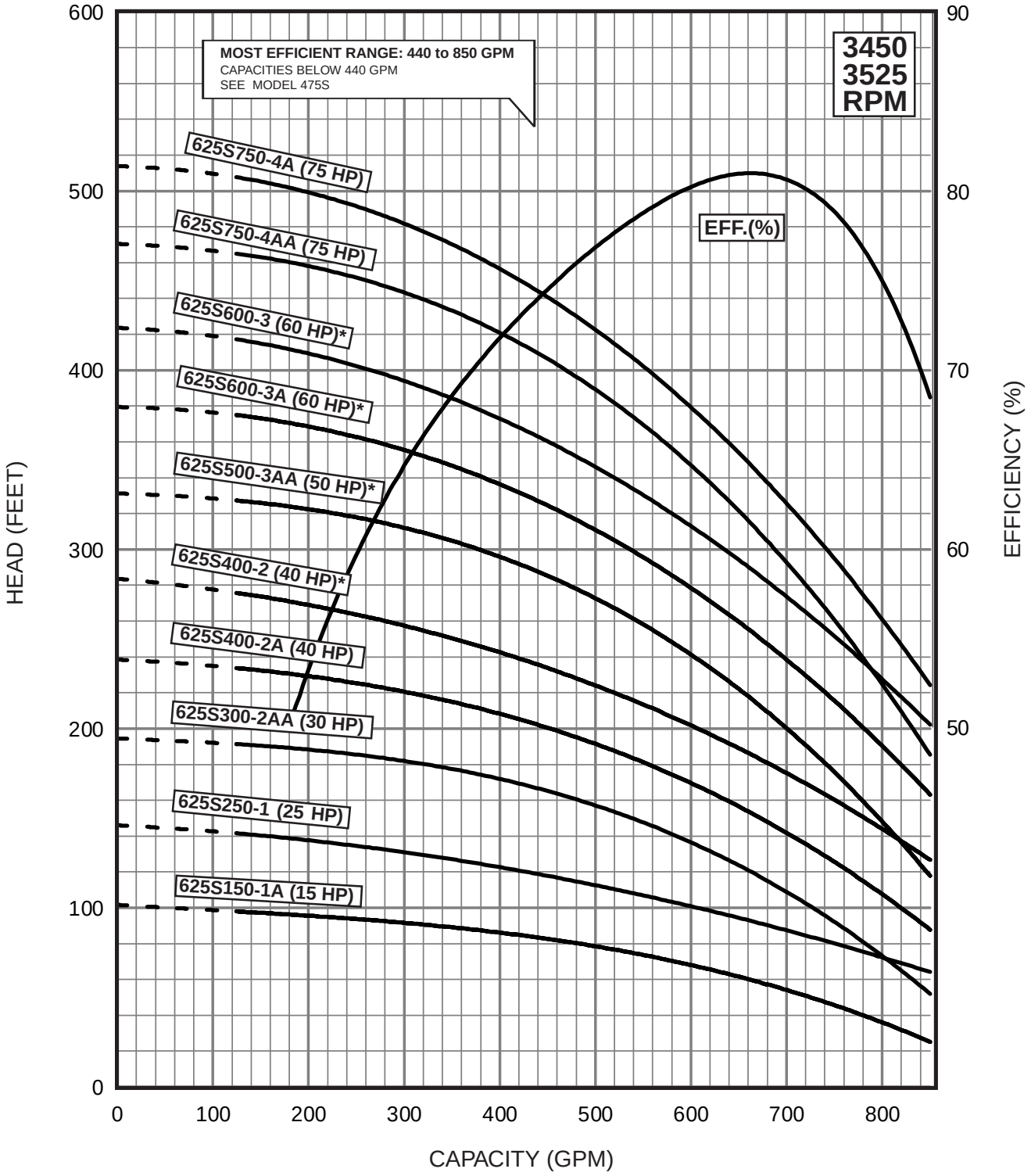
MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT (1-7 Stgs.)
Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Split Cone Nut	304 Stainless Steel
Split Cone	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	304 Stainless Steel
Coupling	316/329 Stainless Steel
Pump Shaft	431 Stainless Steel
Intermediate Bearings	NBR
Impeller Seal Ring	NBR/PPS
Check Valve Seat	NBR/316 Stainless Steel
Top Bearing	NBR/304 Stainless Steel
Upthrust Disc	Carbon/Graphite HY22
Check Valve Spring	401 Stainless Steel
O-Ring	NBR
Valve Seat	304 Stainless Steel
Lower Valve Seat Retainer	304 Stainless Steel
Upper Valve Seat Retainer	316 Stainless Steel
Valve Guide	304 Stainless Steel

NOTES: Specifications are subject to change without notice.



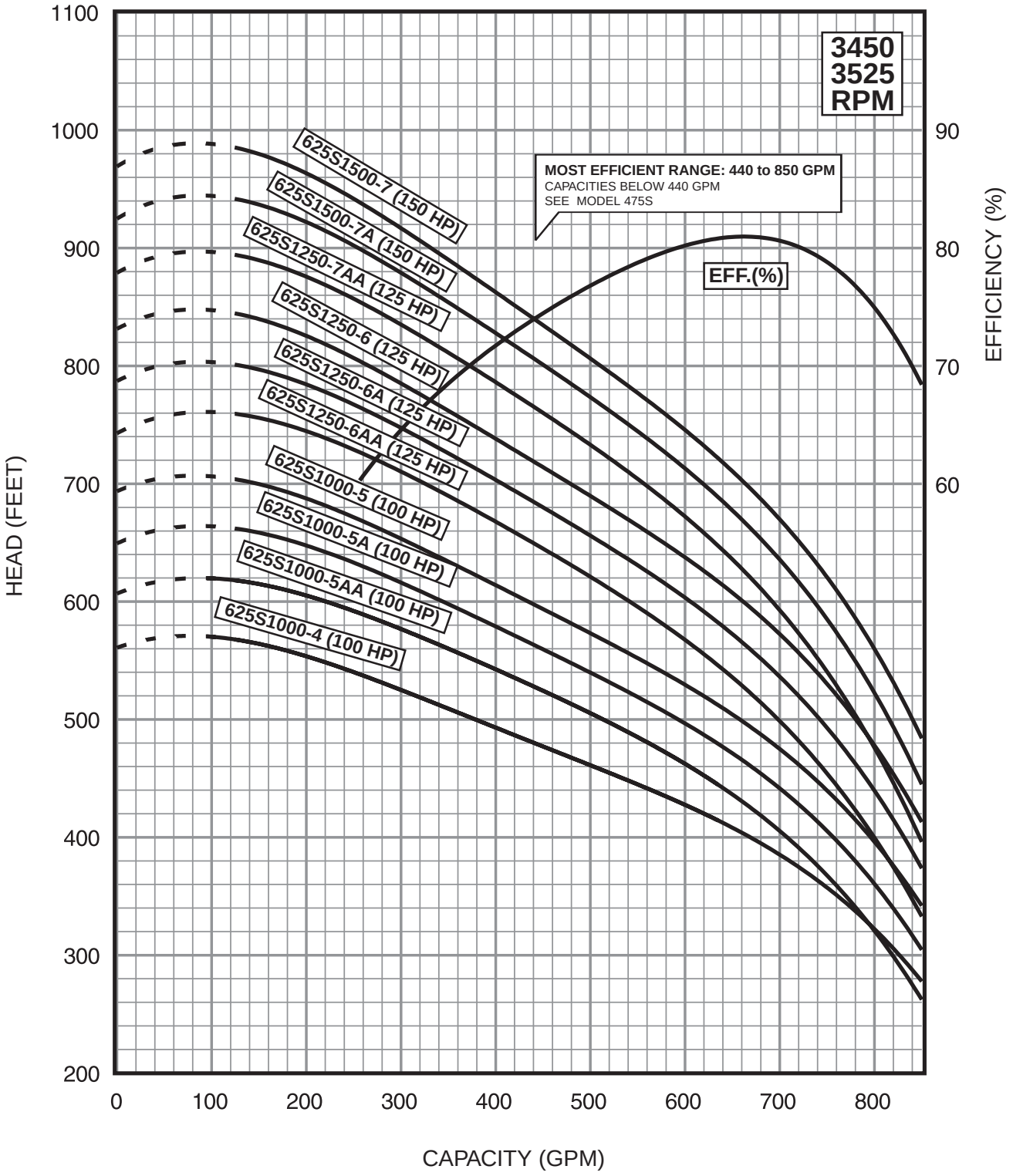
FLOW RANGE: 125 - 850 GPM **OUTLET SIZE: 6" NPT** **NOMINAL DIA. 10"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
6" MOTOR STANDARD,15-60 HP/3450 RPM.
8" MOTOR STANDARD, 75-150 HP/3525 RPM.
* Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 10 ft. min. submergence.

FLOW RANGE: 125 - 850 GPM **OUTLET SIZE: 6" NPT** **NOMINAL DIA. 10"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
6" MOTOR STANDARD,15-60 HP/3450 RPM.
8" MOTOR STANDARD, 75-150 HP/3525 RPM.
* Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 10 ft. min. submergence.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
800S200-1A	A	20	6"	6" NPT	53.1	27.5	25.6	5.4	8.3	219
800S300-1	A	30	6"	6" NPT	57.6	32.0	25.6	5.4	8.3	241
800S400-2AA*	A	40	6"	6" NPT	66.2	34.4	31.8	5.4	8.3	320
800S500-2A*	A	50	6"	6" NPT	87.5	55.7	31.8	5.4	8.3	402
800S500-2*	A	50	6"	6" NPT	87.5	55.7	31.8	5.4	8.3	402
800S600-3AA*	A	60	6"	6" NPT	99.6	61.7	37.9	5.4	8.3	448
800S400-2AA*	A	40	8"	6" NPT	66.2	34.4	31.8	7.5	8.6	459
800S500-2A*	A	50	8"	6" NPT	87.5	55.7	31.8	7.5	8.6	499
800S500-2*	A	50	8"	6" NPT	87.5	55.7	31.8	7.5	8.6	499
800S600-3AA*	A	60	8"	6" NPT	99.6	61.7	37.9	7.5	8.6	477
800S750-3A	A	75	8"	6" NPT	85.3	47.4	37.9	7.5	8.6	547
800S750-3	A	75	8"	6" NPT	85.3	47.4	37.9	7.5	8.6	547
800S1000-4AA	A	100	8"	6" NPT	98.9	54.9	44.0	7.5	8.6	635
800S1000-4A	A	100	8"	6" NPT	98.9	54.9	44.0	7.5	8.6	635
800S1000-4	A	100	8"	6" NPT	98.9	54.9	44.0	7.5	8.6	635
800S1250-5AA	A	125	8"	6" NPT	118.9	68.8	50.1	7.5	8.6	837
800S1250-5A	A	125	8"	6" NPT	118.9	68.8	50.1	7.7	8.6	837
800S1250-5	A	125	8"	6" NPT	118.9	68.8	50.1	7.7	8.6	837

NOTES: All models suitable for use in 10" wells, unless otherwise noted.
Weights include pump end with motor in lbs.
*Alternate motor sizes available.

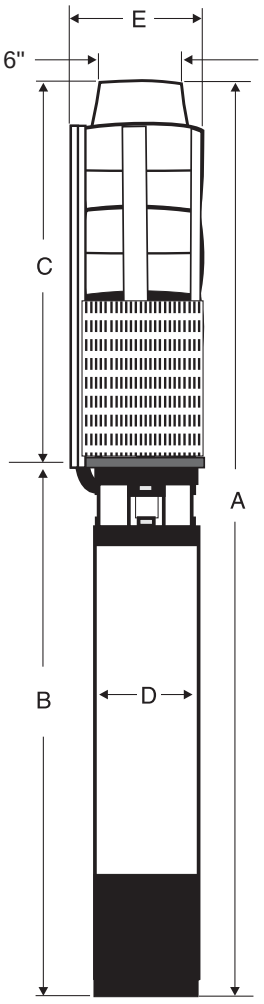
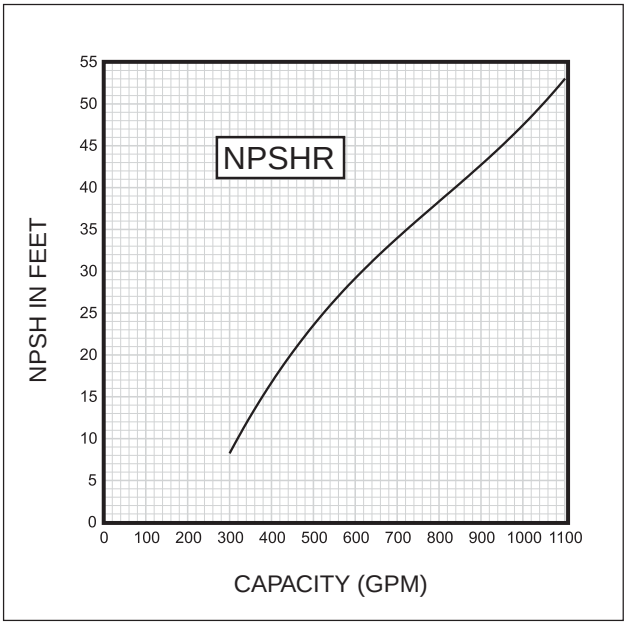


Fig. A

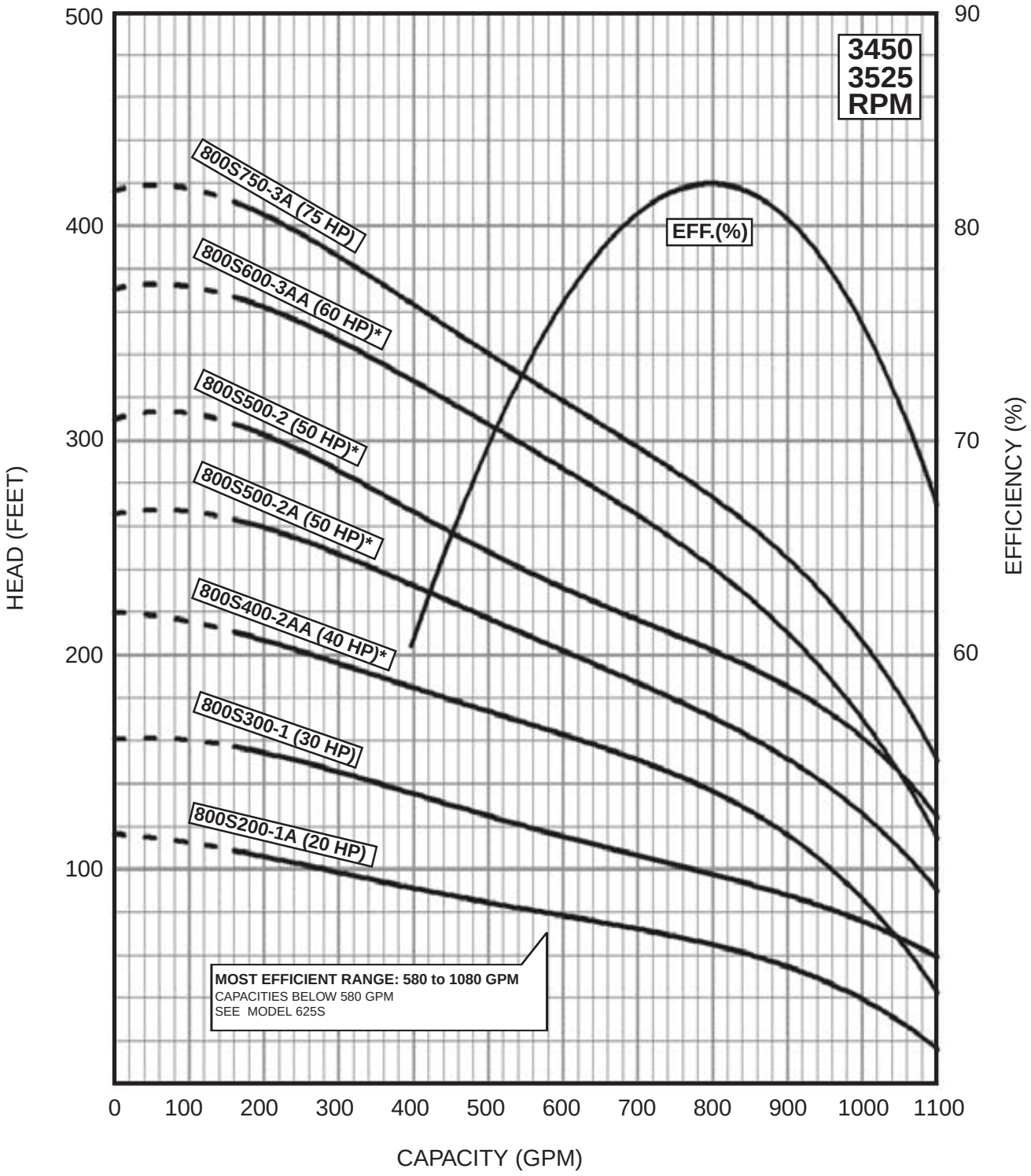
MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT
Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Split Cone Nut	304 Stainless Steel
Split Cone	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	316 Stainless Steel
Coupling	316/329 Stainless Steel
Pump Shaft	431 Stainless Steel
Intermediate Bearings	NBR
Impeller Seal Ring	NBR/PPS
Top Bearing	NBR/316 Stainless Steel
Upthrust Disc	Carbon/Graphite HY22
O-Ring	NBR
Valve Seat	304 Stainless Steel
Lower Valve Seat Retainer	316 Stainless Steel
Upper Valve Seat Retainer	304 Stainless Steel
Valve Guide	304 Stainless Steel
Valve Cup Spring	304 Stainless Steel

NOTES: Specifications are subject to change without notice.



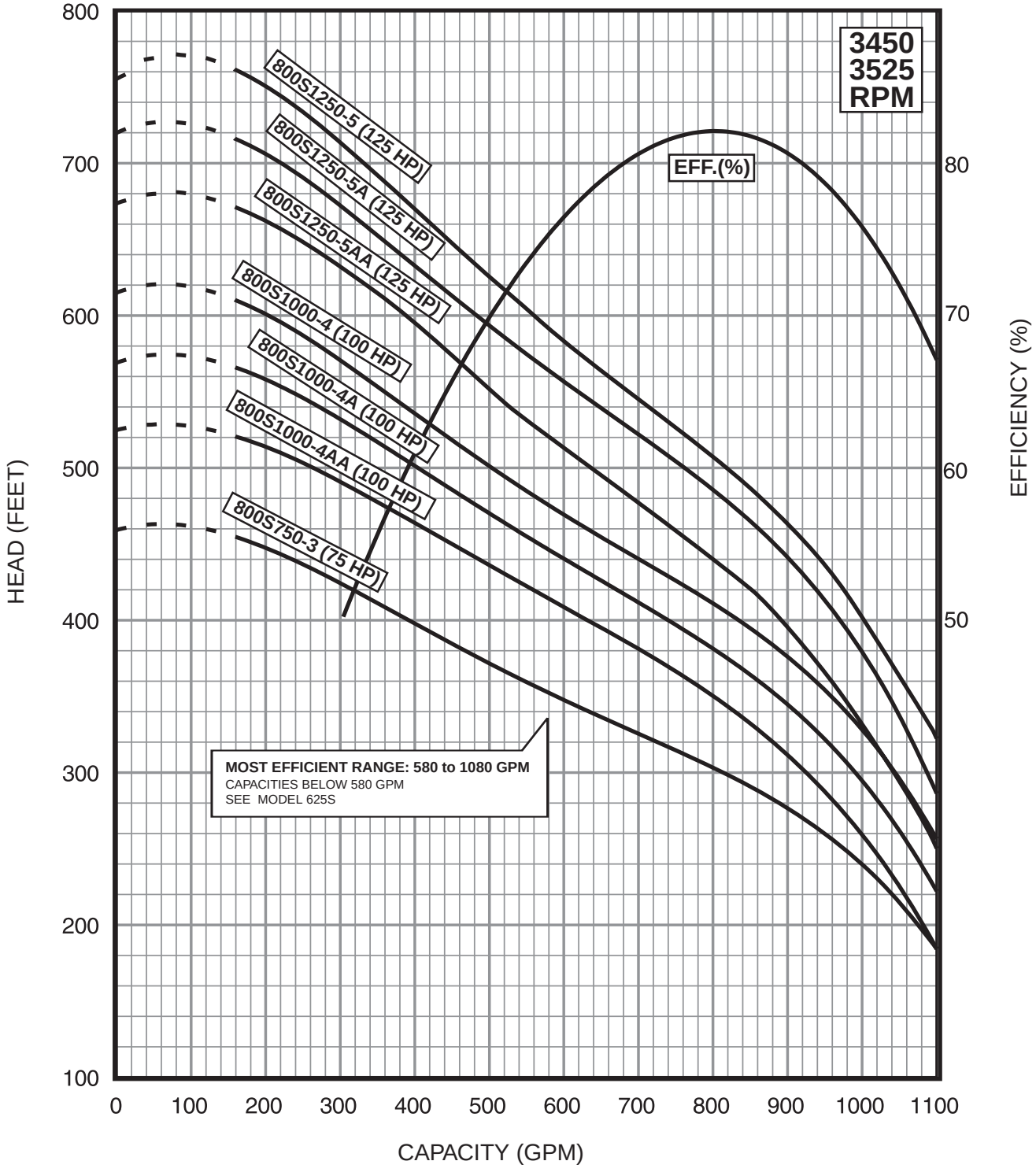
FLOW RANGE: 160 - 1100 GPM **OUTLET SIZE: 6" NPT** **NOMINAL DIA. 10"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
6" MOTOR STANDARD, 20-60 HP/3450 RPM.
8" MOTOR STANDARD, 75-125 HP/3525 RPM.
* Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 10 ft. min. submergence.

FLOW RANGE: 160 - 1080 GPM **OUTLET SIZE: 6" NPT** **NOMINAL DIA. 10"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
6" MOTOR STANDARD, 20-60 HP/3450 RPM.
8" MOTOR STANDARD, 75-125 HP/3525 RPM.
* Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 10 ft. min. submergence.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
1100S300-1A	A	30	6"	6" NPT	66.8	35.7	31.1	5.4	9.7	252
1100S400-1*	A	40	6"	6" NPT	68.3	37.2	31.1	5.4	9.7	276
1100S600-2AA*	A	60	6"	6" NPT	79.9	41.8	38.1	5.4	9.7	459
1100S750-2A	A	75	8"	6" NPT	85.5	47.4	38.1	7.6	9.7	558
1100S1000-2	A	100	8"	6" NPT	93.8	55.7	38.1	7.6	9.7	558
1100S1000-3AA	A	100	8"	6" NPT	100.8	55.7	45.1	7.6	9.7	657
1100S1250-3A	A	125	8"	6" NPT	102.1	57.0	45.1	7.7	9.7	836
1100S1250-3	A	125	8"	6" NPT	102.1	57.0	45.1	7.7	9.7	836
1100S1500-4AA	A	150	8"	6" NPT	129.8	77.8	52.0	7.7	9.7	1007
1100S1500-4A	A	150	8"	6" NPT	129.8	77.8	52.0	7.7	9.7	1007
1100S1750-4	A	175	8"	6" NPT	137.8	85.8	52.0	7.7	9.7	1007
1100S1750-5AA*	A	175	8"	6" NPT	144.7	85.8	58.9	7.7	9.7	1089
1100S1750-5A*+	A	175	8"	6" NPT	144.7	85.8	58.9	7.7	9.7	1089
1100S2000-5*+	A	200	8"	6" NPT	153.7	94.8	58.9	7.7	9.7	1197
1100S2500-6AA+	A	250	10"	6" NPT	145.2	79.5	65.7	9.1	10.9	1263
1100S2500-6A+	A	250	10"	6" NPT	145.2	79.5	65.7	9.1	10.9	1263
1100S2500-6+	A	250	10"	6" NPT	145.2	79.5	65.7	9.1	10.9	1263

NOTES: All models suitable for use in 10" wells, unless equipped with 10" motor.
Weights include pump end with motor in lbs.
* Alternate motor sizes available.
+ Designed to fit Hitachi® Motors.

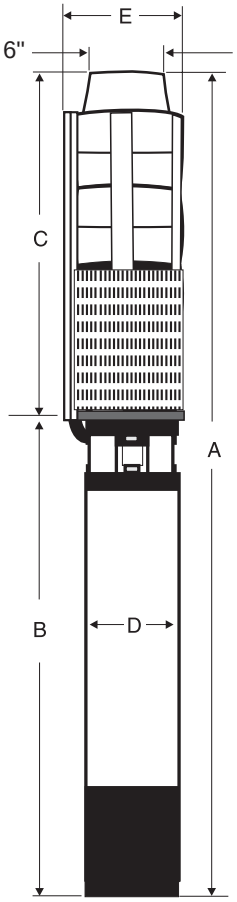
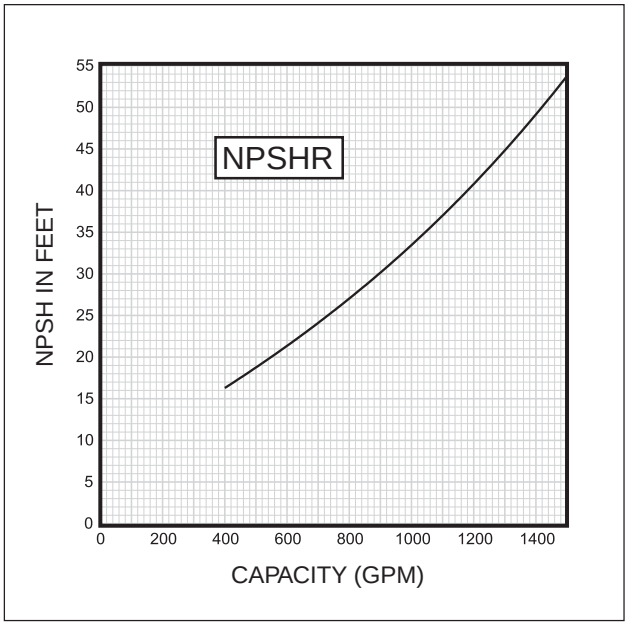


Fig. A

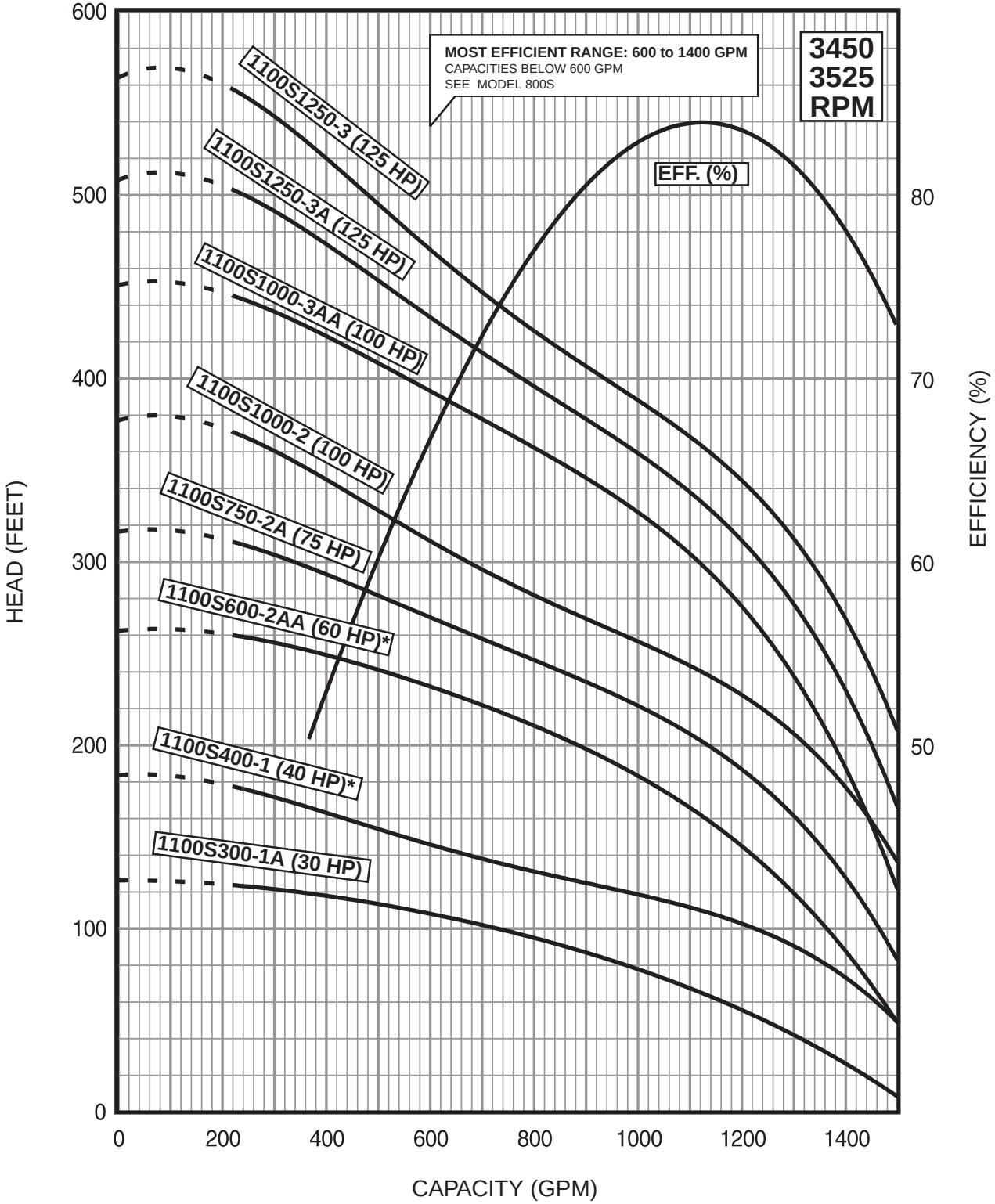
MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT
Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Split Cone Nut	304 Stainless Steel
Split Cone	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	316 Stainless Steel
Coupling	316/329 Stainless Steel*
Coupling Key	302/304 Stainless Steel**
Pump Shaft	431 Stainless Steel
Intermediate Bearings	NBR
Impeller Seal Ring	NBR/PPS
Top Bearing	NBR/316 Stainless Steel
Upthrust Disc	Carbon/Graphite HY22
O-Ring	NBR
Valve Seat	304 Stainless Steel
Lower Valve Seat Retainer	316 Stainless Steel
Upper Valve Seat Retainer	304 Stainless Steel
Valve Guide	304 Stainless Steel
Valve Cup Spring	304 Stainless Steel

NOTES: Specifications are subject to change without notice.
* 10" Coupling made of 329 Stainless Steel.
** Used in 10" motor coupling only.



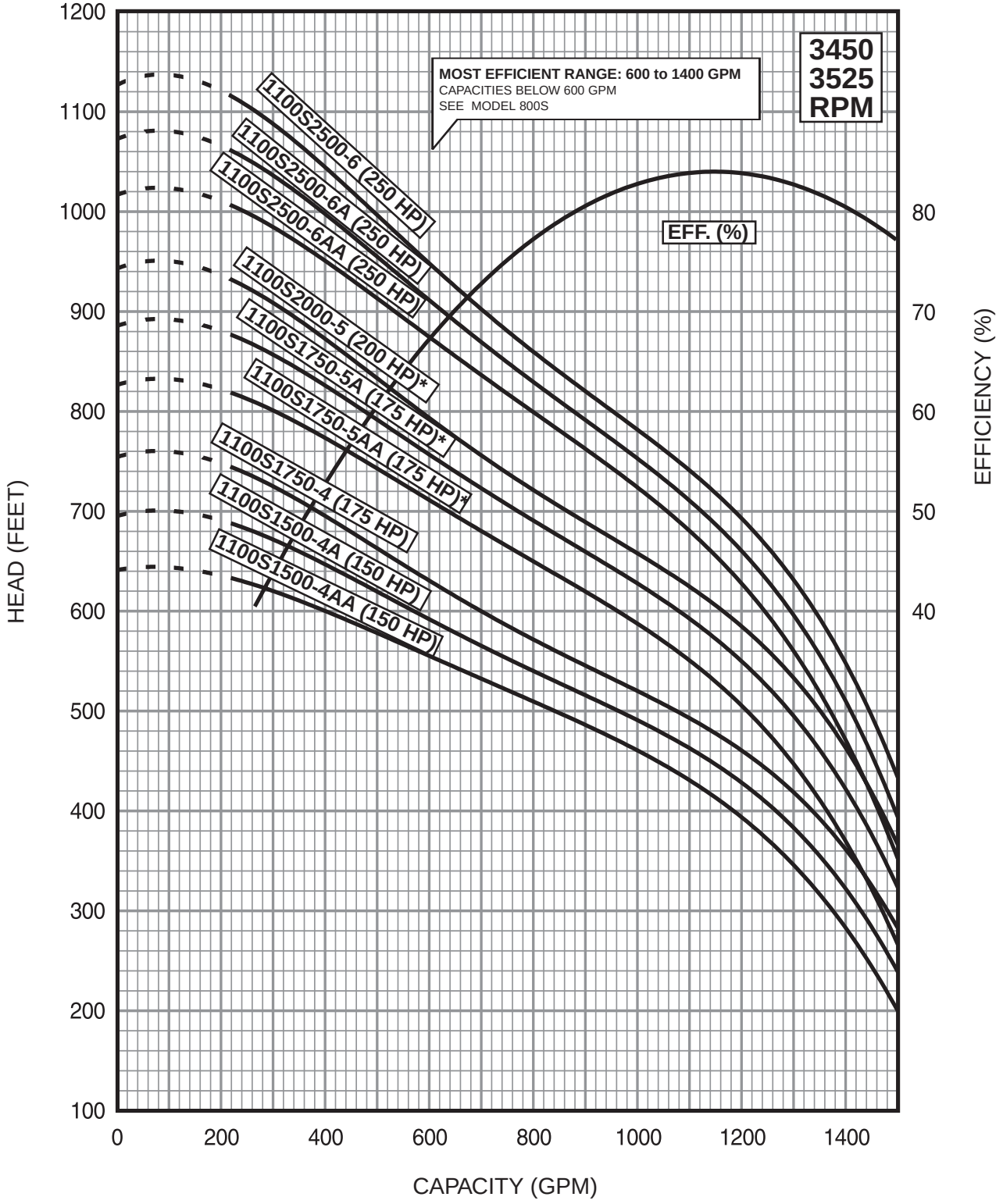
FLOW RANGE: 220 -1400 GPM **OUTLET SIZE: 6 " NPT** **NOMINAL DIA. 10"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
6" MOTOR STANDARD, 30-60 HP/3450 RPM.
8" MOTOR STANDARD, 75-200 HP/3525 RPM.
10" MOTOR STANDARD, 250 HP/3500 RPM.
* Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 10 ft. min. submergence.

FLOW RANGE: 220 -1400 GPM **OUTLET SIZE: 6 " NPT** **NOMINAL DIA. 10"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
6" MOTOR STANDARD, 30-60 HP/3450 RPM.
8" MOTOR STANDARD, 75-200 HP/3525 RPM.
10" MOTOR STANDARD, 250 HP/3500 RPM.
* Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 10 ft. min. submergence.

CONTROL BOX SA-SPM5

Enclosure

NEMA Type 3R rated suitable for outdoor mounting provided with mounting holes, progressive knockouts, and hinged door. 18 gauge steel construction with a gray colored epoxy coating provides great mechanical properties and corrosion protection.

Product Range

Provided in 115 VAC, 60 Hz, Single-phase for 1/3 HP and 1/2 HP motors.

Provided in 230 VAC, 60 Hz, single-phase for 1/3 HP, to 5 HP motors.

Internal wiring

Internal wire is 14 AWG, THHN, 105 degrees C, 600 VAC rated insulation.

Voltage relay

UL Recognized General Electric™ voltage relay.

Start capacitor

User friendly quick disconnect brackets for UL Recognized Mallory™ start capacitor.

Pull handle disconnect

The pull handle disconnect is available to break voltage between line/service voltage and the starting components and motor leads.

G111 & G231 PumpSaver

The **Model G111** fits inside 1/3 and 1/2 Hp 115V control boxes.
Model G231 fits inside 1/3, 1/2, 3/4, and 1 Hp 230V control boxes. The PumpSaver Model G111/231 is a current monitor designed to protect single phase pumps from dry well, dead head, jammed impeller, and over & under voltage conditions. Typical applications include residential waterwells, commercial water wells, irrigation wells, and golf course systems.

Features and benefits:

- Restart delay can be set up to 225 minutes or placed in manual reset mode.
- Can be calibrated to specific pump/motor combinations and various conditions.
- “Run Light” conveniently shows that the unit is functional.
- Fits in existing Grundfos control box – saving enclosure costs.
- Quick easy installation.

Made for pumps by pump experts

Simple set-up a priority
Simple installation and set-up was a major priority for the MP 204 designers. Mounting is done by means of four screws or by sliding the unit onto a mounting rail, and the entire set-up can be completed in just two minutes. The simple menu is used to set four parameters: rated motor amps, nominal voltage, trip class, and no. of motor phases. After just 120 seconds of setting, the unit is ready to go.

Electronic pump protection made simple
Submersible motors are made to be very strong indeed. But that does not mean they cannot benefit from extra protection that prolongs their lifetime and safeguards them against external threats. That is why we created the new MP 204 motor protection unit. Made especially for pump motors by pump specialists, it was designed to bring you protection that is as simple to use as it is efficient. Our engineers crammed it full of all the protection features you need – but kept it easy to install, set, and use.

Protect your motors against external threats
The MP 204 protects pump motors against undervoltage, overvoltage and other variations in power supply. So even if your external power supply is not entirely steady, your SP pump will remain as reliable as ever. Very importantly, the extra protection also reduces wear, thereby prolonging the motor's lifespan. Reduced power consumption is a strong indication that the pump is about to run dry, so the MP 204 will immediately stop the pump if the well goes dry.

Access more functions with the R 100 remote control

R 100 remote

The R 100 remote control from Grundfos gives you access to even more options. For example, you can adjust factory settings, carry out service and troubleshooting, and get read-outs of data stored in the MP 204 unit.

Technical data – MP 204

• Enclosure class:	NEMA 1 (IP 20)
• Ambient temperature:	-4°F to 140°F (-20°C to 60°C)
• Relative humidity:	99%
• Voltage range:	80-610VAC
• Current range:	3-999A
• Frequency:	47 – 63 Hz
• IEC trip class:	1 – 45
• Special Grundfos trip class:	0.1 – 30 s
• Voltage variations:	-25/+15% of nominal voltage
• Approvals:	EN 60947, EN 60355, UL/CSA 508
• Marking:	SE, cUL, C-tick

* For currents above 120A, external transformers required

Monitoring parameters

- Insulation resistance before start-up
- Temperature (Tempcon, PT sensor and PTC/thermal switch)
- Overload / underload
- Overvoltage / undervoltage
- Phase sequence
- Phase missing
- Power factor (cos φ)
- Power consumption
- Harmonic distortion
- Current asymmetry
- Run and start capacitor (single-phase)
- Operating hours and number of starts

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

GRUNDFOS Single Phase Lightning Arrestor
(Optional accessory for surge protection in single phase submersible motors.)

Part No. 825017

GRUNDFOS Three Phase Lightning Arrestor

All Ratings
Part No. 825045

Parallel Pipe Ejector/Foot Valve

EJECTOR	FOR USE WITH	HP	NOM. DEPTH	MIN. WELL DIA.	PRESSURE CONNECT	SUCTION CONNECT	ORDER NO.
5050	JS-5	1/2	50'	4"	1"	11/4"	465118
5100	JS-5	1/2	100'	4"	1"	11/4"	465119
7050	JS-7	3/4	50'	4"	1"	11/4"	465120
7100	JS-7	3/4	100'	4"	1"	11/4"	465121
10050	JS-10	1	50'	4"	1"	11/4"	465136
10100	JS-10	1	100'	4"	1"	11/4"	465137

GRUNDFOS Three Inch Stainless Steel Well Seal

Part No.	Part Name
1B5102	Well Seal

Part 1 – INTRODUCTION

Part 2 – CABLE SELECTION

Part 3 – MISC. TECHNICAL DATA, FORMULAS, AND CONVERSIONS

PART 1: INTRODUCTION

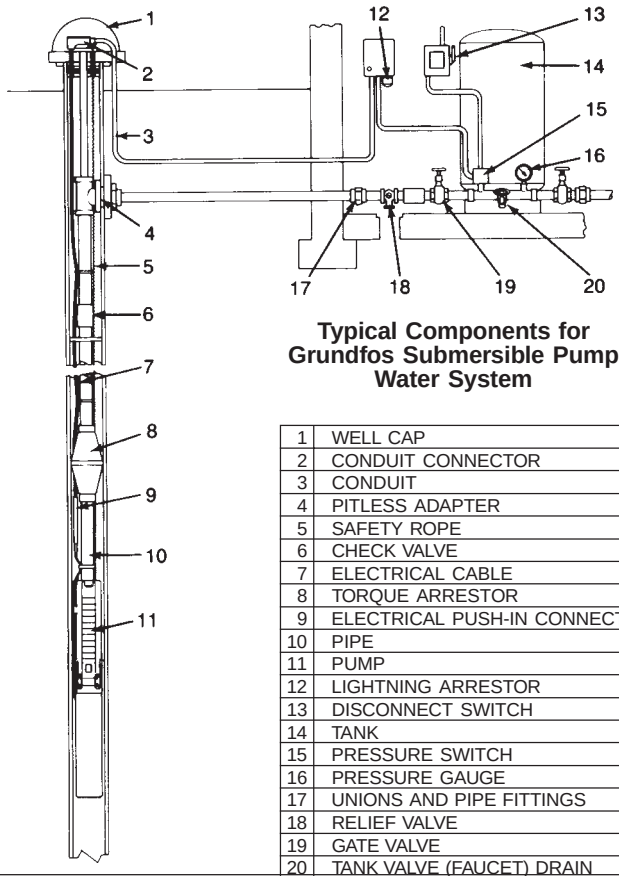
General

This section will provide the technical information needed to properly select GRUNDFOS groundwater products. The information applies primarily to domestic groundwater systems using 4-inch wells with submersible or jet pumps, pressure tanks, and accessories. It is important to be familiar with typical system components and their basic hydraulic principles to ensure a better understanding of the more technical information found later in this section.

Prior to selecting the pump, the basic system requirements must be determined. System capacity and system pressure must be calculated and friction losses determined to ensure proper system performance. These calculations are covered in detail in **Part 1.** In **Part 2**, information is provided on proper cable selection. Also provided in **Part 3** are miscellaneous technical data and formulas commonly used in the selection of domestic groundwater systems.

Typical System Components

Domestic groundwater systems are made up of a pump, storage tank, and accessories to operate the system automatically. Pumps are generally of the submersible or jet variety and include the pump and motor as a unit. Refer to Figure 8-A for the components found in a typical automatic groundwater pumping system.



Typical Components for Grundfos Submersible Pump Water System

1	WELL CAP
2	CONDUIT CONNECTOR
3	CONDUIT
4	PITLESS ADAPTER
5	SAFETY ROPE
6	CHECK VALVE
7	ELECTRICAL CABLE
8	TORQUE ARRESTOR
9	ELECTRICAL PUSH-IN CONNECTOR
10	PIPE
11	PUMP
12	LIGHTNING ARRESTOR
13	DISCONNECT SWITCH
14	TANK
15	PRESSURE SWITCH
16	PRESSURE GAUGE
17	UNIONS AND PIPE FITTINGS
18	RELIEF VALVE
19	GATE VALVE
20	TANK VALVE (FAUCET) DRAIN

FIGURE 8-A
Components found in a typical automatic groundwater pumping system including a submersible pump, pressure tank, and pressure control accessories.

In a ***closed, automatic water system*** a pressure tank is used to store water and maintain system pressure between specified limits (such as 30 to 50 psi). As the water level in the tank rises, tank air is compressed in the upper part of the tank until the upper pressure limit is reached (i.e., 50 psi). At this “cut-out” point a pressure switch opens the electrical circuit to the motor and the pump stops.

The compressed air in the tank acts like a spring pushing down on the water to create system pressure. When a valve is opened in the water system, the air pressure in the upper part of the tank forces the water to flow out of the tank and into the system. As the water is drawn from the tank, the air occupies a larger space and the pressure drops until the lower limit is reached (i.e., 30 psi). At this “cut-in” point the pressure switch closes the electrical circuit to the motor and the pump starts. A cycle is thereby completed.

In an ***open, automatic water system*** the pump is used to fill a large, elevated storage tank which utilizes gravity to maintain system pressure. Tank level controls are used to cycle the pump to maintain water levels within prescribed limits.

Refer to the following illustrations for schematic layouts of typical domestic groundwater systems and components: Figure 8-B (Submersible Pump - Closed System), Figure 8-C (Submersible Pump - Open System), Figure 8-D (Shallow Well Jet Pump), and Figure 8-E (Deep Well Jet Pump).

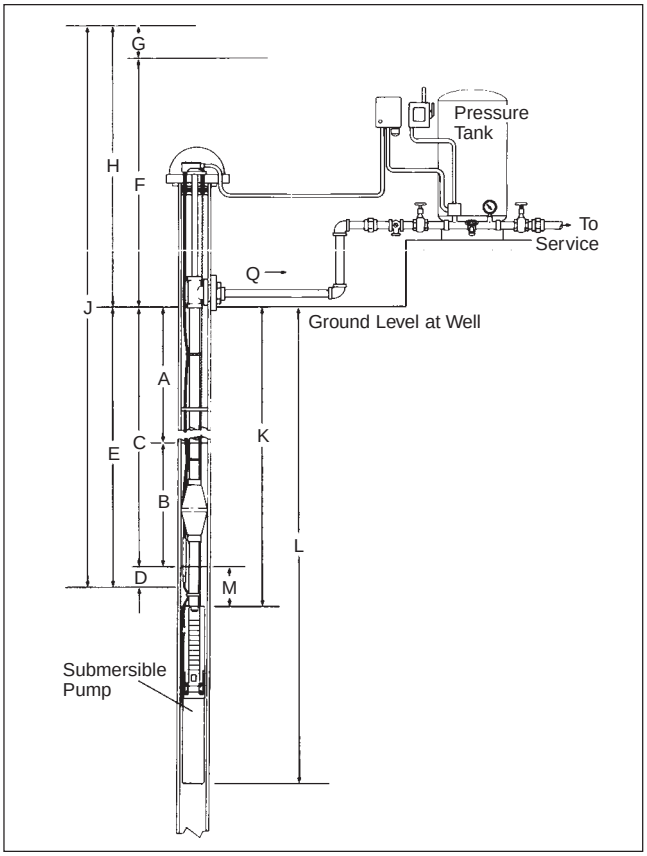


FIGURE 8-B
Figure 8-B illustrates a schematic layout of a CLOSED goundwater pumping system using a submersible pump and pressure tank set for automatic operation. A pressure switch controls the cycling of the pump.

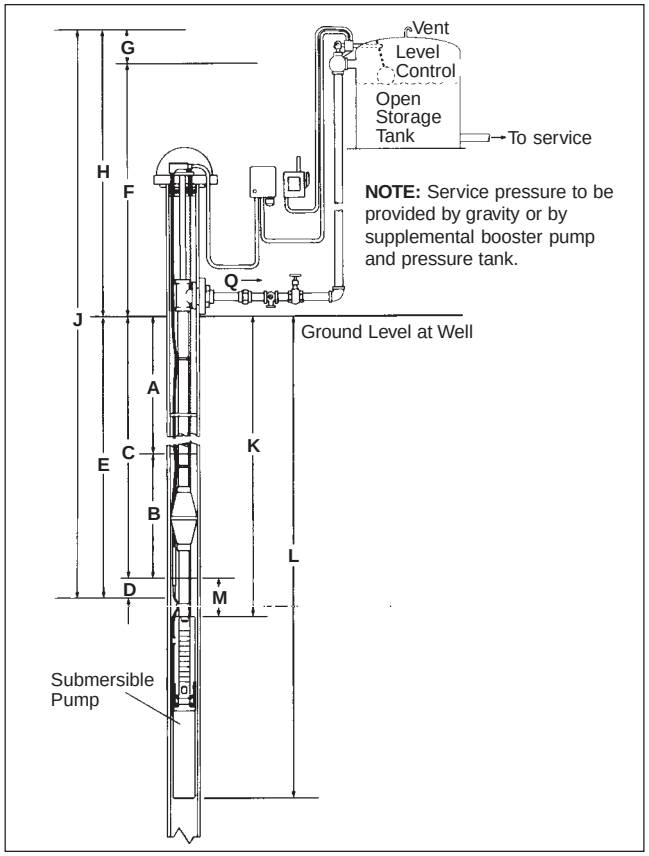


FIGURE 8-C
Figure 8-C illustrates a schematic layout of an OPEN groundwater pumping system using a submersible pump and an elevated storage tank set for automatic operation. A level control on the storage tank controls the cycling of the pump.

Closed Groundwater System with Submersible Pump

- **A. STATIC WATER LEVEL (in feet):** vertical distance from the top of the well to the standing water level or water table.
- **B. DRAWDOWN (in feet):** reduction in the water level during pumping (varies with well yield and pump capacity).
- **C. PUMPING WATER LEVEL or LIFT (in feet):** C = A + B.
- **D. FRICTION LOSSES in the WELL (in feet):** friction losses caused by the drop pipe and fittings between the pump and the top of the well.
- **E. TOTAL LIFT in the WELL (in feet):** E = A + B + D.
- **F. STATIC DISCHARGE HEAD (in feet):** for PRESSURE TANK SYSTEMS it is the elevation rise in feet of the pressure tank, discharge nozzles, etc., above the top of the well plus the pressure (in feet) required at that level.
- **G. FRICTION LOSSES in the DISCHARGE SYSTEM (in feet):** friction losses caused by piping, valves, and fittings between the top of the well and the point of discharge.
- **H. TOTAL DISCHARGE HEAD (in feet):** H = F + G.
- **J. TOTAL PUMPING HEAD (in feet):** J = E + H.
- **K. SETTING OF PUMP (in feet):** vertical distance from the top of the well to the top of the pump.
- **L. OVERALL LENGTH (in feet):** vertical distance from the top of the well to the bottom of the pump.
- **M. SUBMERGENCE (in feet):** M = K - C.
- **Q. CAPACITY (in gpm or gph):** rate of pumping.

Open Groundwater System with Submersible Pump

- **A. STATIC WATER LEVEL (in feet):** vertical distance from the top of the well to the standing water level or water table.
- **B. DRAWDOWN (in feet):** reduction in the water level during pumping (varies with well yield and pump capacity).
- **C. PUMPING WATER LEVEL or LIFT (in feet):** C = A + B.
- **D. FRICTION LOSSES in the WELL (in feet):** friction losses caused by the drop pipe and fittings between the pump and the top of the well.
- **E. TOTAL LIFT in the WELL (in feet):** E = A + B + D.
- **F. STATIC DISCHARGE HEAD (in feet):** for OPEN DISCHARGE SYSTEMS it is the elevation of the highest water level above the top of the well.
- **G. FRICTION LOSSES in the DISCHARGE SYSTEM (in feet):** friction losses caused by piping, valves, and fittings between the top of the well and the point of discharge.
- **H. TOTAL DISCHARGE HEAD (in feet):** H = F + G.
- **J. TOTAL PUMPING HEAD (in feet):** J = E + H.
- **K. SETTING OF PUMP (in feet):** vertical distance from the top of the well to the top of the pump.
- **L. OVERALL LENGTH (in feet):** vertical distance from the top of the well to the bottom of the pump.
- **M. SUBMERGENCE (in feet):** M = K - C.
- **Q. CAPACITY (in gpm or gph):** rate of pumping.

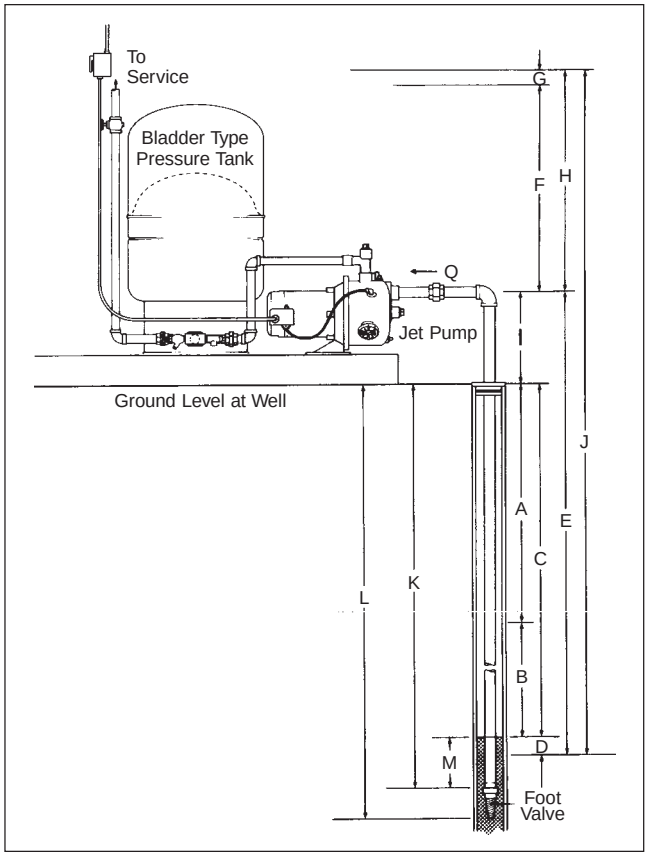


FIGURE 8-D
Figure 8-D illustrates a schematic layout of a SHALLOW WELL groundwater pumping system using a shallow well JET PUMP designed for setting to 25 feet. The pressure tank is set for automatic operation with a pressure switch controlling the cycling of the pump.

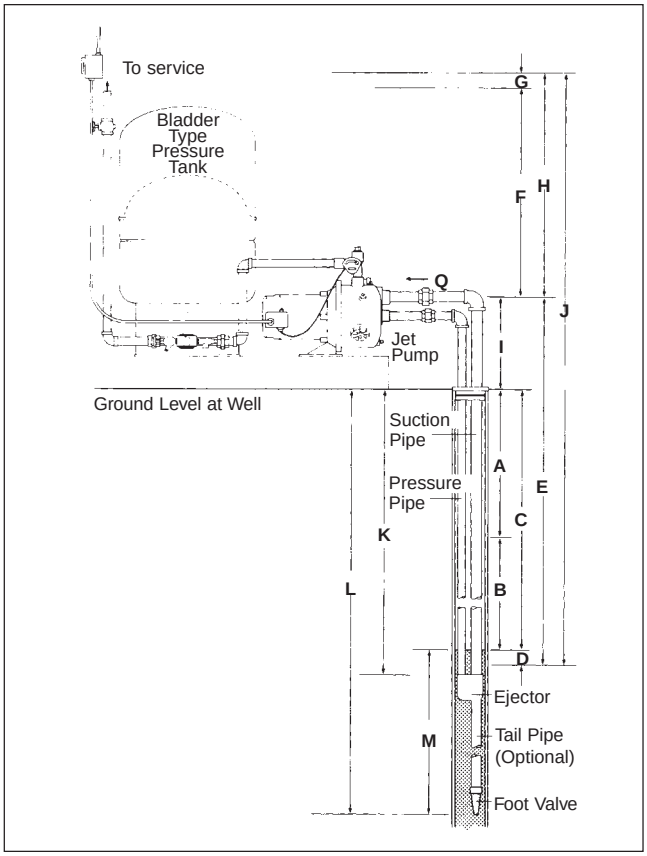


FIGURE 8-E
Figure 8-E illustrates a schematic layout of an DEEP WELL groundwater pumping system using a deep well JET PUMP designed for settings to 100 feet. The pressure tank is set for automatic operation with a pressure switch controlling the cycling of the pump.

CLOSED GROUNDWATER SYSTEM WITH SHALLOW WELL JET PUMP

A. Statics Water Level (in feet): vertical distance from the top of the well to the standing water level or water table.

B. Drawdown (in feet): reduction in the water level during pumping (varies with well yield and pump capacity).

C. Pumping Water Level or Lift (in feet): C = A + B.

D. Friction Losses in the Suction System (in feet): friction losses caused by suction piping between the pump and foot valve.

E. Total Suction Lift (in feet): E = A + B + D + I.

F. Static Discharge Head (in feet): for *Pressure Tanks Systems* it is the elevation rise in feet of the pressure tank, discharge nozzles, etc., above the pump plus the pressure (in feet) discharge nozzles, etc., above the pump plus the pressure (in feet) required at that level. For *Open Discharge Systems* it is the elevation in feet of the highest water level above the pump.

G. Friction Losses in the Discharge System (in feet): friction losses caused by piping, valves, and fittings between the top of the well and the point of discharge.

H. Total Discharge Head (in feet): H = F + G.

I. Elevation of the Pump above the Top of the Well (in feet).

J. Total Pumping Head (in feet): J = E + H.

K. Setting of the Foot Valve or Strainer (in feet): vertical distance from the top of the well to the top of the foot valve or strainer.

L. Overall Length (in feet): vertical distance from the top of the well to the bottom of the foot valve or strainer.

M. Submergence (in feet): M = K - C.

Q. Capacity (in gpm or gph): rate of pumping.

CLOSED GROUNDWATER SYSTEM WITH SHALLOW WELL JET PUMP

A. Static Water Level (in feet): vertical distance from the top of the well to the standing water level or water table.

B. Drawdown (in feet): reduction in the water level during pumping (varies with well yield and pump capacity).

C. Pumping Water Level or Lift (in feet): C = A + B.

D. Friction Losses in the Suction System (in feet): friction losses caused by suction piping between the pump and foot valve.

E. Total Suction Lift (in feet): E = A + B + D + I.

F. Static Discharge Head (in feet): for PRESSURE TANK SYSTEMS it is the elevation rise in feet of the pressure tank, discharge nozzles, etc., above the pump plus the pressure (in feet) discharge nozzles, etc., above the pump plus the pressure (in feet) required at that level. For OPEN DISCHARGE SYSTEMS it is the elevation in feet of the highest water level above the pump.

G. Friction Losses in the Discharge System (in feet): friction losses caused by piping, valves, and fittings between the top of the well and the point of discharge.

H. Total Discharge Head (in feet): H = F + G.

I. Elevation of the Pump above the Top of the Well (in feet).

J. Total Pumping Head (in feet): J = E + H.

K. Setting of the Foot Valve or Strainer (in feet): vertical distance from the top of the well to the top of the foot valve or strainer.

L. Overall Length (in feet): vertical distance from the top of the well to the bottom of the foot valve or strainer.

M. Submergence (in feet): M=K–C. The ejector should be set as close to the bottom of its maximum depth rating as the well will permit.

Q. Capacity (in gpm or gph): rate of pumping.

Head and Pressure

Head and pressure are related in a very simple and direct manner. Since water has known weight, we know that a 231 foot long, one-inch square pipe holds 100 pounds of water. At the bottom of the one-inch square pipe we refer to the pressure as 100 pounds per square inch (psi). For any diameter pipe 231 feet high, the pressure will always be 100 psi at the bottom. Refer to Figure 8-F.

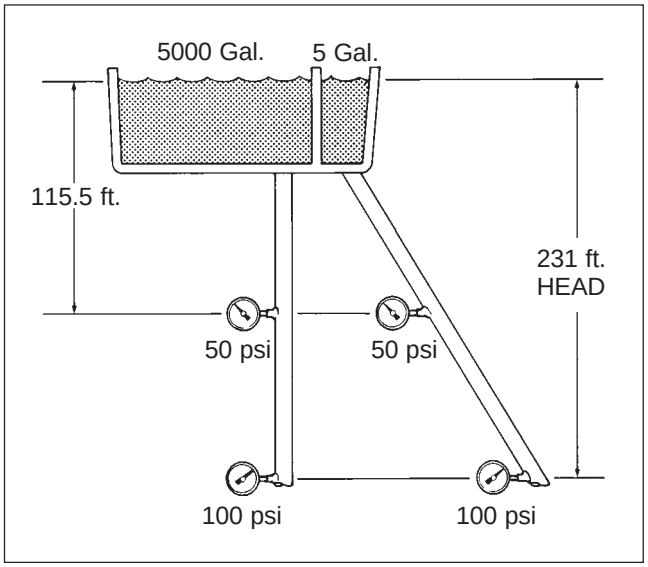


FIGURE 8-F
Figure 8-F illustrates the relationship between head and pressure.

Head is usually expressed in feet and refers to the height, or elevation, of the column of water. In Figure 8-F we see that a column of water 231 feet high creates a pressure reading of 100 psi. That same column of water is referred to as having 231 feet of **head**. Thus, for water, 231 feet of head is equivalent to 100 psi. Or, 2.31 feet of head equals 1 psi.

It should be noted that head and pressure readings for non-flowing water depend on the elevation of the water and not on the volume of water nor the size or length of piping.

Flow and Friction Loss

Flow is measured as the volume of water moved over a given length of time. This is generally referred to as gallons per minute (gpm) for larger flows and gallons per hour (gph) for smaller flows. When water moves through a pipe, it must overcome resistance to flow caused by friction as it moves along the walls of the pipe as well as resistance caused by its own turbulence. Added together, these losses are referred to as **friction losses** and may significantly reduce system pressure.

Figure 8-G illustrates the relationship of flow and friction loss. For any flow through a level pipe the gauge pressure at the pipe inlet will be greater than the gauge pressure at the pipe outlet. The difference is attributed to friction losses caused by the pipe itself and by fittings.

In general, friction losses occur or are increased under the following conditions:

1. Friction losses result from flow through any size or length of pipe (Figure 8-G).

2. Friction losses increase as the flow rate increases or as the pipe size decreases (if the flow rate doubles for a given pipe size, friction losses quadruple, Figure 8-G).

3. Friction losses increase with the addition of valves and fittings to the system (Figure 8-G).

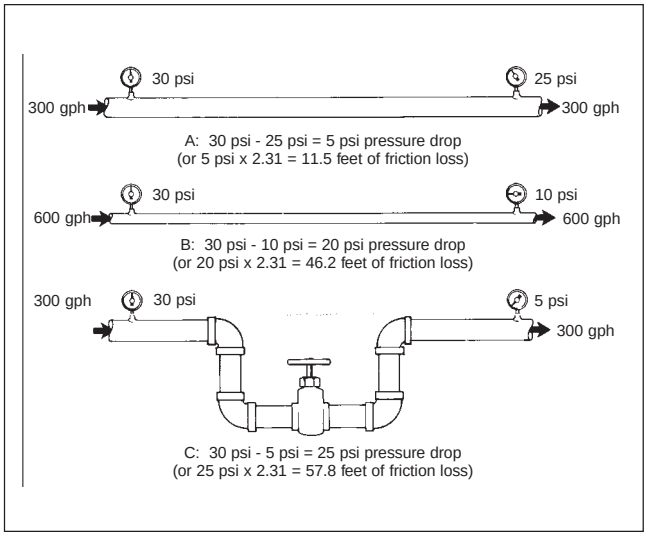


FIGURE 8-G
As shown in these illustrations friction losses increase with additional flow

Power is required to push water to a higher elevation, to increase outlet pressure, to increase flow rates, and to overcome friction losses. Good system design and common sense indicate that friction losses should be minimized whenever possible. The costs of larger pumps, bigger motors, and increased power consumption to overcome friction losses must be balanced against the increased cost of larger, but more efficient, system piping. In either case, unnecessary valves and fittings should be eliminated wherever possible.

Submersible Pumps vs. Jet Pumps

Submersible and jet pumps are both used in domestic groundwater systems. When high flow rates and pressure settings are required at high operating efficiencies, submersible pumps are generally preferred. Submersible pumps have the advantage of performing well both in shallow well applications as well as at depths to 2,000 feet. An extensive range of submersible pump models is also available allowing a precise match to exact system requirements.

Convertible jet pumps are sometimes an economical alternative to submersibles, especially in shallow well installations of 25 feet or less. The pumps are less expensive, installation is simplified, and they are easily converted for deep well installations down to 100 feet (Figure 8-H).

In “weak” well applications where the pump lowers the water level in the well faster than the well can replenish itself, a deep well jet pump with a tail pipe is particularly effective when flow requirements are relatively small. By adding 35 feet of tail pipe below the jet assembly with the foot valve attached to the bottom, it will not be possible to pull the well down and allow air to enter the system. Pump delivery remains at 100% of the rated capacity down to the level of the jet assembly. If the water level falls below that point, flow decreases in proportion to the drawdown as shown in Figure 8-I. When pump delivery equals well inflow, the water level remains constant until the pump shuts off. At 33.9 feet of drawdown the pump will no longer deliver water but the foot valve will remain fully submerged.

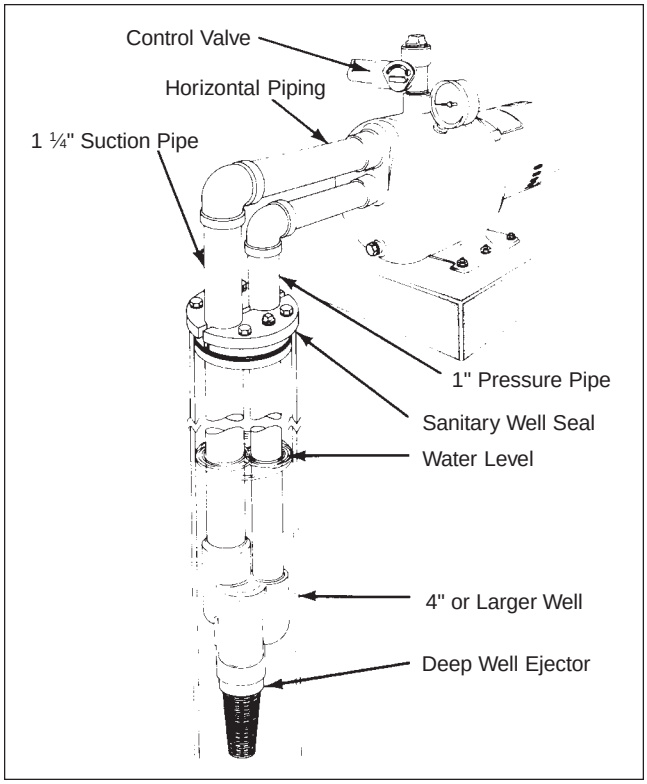


FIGURE 8-H
Figure 8-H illustrates a convertible jet pump set for deep well use (to 100 feet).

Final Pump Selection

Final pump selection will depend upon specific application requirements and cost considerations. Regardless of the pump type, system flow and head requirements (discussed in detail in Part 2) must be determined prior to actual pump selection.

Flow requirement will be determined by the size of the house or farm (including the number of bathrooms, outlets and appliances), the size of family, and the number of farm animals, if applicable.

Total Pumping Head must be calculated to ensure that the pump selected will meet all head or discharge pressure requirements. Total pumping head is the combination of the total suction lift (or lift in well), plus the pump discharge head (consisting of the elevation from the pumping water level to pressure tank plus pressure tank discharge pressure), plus all system friction losses.

Total Dynamic Head is equivalent to total pumping head plus velocity head. In most residential systems, velocity head is negligible. Because of this, the velocity head term has been left out of future examples and formulas. From the information gathered on flow and head requirements, a specific submersible or jet pump may be selected and an appropriately sized pressure tank ordered.

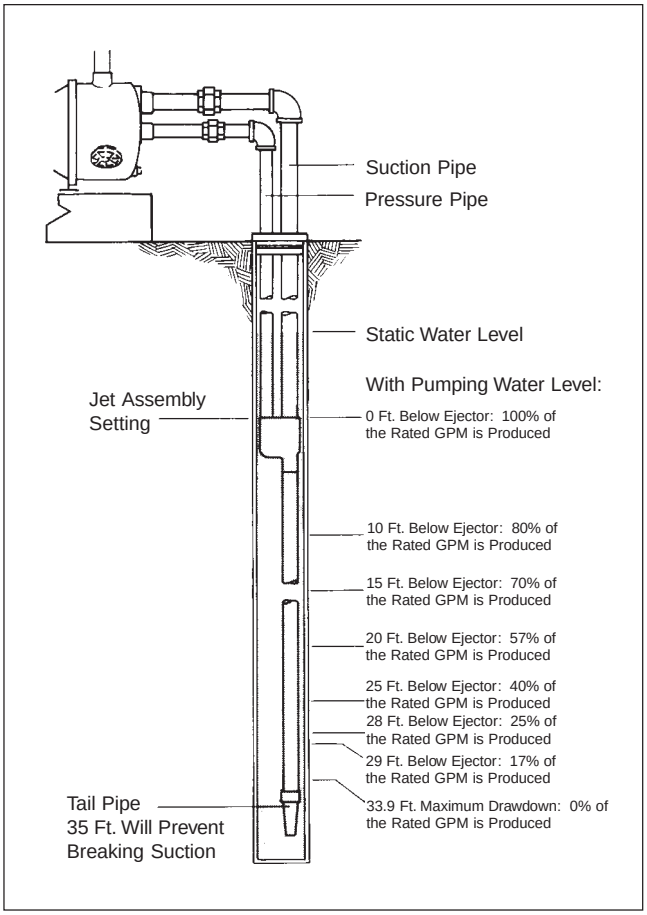


FIGURE 8-I
Figure 8-I illustrates the use of a tail pipe on a deep well convertible jet pump to compensate for weak well conditions.

PART 2: CABLE SELECTION

Submersible Pump Cable Selection Charts (60 Hz)

CABLE LENGTH SELECTION TABLES

The following table (Table 8-Q(2)) lists the recommended copper cable sizes and various cable lengths for submersible pump motors. Proper wire size will ensure that adequate voltage will be supplied to the motor.

This table complies with the 1978 edition of the National Electric Table 310-16, Column 2 for 75°C wire. The ampacities (current carrying properties of a conductor) have been divided by 1.25 per the N.E.C., Article 430-22, for motor branch circuits based on motor amps at rated horsepower.

To assure adequate starting torque, the maximum cable lengths are calculated to maintain 95% of the service entrance voltage at the motor when the motor is running at maximum nameplate amps. Cable sizes larger than specified may always be used and will reduce power usage.

The use of cables smaller than the recommended sizes will void the warranty. Smaller cable sizes will cause reduced starting torque and poor motor operation.

CALCULATING MIXED CABLE SIZES

In a submersible pump installation any combination of cable sizes may be used as long as the total percentage length of the individual cables does not exceed 100%. Mixed cable sizes are most often encountered when a pump is being replaced with a larger horsepower model and part of the old cable will be left in place.

In the following example, a 2 HP, 230 volt, 1 phase pump is being installed to replace a smaller model. The 115 feet of buried #12 cable located between the service entrance and the well head will be used in the replacement installation. The well driller must be able to calculate the required size of cable in the well to connect the new motor at a setting of 270 feet.

Cable Size Calculation:
Step 1–Check Table 8-Q(2) to see if the 115 feet of existing #12 cable is large enough to provide current to the larger 2 HP replacement pump. The table tells us that #12 cable is adequate for a maximum length of 250 feet.

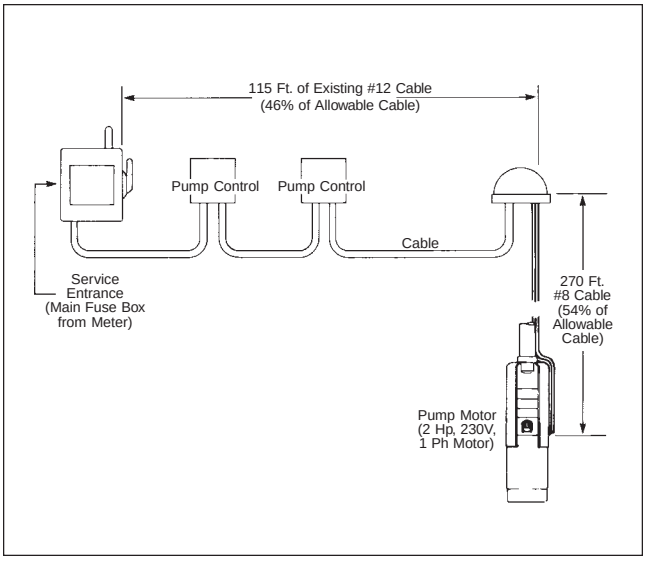


FIGURE 8-Q(1)
Example of Mixed Cable Installation

Step 2–Since 250 feet is the maximum allowable cable length for the #12 cable, calculate the percent used by the 115-foot run. (115 ft. ÷ 250 ft. = 46%)

Step 3–With 46% of the total allowable cable used between the service entrance and the well head, 54% remains for use in the well (100% - 46% = 54%). Therefore, the 270 feet of cable required in the well can utilize only 54% of the total feet allowed in the table.

Step 4–From Table 8-Q(2) determine the proper size cable required for the 2 HP pump set at 270 feet. (Remember, you are limited to 54% of the length listed in the table.) A check of #10 cable at 2 HP indicates that only 210 feet of this cable could be used (390 ft. x 54% = 210 ft.). Since this is less than the 270 required, the next larger size should be tried. For #8 cable, 54% of 620 feet = 335 feet. ***The #8 cable is suitable for use in the well at a pump setting of 270 feet.***

See Chart 8-Q(2) next page.

MAXIMUM MOTOR CABLE LENGTH

(Motor Service to Entrance)

TABLE 8-Q(2)
Single Phase 60Hz

Motor Rating		Copper Wire Size												
Volts	**HP**	**14**	**12**	**10**	**8**	**6**	**4**	**2**	**0**	**00**	**000**	**0000**	**250**	**300**
115	1/3	130	210	340	540	840	1300	1960	2910					
	1/2	100	160	250	390	620	960	1460	2160					
230	1/3	550	880	1390	2190	3400	5250	7960						
	1/2	400	650	1020	1610	2510	3880	5880						
	3/4	300	480	760	1200	1870	2890	4370	6470					
	1	250	400	630	990	1540	2380	3610	5360	6520				
	1½	190	310	480	770	1200	1870	2850	4280	5240				
	2	150	250	390	620	970	1530	2360	3620	4480				
	3	120	190	300	470	750	1190	1850	2890	3610				
	5			180	280	450	710	1110	1740	2170				
	7½				200	310	490	750	1140	1410				
	10					250	390	600	930	1160				

Three Phase 60Hz

Volts	**HP**	**14**	**12**	**10**	**8**	**6**	**4**	**2**	**0**	**00**	**000**	**0000**	**250**	**300**
208	1½	310	500	790	1260									
	2	240	390	610	970	1520								
	3	180	290	470	740	1160	1810							
	5		170	280	440	690	1080	1660						
	7½			200	310	490	770	1180	1770					
	10				230	370	570	880	1330	1640				
	15					250	390	600	910	1110	1340			
	20						300	460	700	860	1050	1270		
	25							370	570	700	840	1030	1170	
	30							310	470	580	700	850	970	1110
230	1½	360	580	920	1450									
	2	280	450	700	1110	1740								
	3	210	340	540	860	1340	2080							
	5		200	320	510	800	1240	1900						
	7½			230	360	570	890	1350	2030					
	10				270	420	660	1010	1520	1870				
	15					290	450	690	1040	1280	1540			
	20						350	530	810	990	1200	1450		
	25						280	430	650	800	970	1170	1340	
	30							350	540	660	800	970	1110	1270
460	1½	1700												
	2	1300	2070											
	3	1000	1600	2520										
	5	590	950	1500	2360									
	7½	420	680	1070	1690	2640								
	10	310	500	790	1250	1960	3050							
	15			540	850	1340	2090	3200						
	20			410	650	1030	1610	2470	3730					
	25				530	830	1300	1990	3010	3700				
	30				430	680	1070	1640	2490	3060	3700			
	40						790	1210	1830	2250	2710	3290		
	50						640	980	1480	1810	2190	2650	3010	
	60							830	1250	1540	1850	2240	2540	2890
	75								1030	1260	1520	1850	2100	2400
	100									940	1130	1380	1560	1790
	125											1080	1220	1390
	150												1050	1190
	200												1080	1300
	250													1080
575	1½	2620												
	2	2030												
	3	1580	2530											
	5	920	1480	2330										
	7½	660	1060	1680	2650									
	10	490	780	1240	1950									
	15		530	850	1340	2090								
	20			650	1030	1610	2520							
	25			520	830	1300	2030	3110						
	30				680	1070	1670	2560	3880					
	40					790	1240	1900	2860	3510				
	50						1000	1540	2310	2840	3420			
	60						850	1300	1960	2400	2890	3500		
	75							1060	1600	1970	2380	2890	3290	

CAUTION: Use of wire size smaller than listed will void warranty.

Notes: 1. If aluminum conductor is used, multiply lengths by 0.5 Maximum allowable length of aluminum is considerably shorter than copper wire of same size.

2. The portion of the total cable which is between the service entrance and a 3ø motor starter should not exceed 25% of the total maximum length to assure reliable starter operation. Single-phase control boxes may be connected at any point of the total cable length.

3. Cables #14 to #0000 are AWG sizes, and 250 to 300 are MCM sizes.

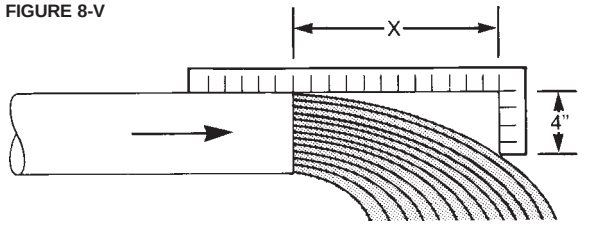
PART 3: MISC. TECHNICAL DATA, FORMULAS, AND CONVERSION

Calculating Discharge Rate by Using The Horizontal Open Discharge Method

The most reliable method of measuring flow is to use a flow meter. When a flow meter is not available, however, it is possible to estimate the discharge capacity by constructing an "L" shaped measuring stick similar to that shown in Figure 8-V. With the water flowing from the pipe, place the long end of the "L" on top of the pipe. Position the "L" so that the end of the short 4-inch side just touches the stream of water as the stream slants downward. Note the horizontal distance "X" from this point to the open end of the discharge pipe. With the value "X" and and the nominal inside diameter of the pipe, use Table 8-X to find the discharge rate in gallons per minute.

EXAMPLE: Horizontal distance "X" is measured to be 12 inches. The size of the pipe Is known to be 1½" (nominal diameter). Find 12 inches in the left hand column of the chart and move across to the 1½" pipe size column. Table 8-X indicates that the discharge rate is 40.0 gallons per minute.

FIGURE 8-V



Calculating Low Capacity Outlets: A simple procedure for measuring low capacity outlets such as small pump outlets, hose spigots, and faucets is to record the amount of time it takes to fill a container of known size.

EXAMPLE: Select a container of known size such as a 5-gallon paint bucket. With a watch, measure, in seconds, the amount of time it takes to fill the bucket. If it takes 30 seconds to fill a 5-gallon bucket, Table 8-W indicates that the flow is 10.0 gallons per minute. To obtain gallons per hour (gph) multiply 10.0 x 60 to obtain 600 gph.

TABLE 8-W

Discharge Rate in Gallons Per Minute (GPM) for Low Capacity Systems

Capacity of Container (Gallons)	Time (in seconds) to Fill Container							
	10	15	20	30	45	60	90	120
	Discharge Rate in Gallons Per Minute (GPM)							
1	6.0	4.0	3.0	2.0	1.3	1.0	.7	.5
3	18.0	12.0	9.0	6.0	4.0	3.0	2.0	1.5
5	30.0	20.0	15.0	10.0	6.7	5.0	3.3	2.5
10	60.0	40.0	30.0	20.0	13.3	10.0	6.7	5.0

NOTE: Multiply gallons per minute (GPM) by 60 to obtain gallons per hour (GPH).

Calculating Distance to Water Level

Install ⅛" or ¼" pipe or tubing into the well so that the end of the tubing extends 10 to 20 feet below the lowest possible pumping water level. Be sure that all joints in the tubing are airtight. As the tubing is lowered into the well measure its length. Record the measurement.

TABLE 8-X

Discharge Rate in Gallons Per Minute (GPM) for Large Capacity Systems

Horiz. Dist. (X) Inches	Nominal Pipe Size (in Inches)									
	1	1 ¼"	1 ½"	2"	2 ½"	3"	4"	5"	6"	8"
	Discharge Rate in Gallons Per Minute (GPM)									
4	5.7	9.8	13.3	22.0	31	48	83			
5	7.1	12.2	16.6	27.5	39	61	104	163		
6	8.5	14.7	20.0	33.0	47	73	125	195	285	
7	10.0	17.1	23.2	38.5	55	85	146	228	334	380
8	11.3	19.6	26.5	44.0	62	97	166	260	380	665
9	12.8	22.0	29.8	49.5	70	110	187	293	430	750
10	14.2	24.5	33.2	55.5	78	122	208	326	476	830
11	15.6	27.0	36.5	60.5	86	134	229	360	525	915
12	17.0	29.0	40.0	66.0	94	146	250	390	570	1000
13	18.5	31.5	43.0	71.5	102	158	270	425	620	1080
14	20.0	34.0	46.5	77.0	109	170	292	456	670	1160
15	21.3	36.3	50.0	82.5	117	183	312	490	710	1250
16	22.7	39.0	53.0	88.0	125	196	334	520	760	1330
17		41.5	56.5	93.0	133	207	355	550	810	1410
18			60.0	99.0	144	220	375	590	860	1500
19				100.0	148	232	395	620	910	1580
20					156	244	415	650	950	1660
21						256	435	685	1000	1750

Once the tubing is fixed in a stationary position at the top of the well, connect an air line and pressure gauge. With a tire pump or other air supply, pump air into the line until the pressure gauge reaches a point where it doesn't read any higher. Record the pressure gauge reading at this point.

Figure 8-Y illustrates a typical method for measuring distance to water level:

X = Distance to water level (in feet). This figure to be determined.

Y = Total length of air line (in feet).

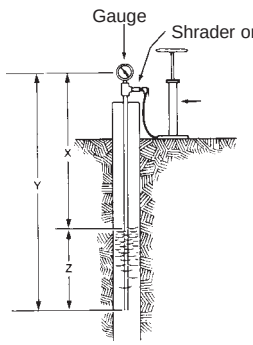
Z = Length of submerged air line. This value is obtained from the pressure gauge reading which reads in pounds per square inch (psi). Multiply the pressure gauge reading by 2.31 to obtain the length of the submerged air line in feet.

Distance to water level (X) = (Y) - (Z)

= The total length of the air line (Y) minus the length of the submerged portion of the air line (Z).

Figure 8-Y

Calculating the distance to water level.



Example:
Assume that the air line is 100 feet long and the pressure gauge reads 8 psi. Calculate the distance to water level (X).

8 psi x 2.31 = 18.5 feet

(X) = 100 feet (Y) - 18.5 feet (Z)

= 81.5 feet = distance to water level

FORMULAS

TEMPERATURE CONVERSIONS:

Degrees **C** = $\frac{5}{9}$ x (Degrees F - 32)

Degrees **F** = ($\frac{9}{5}$ x Degrees C) + 32

Area of a Circle:

Area = πr^2

Circumference of a Circle:

Circumference = $2 \pi r$

r = radius

π = 3.14

Volume of a Tank or Cistern:

3.14 x (radius of tank)^2 x (ht. of tank) x 7.48 = Gallons
Radius and height of tank measured in feet
7.48 = number of gallons per cubic foot of water

WORK, POWER, AND EFFICIENCY:

The amount of work required to lift 1 pound to a height of 1 foot is defined as 1 ft.-lb. To lift 100 pounds to a height of 60 feet is 100 pounds x 60 feet = 6,000 ft-lbs. This amount of energy remains the same whether it takes one minute or one hour to lift the weight. The rate of working, however, is referred to as **power** and was 6,000 ft-lbs. per minute in the first case and 100 foot pounds per minute in the second case.

Power can be represented either mechanically or electrically. **Mechanical power** is measured in horsepower (HP). One HP is the theoretical power required to raise 33,000 pounds to a height of one foot in one minute, or:

1 HP = 33,000 ft.-lb./minute
= 550 ft.-lb./second

Electrical power is measured in watts(w) or kilowatts(kw), and:

1,000 w = 1 kw = 1.34 hp, or
1 HP = 745 w = 0.746 kw

WATER HORSEPOWER (WHP):

Water horsepower is the power required to raise water at a specified rate against a specified head, assuming 100% efficiency.

$$\text{WHP} = \frac{\text{GPM x Total Pumping Head}}{3{,}960}$$

BRAKE HORSEPOWER (BHP):

Brake horsepower is based on test data and can be either the horsepower developed at the motor shaft (motor output) or that absorbed at the pump shaft (pump input).

$$\text{Pump BHP} = \frac{\text{WHP x 100}}{\text{Pump Efficiency (\%)}}$$

$$= \frac{\text{GPM x Total Pumping Head x 100}}{\text{3,960 x Pump Efficiency (\%)}}$$

$$\text{Motor BHP} = \frac{\text{Power input x Motor Efficiency (\%)}}{100}$$

$$= \frac{\text{1.34 x kw input x Motor Efficiency (\%)}}{100}$$

PUMP EFFICIENCY:

Pumps and motors, like all machines, are not 100% efficient. Not all of the energy supplied to them is converted into useful work. Pump efficiency is the ratio of power output to power input, or:

$$\text{Efficiency (\%)} = \frac{\text{Power Output x 100}}{\text{Power Input}}$$

$$\text{Pump Eff. (\%)} = \frac{\text{WHP x 100}}{\text{Pump BHP (Input)}}$$

$$= \frac{\text{GPM x Total Pumping Head x 100}}{\text{3960 x Pump BHP (Input)}}$$

$$\text{Motor Eff. (\%)} = \frac{\text{Motor BHP (Output) x 100}}{\text{1.34 x kw input}}$$

$$\text{Plant Eff. (\%)} = \frac{\text{GPM x Total Pumping Head x 100}}{\text{5,300 x kw Input}}$$

ELECTRIC POWER (AC):

E = Electrical pressure (volts). Similar to hydraulic head.

I = Electrical current (amps). Similar to rate of flow.

W = Electrical power (watts) = E x I x PF

kw = Kilowatt (1,000 watts)

kw-hr. = Kilowatt-hour = 1,000 watts for one hour

Apparent Power = E x I = volt-amperes

PF = Power Factor = Useful Power ÷ Apparent Power

Power Calculations for Single-Phase Power
W (Watts) = E x I x PF
NOTE: When measuring single-phase power use a single-phase wattmeter.

Input HP to motor = W ÷ 746 = 1.34 x kw

Power Calculations for Three-Phase Power
W (Watts) = 1.73 x E x I x PF
Where: E = effective (RMS) voltage between phases
I = average current in each phase
NOTE: When measuring three-phase power use either (1) three-phase wattmeter, (2) single-phase wattmeters, or the power company's revolving disc wattmeter.

When calculating power with a revolving disc wattmeter use the following formulas:

$$\text{kw input} = \frac{\text{K x R x 3.60}}{\text{t}}$$

$$\text{Input HP (to motor)} = \frac{\text{K x R x 3,600}}{\text{746 x t}}$$

$$= \frac{\text{K x R x 4.83}}{\text{t}}$$

FORMULAS

Motor BHP (output) = $\frac{\text{Input HP x Motor Eff.(\%)}}{100}$

Where K = Meter constant = watts per revolution of revolving disc (value of K is marked on the meter nameplate or on the revolving disc). Where current transformers are used, multiply meter constant by current transformer ratio.

R = Number of disc revolutions counted.
t = Time in seconds for R revolutions.

CALCULATING OPERATING COSTS OF PUMPS:
Costs in Cents per 1,000 Gallons:

Cost (¢) = $\frac{\text{kw Input x r x 1,000}}{\text{GPH}}$

Cost in Cents per Acre-Inch

Cost (¢) = $\frac{\text{kw Input x r x 452.6}}{\text{GPM}}$

Where: r = cost of power in cents per kw-hr.

FRICTION LOSS TABLES

Friction Loss Table – SCH 40 STEEL PIPE

(Friction Loss in Feet of Head Per 100 Feet of Pipe)

GPM	GPH	1/2" ID 0.622"	3/4" ID 0.824"	1" ID 1.049"	1 1/4" ID 1.380"	1 1/2" ID 1.610"	2" ID 2.067"	2 1/2" ID 2.469"	3" ID 3.068"	4" ID 4.026"
2	120	4.8								
3	180	10	2.5							
4	240	17.1	4.2							
5	300	25.8	6.3	1.9						
6	360	36.5	8.9	2.7						
7	420	48.7	11.8	3.6						
8	480	62.7	15	4.5						
9	540	78.3	18.8	5.7						
10	600	95.9	23	6.9	1.8					
12	720		32.6	9.6	2.5	1.2				
14	840		43.5	12.8	3.3	1.5				
16	960		56.3	16.5	4.2	2				
20	1,200		86.1	25.1	6.3	2.9				
25	1,500			38.7	9.6	4.5	1.3			
30	1,800			54.6	13.6	6.3	1.8			
35	2,100			73.3	18.2	8.4	2.4			
40	2,400			95	23.5	10.8	3.1	1.3		
45	2,700				29.4	13.5	3.9	1.6		
50	3,000				36	16.4	4.7	1.9		
60	3,600				51	23.2	6.6	2.7		
70	4,200				68.8	31.3	8.9	3.6	1.2	
80	4,800				89.2	40.5	11.4	4.6	1.6	
90	5,400					51	14.2	5.8	2	
100	6,000					62.2	17.4	7.1	2.4	
120	7,200						24.7	10.1	3.4	
140	8,400						33.2	13.5	4.5	1.2
160	9,600						43	17.5	5.8	1.5
200	12,000						66.3	27	8.9	2.3
260	15,600							45	14.8	3.7
300	18,000							59.6	19.5	4.9

Friction Loss Table – SCH 40 PVC

(Friction Loss in Feet of Head Per 100 Feet of Pipe)

GPM	GPH	1/2" ID 0.622"	3/4" ID 0.824"	1" ID 1.049"	1 1/4" ID 1.380"	1 1/2" ID 1.610"	2" ID 2.067"	2 1/2" ID 2.469"	3" ID 3.068"	4" ID 4.026"
2	120	4.1								
3	180	8.7	2.2							
4	240	14.8	3.7							
5	300	22.2	5.7	1.8						
6	360	31.2	8	2.5						
7	420	41.5	10.6	3.3						
8	480	53	13.5	4.2						
9	540	66	16.8	5.2						
10	600	80.5	20.4	6.3	1.7					
12	720		28.6	8.9	2.3	1.1				
14	840		38	11.8	3.1	1.4				
16	960		48.6	15.1	4	1.9				
20	1,200		60.5	22.8	6	2.8				
25	1,500			38.7	9.1	4.3	1.3			
30	1,800				12.7	6	1.8			
35	2,100				16.9	8	2.4			
40	2,400				21.6	10.2	3	1.1		
45	2,700				28	12.5	3.8	1.4		
50	3,000					15.4	4.6	1.7		
60	3,600					21.6	6.4	2.3		
70	4,200					28.7	8.5	3	1.2	
80	4,800					36.8	10.9	3.8	1.4	
90	5,400					45.7	13.6	4.8	1.8	
100	6,000					56.6	16.5	5.7	2.2	
120	7,200						23.1	8	3	
140	8,400						30.6	10.5	4	1.1
160	9,600						39.3	13.4	5	1.4
200	12,000						66.3	20.1	7.6	2.1
260	15,600							32.4	12.2	3.4
300	18,000							42.1	15.8	4.4

Friction Loss Table – VALVES and FITTINGS

(Friction Loss in Equivalent Number of Feet of Straight Pipe)

TYPE OF FITTING AND APPLICATION	PIPE AND FITTING	NOMINAL SIZE OF FITTING AND PIPE 1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"
		EQUIVALENT LENGTH OF PIPE(IN FEET)						
Insert Coupling	Plastic	3	3	3	3	3	3	3
Threaded Adapter (Plastic to Thread)	Plastic	3	3	3	3	3	3	3
90° Standard Elbow	Steel	2	2	3	4	4	5	6
	Plastic	2	2	3	4	4	5	6
Standard Tee (Flow Through Run)	Steel	1	2	2	3	3	4	4
	Plastic	1	2	2	3	3	4	4
Standard Tee (Flow Through Side)	Steel	4	5	6	7	8	11	13
	Plastic	4	5	6	7	8	11	13
Gate Valve[1]	Steel	1	1	1	1	2	2	2
Swing Check Valve[1]	Steel	5	7	9	12	13	17	21

NOTES:

Based on schedule 40 steel and plastic fittings.

Figures given are friction losses in terms of Equivalent Lenghts of straight pipe.

① Friction loss figures are for screwed valves and are based on equivalent lengths of steel pipe.

CONVERSION TABLES

UNITS OF FLOW

CONVERT TO / CONVERT FROM	U.S. GALLONS PER MINUTE	MILLION U.S. GALLONS PER DAY	CUBIC FEET PER SECOND	CUBIC METERS PER HOUR	LITERS PER SECOND
	MULTIPLY BY:				
(1) U.S. GALLON PER MINUTE	1	0.001440	0.00223	0.2271	0.0631
(1) MILLION U.S. GALLONS PER DAY	694.5	1	1.547	157.7	43.8
(1) CUBIC FOOT PER SECOND	448.83	0.646	1	101.9	28.32
(1) CUBIC METER PER HOUR	4.403	0.00634	0.00982	1	0.2778
(1) LITER PER SECOND	15.85	0.0228	0.0353	3.60	1

UNITS OF PRESSURE AND HEAD

CONVERT TO / CONVERT FROM	LBS. PER SQUARE INCH	FEET OF WATER ①	METERS OF WATER ①	INCHES OF MERCURY ②	ATMOSPHERES	KILOGRAMS PER SQUARE CM
	MULTIPLY BY:					
(1) LB. PER SQUARE INCH	1	2.31	0.704	2.04	0.0680	0.0703
(1) FOOT OF WATER ①	0.433	1	0.305	0.881	0.02945	0.0304
(1) METER OF WATER ①	1.42	3.28	1	2.89	0.0966	.1
(1) INCH OF MERCURY ②	0.491	1.135	0.346	1	0.0334	0.0345
(1) ATMOSPHERE (at Sea Level)	14.70	33.96	10.35	29.92	1	1.033
(1) KILOGRAM PER SQUARE CM	14.22	32.9	10	28.96	0.968	1

NOTES: ① Equivalent units are based on density of fresh water at 68°F.
② Equivalent units are based on density of mercury at 32°F.
Each 1,000 feet of ascent decreases pressure about ½ pound per square inch.

UNITS OF VOLUME AND WEIGHT

CONVERT TO / CONVERT FROM	U.S. GALLONS	IMPERIAL GALLONS	CUBIC INCHES	CUBIC FEET	ACRE FEET	POUNDS ③	CUBIC METERS	LITERS
(1) U.S. GALLON	1	0.833	231	0.1337	3.07×10^{-6}	8.34	0.003785	3.785
(1) IMPERIAL GALLON	1.201	1	277.4	0.1605	3.69×10^{-6}	10.01	0.004546	4.546
(1) CUBIC INCH	0.00433	0.00360	1	0.000579	—	0.0361	1.64×10^{-5}	0.0164
(1) CUBIC FOOT	7.48	6.23	1728	1	2.30×10^{-5}	62.4	0.02832	28.32
(1) ACRE FOOT	325,850	271,335	—	43,560	1	2.7×10^{6}	1233.5	1.23×10^{6}
(1) POUND ③	0.120	0.0998	27.7	0.0160	3.68×10^{-7}	1	4.54×10^{-4}	0.454
(1) CUBIC METER	264.2	220	61,024	35.315	8.11×10^{-4}	2202	1	1000
(1) LITER	0.2642	0.220	61.024	0.0353	8.11×10^{-7}	2.202	0.001	1

NOTES: ③ Weight equivalent basis water at 60°F.

UNITS OF LENGTH

(1) Inch = 0.0833 Ft. = 0.0278 Yd. = 25.4 mm = 2.54 cm
(1) Ft. = 12 Inches = 0.333 Yd. = 30.48 cm = 0.3048 Meter
(1) Yard = 36 Inches = 3 Ft. = 91.44 cm = 0.9144 Meters

(1) Mile = 5280 Ft. = 1760 Yds. = 1.61 km = 1609 Meters
(1) Meter = 3.281 Ft. = 39.37 In. = 0.000621 Miles = 0.001 km
(1) Kilometer = 1000 m = 1093.61 Yds. = 0.62137 Miles = 3281 Ft.

BE > THINK > INNOVATE >

Being responsible is our foundation
Thinking ahead makes it possible
Innovation is the essence

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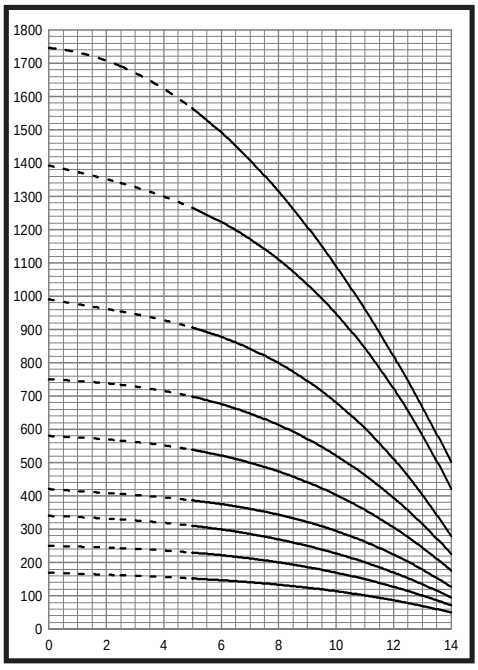
Performance Curves and Technical Data

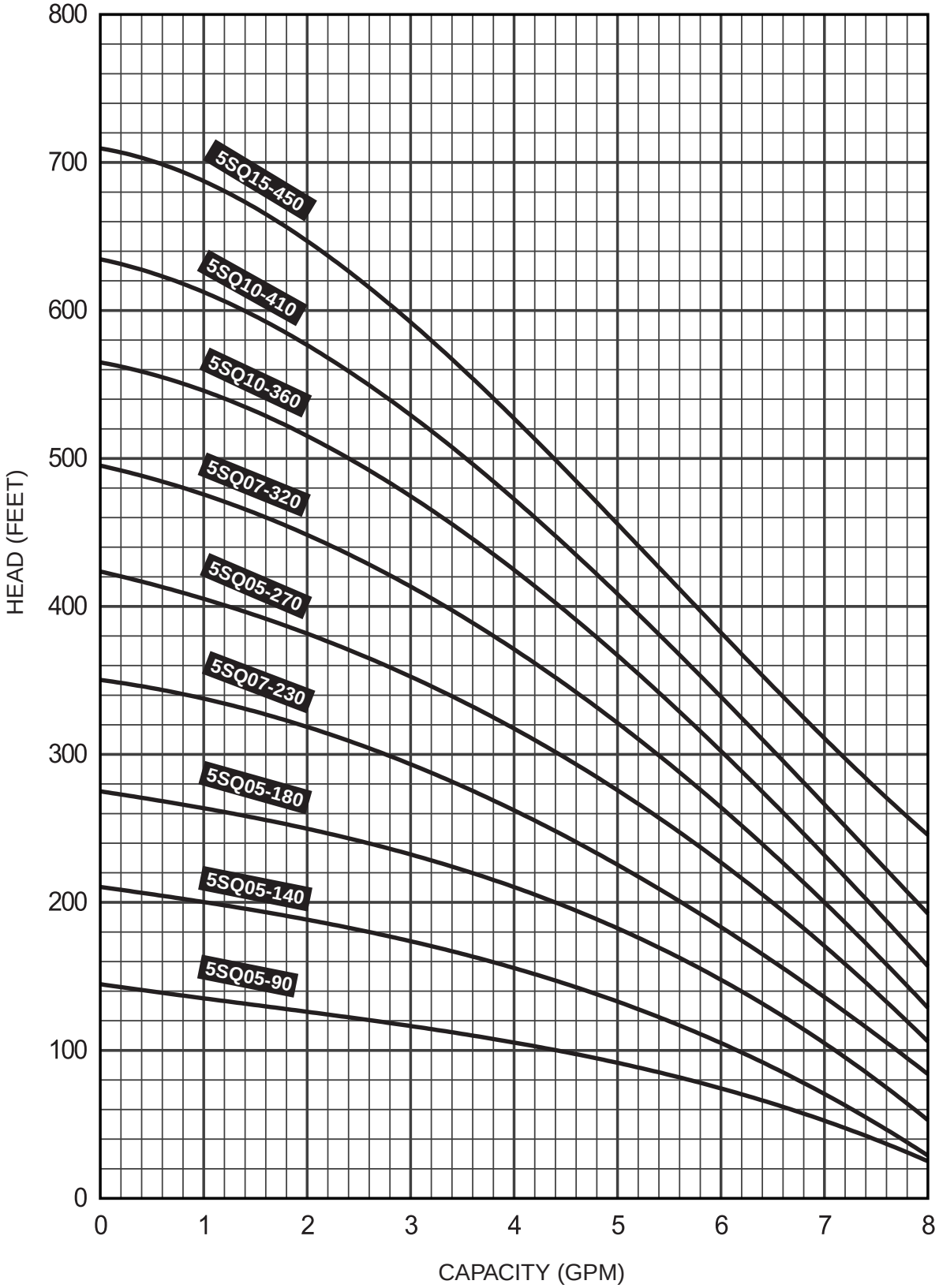
For 3-Inch & larger well applications



Performance Curves

Materials of Construction

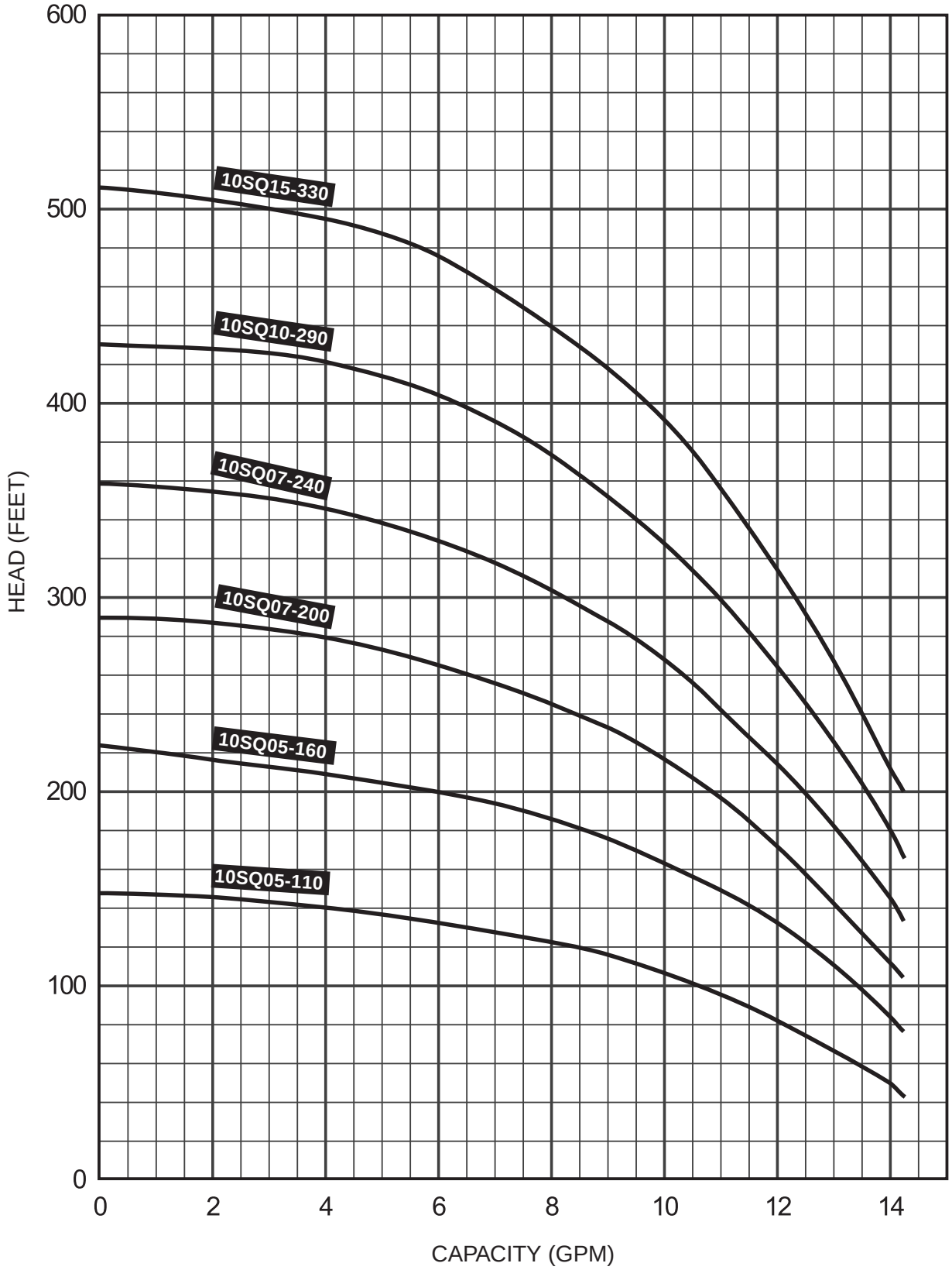
OUTLET SIZE: 1" NPT **NOMINAL DIA. 3"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

PERFORMANCE CONFORMS TO ISO 9906 ANNEX A

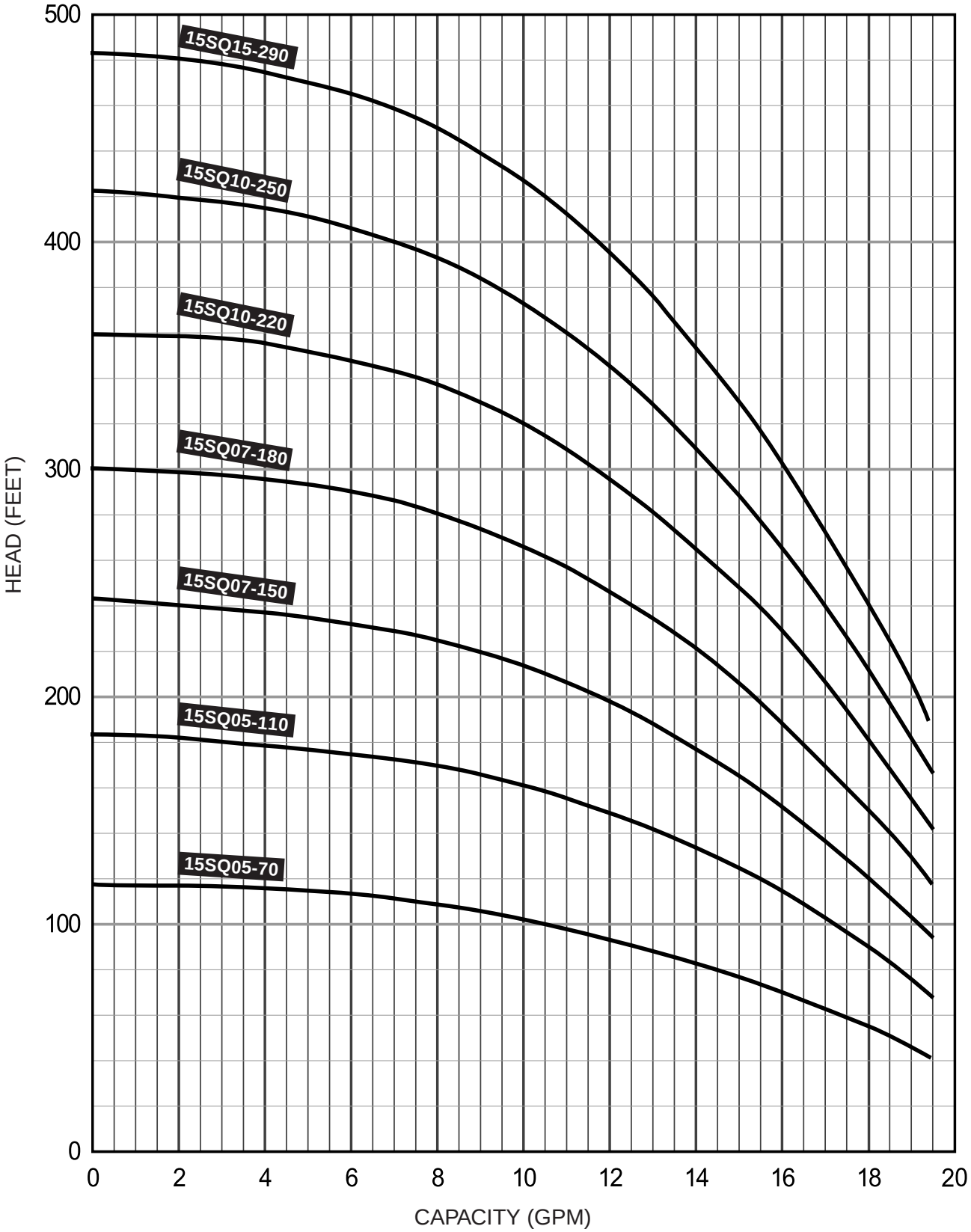
OUTLET SIZE: 1 1/4" NPT **NOMINAL DIA. 3"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

PERFORMANCE CONFORMS TO ISO 9906. (E) ANNEX A

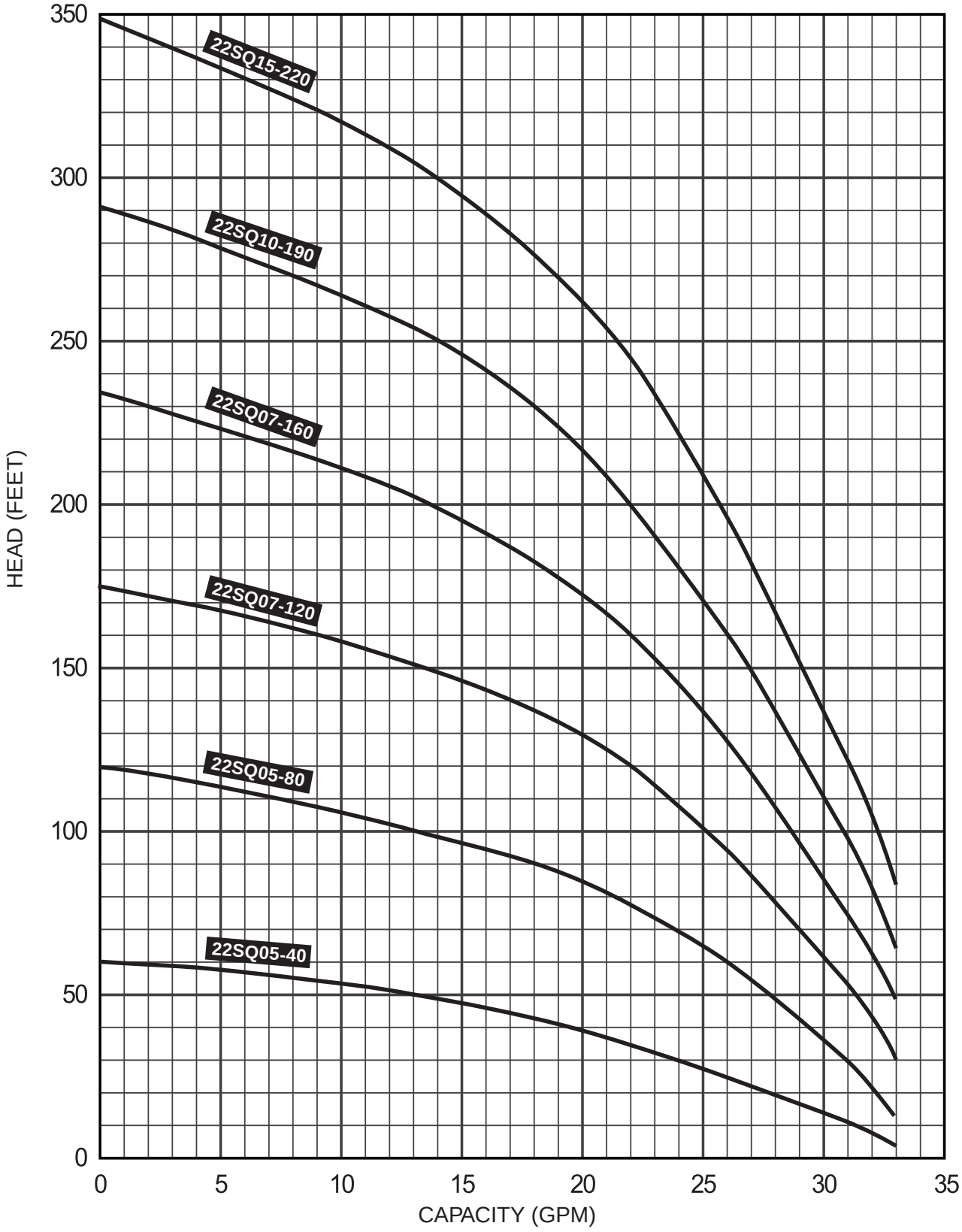
OUTLET SIZE: 1 1/4" NPT **NOMINAL DIA. 3"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

PERFORMANCE CONFORMS TO ISO 9906. (E) ANNEX A

OUTLET SIZE: 1 1/2" NPT **NOMINAL DIA. 3"**



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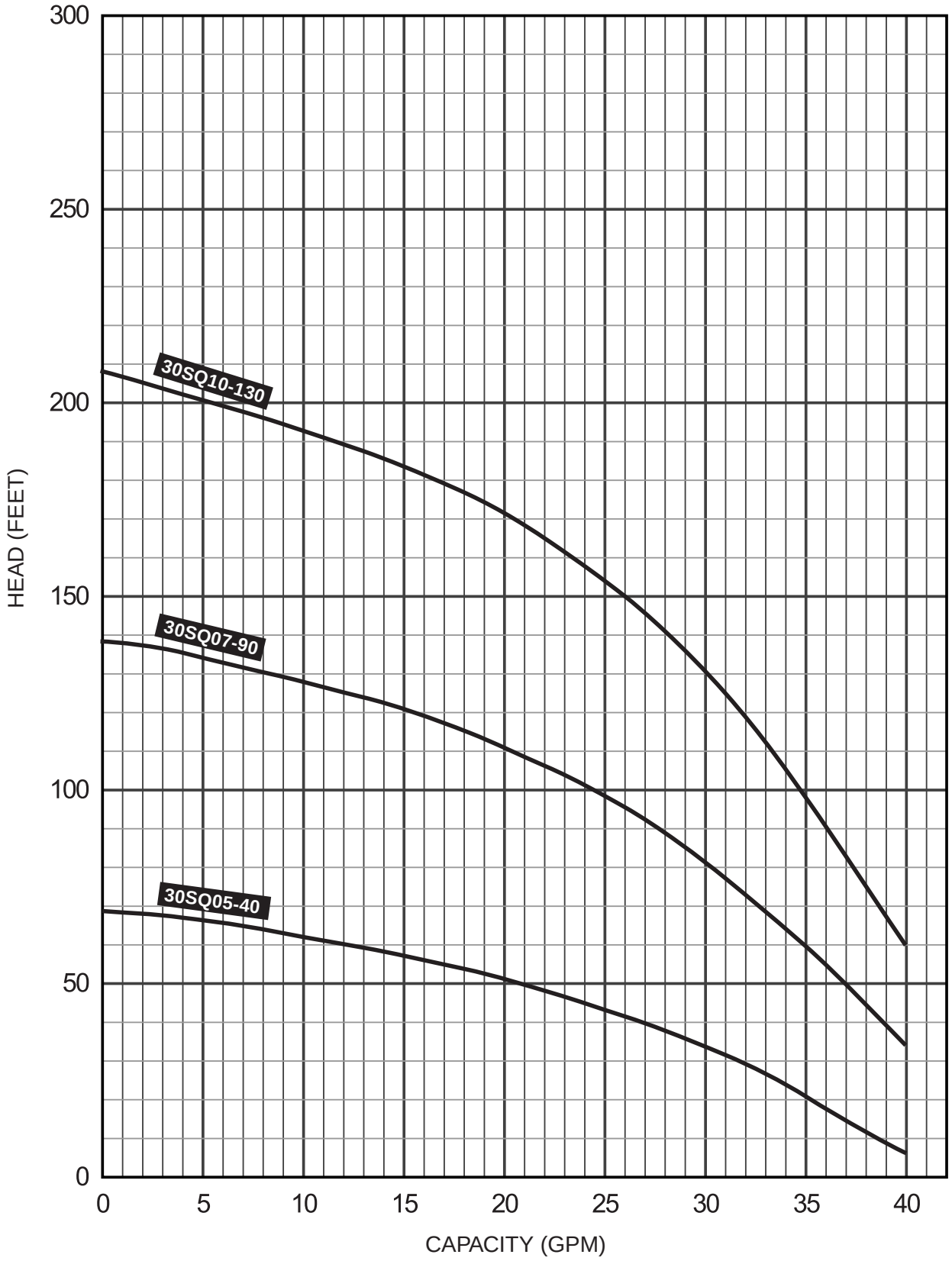
PERFORMANCE CONFORMS TO ISO 9906. (E) ANNEX A

OUTLET SIZE: 1 1/2" NPT **NOMINAL DIA. 3"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

PERFORMANCE CONFORMS TO ISO 9906. (E) ANNEX A

Dimensions and Weights

MODEL	FIG.	HP	MOTOR SIZE	DISCHARGE SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
5SQ/SQE05-90	A	1/2	3"	1" NPT	30.4	19.8	10.6	2.6	2.9	12
5SQ/SQE05-140	A	1/2	3"	1" NPT	30.4	19.8	10.6	2.6	2.9	12
5SQ/SQE05-180	A	1/2	3"	1" NPT	31.5	19.8	11.6	2.6	2.9	12
5SQ/SQE07-230	A	3/4	3"	1" NPT	33.6	19.8	13.7	2.6	2.9	13
5SQ/SQE07-270	A	3/4	3"	1" NPT	33.6	19.8	13.7	2.6	2.9	13
5SQ/SQE07-320	A	3/4	3"	1" NPT	34.6	19.8	14.8	2.6	2.9	13
5SQ/SQE10-360	A	1	3"	1" NPT	38.2	21.3	16.9	2.6	2.9	16
5SQ/SQE10-410	A	1	3"	1" NPT	38.2	21.3	16.9	2.6	2.9	16
5SQ/SQE15-450	A	1 1/2	3"	1" NPT	39.3	21.3	18.0	2.6	2.9	16
10SQ/SQE05-110	A	1/2	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
10SQ/SQE05-160	A	1/2	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
10SQ/SQE07-200	A	3/4	3"	1 1/4" NPT	31.5	19.8	11.6	2.6	2.9	13
10SQ/SQE07-240	A	3/4	3"	1 1/4" NPT	33.6	19.8	13.7	2.6	2.9	13
10SQ/SQE10-290	A	1	3"	1 1/4" NPT	35.0	21.3	13.7	2.6	2.9	16
10SQ/SQE15-330	A	1 1/2	3"	1 1/4" NPT	36.14	21.3	14.8	2.6	2.9	16
15SQ/SQE05-70	A	1/2	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
15SQ/SQE05-110	A	1/2	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
15SQ/SQE07-150	A	3/4	3"	1 1/4" NPT	31.5	19.8	11.6	2.6	2.9	13
15SQ/SQE07-180	A	3/4	3"	1 1/4" NPT	33.6	19.8	13.7	2.6	2.9	13
15SQ/SQE10-220	A	1	3"	1 1/4" NPT	35.0	21.3	13.7	2.6	2.9	16
15SQ/SQE10-250	A	1	3"	1 1/4" NPT	36.1	21.3	14.8	2.6	2.9	16
15SQ/SQE15-290	A	1 1/2	3"	1 1/4" NPT	38.2	21.3	16.9	2.6	2.9	16
22SQ/SQE05-40	A	1/2	3"	1 1/2" NPT	30.4	19.8	10.6	2.6	2.9	12
22SQ/SQE05-80	A	1/2	3"	1 1/2" NPT	30.4	19.8	10.6	2.6	2.9	12
22SQ/SQE07-120	A	3/4	3"	1 1/2" NPT	31.5	19.8	11.6	2.6	2.9	13
22SQ/SQE07-160	A	3/4	3"	1 1/2" NPT	33.6	19.8	13.7	2.6	2.9	13
22SQ/SQE10-190	A	1	3"	1 1/2" NPT	38.2	21.3	16.9	2.6	2.9	16
22SQ/SQE15-220	A	1 1/2	3"	1 1/2" NPT	38.2	21.3	16.9	2.6	2.9	16
30SQ/SQE05-40	A	1/2	3"	1 1/2" NPT	30.4	19.8	10.6	2.6	2.9	12
30SQ/SQE07-90	A	3/4	3"	1 1/2" NPT	30.4	19.8	10.6	2.6	2.9	13
30SQ/SQE10-130	A	1	3"	1 1/2" NPT	35.0	21.3	13.7	2.6	2.9	13

DISCHARGE SIZES
1" NPT 5SQ/SQE
1 1/4" NPT 10-15SQ/SQE
1 1/2" NPT 22-30 SQ/SQE

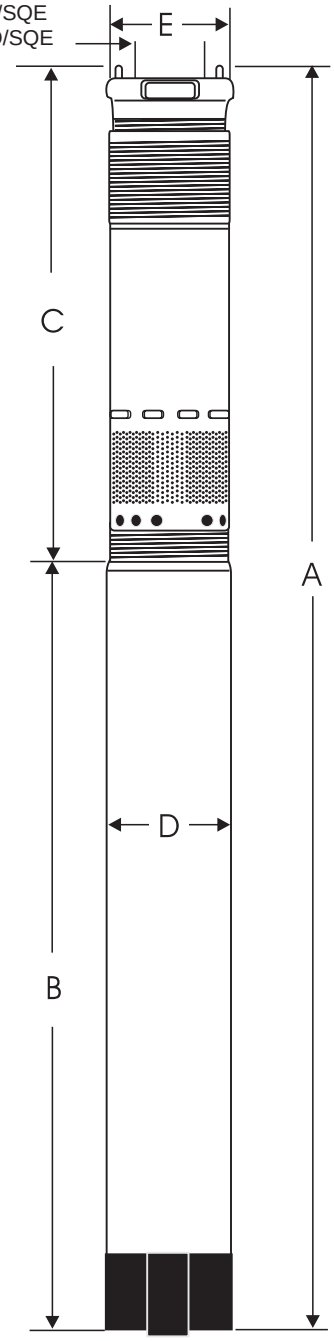


Fig. A

MATERIALS OF CONSTRUCTION

COMPONENT	SPLINED SHAFT
Valve Casing	Polyamide
Discharge Chamber	304 Stainless Steel
Valve Guide	Polyamide
Valve Spring	316LN Stainless Steel
Valve Cone	Polyamide
Valve Seat	NBR Rubber
O-ring	NBR Rubber
Lock Ring	310 Stainless Steel
Top Bearing	NBR Rubber
Top Chamber	Polyamide
Guide Vanes	Polyamide
Impeller	Polyamide w/tungsten carbide bearings
Bottom Chamber	Polyamide
Neck Ring	TPU/PBT
Bearing	Aluminum Oxide
Suction Interconnector	Polyamide
Ring	304 Stainless Steel
Pump Sleeve	304 Stainless Steel
Cone for Pressure Equalization	Polyamide
Spacer	Polyamide
Sand Trap	316 Stainless Steel
Shaft w/Coupling	304 Stainless Steel
Cable Guard	304 Stainless Steel

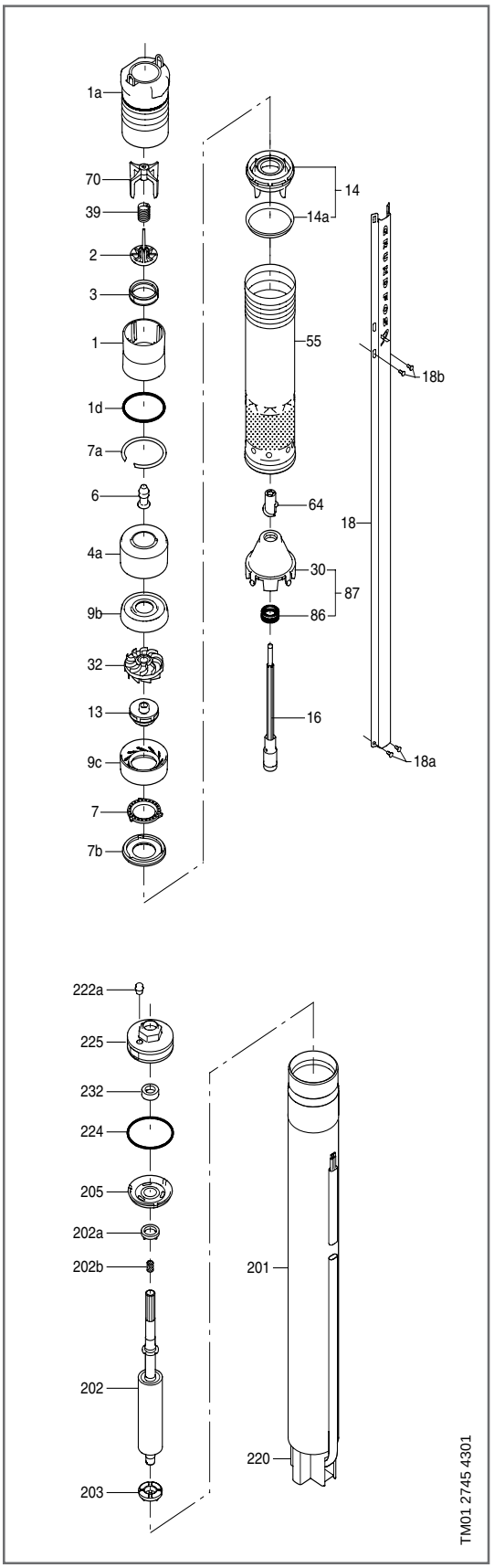
NOTES: Specifications subject to change without notice.

Material specification (Pump)

Pos.	Component	Material	DIN W.-Nr. SQ/SQE	AISI	DIN W.-Nr. SQ-N	AISI
1	Valve casing	Polyamide				
1a	Discharge chamber	Stainless steel	1.4301	304	1.4401	316
1d	O-ring	NBR rubber				
2	Valve cup	Polyamide				
3	Valve seat	NBR rubber				
4a	Empty chamber	Polyamide				
6	Top bearing	NBR rubber				
7	Neck ring	TPU/PBT				
7a	Lock ring	Stainless spring steel	1.4310	310	1.4401	316
7b	Neck ring retainer	Polyamide				
9b	Chamber top	Polyamide				
9c	Chamber bottom	Polyamide				
13	Impeller with tungsten carbide bearing	Polyamide				
14	Suction inter-connector	Polyamide				
14a	Ring	Stainless steel	1.4301	304	1.4401	316
16	Shaft with coupling	Stainless steel	1.4301	304	1.4401	316
		Sintered steel				
18	Cable guard	Stainless steel	1.4301	304	1.4401	316
18a 18b	Screws for cable guard	Stainless steel	1.4401	316	1.4401	316
30	Cone for pressure equalisation	Polyamide				
32	Guide vanes	Polyamide				
39	Spring	Stainless spring steel	1.4406	316LN	1.4406	316LN
55	Pump sleeve	Stainless steel	1.4301	304	1.4401	316
64	Priming screw	Polyamide				
70	Valve guide	Polyamide				
86	Lip seal ring	NBR rubber				
87	Cone for pressure equalization complete	Polyamide/ NBR rubber				

Material specification (Motor)

Pos.	Component	Material	DIN W.-Nr. MS 3/ MSE 3	AISI	DIN W.-Nr. MS 3-NE	AISI
201	Stator	Stainless steel	1.4301	304	1.4401	316
202	Rotor	Stainless steel	1.4301	304	1.4401	316
202a	Stop ring	PP				
202b	Filter	Polyester				
203	Thrust bearing	Carbon				
205	Radial bearing	Ceramic/ tungsten carbide				
220	Motor cable with plug	EPR				
222a	Filling plug	MS 3: NBR MSE 3: FKM				
224	O-ring	FKM				
225	Top cover	PPS				
232	Shaft seal	MS 3: NBR MSE 3: FKM				
	Motor liquid	SML-2				



ELECTRIC	
Supply Voltage:	1x200-240V +6%/-10%, 50/60 Hz, PE 1x100-115V +6%/-10%, 50/60 Hz, PE
Operation Via Generator:	As a minimum, the generator output must be equal to the motor P1[kw] + 10%
Starting Current:	The motor starting current is equal to the highest value stated on the motor nameplate
Starting:	Soft Start
Run-up Time:	Maximum: 2-seconds
Motor Protection:	Motor is protected against: Dry running, overvoltage, undervoltage, overload, overtemperature
Power Factor:	PF=1
Motor Cable:	3 Wire, 14AWG XLPE
Motor Liquid:	Type SML 2
pH Values:	SQ and SQE: 5 to 9
Liquid Temperature:	The temperature of the pumped liquid must not exceed 104°F
Note: If liquids with a viscosity higher than that of water are to be pumped, please contact Grundfos	
PIPING CONNECTION	
Discharge Port:	5SQ/SQE - 1” NPT 10-15SQ/SQE - 1-1/4” NPT 22-30SQ/SQE - 1-1/2” NPT
STORAGE CONDITIONS	
Minimum Ambient Temperature:	-4°F
Maximum Ambient Temperature:	+140°F
Frost Protection:	If the pump has to be stored after use, it must be stored at a frost-free location or it must be ensured that the motor liquid is frost proof.
OPERATING CONDITIONS	
Minimum Ambient Fluid Temperature:	+ 34°F
Maximum Ambinet Fluid Temperature:	+140°F
APPROXIMATE DIMENSIONS AND WEIGHT	
Motor Dimensions (MS 3 & MSE 3):	
0.50 [Hp]	20.9” length x 2.68 diameter
0.75 [Hp]	20.9” length x 2.68 diameter
1.0 - 1.5 [Hp]	22.3” length x 2.68 diameter
Motor Weights (MS3 & MSE3)	
0.50 [Hp]	6.0 lbs
0.75 [Hp]	7.1 lbs
1.0 - 1.5 [Hp]	8.2 lbs
Pump End Dimensions:	
Pump Diameter:	2.68
Pump Diameter, incl cable guard	2.91
Pump End Dimensions (min. and max.):	
5SQ/SQE	10.6” to 18.0”
10SQ/SQE	10.6” to 14.8”
15SQ/SQE	10.6” to 16.9”
22SQ/SQE	10.6” to 13.7”
30SQ/SQE	10.6" to 13.7"
Pump End Weights (min. and max.):	
All SQ/SQE Models	2.2 lbs to 3.5 lbs
Well Diameter:	3-inch or larger
Installation Depth (maximum)	500 feet below static water level

PRODUCT DATA SHEET

January, 2007

4000 GALLON POLY TANK

(Original Style and Total Drain)

GENERAL INFORMATION

This type of tank is not to be used for food applications. Potable water applications are *generally* not acceptable and must be reviewed by the Corporate office first for approval.

WEIGHTS AND MEASURES

» Capacity:	4000 gallons (nominal)
» Height‡:	10′-9″ (to top tangent line) 12′-5″ (to top of dome) 12′-10″ (to highest point on top lid)
» Diameter:	8′-0″ (nominal)
» Weight*:	Tank: 1450 lbs. – 1550 lbs. Pad: 320 lbs.

* Varies with origin of manufacture.
‡ Does not include height of pad. Add four inches for pad thickness to determine heights from grade when pad is used.

DESIGN PARAMETERS

» Tank Material:	High Density Polyethylene
» Design Pressure:	0 psi – vented to atmosphere
» Design Vacuum:	0 psi – vented to atmosphere
» Spec. Gravity Limit:	Original Style – 1.65 Total Drain – 1.9
» Temp. Limit:	150° F
» Certification:	ASTM D1998 (not UL listed)

RESTRICTIONS

» Sulfuric Acid Storage:	• 80% concentration maximum • Use only tanks with equipment numbers ≥ 4275 • Previously repaired tank cannot be used (equipment number should have "W" at end) • 100° F maximum temperature • Top fill only • Top manway must be open during pneumatic filling of tank • Use flexible plumbing fixtures resistant to sulfuric acid

FEATURES

» Top Vent:	2″ PVC U-vent (two threaded street elbows)
» Manway:	Top mounted with 24″ opening (34″ diameter screw-on cover)
» Valves:	3″ Spears butterfly valve with PVC body and disc, Viton O-Ring seal and 316 SS stem.
» Ladder:	Top mounted bracket for ladder hook-up. Ladder is not permanently mounted to tank.
» Piping Connections:	Inlet – 3″ with butterfly valve Outlet – 3″ with butterfly valve Top – 4″ PVC adapter and PVC cap

MISCELLANEOUS

» Options:	Secondary containment berm

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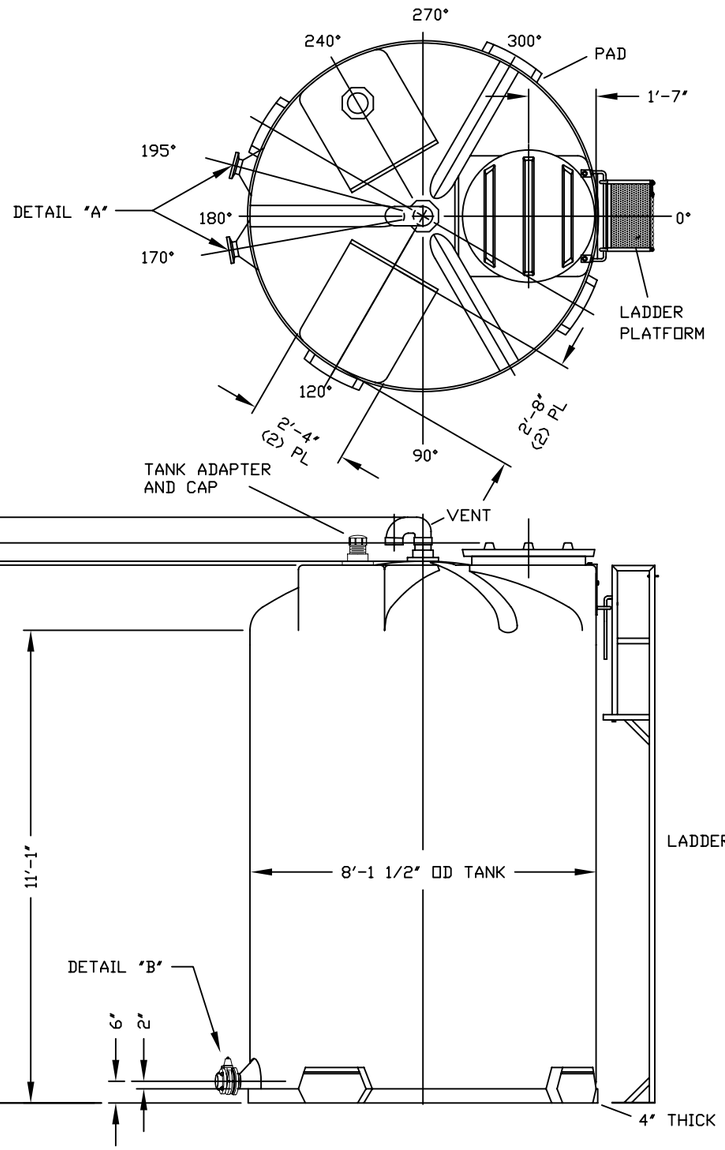
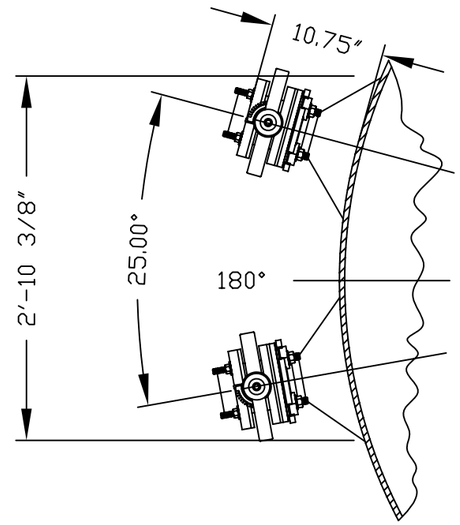
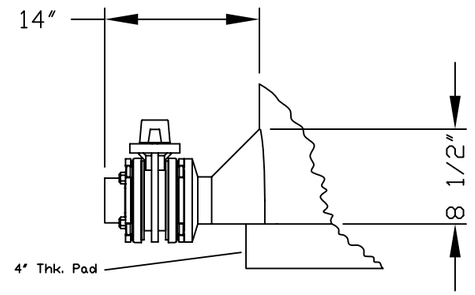




DETAIL "A"
VALVE LAYOUT & CLEARANCE
SCALE: NONE

SULFURIC ACID RESTRICTIONS

1. Do not store sulfuric acid above 80% concentration. For concentrations equal to or less than 80%, use tanks with equipment numbers equal to or greater than P4275. Do not use tanks with lower equipment numbers for sulfuric acid. Concentrations greater than 80% require Corporate approval.
2. Sulfuric acid must be less than 100 degrees to be stored in this tank.
3. Sulfuric acid must be filled through the top of the tank only.
4. Tank vent must always be open when storing sulfuric acid.



DETAIL "B"
IMFO (INTEGRALLY MOLDED FLANGED OUTLET)
SCALE: NONE

NOTES:
1. THIS IS A COMPUTER GENERATED DRAWING. DO NOT REVISE BY HAND.
2. DIMENSIONS WILL VARY ±3% DUE TO VARIATIONS IN MULTIPLE MOLDS & CONDITIONS PREVALENT DURING MANUFACTURE & USAGE.
3. DESIGN TANK WALL THICKNESS FOR 1.9 SpG PRODUCT.
4. SEE DWG "BK4TUFC", TITLED "BAKER 4000 GALLON STORAGE TANK TYPICAL FITTING INSTALLATION", FOR FITTING LOCATIONS.

CALIFORNIA VERSION

SPECIFICATIONS:

1) Tank Weight: 1250 lbs.
2) Pad Weight: 300 lbs.
3) Tank Material: HDPE
4) Design Pressure: 0 psig
5) Vacuum Rating: Atmospheric only
6) Temperature limit: 150°F
7) Specific Gravity limit: Original Style - 1.65;
Total Drain - 1.90

NOTES:

1. This drawing is a baseline representation for this model of tank. Variations between this drawing and the actual equipment in the field can and do exist, primarily with appurtenance locations, sizes and quantities. Consult your local BakerCorp representative if specific needs exist.
2. THIS TANK IS *NOT DESIGNED FOR TRANSPORTING LIQUIDS*. It should be moved only when empty..

REV.	DESCRIPTION	DATE	BY
G			
F			
E			
D			
C			
B	Revised dimensions	10/9/06	PJB
A	Added pad, valves, vent, ladder & bulkhead fitting.	6/5/06	PJB

BAKERCORP™ 3020 OLD RANCH PARKWAY
SEAL BEACH, CA 90740-2751

SCALE: Do Not Scale	SIZE B		ORIGINAL DWG. DATE 05SEP02
DRAWN BY: P.J.B.	APPROVED BY: –		CAT/CLASS ––
TITLE 4000 GALLON POLY TANK TOTAL DRAIN (IMFO)			SHEET 1 OF 1
DRAWING NO. S-3-M0001-1-			REV. B

HIGH-DENSITY POLYETHYLENE BLACK GAS

ASTM D2513; OIL & GAS GATHERING PIPE API 15 LE

TECHNICAL & INSTALLATION GUIDE

JM Eagle™

Building essentials for a better tomorrow™

HIGH-DENSITY POLYETHYLENE BLACK GAS

CONTENTS

WARRANTY

J-M Manufacturing Company Inc. (JM Eagle™) warrants that its standard polyvinyl chloride (PVC), polyethylene (PE), conduit/plumbing/solvent weld and Acrylonitrile-Butadiene-Styrene (ABS) pipe products ("Products") are manufactured in accordance with applicable industry specifications referenced on the Product and are free from defects in workmanship and materials. Every claim under this warranty shall be void unless in writing and received by JM Eagle™ within 30 days of the date the defect was discovered, and within one year of the date of shipment from the JM Eagle™ plant. Claims for Product appearance defects, such as sun-bleached pipe etc., however, must be made within 30 days of the date of the shipment from the JM Eagle™ plant. This warranty specifically excludes any Products allowed to become sun-bleached after shipment from the JM Eagle™ plant. Proof of purchase with the date thereof must be presented to the satisfaction of JM Eagle™, with any claim made pursuant to this warranty. JM Eagle™ must first be given an opportunity to inspect the alleged defective Products in order to determine if it meets applicable industry standards, if the handling and installation have been satisfactorily performed in accordance with JM Eagle™ recommended practices and if operating conditions are within standards. Written permission and/or a Return Goods Authorization (RGA) must be obtained along with instructions for return shipment to JM Eagle™ of any Products claimed to be defective.

The limited and exclusive remedy for breach of this Limited Warranty shall be, at JM Eagle's sole discretion, the replacement of the same type, size and like quantity of non-defective Product, or credits, offsets or combination of thereof, for the wholesale purchase price of the defective unit.

This Limited Warranty does not apply for any Product failures caused by user's flawed designs or specifications, unsatisfactory applications, improper installations, use in conjunction with incompatible materials, contact with aggressive chemical agents, freezing or overheating of liquids in the Product and any other misuse causes not listed here. This Limited Warranty also excludes failure or damage caused by fire stopping materials, tread sealants, plasticized vinyl products or damage caused by the fault or negligence of anyone other than JM Eagle™, or any other act or event beyond the control of JM Eagle™.

JM Eagle's liability shall not, at any time, exceed the actual wholesale purchase price of the Product. The warranties in this document are the only warranties applicable to the product and there are no other warranties, expressed or implied. This Limited Warranty specifically excludes any liability for general damages, consequential or incidental damages, including without limitation, costs incurred from removal, reinstallation, or other expenses resulting from any defect. IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE SPECIFICALLY DISCLAIMED AND JM EAGLE™ SHALL NOT BE LIABLE IN THIS RESPECT NOTWITHSTANDING JM EAGLE'S ACTUAL KNOWLEDGE THE PRODUCT'S INTENDED USE.

JM Eagle's Products should be used in accordance with standards set forth by local plumbing and building laws, codes or regulations and the applicable standards. Failure to adhere to these standards shall void this Limited Warranty. Products sold by JM Eagle™ that are manufactured by others are warranted only to the extent and limits of the warranty of the manufacturer. No statement, conduct or description by JM Eagle™ or its representative, in addition to or beyond this Limited Warranty, shall constitute a warranty. This Limited Warranty may only be modified in writing signed by an officer of JM Eagle™.

1.0 INTRODUCTION

These product lines are manufactured from a high-density material. The Gas Piping System can be joined by butt fusion, socket fusion, saddle fusion, mechanical fittings, or electrofusion. All methods are reliable means of joining the Gas Piping System. Generally, the choice of which system to use is at the discretion of the individual user.

Installer training for the proper use and installation of polyethylene pipe is a critical factor in its long-term performance. The Gas System has ample safety factors included in its design for providing reliable long-term performance in service, if the system is properly installed and operated at design pressures. The importance of proper training in the installation and operation of polyethylene plastic piping systems cannot be overemphasized.

Installation and operating recommendations are included in this bulletin to help the operator develop effective training programs.

Publications by the American Gas Association, the American Society for Testing and Materials, and the Plastics Pipe Institute can be helpful in assuring proper installation. Use of this information will minimize the potential for failure resulting from improper installation practices.

The Gas Piping System is manufactured to meet the requirements of ASTM D2513, which is necessary to meet the Pipeline Safety Regulations Part 192, Minimum Federal Safety Standards for the transport of natural gas.

2.0 PRODUCT & TECHNICAL INFORMATION

2.1 CODE COMPLIANCE

All Gas Pipe and Fittings meet the requirements specified in ASTM D2513. This Standard Specification is incorporated, by reference, in Appendices A and B of Part 192, Title 49 of the Code of Federal Regulations (CFR), “Transportation of Natural and Other Gas by Pipeline: Minimum Safety Standards.” All Gas butt fusion and socket fusion fittings also meet the requirements of ASTM D3261 and ASTM D2683 respectively.

2.2 PHYSICAL PROPERTIES

Typical physical properties of Gas Pipe are available in polyethylene gas distribution catalogs.

2.3 LONG-TERM STRENGTH

The industry standard for establishing the design basis for polyethylene gas distribution systems is ASTM D2837, "Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials." This standard assigns the long-term strength of the pipe based on hydrostatically tested samples at a range of pressures that result in creep rupture failures (normally ductile) over a period of 10,000 hours or more. A regression analysis of these burst data is made to project the failure curve to 100,000 hours establishing the Long-Term Hydrostatic Strength (LTHS). Based on this, a Hydrostatic Design Basis (HDB) is assigned for each standard temperature tested.

The pressure rating and associated ASTM D2513 designation for two temperatures are listed in PPI's TR-4 report.

2.4 PIPE PRESSURE RATING

Design pressure ratings for Gas Pipe can be calculated by using the following formula given in the Department of Transportation (D.O.T.), minimum federal safety standards for gas lines, subpart C, Section 192.121:

P=2S/(SDR-1) X 0.32

Where:

P= PRESSURE RATING IN PSI GAGE
S= HYDROSTATIC DESIGN BASIS CATEGORY, PSI
SDR= STANDARD DIMENSION RATIO

2.5 EFFECT OF ENVIRONMENTAL EXPOSURE ON PHYSICAL PROPERTIES

2.5.1 CHEMICAL RESISTANCE

Polyethylene Gas Pipe, for all practical purposes, is chemically inert. It has good resistance to most solvents and chemicals that it is likely to encounter in dry natural and manufactured gas distribution services. Examples are odorants (mercaptans), fogging oils, antifreezes (glycols and other alcohols) and the many constituents of natural and synthetic gas.

Gas pipe meets the chemical resistance specifications outlined in ASTM D2513. Chemical resistance data for polyethylene pipe can be found in the PPI Technical Report TR-19, "Thermoplastic Piping for the Transport of Chemicals" or through your JM Eagle™ sales representative.

2.5.2 WEATHER RESISTANCE

Gas Pipe is protected against degradation caused by ultraviolet rays from direct sunlight. The polyethylene resin contains 2 percent to 3 percent of finely divided carbon black. This provides the black color for black gas pipe. Carbon black is the most effective additive for enhancing the weathering characteristics of polyethylene pipe. JM Eagle™ gas pipe can be safely stored outside in most climates for periods of many years without danger of loss of physical properties due to ultraviolet exposure. In general, JM Eagle™ recommends the use of a first-in, first-out inventory management procedure.

2.5.3 INSTALLATION TEMPERATURES

Gas Pipe can be installed at any ambient temperature condition in which normal installation operations would continue. In cold weather, however, special procedural recommendations, as outlined in this bulletin, should be followed.

2.5.4 THERMAL EXPANSION AND CONTRACTION

The coefficient of thermal expansion for Gas Pipe is 9 x 10^{-5} inch/inch/degrees F. This translates to an easy rule of thumb: the pipe changes in length 1 inch per 10 degrees F change in temperature per 100 feet of pipe length.

The effect of expansion and contraction must be considered when using compression type fittings. The fitting must possess sufficient pullout resistance to counteract the thermal stress forces generated by the pipe.

2.5.5 PERMEATION

All types of plastics are permeable by gases to varying extents. The constituents of natural gas are somewhat permeable through polyethylene pipe, but not enough to have any detrimental effects on function in fuel gas service.

Because methane is the primary constituent of natural gas, it may be of interest to know its rate of permeation through Gas Pipe. The American Gas Association (AGA) “Plastic Pipe Manual for Gas Service” lists the permeability rate of methane through HDPE as:

$$2.4 \times 10^{-3} \quad \frac{\text{Ft}^3 \text{ of gas-mils of wall thickness}}{\text{Ft}^2 \text{ pipe area x day x pressure in atmospheres}}$$

The rates of permeation for other constituents of natural gas, except hydrogen, are generally equivalent to, or less than, that for methane.

Even though the value for hydrogen is five times that of methane, considering its relatively low concentration in most natural and synthetic gas, it is apparent that the actual amount that could permeate is normally so low as to be insignificant.

2.5.6 EFFECT OF EXTERNAL LOADING STRESSES

Consideration must be given to the installation of all plastic piping systems, including the Gas Piping System, to avoid failures caused by excessive external stress. Field experience has shown that excessive externally induced stresses can act independently or together with internal pressure to exceed material strength and cause failure. Because polyethylene is subject to “crack propagation” under excessive stress conditions, such failures may not occur until after several years of use. Excessive installed bending in plastic piping systems, particularly at joints, can exceed stress limits and result in failure. Pipe where joined to fittings should be laid true to line and grade and backfilled carefully to prevent differential settlement, and thus excessive bending. See Permanent Minimum Bending Radius Limits.

Excessive stresses and failure of plastic pipe can also result from impact, indentations or deflection. Avoid excessive compaction forces and particularly avoid installation of the pipe against a source of point loading. The bed for the pipe and fill materials around the pipe must be free of rocks, blocking materials or other sources of point loading or deflection. Heavy machine compaction as by roller or hydrohammer should be used only for consolidation of final backfill with a minimum of 24 inches of previously layered and compacted backfill.

ASTM D2774, “Standard Recommended Practice for Underground Installation of Thermoplastic Pressure Piping,” provides additional information for direct burial of Gas Pipe.

2.5.7 PLASTIC PIPE DAMAGE & REPAIR

Industry surveys indicate the primary causes for repair of plastic piping are from third party damage and poor workmanship in the initial installation. Repair can be minimized by using careful mapping and location methods and by proper training and inspection procedures. When repair is required, an advantage of Gas Polyethylene Pipe is its capability of being squeezed to control gas flow quickly and localize system shutdown.

Recommended procedures for repair are outlined in the Gas Piping Technology Committee (GPTC) of the AGA Guide as well as the AGA “Plastic Pipe Manual.’’

Squeeze-off in sections of pipe, which are to be left in the system, should only be done using approved techniques and properly designed equipment to minimize pipe damage. Procedures for squeezing-off Gas Pipe are provided in the squeeze-off section of this bulletin.

An Electrofusion System and the MetFit Mechanical Fitting System (through 2") are useful in making repairs to polyethylene pipe.

2.5.8 PRODUCT DISPOSAL

At present, most polyethylene is disposed of by landfill. Gas Polyethylene Pipe is quite stable and poses no health hazards in properly operated landfill situations.

In some instances, polyethylene refuse is burned. Under conditions of good combustion, such as is found in forced draft incinerators, polyethylene is converted to carbon dioxide and water. Incomplete combustion results in the generation of volatiles that are the same as those produced during high-temperature processing operations. Carbon monoxide and acrolein are believed to be the most toxic fume components produced under poor combustion conditions.

The combustion of polyethylene is discouraged where large amounts of oxygen cannot be maintained. Such situations include open burning or dump fires and pit burning. When the oxygen supply during burning is limited, the smoke produced should be considered toxic and not inhaled. The same is true for smoke produced from wood and paper burned under poor combustion conditions. Applicable regulations should be considered in the disposal of solid waste.

3.0 INSTALLATION GUIDELINES

3.1 HANDLING

Gas Pipe is a tough flexible product that is able to withstand normal installation handling. However, unusually rough handling of Gas Pipe can result in damage to the pipe wall. Care should be taken to avoid pushing or pulling Gas Pipe over or around sharp projections. Gas Pipe is subject to impact

damage when dropped from excessive heights or when heavy objects are dropped upon it, particularly during cold weather. Kinking or buckling should be avoided and any section of pipe that has been damaged in this manner should be cut out. Based on pipe pressure tests, a good rule of thumb in determining if a scratched piece of pipe should be cut out of the piping system is: if the scratch depth is greater than 10 percent of the pipe wall thickness, then the section should be removed or repaired.

3.2 UNLOADING AND LOADING

When unloading or loading a shipment of Gas Pipe, forklift operators should be cautioned against damaging the pipe with the fork or tines of the lift truck. Coils of pipe are strapped or palletized for easy unloading or loading. When unloading or loading straight sticks of pipe, allow for some bending in the middle of the lift. Position forklift tines as far apart as possible to reduce the amount of bending. This will enable operators to lift the load without raising the forks to excessive heights which risks dropping the load.

Pipe unloaded by hand from a truck bed should be rolled down inclined planks to keep damage to a minimum. It should not be dropped to the ground. Never drop the pipe onto hard pavements or rocky terrain from truck beds. This is particularly important when unloading pipe at temperatures of 40 degrees F or below; under these conditions, the pipe is stiffer and more susceptible to damage from impact.

WARNING: When breaking down bulk packs, take care to stand clear of the pipe while strapping is being cut. Coiled High-Density Polyethylene (HDPE) pipe may contain energy as in a spring. Uncontrolled release, i.e., cutting of straps, can result in dangerous uncontrolled forces. All safety precautions and proper equipment is required.

3.3 STRINGING

Reel trailers can be helpful when stringing out coiled pipe for direct burial, plow-in, pull-in or insertion renewal. It is helpful when handling coiled pipe to string the pipe out on the ground upon arrival at the job site. This allows time for the coil set to relax, and will simplify handling and emplacement of the pipe.

When uncoiling pipe by hand, only cut those straps on the coils which are necessary to uncoil outer rolls; cut internal bands whenever necessary as the coil is unrolled.

Always inspect the pipe as it is being uncoiled and during installation to make sure no damage to the pipe has occurred during shipment and subsequent handling at the job site.

3.4 DRAGGING

Occasionally, when long strings of pipe are joined together, it is necessary to drag the pipe to where it will be installed. When the pipe must be dragged over rocky terrain or hard pavement, take precautions to protect the pipe from abrasion. Sandbags, used tires or short logs may be used to support the pipe and prevent hard contact with sharp rocks or hard pavement.

3.5 CUTTING

Gas Pipe should be cut with pipe cutters designed for plastic pipe. These tools easily provide the square cut ends that are necessary to provide satisfactory fusion joints. If carpenter or hacksaws are used to cut the pipe, special care must be taken to ensure square cut ends and to clean the resultant sawdust from inside the pipe.

WARNING: Before cutting coiled pipe, restrain both sides of cut. Pipe is under tension. Unrestrained pipe can spring back forcibly while being cut and could cause personal injury.

3.6 COLD-WEATHER HANDLING

Polyethylene is a tough piping material, yet colder temperatures can reduce resistance to damage from mechanical abuse, such as impact. Avoid dropping the pipe, especially in cold weather. Although the recommended method of unloading is to use a forklift or crane, an alternate method is to roll the sticks of pipe down inclined planks. In all cases the pipe should be inspected for damage.

When handling coiled pipe at temperatures below 40 degrees F, it is helpful to uncoil the pipe that is to be installed and let it straighten out prior to making the installation. This can be done by gradually uncoiling the pipe and covering it with dirt at intervals to keep it from coiling up again. Always be careful when cutting the straps on coils of pipe because the outside end of a coil may spring out when the strapping is removed.

In cold weather conditions, more effort will be required to uncoil the pipe and piping will spring back more forcibly if the ends are not anchored or restrained. Carefully follow equipment manufacturers' recommendations and guidelines for cold-weather conditions.

3.7 OTHER HANDLING PRECAUTIONS

During the transport of pipe, it should be continuously supported in a manner so as to minimize movement between the pipe and its support. Any practice of carrying supplies or equipment on top of plastic pipe should be avoided because of damage from sharp edges and other projections.

Care should be taken to protect the pipe from excessive heat. Be particularly careful of open flames. Do not lay an open flame or torch across pipe surfaces.

3.8 TRENCHING

For direct burial of Gas Pipe, trench bottoms should be relatively smooth, continuous and free of rocks and other debris. When ledge rock, hardpan or boulders are encountered, the bottom of the trench should be padded with sand or other fine grained fill materials. The trench should be wide enough to allow (a) fusion in the ditch if required, (b) snaking of the pipe along the bottom of the trench if needed, and (c) filling and compaction of side-fills. Minimum trench widths can be utilized in most instances by joining the pipe before lowering it into the trench.

Generally, sufficient cover must be maintained to provide reasonable protection against anticipated external stress loads. Gas Pipe should be installed at a minimum depth of 24 inches.

3.9 PIPE PLACEMENT IN TRENCHES

Gas Pipe can be joined either above ground or in the ditch as the situation dictates. Though most joining can be accomplished above ground, joining that must be done in the ditch should be well planned to ensure that enough space is available and that proper alignment is achieved. Care should be taken to avoid buckling, gouging, and other mechanical damage when lowering Gas Pipe into the ditch.

Align all pipe true to line and grade. As mentioned earlier, extremely cold weather makes Gas Pipe stiffer and increases the likelihood of impact damage.

Because plastic pipe contracts as it cools, it is desirable in warm weather to snake the pipe in the bottom of the trench. This provides for “slack” in the pipeline to be taken up as the pipe cools and contracts in the ditch prior to backfilling.

3.10 VALVE INSTALLATION

In the event valves are used in a Gas Pipe installation, it is recommended that the guidelines provided in the Federal Regulations be followed. The Code of Federal Regulations Title 49, Part 192.193 states: “Each valve installed in plastic pipe must be designed so as to protect the plastic material against excessive torsion or shearing loads when the valve or shut-off is operated and from any other secondary stresses that might be exerted through the valve or its enclosure.” Following these recommendations will help avoid damage to the piping system.

3.11 PIPE LOCATING

Polyethylene materials are generally not detectable by standard magnetic locating equipment. There are several methods available to aid in the detection of polyethylene pipelines. These include tracer wires, identification tape, detection tape, line markers, electronic marker systems and acoustic pipe tracing. When installing the Gas System, consideration should be given to a method or methods that will allow the pipeline to be located in the future. This alerts the locating personnel that the pipeline may not be identifiable by standard locating equipment. A standard method for locating plastic

pipe is to use an electrical conductor (such as metallic wire or metallic tape) installed with the pipe. This will permit location with electronic detectors. The AGA (American Gas Association) PLASTIC PIPE MANUAL FOR GAS SERVICE (2006 Edition) provides the following information on the use and placement of such electrical conductors: “Companies have reported that current surges (such as developed by lightning strikes) have followed the tracer causing physical damage to plastic pipe. Where practical, a separation of wire and pipe may be beneficial. However, separation may lead to difficulty in precise location of the plastic pipe. The engineer must consider the relative importance of locating the pipe versus the possibility of current surges.”

3.12 BACKFILLING & COMPACTION

Backfilling and compaction of installed Gas Pipe must be accomplished so as to avoid induced bending stresses both as a result of the backfilling itself and from differential settling of fill materials subsequent to the backfilling operation. Additionally, care should be taken to avoid mechanical damage to the pipe from the fill material itself.

Attention to careful emplacement, filling and compaction procedures will prevent such induced stresses and mechanical damage.

Gas Pipe installations should be continuously supported beneath their entire lengths by clean and firm backfill materials (no rocks). Intermittent blocking should not be used to support pipe excavated sections.

Relatively compactible and clean fill materials should be used to bed newly installed pipe with particular attention to filling voids beneath transition connections. Side-fill compaction should be utilized to develop lateral passive soil forces when backfilling larger diameter thin wall pipes. The first layer of fill material around and about 12 inches over the pipe should be free from rocks or frozen chunks which could damage the pipe. This layer should be well compacted by hand. Successive layers should be spread uniformly to fill the trench completely. Large rocks, frozen earth and decomposable debris such as wood should not be included in the backfill.

Heavy rollers and large mechanical tampers such as hydrohammers should only be used to consolidate the final backfill and even then there should be a minimum of 24 inches of layered and previously compacted cover.

3.13 PERMANENT MINIMUM BENDING RADIUS LIMITS

The permanent minimum-bending radius at fusions (butt, saddle, socket and electrofusion) in the Gas System should be 90 times the pipe diameter. Gas Pipe without fusions can accommodate a permanent bending radius of 20 times the pipe diameter. Tighter bends down to 10 times the pipe diameter can be made if they are temporary, such as in the plowing or the insertion method of installation.

3.14 PRESSURE TESTING AND LEAK DETECTION

JM Eagle™ recommends pressure testing and leak detection for newly installed Gas Pipe and Fittings. An excellent guide is the procedure outlined in the Federal Regulations, which must be followed for any system that should ever fall within the jurisdiction of the Federal Regulations.

The CFR Title 49, Part 192.513 lists the test requirements for plastic pipelines:

a. Each segment of a plastic pipeline must be tested in accordance with this section.
b. The test procedure must ensure discovery of all potentially hazardous leaks in the segment being tested.
c. The test pressure must be at least 150 percent of the maximum operating pressure, or 50 psig, whichever is greater.
d. The temperature of thermoplastic material must not be more than 140 degrees F during the test.

State and local codes, as well as utility standards, often dictate pressure test duration. Generally, test duration should be determined by consideration of the volumetric content of the test section and the instrumentation used to ensure discovery of all leaks. Air or inert gases are standard test mediums.

Pressure testing of Gas Pipe should not be initiated until about 20 minutes after the final heat fused joint is made. It is generally desirable to pressure test new installations prior to backfilling so that soap bubble checks of joints can be used to locate leaks, if they occur. The test section should be tied down at intervals to prevent whipping of the pipeline should sudden pressure release occur. This is particularly important when pressure testing sections of pipe on top of the ground prior to insertion.

When using expandable caps or compression type couplings as test heads, adequate pullout resistance of the mechanical connector must be demonstrated. Additional methods including anchoring, sandbagging, staking or strapping should be used for safety. Many utilities use transition fittings with welded on closure caps as test heads.

When using air compressors to pressure test sections of Gas Pipe, care should be taken to minimize contamination of the pipe with excessive amounts of oil or other agents. Oil has the effect of plasticization of Gas Pipe that results in a small decrease in strength in regions where high concentrations of oil are absorbed by the plastic. For this reason, traps or filters should be used on the discharge side of the compressor to minimize the amount of contamination. Also, the temperature of the air from the compressor must be low enough so as not to allow the test temperature to exceed the maximum allowable 140 degrees F.

When time testing large volume sections of Gas Pipe, the operator should be aware of the creep characteristics of plastic pipe and the effects of temperature change. After initial pressurization, polyethylene pipe may continue to expand slightly, causing a noticeable drop in gauge reading that will stabilize after a few minutes. A long-term reading should be initiated when the stabilization point has been reached. Of course, any heating and cooling of the test medium as in an overnight test will affect pressure readings, which could conceivably mask or falsely indicate slow leaks. No specific guidelines can be given, as readings would vary greatly depending on volume and temperature characteristics.

It is occasionally necessary to use gaseous leak detection tracers to locate leaks in a buried system. Commercial odorants in liquid form should not be injected directly into the Gas System because they can temporarily affect the strength of polyethylene. Odorants should be vaporized prior to injection. When bar-holes are sunk to provide a path to the surface for the tracers, care should be taken to avoid puncturing the buried pipeline.

3.15 SAFETY AND FIELD PRECAUTIONS

1. **WARNING:** Treat electrical tools as potential sources of ignition and follow standard safety procedures for working in explosive atmospheres.
2. **WARNING:** Only properly trained and qualified personnel should make fusions.
3. **WARNING:** Wear suitable gloves and eye protection.
4. **WARNING:** Temperature of fusion tools should be checked to be sure that they conform to the recommended operating temperature range.
5. **WARNING:** When breaking down bulk packs, take care to stand clear of pipe while strapping is being cut. Coiled HDPE pipe may contain energy as in a spring. Both the straps and the pipe may spring outward when the strap is cut and could cause severe injury. All safety precautions and proper equipment is required.
6. **WARNING:** Before cutting coiled pipe, restrain both sides of cut. Pipe is under tension. Unrestrained pipe can spring back forcibly while being cut and could cause personal injury.
7. **WARNING:** Understand and follow all equipment manufacturer's recommendations and guidelines.

3.16 HEATING TOOL MAINTENANCE

Clean heater adaptors carefully before and after each fusion. Remove any residual polyethylene using a clean non-synthetic cloth. Never use metal objects to clean heater adaptors because they can damage the surface.

The heating tool temperature recommendations shown in this bulletin represent the temperature on the surface of the heater adaptors that actually contact the pipe or fitting. This temperature should be monitored daily to ensure compliance with recommendations.

The operator can usually expect the tool thermometer to indicate a higher temperature than specified in order to achieve the correct surface temperature. In addition, the operator will normally encounter variations in heater adaptor temperature due to different adaptor configurations. In these cases, the adaptor having the lower temperature should be set at the recommended temperature.

4.0 FUSION PROCEDURES

WARNING: Understand and follow all equipment manufacturers' recommendations and guidelines.

4.1 SOCKET FUSION

4.1.1 EQUIPMENT

1. Pipe or tubing cutter
2. Cold ring
3. Depth gauge
4. Chamfering tool
5. Heating tool
6. Female and male heater adaptors
7. Fitting puller
8. Clean non-synthetic cloth

4.1.2 PROCEDURES

1. Cut the pipe squarely with a pipe or tubing cutter.
2. Chamfer pipe using a chamfering tool.
3. Clean the end of the pipe with a clean non-synthetic cloth.
4. Install the depth gauge and cold ring. Remove depth gauge once cold ring is secured. Ensure pipe is sufficiently round once cold ring is installed.
5. Place a fitting puller on couplings, caps and reducers 2-inch IPS through 4-inch IPS.
6. Check the heater adaptor faces for proper joining temperature 500 degrees F (± 10 degrees F).
7. Place the fitting on the tool and then the tool on the pipe. Push the tool, pipe and fitting together with even pressure.
8. When the fitting is against the tool and the tool against the cold ring, begin the heating cycle shown in Table 1.
9. When you have heated for the proper cycle time, remove the fitting from the tool with a quick snap action. Then remove the tool from the pipe in the same way.

10. Quickly inspect the melt pattern on the pipe and fitting. If an incomplete pattern is obtained, repeat Steps 1 to 9 using a longer heating cycle and new fitting.
11. Within 3 seconds, carefully line up and push the fitting onto the pipe until it bottoms against the cold ring on the pipe. Do not twist or rotate the fitting.
12. Hold the joint firmly together without movement for the recommended holding time shown in Table 1. After an additional 3 minutes, release the cold ring and fitting puller.
13. Inspect the entire circumference of the fused joint to be sure there are no open gaps in the pipe to fitting juncture, and that the melt is pressed against the coupling all the way around. If a gap is found or the joint is not aligned properly, cut it out and repeat the procedure. See a properly made socket fusion joint appearance in Figure A. Only accept joints that meet these requirements. Never allow a questionable joint to be installed.
14. Wait an additional 10 minutes prior to pressure testing or burial.

SOCKET FUSION TIME CYCLES *(Heater Face at 500° F)*		
PIPE SIZE	**HEATING TIME** (sec)	**HOLDING TIME** (sec)
½" CTS	9-10	30
¾" CTS	9-10	30
1" CTS	14-16	30
1¼" CTS	14-16	30
½" IPS	9-10	30
¾" IPS	12-14	30
1" IPS	15-17	40
1¼" IPS	18-21	40
1½" IPS	20-23	40
2" IPS	24-28	40
3" IPS	28-32	50
4" IPS	32-37	50

Table 1

Figure A

4.1.3 COLD-WEATHER CONSIDERATIONS (BELOW 55ºF)

- Carefully remove (by light tapping or scraping) the ice and frost from the fusion areas and the areas to be clamped. Otherwise, ice will melt when exposed to the heating tool and spot chill the polyethylene. This could cause incomplete fusion.
- If possible, store fittings at room temperature (such as in truck cab) prior to use. This will reduce fitting contraction and make placing fitting on heater adaptor easier.
- Cold weather also causes pipe contraction that can result in a loose or slipping cold ring. For best results, clamp one cold ring in its normal position behind the depth gauge. Place shim material (i.e., a piece of paper or rag) around the inside diameter of a second cold ring and clamp this cold ring directly behind the first cold ring to prevent slippage.
- Shield the heating tool and fusion area from the wind, snow and freezing rain.
- Ensure heater adaptor faces maintain a temperature of 500 degrees F ±10 degress F.
- The length of cycle necessary to obtain a complete melt pattern will depend not only on the outdoor temperature, but also on wind conditions, pipe contraction and operator technique. The maximum heating cycle times shown in Table 1 should be used as a starting point for determining the exact heating cycle time for the particular installation conditions.

Determining the exact heating cycle time can be accomplished by making a test melt pattern on a piece of cold scrap pipe. If the initial melt pattern is incomplete, try a 5-second-longer cycle on another cold piece of scrap pipe. Continue this process until a complete melt pattern is obtained. Avoid cycles in excess of that required to achieve a good melt pattern.

Once the optimum heating cycle is established, begin fusion by placing the female adaptor on the pipe.

Start counting the heating cycle once the pipe is completely seated. The socket fitting should then be pushed on the male adaptor. There should be no problem with melt development in the fitting since the fit will be snug.

- Work quickly once pipe and fitting have been removed from the heating tool so that melt heat loss is minimized. But, still take time (2-3 seconds) to inspect both melt patterns.

4.2 BUTT FUSION

In addition to the following procedure, JM Eagle™ also has tested and endorses TR-33, the generic butt fusion procedure that is available at www.plasticpipe.org.

4.2.1 HEATING TIME

The heating time for virtually all large diameter pipe is determined by visually observing the melt bead during heating. For sizes 8 inches and larger, a bead width of three sixteenths of an inch to one quarter of an inch is recommended.

4.2.2 INTERFACIAL PRESSURE

The interfacial pressure for butt joints has been expanded to 60 to 90 psi. For hydraulic machines, the fusion force is determined by multiplying the interfacial pressure times the calculated pipe end area. The gauge pressure is theoretical; the internal and external drag needs to be added to this figure to obtain the actual fusion pressure required by the machine. Contact the machine manufacturer for set-up details.

4.2.3 HOLDING & COOLING TIME

The molten joint must be held immobile under pressure until cooled adequately to develop its strength. Due to the heavy weight of large diameter, heavy (lower SDR number) wall pipe, the newly made joint must be able to withstand the added stress of pipe removal from the machine. The fusion force should be held in the machine until the surface of the bead is cool to the touch. Ambient field conditions may require a cooling time of 30 to 90 seconds per inch of pipe diameter to achieve the cool temperature for removal from the machine. Pulling, installation, or rough handling of the pipe should be avoided for an additional 30 minutes.

WARNING: Understand and follow all equipment manufacturer's recommendations and guidelines.

4.2.4 EQUIPMENT

1. Pipe cutter
2. Butt fusion machine
3. Clean non-synthetic cloth

4.2.5 PROCEDURES

1. Install appropriate shell clamp liners and any other equipment required to fuse the size pipe (fitting) to be joined.
2. Select and control heating tool temperature. Temperatures of 500 degrees F (±10 degress F) or 375 degrees to 400 degrees F and 440 degrees F (±10 degrees F) may be used.
3. The pipe must be clean and dry. Wipe the inside and outside of pipe to be joined with a clean cloth. Make sure all foreign matter is removed. Cut off damaged or flattened pipe ends.
4. Swing facing unit into place and lock.
5. Retract movable shell back against the stops.
6. Position longer lengths of pipe in stationary shell clamp by placing pipe end lightly against the facing unit plate so that a sufficient amount of pipe end will be removed during facing. Close shell and tighten sufficiently to prevent slippage. Position shorter pipe or fitting

in movable shell in similar manner. In the case of coiled pipe, print lines should be 180 degrees apart to form an “S” configuration in the pipe. If the pipe is out-of-round, wait 2 minutes for pipe relaxation and retighten the shells.

7. Turn on facer motor and advance the pipe (fitting) ends against the facer cutters using enough pressure to cut a continuous ribbon. Continue facing until stops are reached and both ends are completely parallel and smooth. Remove facing unit per butt fusion machine manufacturer’s instructions.
8. Remove the shavings from pipe ends and facer base. Faced pipe ends should be kept clean and free of dust, water oil or anything that might contaminate the fusion area.
9. Check the ends of the faced pipe. If either pipe is not completely faced, go back to Step 3. Facing should be occasionally checked by carefully placing a straight edge across a faced pipe end to insure that the entire surface is level for complete contact of the pipe with the heating tool.
10. Bring the faced pipe ends together to ensure that the pipe will not slip in the shells. Check for high-low alignment between pipe ends. Tighten the inside clamp on the high side to align pipe ends as closely as possible.

    Never loosen the low side clamp. If the pipe ends are not aligned or if gaps are present, adjust the pipe in the shells and go back to Step 3.
11. Retract the shells and position the heating tool between the pipe ends.
12. Move the pipe and/or the fitting ends against the heating tool firmly to assure complete contact; then relax to slight contact pressure only.
13. Heating guidelines shown in Table 2 should develop an approximate bead width of the size shown in Table 3. Heating cycle starts when a complete, uniform bead of molten material is visible around the entire circumference of both ends. It is optional to develop melt based on visual appearance provided that Bead Width guidelines shown in Table 3 are attained.
14. At the end of the heating cycle, quickly retract the pipe shell clamps to snap the heater away from the pipe ends. Remove the heater without touching the pipe (if melted material is pulled off the pipe ends, allow the pipe to cool and then repeat the entire procedure). Bring the melted ends together rapidly (do not slam) to develop a double roll back of each bead onto the pipe. Use only enough pressure to form a double rollback bead. This operation should take no longer than three seconds.

NOTE: Hydraulic butt fusion machines should be set using an interfacial pressure of 60 to 90 psi. Refer to butt fusion machine manufacturer's recommendation for specific machine settings.

15. Maintain pressure for the "Holding Time Cycle" shown in Table 2.
16. Release pressure and allow joint to cool in the machine for an additional 3 minutes. Open shells and remove the pipe from the machine handling it with care.
17. Inspect the entire circumference of the fused joint for uniformity in size and shape. Each bead width should be the approximate dimensions shown in Table 3. See Figure B for a properly made butt fusion joint. Only accept joints meeting these requirements. Never allow a questionable joint to be installed.
18. Visually mitered joints (angled, offset) shoud be cut out and re-fused.
19. Allow further cooling of 20 minutes or until bead is not hot to the touch, before subjecting the pipe to rough handling.

4.2.6 COLD WEATHER CONSIDERATIONS (BELOW 55 DEGREES F)

- Carefully remove (by light tapping or scraping) the ice and frost from the fusion areas and the areas to be clamped. Otherwise, ice will melt when exposed to the heating tool and spot chill the polyethylene. This could cause incomplete fusion.
- Shield the heating tool and fusion area from the wind, snow and freezing rain.
- Ensure heating tool maintains temperature.
- Normally, the shell clamps are more than adequate to prevent pipe slipping in the liner. However, contraction in the pipe O.D. (because of low temperature) may, on occasion, result in pipe slippage in the shell. A shim layer (pressure sensitive tape or metal shim, etc.) can be placed on the liner I.D. to provide clamping restraint to the pipe.
- Follow the standard procedure with particular attention to the fusion steps. The timed cycles remain the same, but it may take longer to develop the initial melt bead completely around the pipe ends. Do not increase pressure. Quickly snapping the pipe from the heater and immediate closing of the shells to minimize melt cooling is important.

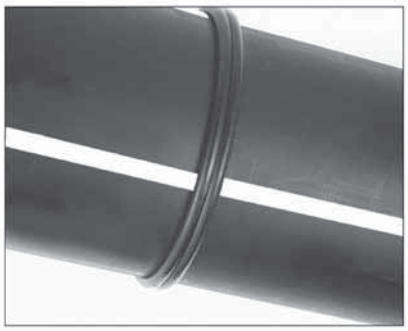


Figure B

BUTT FUSION TIME CYCLE GUIDELINES			
PIPE SIZE	**440°F HEATING TIME** (sec)	**500°F HEATING TIME** (sec)	**HOLDING TIME** (sec)
* ½" CTS	15-18	6-7	50
* ¾" CTS	16-19	8-10	50
* 1" CTS	18-22	14-17	50
* 1¼" CTS	20-24	16-19	50
* ½" IPS	16-19	8-10	50
* ¾" IPS	18-22	14-17	50
* 1" IPS	20-24	16-19	50
1¼" IPS	35-42	18-22	70
1½" IPS	50-60	26-31	90
2" IPS	55-66	28-34	90
3" IPS	65-78	30-36	120
4" IPS	75-90	35-42	120
6" IPS	105-126	55-66	180
8" IPS & larger	Visual	Visual	Cool To Touch

Table 2

** Socket Fusion recommended for these sizes.*

APPROXIMATE BEAD WIDTH GUIDELINES (400°, 440°, OR 500°F)	
PIPE SIZE	**PROPER MELT**
1¼"- 3"	approximately 1/16"
3" - 6"	1/16" - 1/8"
6" - 8"	1/8" - 3/16"
8" IPS & larger	3/16" - ¼"

Table 3
Each bead after fusion may be slightly wider than those in Table 3.

4.3 SADDLE OR SIDEWALL FUSION PROCEDURE

In addition to the following procedure, JM Eagle™ also has tested and endorses TR-41, the generic fusion procedure that is available from PPI at www.plasticpipe.org.

An application tool must be used when making saddle fusion joints. Follow the tool manufacture's operating procedures for proper use of the tool.

WARNING: Understand and follow all equipment manufacturer's recommendations and guidelines.

4.3.1 EQUIPMENT

1. Application Tool
2. Heating Tool
3. Appropriate size saddle heater adapters
4. 50- to 60-grit utility cloth
5. Clean non-synthetic cloth or lint-free paper towel

4.3.2 PROCEDURE

Place the tool on the main. It must be able to straighten, round and support the main during the heating, joining, and holding steps. A bolster plate is recommended for 6-inch IPS and smaller mains. Heating times start when the fitting and pipe are firmly seated against the heater faces. During heating, the heating tool may be rocked slightly, about 2 degrees, to seek its own alignment and to assure full contact with the main.

Clean main and fitting. Ensure that heater adaptor surfaces are at 500 degrees F ± 10 degrees F and the correct heating faces are installed. Roughen pipe main and fitting fusion surface with 50- to 60-grit utility cloth. Brush any residue away with a clean, dry non-synthetic cloth or paper towel.

Insert fitting into application unit, confirm proper alignment, then secure fitting tightly in unit. Center heater tool under the fitting, then apply and maintain firm, continuous pressure until a complete melt bead is seen on the main. Heat for the period of time shown in Table 6 or until melt bead size shown in Table 4 is visible on the crown of the pipe. Remove the heater from the fitting and the main with a quick snapping action. Quickly check the melt patterns of the heated surfaces for complete, even melt patterns.

APPROXIMATE PIPE MELT BEAD SIZE	
PIPE SIZE	**BEAD THICKNESS**
1¼"	1/32"
2"	1/16"
3" & larger	1/8"

Table 4

If the melt patterns are satisfactory, press the fitting on the pipe within 3 seconds after removing the heater and apply joining/fusion pressure as indicated in Table 6, until a melt bead of the following size appears around the entire base of the fitting:

APPROXIMATE FTG. BASE BEAD SIZE	
PIPE SIZE	**BEAD THICKNESS**
1¼"	1/16"
2"	1/8"
3" & larger	larger than 1/8"

Table 5

Maintain fusion-joining pressure for time specified in Table 6. Remove the application tool after an additional 3 minutes of cooling. For Standard Tap Tees and Service Saddles, let fusion cool an additional 10 minutes before pressure testing or tapping the main. Allow an additional 30 minutes before pressure testing or tapping High Volume Tapping Tees or Branch Saddles.

If melt patterns are unsatisfactory, complete the fusion; allow time for cooling, and then cut off top of the fitting to prevent use. Never reapply the heater for additional time, as the additional heat may risk a blowout on pressurized mains. Determine corrective steps to take and begin a new fusion at a new location.

Carefully inspect the fusion for the required visual criteria. Confirm that fitting is located completely within the pipe melt pattern and ensure that the appropriate size bead width is visible around the entire base of the fitting. Never accept a questionable fusion. See Figure C for an example of a properly made sadle fusion joint.

NOTE: For saddle fusions, it should be emphasized that these heating/fusion recommendations are strictly guidelines. This is true of all saddle fusion procedures. Certain conditions will almost always exist which result in longer or shorter heating times. The most important guideline is to achieve a complete pipe and fitting melt pattern.

STANDARD TAP TEES AND SERVICE-SADDLES				
PIPE SIZE	**HEATING PRESSURE** (lb/)	**FUSION PRESSURE** (lb/)	**HEATING TIME** (sec.)	**COOLING TIME** (sec.)
1¼"	60-70	40-50	45-Saddle 30-Pipe*	70
2"	65-75	45-65	45	70
3"	70-80	50-70	45	70
4"	70-80	60-80	45	70
6"	75-80	70-80	45	70
8"	75-80	70-80	45	70
HIGH VOLUME TAPPING TEES & RECTANGULAR BASE BRANCH SADDLES				
2"	120-140	65-75	55-65	150
3"	125-140	80-100	75-90	180
4"	125-140	90-110	75-90	180
6"	130-140	90-120	85-100	180
8"	130-140	90-120	85-100	180

Table 6

** Use heat shield between main and heater for first 15 seconds of heating cycle.*

NOTE: Times shown are guidelines ONLY. Actual times will depend on field site factors and the condition of the fusion equipment

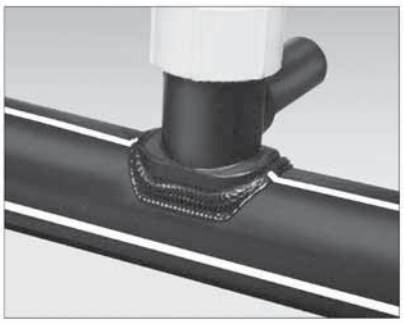


Figure C

4.4 HEAT FUSION QUALIFICATION

Gas socket, saddle and butt fusion joints made according to procedures described in this bulletin have been tested by JM Eagle™ using ASTM test methods given in Table 7 and meet the requirements of DOT Regulation Section 192.283.

The Material Transportation Board has stated that results of tests properly performed by a manufacturer of pipe and fittings may be adopted by a gas utility to qualify socket, saddle and butt fusion procedures pursuant to DOT Regulation Section 192.283. The regulations provide, however, that "it is still the operator who is responsible for compliance of his pipeline."

ASTM TEST METHODS		
TEST	**ASTM NO.**	**REQUIREMENT**
Short term rupture strength (hoop stress)	D1599	Ductile failure
Test for tensile properties of plastics	D638 (1)	> 25%
Time to failure under constant internal pressure (1600) psi hoop stress	D1598	> 1000 hours
Knock-off resistance of saddle fusions	F905	No joint failure

Table 7

(1) As applied to machined specimens of polyethylene pipe joints (socket and butt fusion) at a strain rate of 0.5 inches/rnin.

4.4.1 DOT REGULATIONS FOR PROCEDURES AND PERSONNEL QUALIFICATION

The DOT has ruled that, effective July 1, 1980, Part 192 of Title 49 of the Code of Federal Regulations is amended as follows (for heat fusion joints):

Section 192.283 Plastic Pipe; Qualifying Joining Procedures-Heat Fusion

Before any written procedure established under Section 192.273(b) is used for making plastic pipe joints by a heat fusion method, the procedure must be qualified by subjecting specimen joints made according to the procedure to the following tests:

1. The burst test requirements of Paragraph 6.6 (Sustained Pressure Test) or Paragraph 6.7 (Minimum Hydrostatic Burst Pressure) of ASTM D2513[(2)].
2. For procedures intended for lateral pipe connections subject a specimen joint made from pipe sections joined at right angles according to the procedure to a force on the lateral pipe until failure occurs in the specimen (ASTM F905). If failure initiates outside the joint area, the procedure qualifies for use; and
3. For procedures intended for nonlateral pipe connections, follow the tensile test requirements of ASTM D638, except that the test may be conducted at ambient temperature and humidity. If the specimen elongates no less than 25 percent or failure initiates outside the joint area, the procedure qualifies for use.

Section 192.285 Plastic Pipe; Qualifying Persons to Make Joints

1. No person may make a plastic pipe joint unless that person has been qualified under the applicable procedure by:
    a. Appropriate training or experience in the use of the procedure, and
    b. Making a specimen joint from pipe sections joined according to the procedure that passes the inspection and test set forth below.
2. The specimen joint must be:
    a. Visually examined during and after assembly or joining and found to have the same appearance as a joint or photographs of a joint that is acceptable under the procedure; and
    b. In the case of a heat fusion ... joint:
        i. Tested under Section 192.283;
        ii. Examined by ultrasonic inspection and found not to contain flaws that would cause failure; or
        iii. Cut into at least 3 longitudinal straps, each of which is:
            a. Visually examined and found not to contain voids or discontinuities on the cut surface area; and
            b. Deformed by bending, torque, or impact, and if failure occurs, it must not initiate in the joint area.

4.4.2 PROCEDURES FOR HEAT FUSION QUALIFICATION

1. Prepare fusion joint as described previously in the “Fusion Procedures” section of this manual. Allow joint to cool one hour.
2. Compare the outside appearance of joint with photograph illustrating the correct procedure.
3. Section the joint axially into at least three straps (1-inch wide) to expose the bond area. Leave approximately 8 inches of pipe on both sides of the joint.
4. Inspect the fusion to verify:

Socket Fusion

- Complete melt development
- No gaps or voids
- External melt pressed against coupling
- Bond length
- Proper alignment

Butt Fusion

- Complete and uniform melt beads
- Melt bead rolled back to pipe
- No gaps or voids
- Proper alignment
- Complete facing
- Visually mitered joints (angled, offset) should be cut out and re-fused.

Saddle Fusion

- Complete pipe melt pattern
- No gaps or voids
- Complete melt development around base of fitting
- Fitting placement in pipe melt pattern
- Properly prepared pipe surface

5. Using the sectioned joint from Step #3, perform the bend test as shown in Figures D, E and F. Hold the ends of the strap in the bent position and inspect the fusion area. If there are any gaps or voids evident, the joint should be rejected. The sectioned joint must be free of gaps or voids.
6. If the joint is not representative of the photographs shown in this bulletin, determine the incorrect procedure step taken and make another joint.

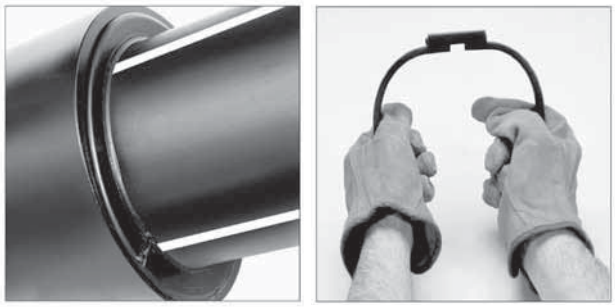


Figure D

Correctly Made Socket Fusion Joint

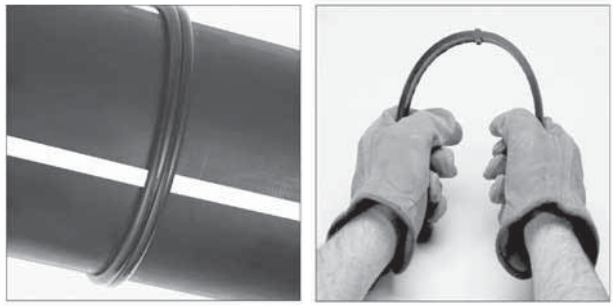


Figure E

Correctly Made Butt Fusion Joint

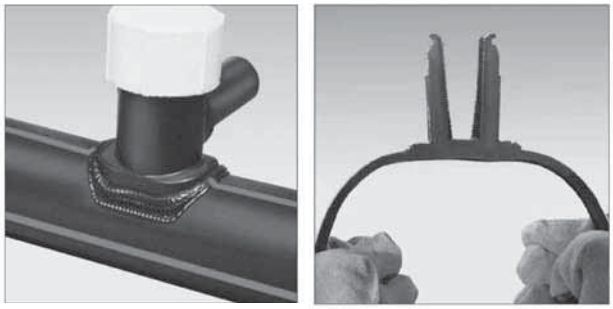


Figure F

Correctly Made Saddle Fusion Joint

5.0 SQUEEZE-OFF

WARNING: Understand and follow all equipment manufacturer's recommendations and guidelines.

Effective flow control is a basic requirement in gas distribution systems. This is accomplished with the Gas Pipe in two ways. The primary method of flow control should be those installed system valves that are available. Secondly squeeze-off using suitable equipment can be used to control flow or isolate a section of pipe. Also, squeeze-off is frequently used to control flow for emergency repairs or during certain pipeline or branch extension operations.

This section describes equipment and explains proper procedures and precautions for effectively and safely squeezing off Gas Pipe for flow control. The pressure rating of the pipe is retained if the recommended procedures and equipment are used.

5.1 TOOLS

Squeeze units suitable for use on Gas Pipe consist of steel bars and a mechanical or hydraulic means of forcing the bars together. These units are designed to squeeze Gas Pipe until the inside surfaces meet. This adequately controls gas flow although a bubble tight seal is not always obtained. A positive locking mechanism should be available.

CAUTION: To assure flow control, yet prevent damage to the pipe, tools have mechanical stops to limit the minimum gap between the squeeze bars. Recommended minimum gaps between the squeeze bars for Gas Pipe are based on the formula:

$$\textbf{Min.gap} = (2)\ (\text{max wall thickness}) \times (0.7)$$

In addition to observing the minimum gap distances between bars, the bars themselves should be rounded to prevent pipe damage.

The user also may want to consult the "Standard Guide for Squeeze-Off of Polyolefin Gas Pressure Pipe and Tubing," Designation F1041, issued by ASTM.

5.2 PRECAUTIONS FOR SQUEEZE-OFF

- Certain precautions should be taken to prevent damage to the squeeze tools or to Gas Pipe during squeeze-off in recognition of the large forces required for flow control, particularly in large main sizes. Damage to the pipe from improper squeeze-off procedures may cause eventual failure.
- Make certain the pipe is centered and squared in the squeeze tool. It is important that the pipe be free to spread as it flattens. Failure to do so may prevent flow control or result in damage to the pipe or the tool.
- Locate the squeeze point at least three pipe diameters away from the nearest fitting or butt-fused joint. Failure to do so may result in damage to the fittings or joints.
- Squeeze-off Gas Pipe only once in the same place. It is possible for scale or other metal particles contained within the gas flow to become trapped at the squeeze point. A second squeeze in the immediate area of the first could force these particles to penetrate into or through the pipe wall.
- Always use a squeeze tool with gap stops to limit the amount of squeeze and use the proper gap stops for the pipe size being squeezed. Using smaller gap stops or otherwise **over-squeezing** the pipe may result in damage to the pipe or tool.
- A bubble tight flow control will not always be obtained through squeeze-off. If more complete flow control is required, a valve should be used or additional squeeze tools used in series to supplement each other.
- Close the squeeze tools until flow is controlled or until the gap stops make contact. Do not use extension levers or “cheater bars”, or otherwise abuse the tools in trying to effect a squeeze-off. Such abuse may overstress the tool and result in failure of the tool and release of the gas flow. Any damaged tool should be repaired or replaced before use for squeeze-off of Gas Pipe.
- Squeeze Gas Pipe slowly or use momentary pauses in the operation to allow for pipe relaxation and reduction in resistance to closure. This is particularly helpful in larger diameters or when the pipe becomes stiffer in cold weather.
- A release rate of 0.5 inches/minute or less is recommended by ASTM F1041 based on a GRI/Battelle Study, “Effect of Squeeze-Off Practices and Parameters on PE Gas Pipe Damage.” *

** Twelfth Plastic Fuel Gas Pipe Proceedings, pp. 228-242 (1991).*

5.3 STATIC ELECTRICITY

WARNING: Treat electrical tools as potential sources of ignition and follow standard safety procedures for working in explosive atmospheres.

Emergency flow control situations requiring squeeze-off may involve working in the vicinity of blowing gas. The possibility and potential hazard of static electricity should be considered and the company standards on **bell-hole** safety followed.

Because static electricity can build up on any non-conductor such as plastic pipe, there is a possibility of a spark discharge of sufficient energy to cause ignition if the proper air/gas mixture is present. It is also possible for repair crews to receive shocks even though ignition does not occur. Therefore, a study was made with a major gas utility to define the nature of static charge buildup on polyethylene pipe. The results of that study indicated that:

1. Potential for ignition is present if all three of the following conditions are present: (a) there is sufficient gas flow to cause extensive turbulence; (b) rust particles or other foreign particles are present in the gas; (c) the charge is present at a point where a combustible air/gas mixture is present.
2. During the study, voltages over 30,000 volts were generated, but no ignitions occurred. The location of the measured charge (on the inner wall of the pipe several inches from the opening) was such that there is some doubt that it is present at a point where the combustible air/gas mixture is also present.
3. Although ignition was not obtained, it is clear that under certain conditions high static charges can be developed and static discharge is a possible ignition source.

Some users have taken precautions to dissipate the charge and minimize the possibility of an ignition and maximize the personal safety of the crew. The objective is to provide a path to ground for any static charge.
These precautions have included:

- Before personnel are permitted in the bellhole, a fine water spray is applied over the entire area including all exposed pipe and dirt.
- The pipe is kept wet during the squeeze-off procedure until squeeze-off is complete.

- A wet rag is applied to the pipe surface to provide dissipation of static charge to ground.
- In freezing weather, a 50/50 solution of antifreeze and water is sometimes necessary.

Squeezing the pipe used for gas distribution causes an increase in the velocity of flowing gas and thus possible increase in static charge development. Therefore, it is suggested that squeeze-off be done in a separate **bell-hole** remote to the leak whenever possible.

Additional information on static electricity is summarized in the report, "Static Electricity Considerations in Repair of Polyethylene Pipe Systems," available from JM Eagle™ sales representatives, and in the AGA "Plastic Pipe Manual for Gas Service."

JM Eagle™ gas pipe conforms to the requirements outlined in ASTM D 2513 specifications for Thermoplastic Gas Pressure Pipe, Tubing and Fittings, which is necessary to meet the Pipeline Safety Regulations Part 192, Minimum Safety Standards for the transport of natural gas.

Gas pipe products (previously produced by US Poly) are currently manufactured by JM Eagle™.

This guide is meant as an explanatory supplement to the materials above on how to install JM Eagle™ Black Gas Pipe under normal or average conditions so as to comply with Standard Laying Specifications. Any discrepancies between the above standards and the written information contained herein should be brought to the attention of Product Assurance immediately for resolution, prior to any actions by either contractor, engineer or municipality.

This guide is not intended to supply design information nor to assume the responsibility of the engineer (or other customer representative) in establishing procedures best suited to individual job conditions so as to attain satisfactory performance.

Engineers, superintendents, contractors, foremen and laying crews will find out much to guide them. This booklet will also be of help in determining pipe needs when ordering.

NOTES:

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JME-014B

JM Eagle™

Building essentials for a better tomorrow™

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PVC Flexible Connector Hose — NSF-61 Certified

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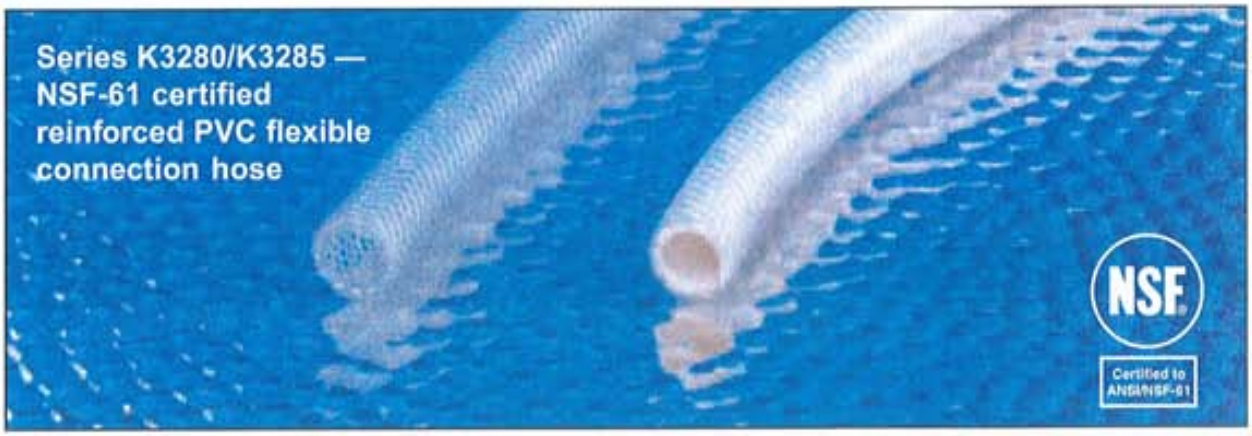


A flexible, non-contaminating NSF-61 certified hose that is ideal for use in drinking water applications.

Construction:

- Tube — Clear K3280[1] or white K3285[2] tube compound is formulated in compliance with applicable FDA[3] regulations, certified under NSF-61[4], and complies with California Proposition 65[5]
- Reinforcement — High tensile strength multifilament polyester yarn
- Cover — Clear PVC compound formulated in compliance with applicable FDA[3] regulations, certified under NSF-61[4], and complies with California Proposition 65[5]

Features:

- Made with PVC compounds certified under NSF-61
- When coupled properly, hose will pass high temperature extreme test requirement at 180°F (82°C) for 0.5 hr duration (ASME A112.18.1M, Section 6.7) and I. A. P. M. O. PS74-95 Section 5.2
- Closely-packed white polyester yarn design ensures minimal expansion of the hose while in service
- Silicone-free
- One-piece lengths (cut pieces also available)

Applications:

- Flexible water connectors
- Transfer of potable water
- Transfer of deionized water
- Water transfer lines for semiconductor manufacturing, where applicable

Service Temperature Range: 14°F (-10°C) to 140°F (60°C)
Domestic Hot and Cold Water

Series K3280/K3285 — NSF-61 PVC hose

Series No.		Size Code	Nominal ID		Nominal OD		Max. Working † Pressure (PSI)		Standard Length Coils	Approx. Wt. per Pkg.
K3280 Clear	K3285 White Tube		(In)	(mm)	(In)	(mm)	@ 70°F (20°C)	@ 150°F (66°C)		
✓	✓	04	.260	6.6	.440	11.1	180	125	500 ft.	28 lbs.
✓	✓	05	.320	8.1	.485	12.3	180	125	500 ft.	29 lbs.
✓	✓	06	.380	9.7	.595	15.1	180	125	500 ft.	46 lbs.
✓	✓	08	.505	12.8	.740	18.8	180	125	500 ft.	64 lbs.

† **Note:** Working Pressure decreases as temperature increases. The pressure ratings of hose assemblies can be affected by the type of fitting used and the coupling procedure. We cannot be responsible for the suitability of the user's fittings or the coupling method used. Use of compression fittings with Kuri Tec® yarn-reinforced hose is not recommended. Hose claims involving use of these fittings will be disallowed.

Compliance Footnotes:

1 Clear PVC compound KC042

2 White PVC compound KC042-W

3 **FDA** — The PVC ingredients used are sanctioned for food contact use under CFR title 21, parts 170-199.

4 **NSF** — Certified by NSF under standard 61, for use in drinking water system components to a maximum use level of 90 square inches per litre. This certification applies only to the hose, including tube and cover materials. Other components attached to the hose are not included.

5 **Proposition 65** — Compounds contain no substances designated as hazardous under California Proposition 65.

20' (6m) BARRIER RAIL

CALTRANS TYPE K

FOR VEHICLE CONTROL AND CONSTRUCTION SITE SAFETY

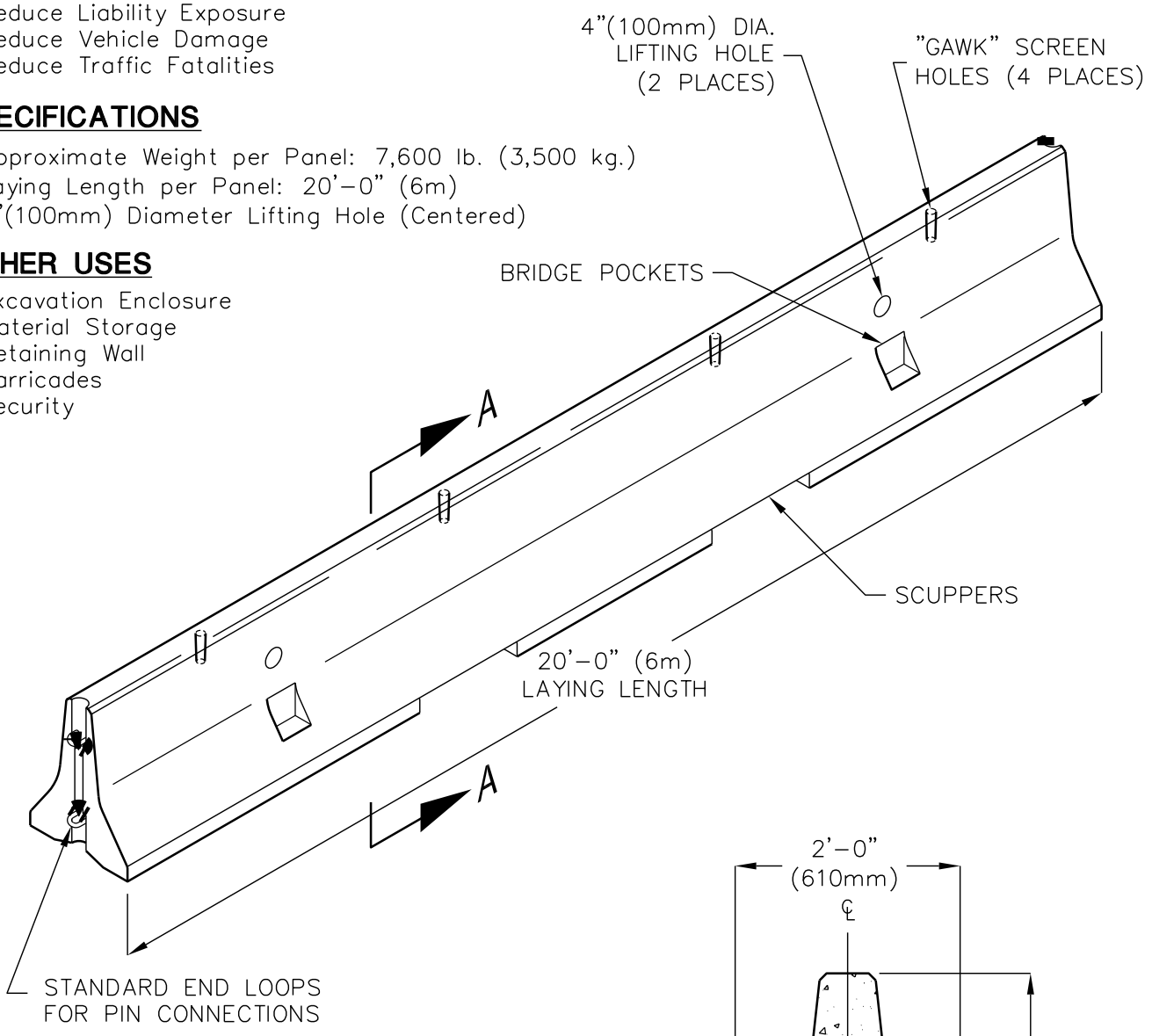
- Reduce Crossover Accidents
- Reduce Liability Exposure
- Reduce Vehicle Damage
- Reduce Traffic Fatalities

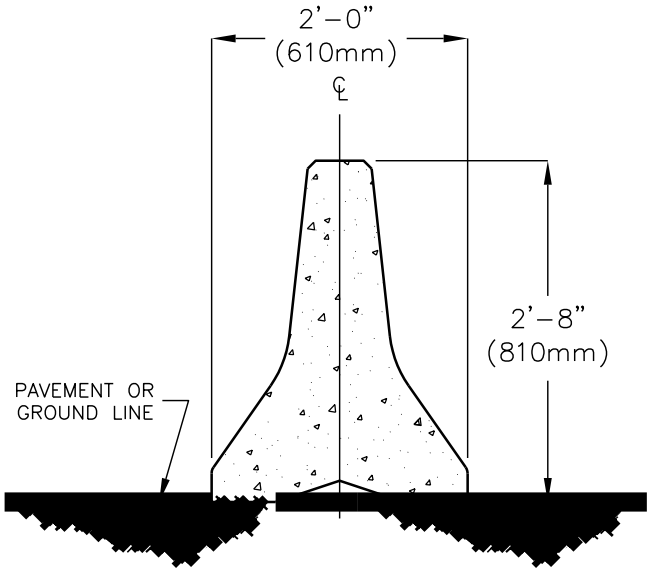
SPECIFICATIONS

- Approximate Weight per Panel: 7,600 lb. (3,500 kg.)
- Laying Length per Panel: 20'–0" (6m)
- 4"(100mm) Diameter Lifting Hole (Centered)

OTHER USES

- Excavation Enclosure
- Material Storage
- Retaining Wall
- Barricades
- Security





SECTION A-A

JENSEN PRECAST MANUFACTURES CONCRETE BARRIER RAILS, IDEALLY SUITED FOR STREET CLOSURES, DETOURS AND CONSTRUCTION SITES. BARRIERS ARE AVAILABLE FOR SALE OR RENTAL ON A SHORT OR LONG DURATION BASIS.

APPROVED BY THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION.

NOTE: METRIC DIMENSIONS ROUNDED TO NEAREST 5mm.

FOR COMPLETE DESIGN AND PRODUCT INFORMATION,
CONTACT JENSEN PRECAST.

1/17/05
20ft_Caltrans_KRAIL.dwg

JENSEN PRECAST®

Drop Over Cable & Pipe Protectors - Keep walkways and industrial areas safe from trip hazards with drop over pipe protectors! These protectors can be used for covering pipes, cables, and hoses in many different applications. The pipe protectors can be connected via "Dog Bone" style connectors for modular applications! Alternate colors for maximum visibility!

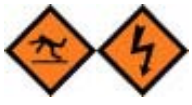
View all Departments

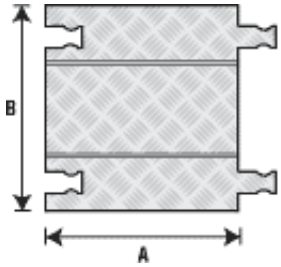
Discount Ramps.Com >> Commercial Utility Ramps >> Cable Ramps / Protectors >> *Drop Over Pipe Protectors*

Protect pipes, conduit, cable and hose lines that are mounted to the ground or floor by positioning the pipe protectors over the area to be protected. Drop over pipe protectors protect from above but do not prevent abrasion from below. Ideal for providing a safe crossing for vehicles and pedestrian traffic in public, commercial and industrial applications. This 3 channel pipe and cable protection system features two extra wide channels to accommodate various quantities and sizes of lines. Alternate the orange and black sections for higher visibility! Custom company logos can be molded into the ramp lids (call for details). *Note: Drop over protectors do not prevent pipe or cable wear from below!*

Pipe Protector Features

- **All weather polyurethane construction**
- **Heavy duty load capacities**
- **Lightweight**
- **Easy setup and assembly**
- **Safety warnings molded into surface**
- **Connect alternate colors for greater visibility**
- **"Dog Bone" shaped connectors interlock modular sections**
- **Custom company logos can be molded into the surface**
- **View Instructions (.pdf)**

Specification Data		Load Capacity Per Tire / Axle		Warnings
Material	Polyurethane (UV stabilized)	**3 Channels**	Max Load at 70°F (21°C)	Safety warning symbols molded into surface. 
Operating Temp	-40°F to 120°F (-40°C to 48°C)	**Per Tire**	10,500 lbs. (4,763 kg)	
Safety Symbols	Per ANSI. Z535.3-1991	**Per Axle**	21,000 lbs. (9,526 kg)	



Item #	Description	(A) Length	(B) Width	(C) Height	(D) Channel Width	(E) Channel Height	Weight	Price
GD3-DO	3-Channel Drop Over Pipe Protector	18 in. (457.2 mm)	19.75 in. (503.6 mm)	1.87 in. (47.6 mm)	(D) 1.65 in (42.1 mm) (D-2) 3.20 in. (81.6 mm)	1.56 in. (39.8 mm)	9.7 lbs. (4.41 kg)	**$97.99** +12 s&h Choose your Color Orange Black Add to Cart

VIEW SHOPPING CART CHECKOUT

Model #	Description	Detailed Information	Price
4in-Rat-Flat Hook	4" **Flat Hook** Ratchet Strap with a 15,000 lb. Break Strength - 5,000 lb Working Load Limit **Weighs:** 14lbs.	 click to enlarge	**$39.99** +10 s&h Add to Cart
4in Rat-J-Hook	4" **J-Hook** Ratchet Strap with a 15,000 lb. Break Strength - 5,000 lb Working Load Limit **Weighs:** 16lbs.	 click to enlarge	**$46.99** +10 s&h Add to Cart
18RAT-J-2	2 inch wide x 18 foot long ratchet straps w/ J-Hooks (pair)	 click picture to enlarge	**$12.99** +8 s&h Add to Cart
18RAT-S-2	2 inch wide x 18 foot long ratchet straps w/ S-Hooks (pair)		**$12.99** +8 s&h Add to Cart
LOAD-BINDER	Heavy Duty Load Binder - 9200 lb. Capacity / 33,000 lb. Break Strength Opens Approx. 8" and works with chains from 3/8" to 1/2"	 click picture to enlarge	**$22.99** +12 s&h Add to Cart

VIEW SHOPPING CART CHECKOUT

Toll Free: 1-888-651-3431 | M - F - 8:30 a.m. - 5:30 p.m. CST
Outside USA: 262-338-3431 | Fax: 262-306-8035
760 S. Indiana Ave. | West Bend, WI 53095