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Operation and Maintenance Manual
Groundwater Remediation System

56th Street and Earll Drive WQARF Site
34th Street Groundwater Treatment System
Phoenix, Arizona

Prepared for: Freescale Semiconductor, Inc.

Exp 06/30/16
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Section 1.0 Introduction

1.1 Purpose and Organization of O&M Manual

This document is the Operation and Maintenance (O&M) Manual (Manual) for the Groundwater Remediation System for the 56th Street and Earll Drive Water Quality Assurance Revolving Fund (WQARF) site (Site) located in Phoenix, Arizona. The Groundwater Remediation System is referred to as the 34th Street Treatment System (System), as it is located in the immediate vicinity of 34th Street and the Salt River Project (SRP) Grand Canal (**figure 1.1**). The System remediates the entire plume/site that contains contributions from other Potentially Responsible Parties (PRPs), as well as the 56th Street facility. The purpose of the Manual is to provide summary of the operation, maintenance, and monitoring requirements for the System. The Manual is intended to assist the O&M contractor (Contractor) and System Operator (Operator) in efficiently conducting activities at the Site. The Manual is organized into the following sections:

i) Section 1.0 presents a general introduction of the Site, purpose and organization of the Manual, organizational structure, and Contractor/Operator requirements

ii) Section 2.0 presents the operational overview of the System

iii) Section 3.0 presents the System equipment and instrumentation list

iv) Section 4.0 presents the inspection and maintenance requirements

v) Section 5.0 presents the monitoring and reporting requirements

The appendices include the Poor Quality Groundwater Withdrawal Permit (PQGWP) (**Appendix A**), Arizona Pollution Discharge Elimination System (AZPDES) Permit (**Appendix B**), Well Construction As-Builts (**Appendix C**), Quality Assurance Manual (**Appendix D**), Record Drawings (**Appendix E**), Siemens Operations and Maintenance Manual (**Appendix F**), Equipment Manuals (**Appendix G**), Siemens Initial Isotherm Carbon Breakthrough Data (**Appendix H**), and Supervisory Controls and Data Acquisition (SCADA) Screens (**Appendix I**).

1.2 Background

The following text has been taken from the January 2013 Arizona Department of Environmental Quality (ADEQ) Water Quality Assurance Revolving Fund (WQARF) Fact Sheet.

> *"The site includes the former Motorola facility located on 14 acres at the northwest corner of 56th Street and Earll Drive in east central Phoenix. The facility was first occupied by Motorola in 1950, was expanded over the years, and used for a variety of product development, research, manufacturing, and testing operations until 1982 when the facility was redeveloped for administrative offices. Some of these operations*

included the use of solvents, acids, and metals. During the manufacturing operations, some solvents were released to the ground primarily through a septic system used in the early operations before the facility was connected to the City of Phoenix sewer system. The property was vacated and sold to developers in 2005. Other possible sources of contaminants to the soils and groundwater include dry cleaners and other businesses and operations yet to be more thoroughly researched in the site area."

The Site was placed on the WQARF registry in June 2002. Freescale entered into a Consent Order RP-28-11 with the ADEQ to implement the Early Response Action (ERA) that became effective on April 22, 2011, pursuant to Arizona Revised Statutes (A.R.S.) 49-282.06 and Arizona Administrative Code (A.A.C.) R18-16-405.

The operations of the System are to comply with following permits and agreements:

- AZPDES Permit No. AZ0025861
- SRP Discharge Agreement
- PQGWP Permit No. 59-541491.0002

1.3 Organizational Structure

Figure 1.2 presents the general project organizational structure, and identifies various personnel, or firms, and their main responsibilities within the organization. **Figure 1.2** may be revised during the operation, maintenance, and monitoring period for the Site to reflect changes in the organizational structure.

Freescale holds management responsibility for the System. The day-to-day operation of the System is the primary responsibility of the Contractor. Descriptions for the positions and responsibilities of the Contractor and the Operator are presented in the following sections.

Table 1.0 presents a detailed listing of the contacts for the Site.

1.3.1 Operation and Maintenance Contractor

The Contractor reports to Freescale, and is responsible for the day-to-day operation, maintenance, and monitoring activities associated with the groundwater extraction, treatment, and discharge aspects of the System. The Contractor has the overall responsibility to ensure that the System operation, maintenance, and monitoring requirements specified in this Manual are fulfilled. The Contractor is responsible for the maintenance of the System operations database, submittal of operation, maintenance and monitoring reports, and for timely preparation and submission of the specified reports to Freescale.

The Contractor's duties include, but are not necessarily limited to, the following:

i) Overall management of the day-to-day operation, maintenance, and monitoring requirements

ii) Preparation of the monthly treated water reports and other reports as required by Freescale, or directed to Freescale by other agencies

iv) Attendance at meetings regarding the System operation, maintenance, and monitoring activities

v) Liaison at the Site with maintenance subcontractors, equipment suppliers, consulting engineers, Freescale, SRP, and ADEQ representatives, and contract services companies

vi) Maintenance of System pipeline service area on Blue Stake database

vii) Inspection of the System components to ensure that these components are maintained according to the requirements stated in the Manual

viii) Management and maintenance of the System database and weekly, monthly, semi-annual, and annual recordkeeping logs

ix) Maintenance of spare parts inventory for critical equipment

x) Arrange for delivery and pick up of equipment and supplies

xi) Arrange for off-Site disposal of System generated non-hazardous waste, and assist Freescale with disposal of hazardous waste, if any

1.3.2 Site Operator

The day-to-day operation, maintenance, and monitoring will be performed by the Operator, assisted by maintenance subcontractors, as necessary. The Operator will be licensed in Arizona as a wastewater treatment plant operator, and will have a minimum of 3 years wastewater treatment experience.

The Operator is primarily responsible for the day-to-day operation, maintenance, and monitoring of the groundwater extraction, treatment, and discharge system. The System has been designed to operate automatically with minimal operator input; therefore, a Site Operator will not be required 24 hours a day. It is anticipated that the Operator will be at the Site for 4 to 8 hours a week to perform normal O&M activities.

The Operator's duties include, but are not necessarily limited to, the following:

i) Operate and maintain the System equipment, including groundwater extraction equipment, groundwater treatment equipment, and groundwater discharge equipment, in an efficient manner and as directed by Freescale

ii) Perform inspections, monitoring, adjustments, and data compilation, in accordance with the System operation requirements

iii) Perform scheduled maintenance and repair, non-scheduled maintenance and repair, and equipment servicing

iv) Record treatment plant influent/effluent flow volume measurement readings, and complete all other operation logs for the System

v) Be available to report to the Site in order to respond to any alarm conditions

1.4 Remediation System Overview

The System uses a proven and effective remedial treatment technology. A System location map has been provided as **Figure 1.1**. The System consists of the following five major sub-systems:

i) **Groundwater Extraction System:** for pumping groundwater from two on-Site extraction wells

ii) **Groundwater Conveyance System:** for conveyance of the extracted groundwater from the extraction wells to a treatment facility by below-ground force mains

iii) **Groundwater Treatment Facility (Facility):** for housing equipment that provides treatment of the extracted groundwater by liquid phase Granular Activated Carbon (GAC) adsorption

iv) **Discharge Conveyance System:** for conveyance of the treated groundwater from the Facility, by a below-ground force main, to the discharge location along the SRP Grand Canal

v) **Controls System:** to provide necessary controls to the System

The System is designed to treat a maximum of 1,100 gallons per minute (gpm) of extracted groundwater using carbon adsorption technology. The extracted groundwater is conveyed through a particulate filter to remove sediments prior to entering the GAC vessels. Treatment of water is achieved by utilizing GAC vessels in primary (lead) and secondary (lag) configuration. Treated groundwater is metered and discharged into the SRP Grand Canal approximately 250 feet west of the Facility.

The System is permitted (AZPDES) to discharge up to a maximum of 2 million gallons per day (1,389 gpm) of groundwater. PQGWP allows up to 1,935 acre-feet (1,200 gpm) of water to be withdrawn each year. In the event that the System must be increased in capacity to greater than the permitted flow rate, amendments to the existing AZPDES Permit, PQGWP, and other applicable permits will be required.

1.4.1 Groundwater Extraction System

The submersible pumps have been sized to pump groundwater from the extraction wells, through the Facility, to the Grand Canal without the need for interim storage and pumping facilities.

The groundwater extraction system consists of two extraction wells as follows:

Extraction well DM-39:

Extraction well DM-39 has been installed with a 12-inch diameter low-carbon steel casing. The well is approximately 184 feet deep, with a 50-foot section of low carbon steel louvered well screen (with 0.05-inch slots). The well screen is installed at the interval from 134 to 184 feet below grade (fbg). A copy of the well installation log is provided in **Appendix C**.

A submersible pump and motor is installed in the well approximately 10 feet above the bottom of the well, with the pump intake elevation located at approximately 171 fbg. A below-ground wellhead vault is constructed around the existing well to accommodate well head equipment. The vault has a double-opening H-20 traffic rated steel lid. A 5-foot perimeter asphalt apron is constructed around the well vault to provide visibility to the canal road maintenance vehicles.

The extraction well pump is required to extract groundwater and pump it through the Facility to the SRP Grand Canal. The pump is a Simflo model SP4C 14 stage submersible pump. The pump utilizes a 10 horsepower (hp), 3,600 hertz (hz), variable speed drive (VFD) compatible motor. A VFD is installed in the Motor Control Cabinet (MCC) to control the speed of the pump and the resulting flow rate. Currently with the installed pump, the well is yielding 90 gpm of groundwater. The yield may increase or decrease due to fluctuations in static groundwater elevations. A copy of the pump curve is located in **Appendix G**.

The power service to the extraction well vault is provided by SRP and is obtained from the MCC located approximately midway between the two extraction wells. The power service is a 480VAC, 60Hz, 3-phase, 4-wire grounded system, with a step-down transformer for 120VAC power.

Well pump controls and associated instrumentation input/output are located within the MCC and control panel located within the Facility.

A well depth sounding tube was installed during the well construction to allow measurements of groundwater surface elevation manually. A level transmitter was installed in the well to measure, monitor, and record continuous water levels by the Supervisory Control and Data Acquisition (SCADA) System. The groundwater surface elevation is monitored to insure that the

drawdown of the groundwater surface elevation does not drop below the set point depth. Should the level become too low, the SCADA system will shut down the well pump motor to protect the System from dry pumping.

Extraction well DM-40:

Extraction well DM-40 has been installed with a 12-inch diameter low-carbon steel casing. The well is approximately 215 feet deep, with a 50-foot section of low carbon steel louvered well screen (with 0.05-inch slots). The well screen is installed at the interval from 165 to 215 fbg. A copy of the well installation log is provided in **Appendix C**.

A submersible pump and motor is installed in the well at approximately 10 feet above the bottom of the well, with the pump intake elevation at 202 fbg. A below-ground wellhead vault is constructed around the existing well to accommodate well head equipment. The vault has a double-opening H-20 traffic rated steel lid. A 5-foot perimeter asphalt apron is constructed around the well vault to provide visibility to the canal road maintenance vehicles.

The extraction well pump is required to extract groundwater and pump it through the Facility to the SRP Grand Canal. The pump is a Simflo model SE7C 3 stage submersible pump. The pump utilized a 60 hp, 3,600 hz, VFD compatible motor. A VFD is installed in the MCC to control the speed of the pump and the resulting flow rate. Currently with the installed pump, the well is yielding 360 gpm of groundwater. The yield may increase or decrease due to fluctuations in static groundwater elevations. A copy of the pump curve is located in **Appendix G**.

The power service to the extraction well vault is provided by SRP and is obtained from the MCC located approximately midway between the two extraction wells. The power service is a 480VAC, 60Hz, 3-phase, 4-wire grounded system, with step-down transformer for 120VAC power.

Well pump controls and associated instrumentation input/output are located within the MCC and control panel located within the Facility.

A well depth sounding tube was installed during the well construction to allow manual measurements of the groundwater surface elevation. A level transmitter was installed in the well to measure, monitor, and, record continuous water levels by the SCADA System. The groundwater surface elevation is monitored to insure that the drawdown of groundwater is not below the set point depth. Should the level become too low, the SCADA system will shut down the well pump motor to protect the System from dry pumping.

1.4.2 Groundwater Conveyance System

The groundwater conveyance sub-system consists of separate underground 8-inch diameter High Density Polyethylene (HDPE) piping from two extraction wells to the Facility. The pipelines are constructed with a minimum of 3 feet of cover. Tracer wire and detection tape is located above each underground pipeline for locating purposes. The SCADA System monitors the individual well flow meters and a pressure transmitter for low flow or low pressure reading that may be indicative of a leak in the conveyance system.

1.4.3 Groundwater Treatment Facility

The Facility sub-system consist of a 70-foot by 42-foot enclosed area with a recessed concrete pad and space for electrical panels. The recessed concrete pad is surrounded by a retaining wall approximately 7 feet in height. The Facility is located within a flood zone, and therefore the retaining wall extends approximately 1 foot above the surrounding grade to provide for flood protection. The GAC vessels are 15 feet 10 inches in height with 3 inches in height added for the equipment grout pad to elevate and anchor the equipment. The top of the recessed concrete GAC pad floor is approximately 6 feet 1 inch below the surrounding grade elevation. The recessed pad is sloped to drain into a sump. Water accumulated within the sump is pumped through the Facility prior to discharging into the SRP Grand Canal. The volume of the recessed containment is approximately 14,340 cubic feet (107,300 gallons). The volume of the sump is 48 cubic feet (360 gallons).

The Facility is constructed of a concrete masonry unit (CMU) wall built on top of the retaining wall. A barbed wire fence is installed on top of the CMU wall to provide added security. The total height of the security wall, excluding the barbed wire, is 9 feet. Access to the Facility is provided by two 8-foot wide double swing gates located on the western side of the Facility to provide access to the maintenance vehicles. Two pipe sleeves are installed along the northern side of the CMU wall to facilitate flexible hosing to connect to the GAC vessels during the carbon change-outs. An additional pipe sleeve is located on the eastern side of the CMU wall for as need maintenance activities.

The Facility includes the following major equipment:

- Piping and instrumentation
- Particulate filters & instrumentation
- GAC adsorption vessels & instrumentation
- Containment area
- Purge water storage tank

Piping and Instrumentation

The Facility conveyance and control infrastructure consists of various pipes, pipe fittings, and instrumentation.

Each extraction well conveyance pipeline transitions from below grade 8-inch diameter HDPE pipe to above grade 8-inch diameter cement-lined ductile iron pipe (DIP) upon entering the Facility. Air/vacuum release valves are located on each well conveyance pipeline. The pipelines are equipped with check valves located immediately after the Air/Vacuum valves to prevent any backflow from the Facility to the extraction wells. Each 8-inch DIP reduces to 6-inch DIP prior to passing through a magnetic flow (mag) meter, and then increases back to 8-inch DIP.

After the mag meter, the extracted water passes through a pressure transmitter and sampling port spool and one of the two 1,750 gpm sediment filters, which are set-up in parallel configuration. Each sediment filter assembly consists of, in the order of flow, a gate valve to manually isolate the filter for maintenance, a solenoid actuated control valve to automatically switch between sediment filter assemblies upon detecting high differential pressure, the sediment filter housing, and a check valve to stop flow back through the assembly.

A centrifugal pump is installed within the Facility to pump stormwater, decanted water from the GAC carbon change-out events, and/or well sampling purge water collected in the holding tank via a common manifold to the process piping that leads into the sediment filters.

After the sediment filters, flow merges into a single 12-inch diameter DIP, followed by another pressure transmitter and sampling port. This sample port allows for sampling of combined influent flows for laboratory analysis. The pre-sediment filter and post-sediment filter pressure transmitters relay a signal to the main programmable logic controller (PLC) (i.e., the system PLC at the Facility), which evaluates pressure differential and automatically switches flow to the other sediment filter upon detection of high differential pressure across the operating filter assembly. If the high or low pressure parameters set in the PLC are met in the pressure transmitter prior to the sediment filters, the PLC will shut down pumps located at both extraction wells, as a high pressure or low pressure situation could mean dead-head (blockage) or a possible leak in the system (if well pumps are running), respectively.

Prior to entering the GAC vessel piping, process piping reduces from 12-inch DIP to 8-inch DIP (factory standard GAC manifold sizing). Each pair of GAC vessels operates in series where the flow will pass through the lead GAC vessel before being routed through the lag GAC vessel. A sample port and pressure transmitter is located in the process piping between the lead and lag GAC vessels. Sampling between the lead and lag vessels will allow verification abilities to detect if contaminant breakthrough has occurred. The pressure transmitter located between the lead

and lag GAC vessels is used in combination with the pressure transmitter upstream of the lead GAC vessel to determine if differential pressure has been exceeded across the lead GAC vessel.

After GAC treatment, the process water is discharged from the lag GAC vessel through an 8-inch DIP. A sample port is installed after the carbon vessels to allow sampling of the treated groundwater.

After treatment through the GAC vessels, the process pipeline transitions back to a single 12-inch DIP, with a check valve and an air/vacuum valve prior to exiting the GAC pad. The discharge pipe transitions from the above-ground 12-inch DIP to under-ground 12-inch HDPE pipe after it exits the Facility.

Particulate Filters & Instrumentation

Within the Facility, there are two influent stainless steel particulate filter housings manufactured by Eaton and rated for 1,750 gpm and a pressure of 150 pounds per square inch (psi). The particulate filter bags are designed to remove particulate matter and sized 30 micron or smaller to prevent plugging of the carbon vessels.

Under normal operation, the process piping feeds the extracted groundwater through one of the two particulate filters. Each filter has a solenoid operated valve located at the influent side, and a check valve located at the discharge side, which allows either filters to be used. A pressure transmitter is located upstream of the particulate filters, and before the GAC vessels. These pressure transmitters send a continuous signal to the main PLC, which calculates differential pressure across the particulate filter(s). If the differential pressure set point is exceeded while the process water is flowing through one particulate filter, the PLC will automatically open the other particulate filter and notify the Operator that the filter requires maintenance. If the differential pressure remains below the set point with process water flowing through both particulate filters, the PLC will close the particulate filter that exceeded the set differential pressure, and allow the other particulate filter to remain open. However, if a high differential pressure is reached across both filters, the System will shut down and the particulate filter elements must be cleaned/replaced before the System operation is resumed. In this scenario, the PLC will initiate an alarm condition to notify the Operator of the system shutdown.

The same model filter is utilized to filter the GAC backwash water. The purpose of the backwash filter is to separate out any carbon fines generated from the GAC vessel prior to discharging into the Grand Canal. The System discharge piping is valved to allow bypass of the backwash filter during normal operating conditions, or to direct the flow through the backwash filter during a backwash procedure. The backwash procedure will be implemented during a

carbon change-out, or when carbon blinding from suspended solids accumulation is expected to be the cause of high differential pressure across a carbon vessel.

GAC Adsorption Vessels & Instrumentation

The System is comprised of one Siemens 1220 HP SYS system. The Siemens 1220 HP SYS is comprised of two 20,000-pound carbon vessels operated in series. A series of butterfly valves are utilized in the piping manifold of the carbon adsorbers, to allow each unit to be operated as the lead or lag vessel. The butterfly valves are manually positioned so that normal flow moves from top to bottom through each of the two vessels. Each carbon adsorber has a built-in pressure relief valve to prevent potential tank rupture due to over pressurization. A pressure transmitter is also located between the lead and lag vessels and at the discharge of the carbon vessels to send pressure signals to the PLC. The PLC evaluates and records differential pressure across the vessels and shuts down the treatment system when the differential pressure across either vessel exceeds a specified level.

Should a "HIGH" differential pressure across either vessel occur, an alarm condition will alert the Operator. If a "HIGH-HIGH" differential pressure across either vessel occurs, the System will shut down and call out the Operator.

Containment Area

At the Facility, the GAC vessels, particulate filters, and a purge water holding tank are located within the recessed reinforced concrete containment area. The containment volume of the recessed GAC pad is approximately 14,340 cubic feet (107,300 gallons). The concrete slab is sloped toward a sump located in the middle of the western side of the containment area. The volume of the sump is 360 gallons. The sump collects water and a pump transfers the collected water to the beginning of the treatment train manifold, upstream of the influent particulate filters.

A "HIGH" float switch installed within the sump sends a signal to the PLC when water accumulates to a specified elevation within the sump, and notifies the operator that water has accumulated. A second "HIGH-HIGH" float switch signals the PLC to shut down the System well pumps and send out an alarm condition to the Operator.

Manually operable ball valves located on the suction side of the sump pump intake allows pumping from either the sump area or purge water holding tank. The discharge sump pump piping is equipped with one check valve to prevent backflow into the containment area. The discharge piping is also equipped with one globe valve that is "normally closed" during routine operations.

Purge Water Storage Tank

A 1,000 gallon poly tank is located within the recessed concrete containment area for storage of purge water generated during the groundwater sampling events. The sump pump system located within the containment area is used to convey purge water back to the beginning of the treatment train manifold, upstream of the influent particulate filters, prior to discharging into the SRP Grand Canal.

1.4.4 Discharge Conveyance System

The discharge conveyance sub-system consists of underground piping at a minimum depth of 3 feet below the existing grade, designed to transfer treated groundwater from the Facility to the SRP Grand Canal.

At the Facility, a pressure transmitter installed within the 12-inch discharge DIP sends signals to the main PLC. If a high discharge pressure occurs, the PLC will shut down the system, as it may indicate a plugged discharge pipeline. Prior to discharging into the SRP Grand Canal, the pipeline reduces from 12-inch HDPE to 8-inch DIP through the discharge flow meter vault. The 12-inch DIP is equipped with an isolation valve prior to entering the flow meter vault.

The piping exiting the flow meter vault transitions from 8-inch DIP, followed by 12-inch DIP, and then to 16-inch DIP. The 16-inch pipe penetrates the SRP Grand Canal concrete bank. An orifice plate followed by a flap gate on the 16-inch DIP is installed at the discharge end of the pipeline.

The discharge end of the pipeline is normally above the normally operated SRP Grand Canal water surface elevation. Water elevations provided by SRP indicate that it is possible during times of unusual maximum operating conditions the discharge end may be below the water surface elevation in the Grand Canal. A check valve located within the Facility, after the GAC vessels, prevents water from siphoning from the Grand Canal back into the System.

1.4.5 Control System

The operation of the extraction, treatment, and discharge systems are controlled by PLCs. The PLCs control automation of the System under normal operating conditions, to shut down the system or portions of the system based on predetermined operational parameters, and to start the system up based on predetermined operational parameters.

The main PLC is housed in an electrical enclosure located within the Facility, and connected to a SCADA system to provide a visual control interface, trending, and automatic logging of data. All control status, monitoring, and alarms are locally displayed on the SCADA system. In addition,

operational data is logged into the SCADA system to allow evaluation of system performance, and to generate data for reporting requirements.

An SRP Remote Terminal Unit (RTU) is also installed within the Facility. The RTU allows SRP to collect data from the SRP discharge flow meter, and the ability to shut down the System via the remote SRP wireless communication network and control system. Electrical components (control panel, PLC, auto dialer, etc.) are housed within a secure control cabinet mounted on the interior of the northwestern Facility block wall.

1.4.5.1 Automatic Control System (PLC/SCADA)

This section discusses the PLC/SCADA used to control operation, the individual components/instrumentation that signal the PLC, the corresponding response by the control system, alarm conditions, and System start-up/shut-down procedures.

The SCADA system is also located within the Facility. The SCADA system provides communication between the PLC and the Operator. The SCADA system also provides a continuous summary of the System of performance in both graphical and data formats.

1.4.5.2 System Instrumentation and Control

The instrumentation and equipment controls include various devices to monitor and control the System performance both locally and remotely. The System instrumentation devices monitor operation and, should the system operate outside of a defined set of parameters, the SCADA system will take the necessary programmed action. The normal operating parameters monitored by the SCADA system are outlined in **Table 1.4.1**. The alarm parameters monitored by the SCADA are outlined in **Table 1.4.2**. During an alarm condition the operator is notified via an automatic telephone call out system.

The SCADA system is accessible remotely by utilizing an internet connection and logging into the website**:** ***https://secure.logmein.com***. The website allows remote viewing of the local SCADA screen as well as control over pre-programmed command buttons, editable set points, and historical trending of specific SCADA monitored parameters. A copy of the SCADA screen shots viewed through the website is located in **Appendix I**.

1.4.6 Utilities

Electricity:

600 Amp, 480V/277V

SRP Meter Address: 1091 North 34th Street

Potable Water:

City of Phoenix – 1 inch water meter

Internet:

CenturyLink

1.4.7 Site Security

The Facility is surrounded by a 9-foot high CMU wall. The MCC is surrounded by a chain link fence. The gates are equipped with locking mechanisms to prevent unauthorized entry.

The Facility is equipped with motion detectors and a camera that can be accessed and viewed remotely via an internet connection (**Appendix I**). A key switch is installed on the inside of the Facility that requires the Operator to insert a key to activate and deactivate the security system. Should the motion detection sensors be triggered, an intrusion alert will be sent to the Operator via an automated telephone call out.

Section 2.0 Operation

2.1 Operational Overview

The System has been designed and constructed with an integral automatic control system. In general, the control system provides automatic control of fundamental process parameters, historical archiving of certain process information, alarm and notification in the event of process abnormalities, and reporting of process information. The process flow, instrumentation, and control devices include high/low pressure sensors, low flow sensors, high current overload, and high water level sensors.

Maintenance operations, such as carbon change-outs and carbon backwashes, will be performed manually by the Operator.

The automated monitoring and control of the System is provided by the following components:

i) Main PLC at the Facility

ii) SCADA computer running Human Machine Interface (HMI) software to provide an interface between the Operator and the automated PLC operations

iii) SRP RTU

Normal operation of the System is controlled from the Control Panel mounted on the northern wall of the Facility and allows the Operator to start up or shut down the System.

2.2 System Start-Up

Prior to System start-up, the Operator needs to inspect the extraction and treatment system components to assess potential problems, inspect piping for signs of leaks or fatigue, verify all control valves and isolation valves are properly positioned, and address any former alarm conditions. Any additional parameters that may affect normal operation of the System should be noted and addressed prior to initiating System start-up. The Operator will then turn each of the two extraction well pump selector switches in "Auto" mode at the MCC cabinet.

Normal System start-up is initiated by activating the "On" button on the SCADA computer control panel located within the Facility. Immediately after start-up, the Operator will monitor the System for a short duration to verify proper operation, and then record any required operational data.

The SCADA system has a HMI which shows current System status and System alarm shut down set point parameters. When performing a System start-up, it may be necessary to change the set point parameters. The main control screens allow the Operator to monitor the current conditions, change the set points for various alarm conditions, and to reset the alarm after it has been activated.

Should the System shut down due to an automatic shutdown condition, the Operator will be notified. The Operator will assess the problem that caused the shutdown, correct the problem, and reset the System, if necessary. Following a re-start, the Operator will monitor the System for sufficient time to ensure that the condition that resulted in the shutdown has been properly addressed.

Prior to conducting maintenance on equipment or instrumentation on the System, appropriate lockout/tagout procedures must be utilized, pressure within the System should be released (if appropriate for task), and mechanical protection (e.g., close valves on either side of instrument being worked on) should be utilized to assure safe working conditions.

It may be necessary to set the influent pipeline low pressure to 0 psi on the SCADA system when conducting a restart for the wells as drainage within the System may have occurred and pressure in the line may remain below the normal operating pressure while the System fills with water.

2.3 System Shutdown

Each extraction well can be switched off at the MCC by turning the appropriate Hand Off/Auto switch to "OFF". Each extraction well can also be switched off from the SCADA computer at the Facility by pressing the extraction well "Off" button.

The entire System can also be shut down from the SCADA computer by pressing the "System Off" button.

2.4 GAC Vessel Carbon Change Out

Sampling between the lead and lag vessels will be conducted monthly to evaluate VOC breakthrough. Once VOC breakthrough between the vessels is detected at levels that exceed the allowable discharge concentrations (see AZPDES Permit in **Appendix B**), a carbon change out will be scheduled. After the initial carbon change out of the first lead adsorber occurs, subsequent carbon change outs of the lead operating adsorber will be scheduled within half of the time it took for the initial lead vessel change out. The scheduled carbon change-outs will exclude operational downtime for maintenance or due to restrictions on Grand Canal flows. A summary of the AZPDES Permit parameters are in **Table 2.0**. The GAC analytical data will be included in the quarterly progress reports to be submitted to the ADEQ WQARF.

The change-out of carbon in a GAC vessel is a manual operation. There are two phases to the carbon change-out process. The first phase of the change-out will be to remove the exhausted carbon. The second phase will consist of placing fresh carbon into the adsorption vessel.

The carbon supply vendor's truck will access the Facility by entering through the driveway entrance located at the end of the 34th Street cul-de-sac, or from the entrance to the Grand Canal from 32nd Street. The carbon truck will back up along the northern side of the Facility and park. The carbon supply vendor will utilize the pipe sleeves installed within the CMU wall to insert the change-out hoses to connect to the GAC vessels. The vendor will operate valves located on the trailer whereas the Operator will operate the valves located on the GAC adsorber valve tree.

The following excerpts are from the manufacturer's O&M manual (**Appendix F**) for the recommended change-out procedures:

Exhausted Carbon Removal

> *"When the activated carbon becomes exhausted the system it is taken off-line for replacement of the spent carbon. The first adsorber is then pressurized up to 30 psig with air. With the addition of utility water, the spent carbon is*

pneumatically displaced as slurry to a bulk transport trailer by slowly opening the slurry outlet valve. To remove 20,000 pounds of carbon approximately 9,000 gallons of water is required to keep the spent GAC in slurry to facilitate removal. This will prevent a line clogging."

Carbon Filling

"Carbon is transferred into the vessels from a bulk pneumatic trailer as slurry through the carbon slurry inlet transfer lines on the vessels. The vessels must have a water cushion before carbon is transferred. The trailer must be filled with water prior to beginning the transfer sequence. The bulk pneumatic trailer is then pressurized to 15 psig. Slowly fully open the appropriate carbon slurry inlet line. While transferring the carbon, the vent lines shall be fully open. All other valves should be in the closed position. The carbon must be soaked for approximately 24 hours with the vent line open to totally dissipate air from the carbon bed."

The Operator shall verify all appropriate procedures are followed prior to conducting the carbon change-out.

Based on the current System operating flow rate and influent VOC concentrations, the carbon change out frequency is estimated to be 18 months. The frequency is based on a carbon usage of 0.0575 pounds/1000 gallons of water treated. A copy of the initial estimated carbon usage information is provided in **Appendix H**

2.5 GAC vessel backwash

The GAC adsorption vessels will be backwashed in accordance with the manufacturer's suggested procedures. A copy of the manufacturer's O&M Manual is provided in **Appendix F**. The manufacturer recommends that after a change-out, the carbon adsorbers should be backwashed after soaking, and prior to being placed in-service to remove carbon fines, entrapped air, and to fully stratify the carbon bed. The manufacturer also recommends backwashing when the differential pressure across either of the carbon adsorption vessels is greater than twice the normal operating pressure. The manufacturer recommends a backwash flow rate of 1,000 gpm; however, a flow of 450 gpm to 500 gpm is acceptable according to the manufacturer as long as the carbon is backwashed until the effluent is clear.

The backwashing of a GAC vessel is a manual operation conducted by the Facility Operator. Backwashing involves running a clean/treated water up-flow through the adsorber to remove carbon fines, or any sediment accumulation on the top carbon surface. Backwashing of a carbon bed is done after fresh carbon has been transferred into an adsorber and wetted, or done on partially spent carbon to remove sediment from the top of the bed.

The reasons for backwashing before placing fresh carbon on-line are to:

- Size segregate the carbon so subsequent backwashing will return the carbon to the same relative position in the bed
- Remove any remaining air from the carbon bed
- Remove carbon fines which can, in some cases, lead to excessive pressure drop and flow restriction

Backwashing is done during operation to remove:

- Sediment from the top of the bed.
- Carbon fines that may be plugging the underdrain nozzles.
- Air that is binding the bed. The need to backwash is indicated by an increased bed pressure drop.

The System piping is configured to allow only one lead GAC vessel backwash at any given time by using treated groundwater. During the backwash cycle, valves will be configured as such that the extracted groundwater is treated by utilizing the lag vessel prior to directing the flow upward through the lead vessel requiring backwash. During the carbon backwash procedure, backwash water will be routed through the backwash particulate filter located along the discharge pipeline. The backwash particulate filter is piped and valved to direct flow through it during backwash operations. The purpose of the backwash particulate filter is to remove carbon fines in the backwash water prior to discharging into the Grand Canal.

2.6 Grand Canal Maintenance

The SRP Grand Canal is periodically shut down for maintenance. During the Grand Canal shutdown period, the System will be shut down as well and any shutdown maintenance/repair/replacement activities will be completed as needed. SRP will be contacted in October every year to obtain their shutdown schedule for the Grand Canal.

Section 3.0 Equipment and Instrumentation List

Table 3.0 provides a list of the System equipment installed.

Details of the equipment installed are provided in the individual manufacturers' equipment manuals located in **Appendix G**.

Section 4.0 Inspection and Maintenance Requirements

Maintenance requirements for the System include routine inspection, scheduled maintenance, unscheduled maintenance, and record keeping of these activities. The scheduled weekly, monthly, semi-annual, and annual inspections are detailed below. Detailed maintenance requirements are provided in the manufacturers' maintenance information as presented in the various equipment manuals.

Documentation requirements for inspection and maintenance activities are discussed in the following sections and equipment manuals are located in **Appendix G**.

Maintenance activities which involve confined space entry must be conducted in accordance with the Operators confined space entry procedures.

4.1 Routine Inspection and Maintenance

Routine inspection and maintenance will include, but not be limited to, weekly, monthly, semi-annual, and annual inspection and maintenance activities, and should be performed according to manufacturer's recommendations detailed in the various manufacturer manuals located in **Appendix G**.

4.1.1 Scheduled Inspection and Maintenance

A listing of the inspection and maintenance work to be performed is summarized in the maintenance schedule in **Table 4.0**. Inspection logs will be filled out for the weekly, monthly, semi-annual, and annual inspections as shown in **Table 4.1**, **Table 4.2**, **Table 4.3**, and **Table 4.4**, respectively, and will be kept on Site.

4.1.2 Weekly Inspection and Maintenance

The weekly inspection is required to ensure that the Site and subsystem equipment are presentable and operational, and that no unusual conditions exist. As necessary, unscheduled maintenance will be performed, or scheduled for completion as soon as possible.

The maintenance work performed will be recorded on an Equipment Maintenance Record Log form for the respective item upon which maintenance is performed. Separate forms, as presented in **Table 4.5**, will be maintained for each unscheduled maintenance item, and will be filed with the respective equipment files maintained at the Facility.

Weekly inspection and maintenance of the System will include the following activities:

i) General visual inspection of the Site security wall and fence, drainage, and carbon adsorbers.

ii) General visual inspection of the carbon unloading areas.

iii) General visual inspection of the System equipment for leaks, overflows, or malfunctions.

iv) Responding to alarms or malfunctioning equipment as necessary. Check affected system and make proper adjustments.

v) General visual inspection of the extraction wells.

vi) Verifying operation of motors on pumps.

vii) Checking supply of safety equipment and tools.

Completed logs will be filed on a weekly basis with the previous inspection records maintained at the Facility.

4.1.3 Monthly, Semi-Annual, and Annual Inspection and Maintenance

Monthly, semi-annual, and annual inspection and maintenance will be performed according to equipment manufacturer's requirements. The maintenance work performed will be recorded on an Equipment Maintenance Record Log for the respective item upon which maintenance is performed. The Equipment Maintenance Record Log for each item will be created on an as-needed basis. Completed logs will be filed and maintained at the Facility.

4.2 Unscheduled Maintenance

Unscheduled maintenance will be performed as required. Unscheduled maintenance items identified by the daily, weekly, monthly, and semi-annual inspection activities may include the following:

i) Repair damage caused by adverse weather events

ii) Repair damage caused by burrowing wildlife and foreign vegetation

iii) Repair damage caused by vandalism

Section 5.0 Monitoring and Report Requirements

5.1 System Sampling

It will be necessary to collect System samples as required by the AZPDES Permit and SRP Discharge Agreement. The sampling performed should be in accordance with the Quality Assurance Manual (**Appendix D**). It is recommended that sampling occur monthly between the

carbon vessels to determine if breakthrough has occurred through the lead carbon vessel to provide sufficient time to have the carbon changed out, thus minimizing the shutdown of the operation of the System.

5.2 Reporting

AZPDES

The AZPDES permit requires submitting a discharge monitoring report (DMR) to the ADEQ monthly, semi-annually and annually for the reporting periods.

As stated in the AZPDES Permit, the permittee shall orally report any non-compliance which may endanger the environment or human health within 24 hours from the time the permittee becomes aware of the event to the ADEQ 24-hr hotline at (602) 771-2330. The permittee shall also notify the Water Quality Compliance Section Manager at (602) 771-2209 by phone call or voice mail by 9 a.m. on the first business day following the non-compliance. The permittee shall also notify the Water Quality Compliance Section in Writing within 5 days of the non-compliance event. The permittee shall include in the written notification: a description of the non-compliance and its cause; the period of non-compliance, including the dates and times; if the non-compliance has not been corrected, the time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the non-compliance.

SRP Discharge Agreement

SRP requires monthly analytical and process flow reporting per the Discharge Agreement. The flow reporting shall be submitted by the 15th of the month for the preceding calendar month. Analytical results shall be submitted to SRP with 45 days of receipt of the analytical results. Annual flow meter verification shall be performed to ensure accuracy. SRP shall be contacted 14 days prior to conducting the verification. The results of the verification shall be submitted to SRP within 30 days of completing the testing. In the event that a key treatment system component has failed that could affect the quality of discharge of the treated groundwater, SRP will be notified immediately by telephone and email.

PQGWP

Per the PQGWP Permit Section 5:

> *"a. Groundwater Withdrawal Monitoring: The permittee shall measure the volume of groundwater from each extraction well listed in Table 1 with an approved water measuring device and method consistent with A.A.C. R12-15-903.*
>
> *b. Water Measuring Device Accuracy and Failures: The water quantity measuring devices and methods shall quantify flow accurately pursuant to*

A.A.C. R12-15-905. If any water quantity measurement devise fails to perform its designated function for more than seventy-two (72) hours, the Permittee shall notify ADWR in writing and shall repair or replace the measuring device as described in A.A.C. R12-15-906.

c. *Groundwater Quality Monitoring: The Permittee shall perform groundwater quality monitoring as described in the remediation documents and submitted to the Arizona Department of Environmental Quality that allows ADWR to determine that the groundwater withdrawn, because of its quality, has on other beneficial use. The Permittee shall notify ADWR of any changes to the groundwater quality data collection plan pursuant to the remediation documents."*

The permittee shall submit an "Annual Water Withdrawal and Use Permit" along with supplemental data reports as described in the PQGWP no later than March 31 following the end of each completed annual reporting period.

ADEQ WQARF Unit

A quarterly report (January 1 through March 31; April 1 through June 30; July 1 through September 30; October 1 through December 31) will be submitted to the ADEQ's WQARF unit by the last day of the month following the end of the reporting quarter period.

The reports will include:

- Percent of time the system operated during the reporting period
- Analytical data from outfall or carbon change out testing
- Totalizer reading on volume of water treated
- Any problems encountered during the reporting period

5.3 Record Keeping

AZPDES

The AZPDES Permit requires the permittee to retain records of the following information:

- Date, exact location, and time of sampling or measurements performed, preservation used.
- Individual(s) who performed the sampling or measurements.
- Date(s) the analyses were performed.
- Laboratory(s) which performed the analysis.
- Analytical techniques or methods used.

- Chain-of-custody forms.
- Any comments, case narrative or summary of results produced by the laboratory. These comments should identify and discuss Quality Assurance/Quality Control (QA/QC) analysis performed concurrently during sample analyses, and should specify analyses met project requirements and 40 CFR 136. If results include information on initial and continuing calibration, surrogate analyses, blanks, duplicates, laboratory control samples, matrix spike and matrix spike duplicate results, sample receipt conditions, or holding times and preservation, these records must also be retained.
- Summary of data interpretation and any correction action taken by the permittee.

SRP Discharge Agreement

The Discharge Agreement requires the permittee to retain records of the monitoring and measurements for 5 years and made available for inspection and copying by SRP within a reasonable time.

Figures

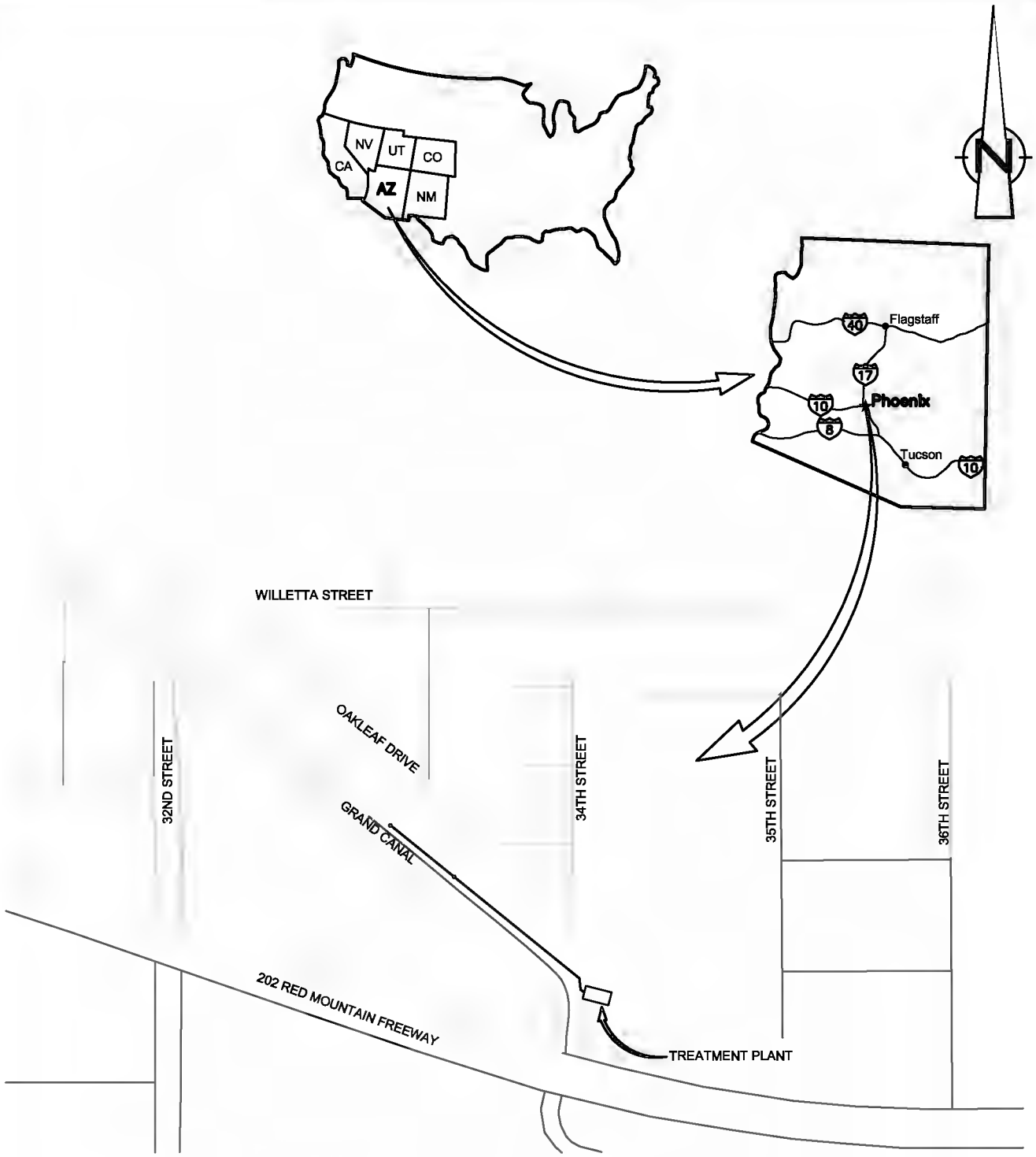

figure 1.1
SITE LOCATION
34TH STREET GROUNDWATER TREATMENT SYSTEM
FREESCALE SEMICONDOCTOR, INC.
Phoenix, Arizona

070386-00(010)GN-PX001 - Site Location Jan 31/2014

figure 1.2
PROJECT ORGANIZATION
34th Street Groundwater Treatment System
Phoenix, Arizona

CONESTOGA-ROVERS & ASSOCIATES

070386 (10)

Tables

TABLE 1.0

CONTACT LIST
56th STREET AND EARLL DRIVE WQARF SITE
34th STREET GROUNDWATER TREATMENT SYSTEM
PHOENIX, ARIZONA

Contact	*Organization*	*Role*
JENN MCCALL	FREESCALE	REMEDIATION PROGRAM MANAGER
ERIC MANNLEIN	CRA	O&M PROJECT MANAGER
MIKE MCNEIL	CRA	OPERATOR
MIKE PATRICK	SRP	MANAGER, WATER TRANSMISSION & COMMUNICATIONS
NICOLE OSUCH	ADEQ	PROGRAM MANAGER
n/a	ADEQ	24-HR REPORTING HOTLINE
n/a	ADEQ	WATER QUALITY COMPLIANCE SECTION MANAGER

Notes:
Freescale = Freescale Semiconductor, Inc.
CRA = Conestoga-Rovers & Associates
SRP = Salt River Project
ADEQ = Arizona Department of Environmental Quality

TABLE 1.4.1

NORMAL OPERATING PARAMETER SUMMARY
GROUNDWATER REMEDIATION FACILITY
56TH STREET AND EARLL DRIVE WQARF SITE
PHOENIX, ARIZONA

Condition	***Normal Operating Condition***
Well Discharge Pressure (DM-39)	50 PSI
Well Discharge Pressure (DM-40)	60 PSI
Well – Water Level LOW (Extraction Well DM-39)	Variable 25 ft Span
Well – Water Level LOW (Extraction Well DM-40)	Variable 25 ft Span
Well Discharge Flow Rate (DM-39)	90 GPM
Well Discharge Flow Rate (DM-40)	360 GPM
Influent Pipeline Pressure/Pre-Particulate Filter	25 PSI
Post-Particulate Filter/Pre-Lead GAC Vessel Pressure	11 PSI
Between Lead/Lag GAC Vessel Pressure	7.5 PSI
GAC PAD Float Switch (High-High Level)	6 PSI
Effluent Flow Rate	450 GPM

Notes:
PSI = pounds per square inch
GPM = gallons per minute
ft = feet

TABLE 1.4.2

SCADA ALARM PARAMETER SUMMARY
GROUNDWATER REMEDIATION FACILITY
56TH STREET AND EARLL DRIVE WQARF SITE
PHOENIX, ARIZONA

Condition	***Alarm Set Point*** [(1)]	***Action***
Pump Motor Fault Well DM-39	VFD Triggered Output	Well Shut-down
Pump Motor Fault Well DM-40	VFD Triggered Output	Well Shut-down
Well – Pressure HIGH/LOW (Extraction Well DM-39)	100 PSI /2 PSI	Well Shut-down
Well – Pressure HIGH/LOW (Extraction Well DM-40)	100 PSI /2 PSI	Well Shut-down
Well – Water Level LOW (Extraction Well DM-39)	15 ft above intake	Well Shut-down Restart at 25 ft above intake
Well – Water Level LOW (Extraction Well DM-40)	15 ft above intake	Well Shut-down Restart at 25 ft above intake
Influent Pipe- Flow LOW (At Facility for DM-39)	20 GPM	System Shut-down
Influent Pipe- Flow LOW (At Facility for DM-40)	100 GPM	System Shut-down
Influent Pipeline High Pressure (At Facility)	50 PSI	System Shut-down
Influent Pipeline Low Pressure (At Facility)	3 PSI	System Shut-down
Particulate Filters High Differential Pressure	25 PSI	Activate Additional Particulate Filter – If pressure remains greater than Set Point system will commence shut-down
GAC Vessel Differential Pressure (Lead/Lag Vessel)	25 PSI/20 PSI	System Shut-down
GAC PAD Float Switch (High-High Level)	1-inch above GAC Pad	System Shut-down
Effluent Low Flow	50 GPM	System Shut-down
Effluent High Pressure	50 PSI	System Shut-down
Control Panel High Temp	Adjustable	System Shut-down

Notes:
VFD = Variable Frequency Drive
PSI = pounds per square inch
GPM = gallons per minute
ft - feet
[(1)] Set Point will be adjusted as need for proper operations.

TABLE 2.0

AZPDES DISCHARGE PARAMETERS SUMMARY
GROUNDWATER TREATMENT SYSTEM
56TH STREETAND EARLL DRIVE WQARF SITE
PHOENIX, ARIZONA

Parameter	*Reporting Units*	*Maximum Allowable Discharge Limitations*		*Monitoring Requirements*	
		Monthly Average	*Daily Maximum*	*Monitoring Frequency*	*Sample Type*
Discharge Limitations and Monitoring Requirements					
Discharge flow	MGD	REPORT (MGD) [1]	REPORT (MGD) [1]	Continuous	Metered
Boron [2] (Mixing Zone - Grand Canal)	µg/L	NA	1,000	Once/month	Discrete
Boron (Discharge)	µg/L	NA	REPORT [1]	Once/month	Discrete
Selenium [3]	µg/L	NA	29.2	Once/month	Discrete
Chloroform	µg/L	20.0	80	Once/month	Discrete
1,2-cis-Dichloroethylene (c-1,2-DCE)	µg/L	NA	70	Once/month	Discrete
Tetrachloroethylene (PCE)	µg/L	NA	5	Once/month	Discrete
Toluene	µg/L	NA	1,000	Once/month	Discrete
Trichloroethylene (TCE)	µg/L	NA	5	Once/month	Discrete
pH [4]	S.I.	Not less than 6.5 S.U. nor greater than 9.0 S.U.		Once/month	Discrete
Discharge Characterization Testing (Selected Metals and Trace Substances)					
Arsenic [5]	µg/L	NA	NA	Once/6 months	Discrete
Cadmium [5]	µg/L	NA	NA	Once/6 months	Discrete
Chromium [5]	µg/L	NA	NA	Once in year 2014	Discrete
Copper [5]	µg/L	NA	NA	Once/6 months	Discrete
Cyanide [5]	µg/L	NA	NA	Once in year 2014	Discrete
Hardness (as $CaCO_3$) [5][6]	µg/L	NA	NA	Once/6 months	Discrete
Lead	µg/L	NA	NA	Once/6 months	Discrete
Mercury	µg/L	NA	NA	Once/6 months	Discrete
Zinc	µg/L	NA	NA	Once in year 2014	Discrete
Discharge Characterization Testing (Selected Volatile Organic Compounds)					
Benzene	µg/L	NA	NA	Once/6 months	Discrete
1,2-Dichloroethane (1,2-DCA)	µg/L	NA	NA	Once/6 months	Discrete
1,1-Dichloroethylene (1,1-DCE)	µg/L	NA	NA	Once/6 months	Discrete
1,2-trans-Dichloroethylene (t-1,2-DCE)	µg/L	NA	NA	Once/6 months	Discrete
Ethyl Benzene	µg/L	NA	NA	Once/6 months	Discrete
1,1,1-Trichoroethane (1,1,1-TCA)	µg/L	NA	NA	Once/6 months	Discrete
Vinyl Chloride	µg/L	NA	NA	Once/6 months	Discrete
Xylene	µg/L	NA	NA	Once/6 months	Discrete

Notes:

MGD = million gallons per day

µg/L = micrograms per liter

NA = not applicable

S.I. = International System of Units

S.U. = standard units

[1] Monitoring and reporting require. No limit set at this time.

[2] Receiving water samples for boron shall be taken from approximate midpoint of the 32nd Street Bridge over the Grand Canal, approximately 1,400 feet downstream of the discharge point (within mixing zone).

[3] Selenium discharge limitations are for total recoverable metals.

[4] pH shall be measured at the time of sampling and does not require use of the a certified laboratory

[5] All metals analyses shall be for total recoverable metals.

[6] Receiving water (Grand Canal) samples for hardness shall be taken a the time samples are tanke for cadmium copper, lead, and zinc. Grand Canal samples shall be taken approximately 50 feet upstream of the 56th Street and Earll Drive WQARF Site Groundwater Treatment System.

TABLE 3.0

MAJOR EQUIPMENT LIST
56TH STREET AND EARLL DRIVE WQARF SITE
34TH STREET GRIUNDWATER TREATMENT SYSTEM
PHOENIX, ARIZONA

Location #	*Equipment Description*
1	SIEMENS HP HIGH PRESSURE ADSORPTION SYST-ASME
2	EATON MAXLINE FILTER HOUSING
3	E&H Promag 53W ELECTROMAG FLOW
4	HerseyMeters 400 Series Disc Meter
5	Goulds NPE CENTRIFUGAL PUMPS
6	Goulds 3STG4 TECH SPECS
7	Simflo Submersible Pump O&M
8	Simflo Threaded Column Pipe
9	Simflo Submersible Discharge Head
10	Watts DBL CHK VALVE backflow 1&1-4 inch ES-007
11	Waterman F-25 Flap Gate
12	Mueller Wedge Gate Valve
13	ValMatic swing check valve
14	ValMatic Flanged Butterfly Valve 150B
15	ClaVal Solenoid Control Valve E-136-03
16	FloMatic Check Valve 402BT 8-inch
17	FloMatic 8-in 402bt Headloss Chart
18	FloMatic 6-in waffer check valve Model 888
19	FloMatic 888 Headloss Chart
20	FloMatic 6-in SS Check Valve 80S6
21	FloMatic 6-in SS ChkValve 80S6 Headloss Chart
22	Franklin Motors Submersible Motors
23	Franklin Motor Catalog
24	Snyder 1000 Gal Poly Tank
25	Snyder 2-In Threaded Bulkhead
26	Oldcastle vault
27	link seal
28	Bradley Safety Shower S19-310FSS
29	Lithonia TWAC-CF
30	Lithonia Fluorescent Lights
31	SIMFLO Model SP4C 14-Stage Pump Curve
32	SIMFLO Model SE7C 3-Stage Pump Curve

TABLE 4.0

INSPECTION SCHEDULE
56TH STREET AND EARLL WQARF SITE
34TH STREET GROUNDWATER TREATMENT SYSTEM
PHOENIX, ARIZONA

	Frequency				
Activity	*Weekly*	*Monthly*	*Semi-Annually*	*Annually*	*Other*
TREATMENT FACILITY					
FACILITY CONDITION	●				
REMOTE TOTALIZER READING	●				
SECURITY SYSTEM	●				
INSPECT LIGHTING	●				
PURGE WATER HOLDING TANK	●				
ELECTRICAL/CONTROLS PANELS (FACILITY)	●				
ELECTRICAL/CONTROLS PANELS (WELLFIELD)	●				
SUMP	●				
DISCHARGE FLOW RATE	●				
DISCHARGE FLOW METER TOTALIZER	●				
INFLUENT PRESSURE	●				
SEDIMENT FILTER DIFFERENTIAL PRESSURE	●				
PRE-CARBON PRESSURE	●				
MID-CARBON PRESSURE	●				
DISCHARGE PRESSURE	●				
INSPECT EYEWASH AND SAFETY SHOWER		●			
EXERCISE ALL VALVES - GAC		●			
FACILITY GATES					
Swing Gate		●			
GAC VESSELS: Inspect carbon vessel nozzles and internals					
Vessel A					During carbon changeout
Vessel B					During carbon changeout
CHECK VALVE ON SUMP PUMP DISCHARGE LINE		●			
TEST BACKFLOW DEVICES				●	
WIRE BRUSH CORROSION ON TANKS AND TOUCH-UP PAINT				●	
SCADA COMPUTER SYSTEM					
CHECK PLC TERMINAL CONNECTION FOR TIGHTNESS				●	
PROGRAMMABLE CONTROLS - BACKUP PROGRAM			●		
SCADA COMPUTER SYSTEM - BACKUP DATA FILES		●			
UNINTERRUPTIBLE POWER SUPPLY			●		
WIRELESS COMMUNICATION SYSTEM			●		
CHECK ELECTRICAL TERMINAL CONNECTIONS FOR TIGHTNESS			●		
EXTRACTION WELLS					
DM-39					
EXTRACTION WELL SITE CONDITION	●				
VAULT CONDITION	●				
FLOW RATE (GPM)	●				
FLOW METER TOTALIZER	●				
DM-40					
WELL SITE CONDITION	●				
VAULT CONDITION	●				
FLOW RATE (GPM)	●				
FLOW METER TOTALIZER	●				
PIPELINE ROUTES					
DM-39 TO TREATMENT FACILITY	●				
DM-40 TO TREATMENT FACILITY	●				
AIR RELEASE VALVE (X5)	●				
OTHER					
TEST SECURITY SYSTEM				●	
HEALTH & SAFETY PLAN REVIEW				●	
FIRE EXTINGUISHERS				●	
PERFORM ANNUAL CALIBRATION OF EFFLUENT FLOW (SRP REQUIREMENT)				●	

TABLE 4.1

WEEKLY INSPECTION LOG
56TH STREET AND EARLL DRIVE WQARF SITE
34TH STREET GROUNDWATER TREATMENT SYSTEM
PHOENIX, ARIZONA

Checked By: _____ ***Date:*** _____

Item	*General Condition*		*Comments*
	Acceptable	*Problem*	
TREATMENT FACILITY:			
Facility Overall Condition			
Remote Totalizer Reading			
Security System			
Inspect Lighting			
Purge Water Holding Tank			
Electrical/Control Panels (FACILITY)			
Electrical/Control Panels (WELLFIELD)			
Sump			
Discharge Flow Rate			
Discharge Flow Meter Totalizer			
Influent Pressure			
Sediment Filter Differential Pressure			
Pre-Carbon Pressure			
Mid-Carbon Pressure			
Discharge Pressure			
EXTRACTION WELLS:			
DM39:			
Well site condition			
Vault Condition			
Flow Rate (GPM)			
Flow Meter Totalizer			
DM40:			
Well site condition			
Vault Condition			
Flow Rate (GPM)			
Flow Meter Totalizer			
PIPELINE ROUTES:			
DM39 to Treatment Facility			
DM40 to Treatment Facility			
Air Release Valves (x5)			
MISCELLANEOUS OBSERVATIONS: (next page)			

TABLE 4.1

WEEKLY INSPECTION LOG
56TH STREET AND EARLL DRIVE WQARF SITE
34TH STREET GROUNDWATER TREATMENT SYSTEM
PHOENIX, ARIZONA

Checked By: ***Date:***

MISCELLANEOUS OBSERVATIONS:

TABLE 4.2

MONTHLY INSPECTION LOG
56TH STREET AND EARLL DRIVE WQARF SITE
34TH STREET GROIUNDWATER TREATMENT SYSTEM
PHOENIX, ARIZONA

Checked By: _____ **Date:** _____

INSPECTION

Item	*General Condition*		*Comments*
	Acceptable	*Problem*	
GAC VESSELS - Inspect carbon vessel nozzles and internals			
(ONLY REQUIRED DURING CARBON CHANGEOUT)			
- Vessel A			
- Vessel B			
EYEWASH AND SAFETY SHOWER			
SCADA COMPUTER SYSTEM - BACKUP DATA FILES			
CHECK VALVE ON SUMP PUMP DISCHARGE			

MAINTENANCE

Item	*General Condition*		*Comments*
	Acceptable	*Problem*	
EXERCISE ALL VALVES - GAC			
EXERCISE ALL VALVES - PIPELINE			
FACILITY GATES			
- SWING GATE			

TABLE 4.3

SEMI-ANNUAL INSPECTION LOG
56TH STREET AND EARLL DRIVE WQARF SITE
34TH STREET GROUNDWATER TREATMENT SYSTEM
PHOENIX, ARIZONA

Checked By: _____ ***Date:*** _____

INSPECTION

	General Condition		
Item	***Acceptable***	***Problem***	***Comments***
UNINTERRUPTIBLE POWER SUPPLY			
CHECK ELECTRICAL TERMINAL CONNECTIONS FOR TIGHTNESS			

MAINTENANCE

	General Condition		
Item	***Acceptable***	***Problem***	***Comments***
WIRELESS COMMUNICATION SYSTEM			
PROGRAMMABLE CONTROLS - BACKUP PROGRAM			

TABLE 4.4

ANNUAL INSPECTION LOG
56TH STREET AND EARLL DRIVE WQARF SITE
34TH STREET GROUNDWATER TREATMENT SYSTEM
PHOENIX, ARIZONA

Checked By: _____ ***Date:*** _____

INSPECTION

	General Condition		
Item	***Acceptable***	***Problem***	***Comments***
HEALTH AND SAFETY PLAN REVIEW			

MAINTENANCE

	General Condition		
Item	***Acceptable***	***Problem***	***Comments***
WIRE BRUSH CORROSION ON TANKS AND TOUCH-UP PAINT			
TEST BACKFLOW DEVICES			
SERVICE FIRE EXTINGUISHERS			
TEST SECURITY SYSTEM			

TABLE 4.5

MAINTENANCE RECORD LOG
56TH STREET AND EARLL DRIVE WQARF SITE
34TH STREET GROUNDWATER SYSTEM
PHOENIX, ARIZONA

ID/TAG NO. _____ *DESCRIPTION:* _____

DATE OF REPAIR	***SPARE PARTS USED***		***DESCRIPTION OF REPAIR***
	DESCRIPTION	***PART NO.***	

Appendix A

Poor Quality Groundwater Withdrawal Permit

ARIZONA DEPARTMENT OF WATER RESOURCES

PERMIT TO WITHDRAW

POOR QUALITY GROUNDWATER

PURSUANT TO A.R.S. § 45-516

PERMIT NO. 59-541491.0002

STATE OF ARIZONA)
)ss.
COUNTY OF MARICOPA)

This is to certify that Application No. 59-541491.0002 meets the requirements of Title 45, Chapter 2, Article 7, Arizona Revised Statutes for a Permit to Withdraw Poor Quality Groundwater. The Director hereby grants a permit to withdraw poor quality groundwater pursuant to Arizona Revised Statutes § 45-516, subject to the following limitations and conditions:

Permit Limitations

Permittee: Freescale Semiconductor, Inc.
2100 E. Elliott Road
MD EL-614
Tempe, AZ 85284

Active Management Area: Phoenix

Sub-basin:	West Salt River Valley
Maximum Amount of Groundwater to be Withdrawn:	1,935 acre-feet per annum
Authorized Points of Withdrawal:	As referenced in Table 1
Authorized Use of Groundwater:	The poor quality groundwater to be withdrawn will be treated to remove volatile organic compounds as part of a remedial action by the Permittee.
Authorized Place of Use for Groundwater Withdrawn:	NW¼, SW¼, NE¼, Section 1, Township 1 North, Range 3 East GSRB&M
Effective Date of Permit:	July 15, 2010
Expiration Date of Permit:	April 22, 2029

Permit Conditions

1. Poor quality groundwater shall be withdrawn by the Permittee pursuant to a remediation being performed at the 56th Street and Earll Drive Water Quality Assurance Revolving Fund (WQARF) site. The remediation activities shall be consistent with any remedial investigation plans and reports (plans), or similar document, approved by the Arizona Department of Environmental Quality. The plans and subsequent modifications and amendments are collectively referred to as the remediation documents, and are incorporated in and made a part of this permit.

2. For the purpose of this permit, poor quality groundwater is defined as groundwater that does not meet the state of Arizona Aquifer Water Quality Standards (AWQSs) for the contaminants of concern as defined in the remediation documents. For the purposes of this permit, the AWQSs are indicators that the groundwater is of poor quality and do not constitute a remediation standard.

3. The issuance of this permit does not constitute endorsement of the assertions or findings of investigations and studies submitted by the Permittee as part of its applications, nor as part of its other efforts to date to delineate the area and extent of contamination or to delineate contamination source or responsibility.

4. This permit shall terminate when the activities performed pursuant to the remediation documents end. If the activities being performed will extend beyond the expiration date of this permit, the Permittee may submit an application to renew this permit within six month prior to the date of the expiration of this permit.

5. Monitoring Requirements:

   a. Groundwater Withdrawal Monitoring:

      The Permittee shall measure the volume of groundwater withdrawn from each extraction well listed in Table 1 with an approved water measuring device and method consistent with A.A.C. R12-15-903.

   b. Water Measuring Device Accuracy and Failures:

      The water quantity measuring devices and methods shall quantify flow accurately pursuant to A.A.C. R12-15-905. If any water quantity measurement device fails to perform its designated function for more than seventy-two (72) hours, the Permittee shall notify ADWR in writing and shall repair or replace the measuring device as described in A.A.C. R12-15-906.

   c. Groundwater Quality Monitoring:

      The Permittee shall perform groundwater quality monitoring as described in the remediation documents and submitted to the Arizona Department of Environmental Quality that allows ADWR to determine that the groundwater withdrawn, because of its quality, has no other beneficial use. The Permittee shall notify ADWR of any changes to the groundwater quality data collection plan pursuant to the remediation documents.

6. Reporting Schedule

   The Permittee shall submit an "Annual Water Withdrawal and Use Report" as required under A.R.S. §45-632, together with supplemental data reports described below, no later than March 31 following the end of each completed annual reporting period. The first reporting period shall be from the effective date of this permit through December 31, 2010. Subsequent reporting periods shall be from January 1 through December 31. Annual reports must be submitted regardless of whether groundwater has been withdrawn. If no groundwater is withdrawn during the reporting period, the Permittee shall indicate that fact on the annual report and in the supplemental data report. The Permittee shall send one (1) copy of all annual and supplemental data reports to **ADWR, Planning and Data Management, 3550 North Central Avenue, Phoenix, AZ 85012.**

7. Supplemental Data Reporting Requirements

   The Permittee shall submit all monitoring data and analyses in the supplemental data reports as specified below. The supplemental data reports (data reports) shall include:

a. Site Map:

The data reports shall include a site map showing the location of all monitoring points and relevant facility features such as extraction wells, monitor wells, and water measurement devices. The site map shall include a contour of the known extent of groundwater contamination above the AWQS. The data reports shall include the map data in electronic format such as an ARCMap (ESRI) shape files used to generate the contour..

b. Groundwater Withdrawal/Injection Data:

The data reports shall quantify all groundwater withdrawals and groundwater injections from the wells listed in Table 1 for the reporting period. The groundwater extraction data shall be presented in summary tables indicating the well registration number, the Permittee's well identifier, beginning and ending flowmeter readings, and the volume of groundwater withdrawn or injected in gallons and acre-feet. The groundwater injection data shall be presented in a summary table indicating the flowmeter readings for the reporting period.

c. Water Quality Monitoring Data:

The data reports shall contain all groundwater quality data collected pursuant to the remediation documents. The water quality data shall be summarized in tables containing the following: monitoring point identifier, the sample date, the analyte, the laboratory method, the applicable regulatory level, and the sample result. Copies of the laboratory shall be included in the data reports in electronic format, such as a portable document format (pdf) on a compact disk.

Table 1

Well Identifier	ADWR Registration Number	Cadastral Locations	Well Depth (feet bgs)
DM-39	55-219352	A(1-3)1ACB	184
DM-40	55-219351	A(1-3)1ACB	215

8. General Provisions:

a. The issuance of this permit does not waive compliance with any federal, state, county or local government statutes, rules or permits.

b. All ADWR agency notifications, other than annual and supplemental data reports, shall be addressed to **ADWR, Groundwater Permitting and Wells, 3550 North Central Avenue, Phoenix, AZ 85012.**

WITNESS my hand and seal of office this 15th day of July, 2010.

Sandy Fabritz-Whitney, Assistant Director

JANICE K. BREWER
Governor

HERBERT R. GUENTHER
Director

ARIZONA DEPARTMENT OF WATER RESOURCES

3550 North Central Avenue, Second Floor
PHOENIX, ARIZONA 85012-2105
(602) 771-8500

July 15, 2010

Freescale Semiconductor, Inc.
Attn: Jen McCall
2100 E Elliot Rd., MD EL-614
Tempe, AZ 85284

Re: Permit to Withdraw Poor Quality Groundwater No. 59-541491.0002.

Dear Ms. McCall:

Your permit as referenced above is enclosed for your records. Please take a moment to review the limitations and conditions of the permit, including monitoring and reporting requirements.

Pursuant to the provisions of A.R.S. § 45-604; any person withdrawing groundwater from a well is required to use a water measuring device to record rates of withdrawal in order to provide or allow the computation of an annual volume of pumpage from the well. The total volume of pumpage shall be reported on an annual report. The annual report shall be submitted no later than March 31 following the end of each completed annual reporting period. Subsequent annual report periods shall be January 1 through December 31. Any water put to a beneficial use shall be used pursuant to a grandfathered groundwater right or groundwater withdrawal permit.

Under A.R.S. § 45-593, the person to whom a well is registered must notify the Department of a change in ownership, physical characteristics or any other data about the well in order to keep the well registration records current and accurate. A Request to Change Well Information form may be obtained online at http://www.azwater.gov.

In accordance with A.R.S. § 45-520 (B), any change in ownership of this permit requires the submittal of a Notification of Change of Ownership of a Groundwater Withdrawal Permit form. This form may be obtained online at http://www.azwater.gov.

If you have any questions about the terms and conditions of the permit or require any administrative corrections to this permit, please contact the Groundwater Permitting and Wells Section at 602-771-8527.

Sincerely,

Sandra Fabritz-Whitney
Assistant Director

Enclosures

cc: File

Appendix B

Arizona Pollution Discharge Elimination System (AZPDES) Permit

Janice K. Brewer
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Henry R. Darwin
Director

1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.azdeq.gov

Decision to Grant AZPDES Permit #AZ0025861

February 28, 2011

LTF ID: 51093
Place ID: 138082

Jenn McCall, Remediation Programs Specialist
Freescale Semiconductor, Inc.
2100 E. Elliot Road, MD EL-614
Tempe, AZ 85284

RE: AZPDES Permit Application No. AZ0025861
56th Street and Earll Drive WQARF Site Groundwater Treatment System (GWTS)
Phoenix, AZ 85008

Dear Ms. McCall:

The Arizona Department of Environmental Quality (ADEQ) has completed the public participation and comment period for the above-referenced facility. Comments were received from Freescale Semiconductor, Inc. during the 30-day comment period. A copy of the comments and ADEQ's response is attached to this letter. ADEQ has made a final decision to issue the AZPDES permit for discharge from the 56th Street and Earll Drive WQARF Site GWTS in Phoenix, Arizona.[1] A copy of the fact sheet and signed permit is enclosed. Please note the effective date and expiration date for your permit. If you wish to renew this permit, a complete and accurate application must be submitted no later than 180 days prior to the permit expiration date.

The review of your AZPDES application was subject to the licensing timeframes statute under Arizona Revised Statutes A.R.S. §§ 41-1072 through 41-1079. Therefore, this letter is the written notification of ADEQ's licensing decision required under A.R.S. § 41-1076 and Arizona Administrative Code (A.A.C.) R18-1-507(A).

This decision was made prior to expiration of the licensing time frames governing your application. Please contact me at (602) 771- 4593 if you have any questions regarding this notice or your permit.

Sincerely,

M. Reza Azizi

M. Reza Azizi
Permits Unit
Surface Water Section
Water Quality Division

Enclosures: Signed AZPDES Permit No. AZ0025861
Fact Sheet
Freescale Comments and ADEQ's Response to Comments

SWSPU11:0017

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[1]This determination is an appealable agency action under A.R.S. § 41-1092. You have the right to request a hearing and file an appeal under A.R.S. § 41-1092.03. To do this you must file a Request for Hearing or Notice of Appeal **within thirty (30) days of receipt of this notice**. A request for Hearing or Notice of Appeal is filed when it is received by ADEQ's Hearing Administrator as follow:

Hearing Administrator
Office of Administrative Counsel
Arizona Department of Environmental Quality
1110 W. Washington Street
Phoenix, AZ 85007

The Request or Notice must contain the following:

1. The name of the party that is filing the appeal;
2. The address of the party that is filing the appeal;
3. The action being appealed; and
4. A concise statement of the reasons for the appeal.

Upon proper filing of a Request for Hearing or Notice of Appeal, ADEQ will serve a Notice of Hearing on all parties to the appeal. If you file a timely Request for Hearing or Notice of Appeal, you have the right to request an informal settlement conference with ADEQ under A.R.S § 41-1092.06. This request must be made in writing no later than 20 days before a scheduled hearing and must be filed with the Hearing Administrator at the above address.

RESPONSE TO COMMENTS

Permit No.	AZ0025861 / 56th St. & Earll Dr. WQARF Site Groundwater Treatment System (facility)
Applicant:	Freescale Semiconductor, Inc. 2100 E. Elliot Rd., MD EL-614, Tempe, AZ 85284
Permit Action:	Final permit decision and response to comments received on the draft permit public noticed on December 9, 2010. Following is ADEQ's response to comments received on the subject draft permit.
Prepared By:	M. Reza Azizi, AZPDES Permit Writer Surface Water Section/ Permits Unit Arizona Department of Environmental Quality 1110 W. Washington St., 5415A-1 Phoenix, AZ 85007 602-771-4593
Date:	1/19/2011

Comments were received on the preliminary draft permit from Freescale Semiconductor, Inc. (Freescale). Following is a description of comments received and ADEQ's responses.

Comments received on December 9, 2010 from Freescale:

COMMENT NO. 1

Freescale requested discharge limitation for chloroform be increased from 6 ug/L to 80 ug/L in the permit. Freescale noted that there are no numeric surface water quality standards for chloroform and four other organic compounds in the receiving water with AgI and AgL designated uses. Freescale further stated that with the exception of chloroform, the proposed limits are based on the Safe Drinking Water Maximum Contaminant Levels (MCLs). ADEQ has, on the other hand, used its best professional judgment to set the limit for chloroform on a much lower level than the MCL. The MCL for disinfection by-products including chloroform is 80 ug/L. Freescale has recommended that the MCL of 80 ug/L be set as the discharge limit for chloroform to be consistent with the other four volatile organic compounds.

RESPONSE NO. 1.

ADEQ concurs with Freescale. The discharge limit for chloroform has been changed from 6 ug/L to 80 ug/L in the final permit. In order to be consistent with this permit change, minor changes were also made to Part VII of the final fact sheet.

COMMENT NO. 2

Freescale stated that the Consent Order between ADEQ and Freescale is now expected to be signed in 2011 and not 2010 as stated in the Part I of the public noticed fact sheet.

RESPONSE NO. 2

The anticipated date for the Consent Order has been changed to 2011 in the final fact sheet as requested.

COMMENT NO. 3

Freescale stated that the facility is now planned for design and construction in 2011 and not 2010 as stated in the Part II of the public noticed Fact Sheet.

RESPONSE NO. 3

The anticipated date for facility design and construction has been changed to 2011 in the final Fact Sheet as requested.

COMMENT NO. 4

Freescale identified a typographical error in Part I.B of the permit. The public noticed permit lists Tables 2.a-2.c while the correct listing should be Tables 2.a-2.b. Also, the public notice erroneously listed the address for Freescale as containing MD EL-6141. The correct number is MD EL 614.

RESPONSE NO. 4

The listing of Tables 2.a-2.b in Part I.B has been corrected in the final permit. The typographical error in the public notice has been noted.

Additionally, the public noticed fact sheet (front page) erroneously listed the permit number as AZ0028861. The final fact sheet has been changed to list the correct permit number of AZ0025861.

ARIZONA POLLUTANT DISCHARGE ELIMINATION SYSTEM (AZPDES)

FACT SHEET

This document gives pertinent information concerning the issuance of the AZPDES permit listed below. This facility is a groundwater remediation system and is considered to be a minor facility under the NPDES program. The effluent limitations contained in this permit will maintain the Water Quality Standards listed in Arizona Administrative Code (A.A.C.) R18-11-101 et. seq. This permit is proposed to be issued for a period of 5 years.

Facility Name:	**56th Street and Earll Drive WQARF Site Groundwater Treatment System**
Permittee's Name:	Freescale Semiconductor, Inc.
Mailing Address:	2100 E. Elliot Road, MD EL-614 Tempe, AZ 85284
Facility Location:	North Side of SRP Grand Canal near 34th Street, North of Loop 202 Phoenix, AZ 85008
Contact Person:	Jenn McCall, Remediation Programs Specialist 480-413-3290; Jenn.mccall@freescale.com
AZPDES Permit No.:	**AZ0025861**
Inventory No.:	106170

I. STATUS OF PERMIT(s)

Freescale Semiconductor, Inc. (Freescale) has applied for a new Arizona Pollutant Discharge Elimination System (AZPDES) permit to allow the discharge of effluent from the proposed 56th Street and Earll Drive Water Quality Assurance Revolving Fund (WQARF) Site Groundwater Treatment System (facility) in Phoenix, Arizona to the Salt River Project (SRP) Grand Canal west of 34th Street and north of State Route Loop 202 in Phoenix, Arizona. This application was received by the Arizona Department of Environmental Quality (ADEQ) on November 6, 2009 and was determined to be administratively complete on January 28, 2010 when the additional information was received. It is anticipated that a Consent Order will be signed between ADEQ (Remedial Project Unit within the Waste Programs Division) and Freescale in 2011 which will contain a Scope of Work regarding groundwater remediation at this WQARF site. A draft Consent Order has already been prepared and is currently under review by both parties. Freescale does not currently have or need an Aquifer Protection Permit (APP) for discharges from this facility. Pursuant to A.R.S. § 49-250(B)(18)(d), a remedial action such as this which has been reviewed and will be approved by ADEQ prior to start of the discharge is exempt from the APP requirement.

II. GENERAL FACILITY INFORMATION

The 56th Street and Earll Drive facility is part of a WQARF, a.k.a. State Superfund, remediation site. As proposed, contaminated groundwater containing certain volatile organic compounds (VOCs) in concentrations higher than aquifer water quality standards will be extracted from two wells, DM-39 and DM-40, and treated via a treatment system with granular activated carbon (GAC). The proposed facility will be located on the north side bank of Grand Canal near 34th Street, north of the State Route Loop 202

Maricopa County, Arizona. Freescale has an agreement with SRP for the extraction wells, and will enter into additional agreements with SRP to include the facility, and the discharge of treated groundwater to the Grand Canal. Freescale will own and operate both the facility and the two extraction wells.

Construction of the two extraction wells was completed in January 2010, and the facility is planned for design and construction in 2011. The facility will treat the contaminated groundwater at an average rate of 1,000 gpm (1.44 mgd).

III. RECEIVING WATER

The State of Arizona has adopted water quality standards to protect the designated uses of its surface waters. Streams have been divided into segments and designated uses assigned to these segments. The water quality standards vary by designated use depending on the level of protection required to maintain that use.

The receiving water for the facility is the SRP Grand Canal, a Phoenix Area Canal below municipal water treatment plant intakes and all other locations, in the Middle Gila River Basin.

Outfall 001 is located at: Township 1 N, Range 3 E, Section 1
Latitude 33° 27' 39.0" N, Longitude 112° 00' 32.6" W

The Grand Canal is not on the 303(d) list and there are no Total Maximum Daily Load (TMDL) issues associated. The outfall discharges to, or the discharge may reach, a surface water listed in Appendix B of A.A.C. Title 18, Chapter 11, Article 1.

The Grand Canal has the following designated uses:

Agricultural Irrigation (AgI)
Agricultural Livestock watering (AgL)

Given the uses stated above, the applicable narrative water quality standards are described in A.A.C. R18-11-108 and the applicable numeric water quality standards are listed in A.A.C. R18-11-109, and in Appendix A thereof. In developing AZPDES permits, the standards for all applicable designated uses are compared and limits that will protect for all applicable designated uses are developed based on the standards.

IV. DESCRIPTION OF DISCHARGE

Since this facility has not been designed, constructed, or placed in operation, and no discharge has been made to the Grand Canal, no discharge monitoring data is available.

V. STATUS OF COMPLIANCE WITH THE EXISTING AZPDES PERMIT

N/A - This is a new permit and as such this section is not applicable

VI. PROPOSED PERMIT CHANGES

N/A - This is a new permit and as such this section is not applicable

VII. DETERMINATION OF DISCHARGE LIMITATIONS AND CHARACTERIZATION

When determining what parameters need monitoring and/or limits included in the draft 56th Street and Earll Drive WQARF Site Groundwater Treatment System permit, both technology-based and water quality-based criteria were compared and the more stringent criteria applied.

Technology-based Limitations: As outlined in 40 CFR Part 133

There are no promulgated technology-based limits for a groundwater treatment system such as the 56th Street and Earll Drive facility. However, it has been demonstrated that this technology allows for efficient removal of volatile organic compounds (VOCs), and the discharge can be sampled with low detection limits. Based on a review of the groundwater data submitted by the applicant and using best professional judgment (BPJ), technology-based limits have been set for **chloroform, 1,2-cis-dichloroethylene (c-DCE), tetrachloroethylene (PCE), toluene, and trichloroethylene (TCE)** in the draft permit. All these parameters have been detected in the groundwater. The proposed limits are based on Safe Drinking Water Act Maximum Contaminant Levels (MCLs) which are the clean-up levels routinely required for groundwater remediation projects of this type.

Water Quality-based Limitations: As outlined in A.A.C. R18-11-109 and Appendix A

Per 40 CFR 122.44(d)(1)(ii), (iii) and (iv), discharge limits must be included in the permit for parameters with "reasonable potential" (RP), that is, those known to be or expected to be present in the effluent at a level that could potentially cause any applicable numeric water quality standard to be exceeded. "Reasonable potential" refers to the possibility, based on the statistical calculations using the data submitted, or consideration of other factors to determine whether the discharge may exceed the Water Quality Standards. RP may also be determined from BPJ based on knowledge of the treatment facilities and other factors. The basis for the RP determination for each parameter with a limit is shown in the table below. Since no effluent (discharge) data was available, groundwater data was used for RP calculation. As a result, RP was calculated for **boron** and **selenium**. The permittee submitted an application for and received a mixing zone for boron. Boron will be monitored with limitations within the mixing zone while selenium will be monitored with limitations at or prior to discharge point (Outfall 001).

The procedures used to determine reasonable potential are outlined in the *Technical Support Document for Water Quality-based Toxics Control (TSD)* (EPA/505/2-90-001). In most cases, the highest reported value for a parameter is multiplied by a factor (determined from the variability of the data and number of samples) to determine a "highest estimated value". This value is then compared to the lowest applicable Water Quality Standard for the receiving water. If the value is greater than the standard, RP exists and a limit is required in the permit.

The proposed permit limits were established using a methodology developed by EPA. Long Term Averages (LTA) were calculated for each designated use and the lowest LTA was used to calculate the average monthly limit (AML) and maximum daily limit (MDL) necessary to protect all uses. This methodology takes into account criteria, effluent variability, and the number of observations taken to determine compliance with the limit and is described in Chapter 5 of the TSD. When the limit is based on human health criteria, the monthly average was set at the level of the applicable standard and a daily maximum limit was determined as specified in Section 5.4.4 of the TSD.

The limits for all parameters except for **boron** in this permit were determined without the use of a mixing

zone. Arizona state water quality rules require that water quality standards be achieved without mixing zones unless the permittee applies for and is approved for a mixing zone. A mixing zone was applied for and granted for boron, and the permit limits will be applied at the edge of the mixing zone. Since a mixing zone was not applied for or granted for any other parameters, all other water quality criteria are applied at end-of-pipe.

Discharge Characterization Testing: As outlined in 40 CFR 122.43(a), 40 CFR 122.44(i), 40 CFR 122.48(b), and A.R.S. 49-203(A)(7)

In addition to monitoring for parameters assigned a permit limit, sampling is required to assess the presence of pollutants in the discharge at certain minimum frequencies for additional suites of parameters. The purpose of *Discharge Characterization Testing* is to characterize the discharge and determine if the parameters of concern are present in the discharge and at what levels. This monitoring will be used to assess RP per 40 CFR 122.44(d)(1)(iii)). If pollutants are noted at levels of concern during the permit term, this permit may also be reopened to add related limits or conditions. The following trace substances and VOCs will be monitored without limitations or assessment levels for discharge characterization in the draft permit: **arsenic, cadmium, chromium (total), copper, cyanide, hardness, lead, mercury, zinc, 1,1,1-trichloroethane (TCA), 1,1-dichloroethylene (1,1-DCE), 1,2-trans-dichloroethylene (t-DCE), 1,2-dichloroethane (1,2-DCA), vinyl chloride, benzene, ethylbenzene,** and **xylene.** Analysis of data showed no RP for the trace substances with applicable water quality standards except for total chromium and cyanide for which no data were submitted. However, they will be monitored without limitations or assessment levels for discharge characterization based on BPJ. Although the groundwater data submitted to ADEQ showed all VOCs as less than the laboratory reporting limits, they are pollutants of concern which are known to be present in similar contaminated WQARF sites around the Metropolitan Phoenix area and are required to be monitored with limitations by SRP who owns and operates the receiving water (Grand Canal). Based on BPJ, **manganese** and **oil & grease** will not be monitored during the term of this permit. The discharge is not expected to contain manganese and oil & grease at levels exceeding the applicable numeric or narrative standards, respectively.

NOTE: In the event the facility does not discharge to a water of the U.S. during any monitoring period (e.g., a calendar month, quarter, year, etc.), no monitoring otherwise required during that period will be required.

Permit Limitations and Monitoring Requirements

The table that follows summarizes parameters that will be monitored with limitations or assessment levels in the permit and the rationale for that decision. Also included are parameters that require monitoring without any limitations or assessment levels, or that have not been included in the permit at all and the basis for that decision. The corresponding monitoring requirements are shown for each parameter. In general, the regulatory basis for monitoring requirements is per 40 CFR §122.44(i) *Monitoring requirements*; and 40 CFR §122.48(b), *Required monitoring*; all of which have been adopted by reference in A.A.C. R18-9-A905, *AZPDES Program Standards.*

Parameter	Lowest Standard/ Designated Use	Maximum Reported Daily Value (Groundwater Extraction Wells)	No. of Samples	Estimated Maximum Value (1)	RP Determination	Proposed Monitoring Requirement/ Rationale (2) (3)
Flow	- - -	- - -	- - -	- - -	- - -	Monitoring of discharge flow is required on a continuous basis using a flow meter.
Benzene	No applicable standards	<1 ug/L	2	N/A	N/A	Discharge monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Chloroform	Technology-based limit based on BPJ	1.4 ug/L	2	N/A	N/A	**Discharge monitoring with limitation is required once per month.**
1,2-Dichloroethane (1,2-DCA)	No applicable standards	<1 ug/L	2	N/A	N/A	Discharge monitoring without limitations or assessment levels is required once per six months for discharge characterization.
1,1-Dichloroethylene (1,1-DCE)	No applicable standards	<0.5 ug/L	2	N/A	N/A	Discharge monitoring without limitations or assessment levels is required once per six months for discharge characterization.
1,2-cis-dichloroethylene (c-DCE)	Technology-based limit based on BPJ	0.64 ug/L	2	N/A	N/A	**Discharge monitoring with limitation is required once per month.**
1,2-trans-Dichloroethylene (t-DCE)	No applicable standards	<0.5 ug/L	2	N/A	N/A	Discharge monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Ethyl benzene	No applicable standards	<2 ug/L	2	N/A	N/A	Discharge monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Tetrachloroethylene (PCE) (Perchloroethylene)	Technology-based limit based on BPJ	1.7 ug/L	2	N/A	N/A	**Discharge monitoring with limitation is required once per month.**
Toluene	Technology-based limit based on BPJ	5.5 ug/L	2	N/A	N/A	**Discharge monitoring with limitation is required once per month.**
1,1,1-Trichloroethane (1,1,1-TCA)	1,000 ug/L / AgI	<0.5 ug/L	2	3.3 ug/L	No RP	Discharge monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Trichloroethylene (TCE)	Technology-based limit based on BPJ	46 ug/L	2	N/A	N/A	**Discharge monitoring with limitation is required once per month.**
Vinyl chloride	No applicable standards	<0.5 ug/L	2	N/A	N/A	Discharge monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Xylene	No applicable standards	<3 ug/L	2	N/A	N/A	Discharge monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Antimony	No applicable standards	<2 ug/L	2	N/A	N/A	No monitoring is required.
Arsenic	200 ug/L / AgL	10.7 ug/L	2	79.2 ug/L	No RP	Monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Barium	No applicable standards	No data	0	N/A	N/A	No monitoring is required.

Parameter	Lowest Standard/ Designated Use	Maximum Reported Daily Value (Groundwater Extraction Wells)	No. of Samples	Estimated Maximum Value (1)	RP Determination	Proposed Monitoring Requirement/ Rationale (2) (3)
Beryllium	No applicable standards	<1.0 ug/L	2	N/A	N/A	No monitoring is required.
Boron	1,000 ug/L / AgI	5,600 ug/L	2	41,440 ug/L	RP exists	**Monitoring with limitations is required once per month. Samples shall be taken within mixing zone approximately 1,400 feet downstream of the discharge point in the receiving water (Grand Canal) (5).** Discharge monitoring without limitations or assessment levels is also required once per month.
Cadmium	50 µg/L/ AgI & AgL	<2 ug/L	2	1.85 µg/L	No RP	Monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Chlorine, total residual (TRC)	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Chromium III	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Chromium VI	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Chromium, total	1,000 ug/L / AgI & AgL	No data	0	N/A	No RP (BPJ)	Monitoring without limitations or assessment levels is required once in 2014 for discharge characterization.
Copper	500 µg/L / AgL	23.6 µg/L	2	174.6 µg/L	No RP	Monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Cyanide	200 µg/L / AgL	No data	0	N/A	No RP (BPJ)	Monitoring without limitations or assessment levels is required once in 2014 for discharge characterization.
E. coli	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Fluoride	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Hardness (Receiving water in Grand Canal) (6)	No Applicable Standard. Hardness is used to determine standards for specific metal parameters.	No data	0	N/A	N/A	A&W standards for cadmium, chromium III, copper, lead, nickel, silver and zinc used for RP determinations were based on the default hardness value of 120 mg/ L since no data was available. Receiving water (Grand Canal) monitoring for hardness is required whenever monitoring for hardness dependent metals is required.
Hydrogen Sulfide	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Iron	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Lead	100 µg/L / AgL	4.1 µg/L	2	30.3 ug/L	No RP	Monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Manganese	10,000 µg/L / AgI	No data	0	N/A	N/A	No monitoring is required based on BPJ.
Mercury	10 µg/L / AgL	<0.2 ug/L	2	0.74 ug/L	No RP	Monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Nickel	No applicable standards	<5 ug/L	2	N/A	N/A	No monitoring is required.
Nitrate, nitrite, total nitrogen	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Oil & grease	No applicable standards	No data	0	N/A	N/A	No monitoring is required.

Parameter	Lowest Standard/ Designated Use	Maximum Reported Daily Value (Groundwater Extraction Wells)	No. of Samples	Estimated Maximum Value (1)	RP Determination	Proposed Monitoring Requirement/ Rationale (2) (3)
pH (7)	Min. 6.5; Max.: 9.0 / AgL A.A.C.R 18-11-109 (B)	No data	0	N/A	Limit is always included.	**Monitoring with limitations is required once per month.**
Phosphorus	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Selenium	20 µg/L / AgI	6.4 µg/L	2	47.4 µg/L	RP exists	**Monitoring with limitations is required once per month.**
Silver	No applicable standards	<5 ug/L	2	N/A	N/A	No monitoring is required.
Thallium	No applicable standards	<0.5 ug/L	2	N/A	N/A	No monitoring is required.
Zinc	10,000 µg/L / AgI	72 µg/L	2	532.8 µg/L	No RP	Monitoring without limitations or assessment levels is required once in 2014 for discharge characterization.
Whole effluent toxicity (WET)	No applicable standards (AgI & AgL)	No data	0	N/A	N/A	No monitoring is required.

Footnotes:

(1) Estimated maximum value is the product of the maximum observed/reported value and the RP multiplier.
(2) Discrete (grab) samples shall be taken for all parameters except for flow which requires continuous measurement using a flow meter. Groundwater quality is not expected to fluctuate sufficiently during a 24-hour period to justify composite sampling.
(3) The monitoring frequencies above are required when the facility is discharging through Outfall 001. If the facility is not discharging during a monitoring period, no sampling is required during that period.
(4) BOD_5 = Biochemical oxygen demand; COD = Chemical oxygen demand; TOC = Total organic carbon; TSS = Total suspended solids
(5) Receiving water (Grand Canal) samples for boron shall be taken from the approximate midpoint of the 32nd Street Bridge over the Grand Canal, approximately 1,400 feet downstream of the discharge point (within Mixing Zone).
(6) Grand Canal (receiving water) samples for hardness shall be taken at the time discharge samples are taken for cadmium, copper, lead, and zinc. They shall be taken from approximately 50 feet upstream of the 56th Street and Earll Drive WQARF Site Groundwater Treatment System.
(7) pH and temperature shall be measured at the time of sampling and do not require use of a certified laboratory.

III. NARRATIVE WATER QUALITY STANDARDS

All narrative limitations in A.A.C. R18-11-108 that are applicable to the receiving water are included in Part I, Sections C and D of the draft permit.

IX. MONITORING AND REPORTING REQUIREMENTS (Part II of Permit)

Section 308 of the Clean Water Act and 40 CFR Part 122.44(i) require that monitoring be included in permits to determine compliance with effluent limitations. Additionally, monitoring may be required to gather data for future effluent limitations or to monitor effluent impacts on receiving water quality. The permittee has the responsibility to determine that all data collected for purposes of this permit meets the requirements specified in this permit and is collected, analyzed, and properly reported to ADEQ.

Monitoring frequencies are based on the nature and effect of the pollutant, as well as a determination of the minimum sampling necessary to adequately monitor the facility's performance. The permittee is responsible for conducting and reporting results to ADEQ on Discharge Monitoring Reports (DMRs) or as otherwise specified in the permit.

Monitoring locations are specified in the permit (Parts I.A, I.B, and I.E) in order to ensure that representative samples of the effluent (discharge) and receiving water are consistently obtained. Surface water (SRP Grand Canal) monitoring for boron shall be conducted within the mixing zone as specified under the Special Conditions (Part III.A) of the proposed permit while surface water samples for hardness shall be taken within 50 feet upstream of the 56th Street and Earll Drive WQARF Site Groundwater Treatment System.

The permit (Part II.A.2) requires the permittee to keep a Quality Assurance (QA) manual at the facility, describing sample collection and analysis processes; the required elements of the QA manual are outlined.

Only discrete (i.e., grab) samples are specified in the permit for all parameters (except for flow) since the quality of groundwater is not expected to fluctuate sufficiently during a 24-hour period to justify composite sampling. Discharge flow shall be measured continuously using a flow meter.

The requirements in the draft permit pertaining to Part II Monitoring and Reporting are included to ensure that the monitoring data submitted under this permit is accurate in accordance with 40 CFR 122.41(e).

Reporting requirements for monitoring results are detailed in Part II, Sections B.1 and 2 of the permit, including completion and submittal of DMRs and AZPDES Flow Record forms. Requirements for retention of monitoring records are detailed in Part II.D of the permit.

X. BIOSOLIDS REQUIREMENTS (Part III in Permit)

N/A – This is not a domestic wastewater treatment plant and does not generate biosolids.

XI. SPECIAL CONDITIONS (Part V in Permit)

Mixing Zone for Boron

The permittee submitted an application with supporting documentation to establish a mixing zone for boron as per A.A.C. R18-11-114.B. Pursuant to A.A.C. R18-11-114.A, ADEQ has reviewed the application and approved establishment of the mixing zone for monitoring boron in the receiving water (SRP Grand Canal). Monthly surface water samples for boron shall be taken from the approximate midpoint of the 32nd Street Bridge over the Grand Canal, approximately 1,400 feet downstream of the discharge point (at the downstream edge of the mixing zone).

Permit Reopener

This permit may be modified based on newly available information; to add conditions or limits to address demonstrated effluent toxicity; to implement any EPA-approved new Arizona water quality standard; or to re-evaluate reasonable potential (RP), if Assessment Levels in this permit are exceeded (A.A.C. R18-9-B906, and 40 CFR Part 122.62 (a) and (b)).

XII. ANTIDEGRADATION

Antidegradation rules have been established under A.A.C. R18-11-107 to ensure that existing surface water quality is maintained and protected. Effluent quality limitations and monitoring requirements have been established under the proposed permit to ensure that the discharge will meet the applicable water quality standards. As long as the permittee maintains consistent compliance with these provisions, the designated uses of the receiving wash will be presumed protected, and the facility will be deemed to meet currently applicable antidegradation requirements under A.A.C. R18-11-107.C.

XIII. STANDARD CONDITIONS

Conditions applicable to all NPDES permits in accordance with 40 CFR, Part 122 are attached as an appendix to this permit.

XIV. ADMINISTRATIVE INFORMATION

Public Notice (A.A.C. R18-9-A907)

The public notice is the vehicle for informing all interested parties and members of the general public of the contents of a draft AZPDES permit or other significant action with respect to an AZPDES permit or application. The basic intent of this requirement is to ensure that all interested parties have an opportunity to comment on significant actions of the permitting agency with respect to a permit application or permit. This permit will be public noticed in a local newspaper after a pre-notice review by the applicant and other affected agencies.

Public Comment Period (A.A.C. R18-9-A908)

Rules require that permits be public noticed in a newspaper of general circulation within the area affected by the facility or activity and provide a minimum of 30 calendar days for interested parties to respond in writing to ADEQ. After the closing of the public comment period, ADEQ is required to respond to all significant comments at the time a final permit decision is reached or at the same time a final permit is actually issued.

Public Hearing (A.A.C R18-9-A908(B))

A public hearing may be requested in writing by any interested party. The request should state the nature of the issues proposed to be raised during the hearing. A public hearing will be held if the Director determines there is a significant amount of interest expressed during the 30-day public comment period, or if significant new issues arise that were not considered during the permitting process.

EPA Review (A.A.C. R18-9-A908(C))

A copy of this draft permit and any revisions made to this draft as a result of public comments received, will be sent to EPA Region 9 for review. If EPA objects to a provision of the draft, ADEQ will not issue the permit until the objection is resolved.

XV. ADDITIONAL INFORMATION

Additional information relating to this proposed permit may be obtained from:

ADEQ
Water Quality Division- Surface Water Permits Unit
Attn: M. Reza Azizi
1110 West Washington Street – Mail Code 5415A-1
Phoenix, Arizona 85007

or by contacting M. Reza Azizi at (602) 771- 4593

XVI. INFORMATION SOURCES

While developing effluent limitations, monitoring requirements and special conditions for the draft permit, the following information sources were used:

1. AZPDES Permit Application Forms 1 and 2C, received November 6, 2009, and along with supporting data, facility diagram and maps submitted by the applicant with the application forms.
2. Supplemental information to the application received by ADEQ on December 22, 2009, January 28, and February 26, 2010.
3. ADEQ files on Freescale 56th Street & Earll Drive WQARF Site
4. Arizona Administrative Code (AAC) Title 18, Chapter 11, Article 1, *Water Quality Standards for Surface Waters,* adopted January 31, 2009.
5. A.A.C. Title 18, Chapter 9, Article 9. *Arizona Pollutant Discharge Elimination System* rules.
6. Code of Federal Regulations (CFR) Title 40:
   Part 122, *EPA administered permit programs: The National Pollutant Discharge Elimination System.*
   Part 124, *Procedures for decisionmaking.*
7. EPA Technical Support Document for Water Quality-based Toxics Control dated March, 1991.
8. *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms* (EPA /821-R-02-013).
9. *U.S. EPA NPDES Permit Writers' Manual,* December 1996.

ADEQ Inventory No. 106170
LTF No. 51093

Permit No. AZ0025861

AUTHORIZATION TO DISCHARGE UNDER THE ARIZONA POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of Arizona Revised Statutes (A.R.S.) Title 49, Chapter 2, Article 3.1; the Federal Water Pollution Control Act, (33 USC §1251 et. seq., as amended), and Arizona Administrative Code (A.A.C.) Title 18, Chapter 9, Articles 9 and 10, and amendments thereto,

Freescale Semiconductor, Inc.
56th Street and Earll Drive WQARF Site Groundwater Treatment System
2100 East Elliot Road, MD EL-614
Tempe, Arizona 85284

is authorized to discharge from the groundwater remediation treatment facility located at the north side bank of the Grand Canal near 34th Street, east of 32nd Street, north of State Route Loop 202 in Phoenix, Maricopa County, Arizona to the Salt River Project (SRP) Grand Canal, a Phoenix Area Canal, in the Middle Gila River Basin at:

Outfall No.	Latitude	Longitude	Legal
001	33° 27' 39.0" N	112° 00' 32.6" W	Township 1N, Range 3 E, Section 1

in accordance with discharge limitations, monitoring requirements and other conditions set forth herein, and in the attached "Standard AZPDES Permit Conditions."

This permit shall become effective on March 25, 2011.

This permit and the authorization to discharge shall expire at midnight, March 26, 2016.

Signed this 22nd day of February, 2011.

Michael A. Fulton, Director
Water Quality Division
Department of Environmental Quality

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PART I. DISCHARGE LIMITATIONS & MONITORING REQUIREMENTS

A. Discharge Limitations and Monitoring Requirements

The permittee shall limit and monitor discharges from Outfall 001 as specified in Table 1 below.

TABLE 1: Discharge Limitations and Monitoring Requirements

Parameter	Maximum Allowable Discharge Limitations (1)		Monitoring Requirement	
	Monthly Average	Daily Maximum	Monitoring Frequency	Sample Type
Discharge flow	REPORT (MGD) (2)	REPORT (MGD) (2)	Continuous	Metered
Boron (3) **(Mixing Zone – Grand Canal)**	NA	1,000 ug/L	Once / month	Discrete
Boron (Discharge)	NA	REPORT (2)	Once / month	Discrete
Selenium (4)	20.0 ug/L	29.2 ug/L	Once / month	Discrete
Chloroform	NA	80 ug/L	Once / month	Discrete
1,2-cis-Dichloroethylene (c -1,2-DCE)	NA	70 ug/L	Once / month	Discrete
Tetrachloroethylene (PCE)	NA	5.0 ug/L	Once / month	Discrete
Toluene	NA	1,000 ug/L	Once / month	Discrete
Trichloroethylene (TCE)	NA	5.0 ug/L	Once / month	Discrete
pH (5)	Not less than 6.5 standard units (S.U.) nor greater than 9.0 S.U.		Once / month	Discrete

Footnotes:
(1) MGD = million gallons per day; ug/L = micrograms per liter; NA = not applicable
(2) Monitoring and reporting required. No limit set at this time. In addition to the average and maximum flows reported on the Discharge Monitoring Report (DMR) forms, daily discharge flow shall be recorded on the **Discharge Flow Record** provided in Appendix B. See Part II.B for reporting requirements.
(3) Receiving water samples for boron shall be taken from approximate midpoint of the 32nd Street Bridge over the Grand Canal, approximately 1,400 feet downstream of the discharge point (within mixing zone). See also Part III.A.
(4) Selenium discharge limitations are for total recoverable metals.
(5) pH shall be measured at the time of sampling and does not require use of a certified laboratory

B. Discharge Characterization Testing

The permittee shall monitor to characterize the facility's discharge from Outfall 001 for the parameters listed in Tables 2.a – 2.b. When the facility discharges, monitoring is to be conducted at the frequency indicated in the tables. **In the event the facility does not discharge during a monitoring period, no monitoring will be required in that period.** No limits or assessment levels (ALs) are established, but the limit of quantitation (LOQ) must be low enough to allow comparison of the results to the applicable surface water quality standards (SWQS). If a LOQ below the water quality standards (WQS) cannot be achieved, then the permittee shall use the method expected to achieve the lowest LOQ, as defined in Appendix A of this permit. Samples are to be representative of any seasonal variation in the discharge.

TABLE 2.a: Discharge Characterization Testing – (Selected Metals and Trace Substances)

Parameter (1)	Reporting Units	Monitoring Requirements	
		Monitoring Frequency	Sample Type
Arsenic	ug/L	Once / 6 month	Discrete
Cadmium	ug/L	Once / 6 month	Discrete
Chromium	ug/L	Once in year 2014	Discrete

TABLE 2.a: Discharge Characterization Testing – (Selected Metals and Trace Substances)

Copper	ug/L	Once / 6 month	Discrete
Cyanide	ug/L	Once in year 2014	Discrete
Hardness (as CaCO3) (2)	mg/L	Once / 6 month	Discrete
Lead	ug/L	Once / 6 month	Discrete
Mercury	ug/L	Once / 6 month	Discrete
Zinc	ug/L	Once in year 2014	Discrete

Footnotes:
(1) All metals analyses shall be for total recoverable metals.
(2) Receiving water (Grand Canal) samples for hardness shall be taken at the time samples are taken for cadmium, copper, lead, and zinc. Grand Canal samples shall be taken approximately 50 feet upstream of the 56th Street and Earll Drive WQARF Site Groundwater Treatment System.

TABLE 2.b: Discharge Characterization Testing - Selected Volatile Organic Compounds

Parameter	Reporting Units	Monitoring Requirements	
		Monitoring Frequency	Sample Type
Benzene	ug/L	Once / 6 month	Discrete
1,2-Dichloroethane (1,2-DCA)	ug/L	Once / 6 month	Discrete
1,1-Dichloroethylene (1,1-DCE)	ug/L	Once / 6 month	Discrete
1,2-trans-Dichloroethylene (t-1,2-DCE)	ug/L	Once / 6 month	Discrete
Ethyl benzene	ug/L	Once / 6 month	Discrete
1,1,1-Trichloroethane (1,1,1-TCA)	ug/L	Once / 6 month	Discrete
Vinyl chloride	ug/L	Once / 6 month	Discrete
Xylene	ug/L	Once / 6 month	Discrete

C. The discharge shall be free from pollutants in amounts or combinations that:

1. Settle to form bottom deposits that inhibit or prohibit the habitation, growth or propagation of aquatic life;
2. Cause objectionable odor in the area in which the surface water is located;
3. Cause off-flavor in aquatic organisms;
4. Are toxic to humans, animals, plants or other organisms;
5. Cause the growth of algae or aquatic plants that inhibit or prohibit the habitation, growth or propagation of other aquatic life or that impair recreational uses;
6. Change the color of the surface water from natural background levels of color.

D. The discharge shall be free from oil, grease and other pollutants that float as debris, foam, or scum; or that cause a film or iridescent appearance on the surface of the water; or that cause a deposit on a shoreline, bank or aquatic vegetation.

E. Samples taken for the monitoring requirements specified in Part I shall be collected at the following locations:

1. Discharge samples shall be taken downstream from the last treatment process and prior to mixing with the receiving water in the Grand Canal.

2. Receiving water samples for flow (if necessary) and **boron** downstream of the discharge point ("Downstream Samples") shall be taken from the approximate midpoint of the 32nd Street Bridge over the Grand Canal, approximately 1,400 feet downstream of the discharge point (at the downstream edge of mixing zone).

3. Receiving water samples for flow (if necessary), **boron**, and **hardness** upstream of the discharge point ("Upstream Samples") shall be taken from the Grand Canal approximately 50 feet upstream of the 56th Street and Earll Drive WQARF Site Groundwater Treatment System.

PART II. MONITORING AND REPORTING

A. Sample Collection and Analysis

1. The permittee is responsible for the quality and accuracy of all data required under this permit.

2. Quality Assurance (QA) Manual

The permittee shall keep a QA Manual on-site that describes the sample collection and analyses processes. If the permittee collects samples or conducts sample analyses in-house, the permittee shall develop a QA Manual that addresses these activities. If a third party collects and/or analyzes samples on behalf of the permittee, the permittee shall obtain a copy of the applicable QA procedures. The QA Manual shall be available for review by ADEQ upon request. The QA Manual shall be updated as necessary to reflect current conditions, and shall describe the following:

a. Project Management, including:

- Purpose of sample collection and sample frequency;
- When and where samples will be collected;
- How samples will be collected;
- Who will collect samples and their qualifications;
- Laboratory(s) that will perform analyses;
- Any field tests to be conducted (detail methods and specify equipment, including a description of any needed calibrations); and
- Pollutants or analytes being measured and for each, the permit-specific limits, Assessment Levels, or thresholds, (e.g. the associated detection limits needed.)

b. Sample collection procedures including

- Equipment to be used;
- Type and number of samples to be collected including QA/QC samples (i.e., background samples, duplicates, and equipment or field blanks);
- Types, sizes, and number of sample bottles needed;

- Preservatives and holding times for the samples (see methods under 40 CFR 136 or 9 A.A.C. 14, Article 6 or any condition within this permit that specifies a particular test method); and
- Chain of custody procedures.

c. Specify approved analytical method(s) to be used and include;

- Limits of Detection (LOD) and Limits of Quantitation (LOQs);
- Required quality control (QC) results to be reported (e.g., matrix spike recoveries, duplicate relative percent differences, blank contamination, laboratory control sample recoveries, surrogate spike recoveries, etc.) and acceptance criteria; and
- Corrective actions to be taken by the permittee or the laboratory as a result of problems identified during QC checks.

d. How the permittee will perform data review; complete DMRs and records used to report results to ADEQ; resolve data quality issues; and identify limitations on the use of the data.

3. Sample collection, preservation and handling shall be performed as described in 40 CFR 136 including the referenced Edition of *Standard Methods for the Examination of Water and Wastewater*, or by procedures referenced in A.R.S Title 9, Chapter 14 of the Arizona Department of Health Services (ADHS) Laboratory Licensure rules. The permittee shall outline the proper procedures in the QA Manual, and samples taken for this permit must conform with these procedures whether collection and handling is performed directly by the permittee or contracted to a third-party.

4. Analytical requirements

a. The permittee shall use a laboratory licensed by the ADHS Office of Laboratory Licensure and Certification that has demonstrated proficiency within the last 12 months under R9-14-609, for each parameter to be sampled under this permit. However, this requirement does not apply to parameters which require analysis at the time of sample collection as long as the testing methods used are approved by ADHS or ADEQ. (These parameters may include flow, dissolved oxygen, pH, temperature, and total residual chlorine.)

b. The permittee must utilize analytical methods specified in this permit. If no test procedure is specified, the permittee shall analyze the pollutant using:

i. A test procedure listed in 40 CFR 136 which is also approved under A.A.C. R9-14-610;
ii. An alternative test procedure approved by EPA as provided in 40 CFR 136 and which is also approved under A.A.C. R9-14-610;
iii. A test procedure listed in 40 CFR 136, with modifications allowed by EPA or approved as a method alteration by ADHS under A.A.C. R9-14-610(C); or
iv. If no test procedure for a pollutant is available under (3)(b)(i) through (3)(b)(iii) above, any Method approved under A.A.C. R9-14-610(C) for wastewater may be used, except the use of field kits is not allowed unless otherwise specified in this permit. If there is no approved wastewater method for a parameter, any other method identified in 9 A.A.C. 14, Article 6 that will achieve appropriate detection and reporting limits may be used for analyses.

c. For results to be considered valid, all analytical work shall meet quality control standards specified in the approved methods.

d. The permittee shall use analytical methods with a Limit of Quantitation (LOQ) that is lower than the discharge limitations, Assessment Levels, Action Levels, or water quality criteria specified in this permit. If all methods have LOQs higher than applicable water quality criteria, the Permittee shall use the approved analytical method with the lowest LOQ.

e. The permittee shall use a standard calibration curve when applicable to the method, where the lowest standard point is equal to or less than the LOQ.

f. If requested, the permittee shall participate in the annual NPDES DMR/QA study and submit the results of this study to ADEQ and ADHS for all laboratories used in monitoring compliance with this permit.

5. Metals Analyses

In accordance with 40 CFR 122.45(c), all discharge metals concentrations shall be measured as "total metals". Discharge Limits and Assessment Levels in this permit are for total metals.

B. Reporting of Monitoring Results

1. The permittee shall report monitoring results on Discharge Monitoring Report (DMR) forms supplied by ADEQ, to the extent that the results may be entered on the forms. The permittee shall submit results of all monitoring required by this permit in a format that will allow direct comparison with the limitations and requirements of this permit. If no discharge occurs during a reporting period, the permittee shall specify "No discharge" on the DMR. The results of all discharge analyses conducted during the monitoring period shall be included in calculations of the monthly average and daily maximums reported on the DMRs if the analyses were by methods specified in Part II.A above.

2. DMRs and attachments are to be submitted (see Appendix A- definitions) by the 28th day of the month following the end of a monitoring period. For example, if the monitoring period ends January 31st, the permittee shall submit the DMR by February 28th. The permittee shall submit original copies of these and all other reports required in this Part, signed by an authorized representative, to ADEQ at the following address:

ADEQ Water Quality Compliance Section
Data Unit Mailcode: 5415B-1
1110 W. Washington St.
Phoenix, AZ 85007

or fax to (602) 771-4505.

For each month, the permittee shall complete and submit a copy of the **AZPDES Discharge Flow Record** (found in Appendix B) with the DMR for that month, along with copies of the original lab results for all parameters monitored during the reporting period.

3. If requested, the permittee shall submit results of the NPDES DMR/QA study to ADEQ and ADHS for all laboratories used in monitoring compliance with this permit by December 31st of each year. The permittee shall also participate in the DMR-QA study for any DMR-QA parameters that the permittee analyzes (typically pH and chlorine) and submit the results along with the laboratory results. The results shall be submitted to the following addresses:

Arizona Department of Environmental Quality ADEQ Surface Water Permits Unit Mailcode: 5415A-1 1110 W. Washington St. Phoenix, AZ 85007	Arizona Department of Health Services Attn: DMRQA Coordinator 250 N 17th Avenue Phoenix, AZ 85007

4. For the purposes of reporting, the permittee shall use the Limit of Quantitation.

5. For parameters with Daily Maximum Limits or Daily Maximum Assessment Levels in this permit, the permittee shall review the results of all samples collected during the reporting period and report as follows:

Use the following tables for information on how to report data on the DMR when the LOQ for a parameter is greater than the permit limits or standards:

For Daily Maximum Limits/Assessment Levels	The Permittee shall Report on the DMR
When the maximum value of any analytical result is greater than the LOQ	The maximum value of all analytical results
When the maximum value detected is greater than or equal to the laboratory's LOD but less than the LOQ (1)	The numeric result with E4 or E8 flag as applicable (AZ qualifier)
When the maximum value is less than the laboratory's LOD (2)	"< ND" (specify the LOD level, i.e.,< 10 ug/L)

Footnotes:
(1) Not Quantifiable
(2) Below Detection

6. For parameters with Monthly Average Limits or Monthly Average ALs in this permit, the permittee shall review the results of all samples collected during the reporting period and report:

For Monthly Average Limits/Assessment Levels		The Permittee shall Report on the DMR
If only one sample is collected during the reporting period (monthly, quarterly, annually, etc.) (In this case, the sample result **is** the monthly average.)	When the value detected is greater than the LOQ	The analytical result
	When the value detected is greater than or equal to the laboratory's LOD, but less than the LOQ	The numeric result with E4 or E8 flag as applicable (AZ qualifier)
	When the value is less than the laboratory's LOD	"< LOD" (specify the LOD level, i.e., < 10ug/L)

For Monthly Average Limits/Assessment Levels		The Permittee shall Report on the DMR
If more than one sample is collected during the reporting period	All samples collected in the same calendar month must be averaged. $ When all results are greater than the LOQ, all values are averaged $ If some results are < LOQ, use the LOD value in the averaging $ Use '0' for values less than the LOD	The highest monthly average which occurred during the reporting period

7. If the information below is not included on the laboratory reports required in Part II.B.2, the permittee shall attach a report to each DMR that includes, for all analytical results during the reporting period:

   a. The analytical result.

   b. The number or title of the approved analytical method, preparation and analytical procedure utilized by the laboratory, and LOD and the LOQ for the analytical method for the pollutant.

   c. Any applicable data using Arizona Data Qualifiers Revision 3.0 (9/20/2007).

C. Twenty-four Hour Reporting of Noncompliance

The permittee shall orally report any noncompliance which may endanger the environment or human health within 24 hours from the time the permittee becomes aware of the event to:

ADEQ 24 hour hotline at (602) 771-2330

The permittee shall also notify the Water Quality Compliance Section Manager at (602) 771-2209 by phone call or voice mail by 9 a.m. on the first business day following the noncompliance. The permittee shall also notify the Water Quality Compliance Section in writing within 5 days of the noncompliance event. The permittee shall include in the written notification: a description of the noncompliance and its cause; the period of noncompliance, including dates and times, and, if the noncompliance has not been corrected, the time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

D. Monitoring Records

The permittee shall retain records of the following monitoring information:

1. Date, exact location and time of sampling or measurements performed, preservatives used;

2. Individual(s) who performed the sampling or measurements;

3. Date(s) the analyses were performed;

4. Laboratory(s) which performed the analyses;

5. Analytical techniques or methods used;

6. Chain of custody forms;

7. Any comments, case narrative or summary of results produced by the laboratory. These comments should identify and discuss QA/QC analyses performed concurrently during sample analyses and should specify whether analyses met project requirements and 40 CFR 136. If results include information on initial and continuing calibration, surrogate analyses, blanks, duplicates, laboratory control samples, matrix spike and matrix spike duplicate results, sample receipt condition, or holding times and preservation, these records must also be retained.

8. Summary of data interpretation and any corrective action taken by the permittee.

PART III. SPECIAL CONDITIONS

A. MIXING ZONE

1. Mixing Zone and Point of Compliance

A mixing zone has been granted in the Grand Canal for discharges from the 56th Street and Earll Drive WQARF Site Groundwater Treatment System (M56 Facility) with boron concentrations above the applicable standard of 1,000 ug/L (AgI). The mixing zone for boron has been approved following dilution of the M56 Facility discharges with canal flows which include discharges from the Operable Unit 2 (OU2). Outfall 001 and the subsequent mixing zone will be located immediately downstream of the discharges from OU2 and the corresponding mixing zone in the Grand Canal. The receiving water samples to assess compliance with boron limitation of the 56th Street and Earll Drive WQARF Site Groundwater Treatment System permit shall be collected from the approximate midpoint of the 32nd Street Bridge over the Grand Canal, approximately 1,400 feet downstream of the discharge point (Outfall 001).

2. Blending OU2 and 56th Street & Earll Drive Discharges with Grand Canal Flow

The following formulas will be used to calculate the minimum flow of Grand Canal (F_G) above the facility (M56) and OU2 discharges to meet the mixing zone permit limit for boron of 1,000 ug/L (or 1 mg/L).

$$C_D = (F_{OU2} * C_{OU2} + F_{M56} * C_{M56} + F_G * C_G) \div (F_{OU2} + F_{M56} + F_G)$$
$$C_D (F_{OU2} + F_{M56} + F_G) = (F_{OU2} * C_{OU2} + F_{M56} * C_{M56} + F_G * C_G)$$
$$C_D F_{OU2} + C_D F_{M56} + C_D F_G = F_{OU2} * C_{OU2} + F_{M56} * C_{M56} + F_G * C_G$$
$$C_D F_G - F_G * C_G = F_{OU2} * C_{OU2} + F_{M56} * C_{M56} - C_D F_{OU2} - C_D F_{M56}$$
$$F_G (C_D - C_G) = (F_{OU2} * C_{OU2} + F_{M56} * C_{M56} - C_D F_{OU2} - C_D F_{M56})$$
$$\mathbf{F_G = (F_{OU2} * C_{OU2} + F_{M56} * C_{M56} - C_D F_{OU2} - C_D F_{M56}) \div (C_D - C_G)}$$

Where:

F_{OU2} = Flow from OU2
F_{M56} = Flow from M56 (56th Street & Earll Dr.) Facility
F_G = Flow in Grand Canal above OU2 and M56 Facility discharges ("Upstream Sample")
C_{OU2} = Maximum boron concentration in OU2 discharge
C_{M56} = Maximum boron concentration in M56 Facility discharge
C_G = Maximum boron concentration in Grand Canal above OU2 and M56 Facility discharges ("Upstream Sample")
C_D = Boron concentration in Grand Canal Mixing Zone downstream of OU2 and M56 Facility discharges ("Downstream Sample")

All flows and concentrations must be in the same units.

B. REOPENER

This permit may be modified per the provisions of A.A.C. R18-9-B906, and R18-9-A905 which incorporates 40 CFR Part 122. This permit may be reopened based on newly available information; to add conditions or limits to address demonstrated discharge toxicity; to implement any EPA-approved new Arizona water quality standard; or to re-evaluate reasonable potential (RP), if Assessment Levels in this permit are exceeded.

APPENDIX A PART A: ACRONYMS

A.A.C.	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
EQ	Exceptional Quality (biosolids)
AZPDES	Arizona Pollutant Discharge Elimination System
A.R.S.	Arizona Revised Statutes
CFR	Code of Federal Regulations
CFU	Colony Forming Units
Director	The Director of ADEQ or any authorized representative thereof
DMR	Discharge Monitoring Report
EPA	The U.S. Environmental Protection Agency
kg/day	kilograms per day
MGD	Million Gallons per Day
mg/L	milligrams per Liter, also equal to parts per million (ppm)
MPN	Most Probable Number
NPDES	National Pollutant Discharge Elimination System
PFU	Plaque-Forming Unit
QA	Quality Assurance
SSU	Sewage Sludge Unit
ug/L	micrograms per Liter, also equal to parts per billion (ppb)

APPENDIX A PART B: DEFINITIONS

BASE FLOOD means a flood that has a one percent chance of occurring in any given year (or a flood that is likely to occur once in 100 years).

DAILY MAXIMUM CONCENTRATION LIMIT means the maximum allowable discharge of a pollutant in a calendar day as measured on any single discrete sample.

DISCRETE or GRAB SAMPLE means an individual **sample of at least 100 mL** collected from a single location, or over a period of time not exceeding 15 minutes.

HARDNESS means the sum of the calcium and magnesium concentrations, expressed as calcium carbonate ($CACO_3$) in milligrams per liter.

LIMIT OF QUANTITATION (LOQ) means the minimum levels, concentrations, or quantities of a target variable such as an analyte that can be reported with a specific degree of confidence. The calibration point shall be at or below the LOQ. The LOQ is the concentration in a sample that is equivalent to the concentration of the lowest calibration standard analyzed by a specific analytical procedure, assuming that all of the method-specified sample weights, volumes, and processing steps have been followed.

LIMIT OF DETECTION (LOD) means an analyte and matrix-specific estimate of the minimum amount of a substance that the analytical process can reliably detect with a 99% confidence level. This may be laboratory dependent and is developed according to R9014-615(C)(7).

METHOD DETECTION LIMIT (MDL) - See LOD.

MIXING ZONE is an area where a discharge undergoes initial dilution and may be extended to cover the secondary mixing in the ambient water body. A mixing zone is an allocated impact zone where water quality criteria can be exceeded as long as acutely toxic conditions are prevented.

MONTHLY OR WEEKLY AVERAGE CONCENTRATION LIMIT, other than for bacteriological testing, means the highest allowable average calculated as an arithmetic mean of consecutive measurements made during calendar month or week, respectively. The "monthly or weekly average concentration limit" for *E. coli* bacteria means the highest allowable average calculated as the geometric mean of a minimum of four (4) measurements made during a calendar month or week, respectively. The geometric mean is the nth root of the product of n numbers. For either method (CFU or MPN), when data are reported as "0" or non-detect then input a "1" into the calculation for the geometric mean.

PATHOGEN means a disease-causing organism.

SIGNIFICANT DIFFERENCE is defined as statistically significant difference (e.g., 95% confidence level) in the means of two distributions of sampling results.

SUBMIT, as used in this permit, means post-marked, documented by other mailing receipt, or hand-delivered to ADEQ.

APPENDIX B

AZPDES Discharge Flow Record

56th Street and Earll Drive WQARF Site
Groundwater Treatment System- AZ0025861

Discharge to Grand Canal in the Middle Gila River Basin At:

Outfall No.: 001

Location:

Month: **Year:**

DATE	Flow Duration [1] (Total hours per day)	Flow Rate[2] (Total MGD per day)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		

Comment:

Footnotes:

(1) Total time of discharge in hours per day. If actual time is not available, use an estimate of flow duration.

(2) Report flow discharged in MGD. If no discharge occurs on any given day, report 'ND' for the flow for that day

Signature of Authorized Representative:

_____

APPENDIX C

STANDARD AZPDES PERMIT CONDITIONS & NOTIFICATIONS

(Updated as of February 2, 2004)

1. Duty to Reapply [R18-9-B904(C)]
Unless the Permittee permanently ceases the discharging activity covered by this permit, the Permittee shall submit a new application 180 days before the existing permit expires.

2. Applications [R18-9-A905(A)(1)(c) which incorporates 40 CFR 122.22]

   a. All applications shall be signed as follows:

      1) For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

         A) A president, secretary, treasurer, or vice-president of the corporation in charge of a principle business function, or any other person who performs similar policy- or decision-making functions for the corporation, or

         B) The manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

      2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

      3) For a municipality, State, Federal, or other public agency: By either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes: (i) The chief executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of EPA).

   b. All reports required by permits and other information requested by the Director shall be signed by a person described in paragraph (a) of this Section, or by a duly authorized representative of that person. A person is a duly authorized representative only if:

      1) The authorization is made in writing by a person described in paragraph (a) of this section;

      2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.) and,

      3) The written authorization is submitted to the Director.

   c. Changes to Authorization. If an authorization under paragraph (b) of this section is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph (b) of this section must be submitted to the Director prior to or together with any reports, information, or applications to be signed by an authorized representative.

   d. Certification. Any person signing a document under paragraph (a) or (b) of this section shall make the following certification:

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

3. Duty to Comply [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(a)(i) and A.R.S. §49- 262, 263.01, and 263.02.]

   a. The Permittee shall comply with all conditions of this permit and any standard and prohibition required under A.R.S. Title 49, Chapter 2, Article 3.1 and A.A.C. Title 18, Chapter 9, Articles 9 and 10. Any permit noncompliance constitutes a violation of the Clean Water Act; A.R.S. Title 49, Chapter 2, Article 3.1; and A.A.C. Title 18, Chapter 9, Articles 9 and 10, and is grounds for enforcement action, permit termination, revocation and reissuance, or modification, or denial of a permit renewal application.

   b. The issuance of this permit does not waive any federal, state, county, or local regulations or permit requirements with which a person discharging under this permit is required to comply.

   c. The Permittee shall comply with the effluent standards or prohibitions established under section 307(a) of the Clean Water Act for toxic pollutants and with standards for sewage sludge use or disposal established under section 405(d) of the Clean Water Act within the time provided in the regulation that establish these standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

   d. Civil Penalties. A.R.S. § 49-262(C) provides that any person who violates any provision of A.R.S. Title 49, Chapter 2, Article 3.1 or a rule, permit, discharge limitation or order issued or adopted under A.R.S. Title 49, Chapter 2, Article 3.1 is subject to a civil penalty not to exceed $25,000 per day per violation.

   e. Criminal Penalties. Any a person who violates a condition of this permit, or violates a provision under A.R.S. Title 49, Chapter 2, Article 3.1, or A.A.C. Title 18, Chapter 9, Articles 9 and 10 is subject to the enforcement actions established under A.R.S. Title 49, Chapter 2, Article 4, which may include the possibility of fines and/or imprisonment.

4. Need to Halt or Reduce Activity Not a Defense [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(c)]

   It shall not be a defense for a Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

5. Duty to Mitigate [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(d)]

   The Permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

6. Proper Operation and Maintenance [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(e)]

   The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the Permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a Permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

7. Permit Actions [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(f)]

This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the Permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

8. Property Rights [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(g)]

This permit does not convey any property rights of any sort, or any exclusive privilege.

9. Duty to Provide Information [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(h)]

The Permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee shall also furnish to the Director upon request, copies of records required to be kept by this permit.

10. Inspection and Entry [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(i)]

The Permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and such other documents as may be required by law, to:

a. Enter upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b. Have access to and copy, at reasonable times, any records that must be kept under the terms of the permit;

c. Inspect at reasonable times any facilities, equipment (including monitoring equipment or control equipment), practices or operations regulated or required under this permit; and

d. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by A.R.S. Title 49, Chapter 2, Article 3.1, and A.A.C. Title 18, Chapter 9, Articles 9 and 10, any substances or parameters at any location.

11. Monitoring and Records [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(j)]

a. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

b. The Permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report or application, except for records of monitoring information required by this permit related to the Permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by 40 CFR Part 503). This period may be extended by request of the Director at any time.

c. Records of monitoring information shall include:

1) The date, exact place and time of sampling or measurements;

2) The individual(s) who performed the sampling or measurements;

3) The date(s) the analyses were performed;

4) The individual(s) who performed the analyses;

5) The analytical techniques or methods used; and

6) The results of such analyses.

d. Monitoring must be conducted according to test procedures specified in this permit. If a test procedure is not specified in the permit, then monitoring must be conducted according to test procedures approved under A.A.C. R18-9-A905(B) including those under 40 CFR Part 136 unless otherwise specified in 40 CFR Part 503 (for sludge).

e. The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained in this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two years per violation, or by both for first conviction. For a second conviction, such a person is subject to a fine of not more than $20,000 per day of violation, or imprisonment for not more than four years, or both.

Any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained in this permit is subject to the enforcement actions established under A.R.S. Title 49, Chapter 2, Article 4, which includes the possibility of fines and/or imprisonment.

12. Signatory Requirement [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(k)]

a. All applications, reports, or information submitted to the Director shall be signed and certified. (See 40 CFR 122.22 incorporated at R18-9-A905(A)(1)(c))

b. The CLEAN WATER ACT provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or non-compliance shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two years per violation, or by both for a first conviction. For a second conviction, such a person is subject to a fine of not more than $20,000 per day of violation, or imprisonment of not more than four years, or both.

13. Reporting Requirements [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(l)]

a. Planned changes. The Permittee shall give notice to the Director as soon as possible of any planned physical alterations of additions to the permitted facility. Notice is required only when:

1) The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in 40 CFR 122.29(b) (incorporated by reference at R18-9-A905(A)(1)(e)); or

2) The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under 40 CFR 122.42(a)(1) (incorporated by reference at R18-9-A905(A)(3)(b)).

3) The alteration or addition results in a significant change in the Permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.

b. Anticipated noncompliance. The Permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

c. Transfers. (R18-9-B905) This permit is not transferable to any person except after notice to the Director. The Director may require modification or revocation and reissuance of the permit to change the name of the Permittee and incorporate such other requirements as may be necessary under Arizona Revised Statutes and the Clean Water Act.

d. Monitoring reports. Monitoring results shall be reported at the intervals specified elsewhere in this permit.

1) Monitoring results must be reported on a Discharge Monitoring Report (DMR) or forms provided or specified by the Director for reporting results of monitoring of sludge use or disposal practices.

2) If the Permittee monitors any pollutant more frequently than required by the permit, then the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR, or sludge reporting form specified by the Director.

3) Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Director in the permit.

e. Compliance schedules. Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date.

f. Twenty-four hour reporting.

1) The Permittee shall report any noncompliance which may endanger human health or the environment. Any information shall be provided orally within 24 hours from the time the Permittee becomes aware of the circumstances. A written submission shall also be provided within five days of the time the Permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

2) The following shall be included as information which must be reported within 24 hours under this paragraph.

a) Any unanticipated bypass which exceeds any effluent limitation in the permit. (See 40 CFR 122.41(g) which is incorporated by reference at R18-9-A905(A)(3)(a))

b) Any upset which exceeds any effluent limitation in the permit.

c) Violation of a maximum daily discharge limitation for any of the pollutants listed by the Director in the permit to be reported within 24 hours. (See 40 CFR 122.44(g) which is incorporated by reference at R18-9-A905(A)(3)(d))

g. Other noncompliance. The Permittee shall report all instances of noncompliance not reported under paragraphs (d), (e), and (f) of this section, at the time monitoring reports are submitted. The reports shall contain the information listed in paragraph (f) of this section.

h. Other information. Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Director, it shall promptly submit such facts or information.

14. Bypass [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(m)]

a. Definitions

1) "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the

absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

b. Bypass not exceeding limitations. The Permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provision of paragraphs (c) and (d) of this section.

c. Notice.

1) Anticipated bypass. If the Permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of bypass.
2) Unanticipated bypass. The Permittee shall submit notice of an unanticipated bypass as required in paragraph (f)(2) of section 13 (24-hour notice).

d. Prohibition of bypass.

1) Bypass is prohibited, and the Director may take enforcement action against a Permittee for bypass, unless:

a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment down time. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

c) The Permittee submitted notices as required under paragraph (c) of this section.

2) The Director may approve an anticipated bypass, after considering its adverse effects, if the Director determines that it will meet the three conditions listed above in paragraph (d)(1) of this section.

15. Upset [A.R.S.§§49-255(8) and 255.01(E), R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(n)]

a. Definition. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

b. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of paragraph (c) of this section are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

c. Conditions necessary for a demonstration of upset. A Permittee who wishes to establish the affirmative defenses of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

1) An upset occurred and that the Permittee can identify the cause(s) of the upset;

2) The permitted facility was at the time being properly operated; and

3) The Permittee submitted notice of the upset as required in paragraph (f)(2) of Section 13 (24-hour notice).

4) The Permittee has taken appropriate measure including all reasonable steps to minimize or prevent any discharge or sewage sludge use or disposal that is in violation of the permit and that has a reasonable likelihood of adversely affecting human health or the environment per A.R.S. § 49-255.01(E)(1)(d)

d. Burden of proof. In any enforcement proceeding the Permittee seeking to establish the occurrence of an upset has the burden of proof.

16. Existing Manufacturing, Commercial, Mining, and Silvicultural Dischargers [R18-9-A905(A)(3)(b) which incorporates 40 CFR 122.42(a)]

In addition to the reporting requirements under 40 CFR 122.41(l) (which is incorporated at R18-9-A905(A)(3)(a)), all existing manufacturing, commercial, mining, and silvicultural dischargers must notify the Director as soon as they know or have reason to believe:

a. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

1) One hundred micrograms per liter (100 µg/l);

2) Two hundred micrograms per liter (200 µg/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 µg/l) for 2,4-dinitrophenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/l) for antimony;

3) Five times the maximum concentration value reported for that pollutant in the permit application in accordance with 40 CFR 122.21(g)(7) (which is incorporated at R18-9-A905(A)(1)(b)); or

4) The level established by the Director in accordance with 40 CFR 122.44(f) (which is incorporated at R18-9-A905(A)(3)(d)).

b. That any activity has occurred or will occur which would result in any discharge, on a nonroutine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

1) Five hundred micrograms per liter (500 µg/l);

2) One milligram per liter (1 mg/l) for antimony;

3) Ten (10) times the maximum concentration value reported for that pollutant in the permit application in accordance with 40 CFR 122.21(g)(7)(which is incorporated at R18-9-A905(A)(1)(b));

4) The level established by the Director in accordance with 40 CFR 122.44(f) (which is incorporated at R18-9-A905(A)(3)(d)).

17. Publicly Owned Treatment Works [R18-9-A905(A)(3)(b) which incorporates 40 CFR 122.42(b)]

This section applies only to publicly owned treatment works as defined at ARS § 49-255(5).

a. All POTW's must provide adequate notice to the Director of the following:

1) Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to section 301 or 306 of the CLEAN WATER ACT if it were directly discharging those pollutants; and

2) Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.

3) For the purposes of this paragraph, adequate notice shall include information on (i) the quality and quantity of effluent introduced into the POTW, and (ii) any anticipated impact of the change on the quantity or quality of effluent to be discharge from the POTW.

b. Publicly owned treatment works may not receive hazardous waste by truck, rail, or dedicated pipe except as provided under 40 CFR 270. Hazardous wastes are defined at 40 CFR 261 and include any mixture containing any waste listed under 40 CFR 261.31 - 261.33. The Domestic Sewage Exclusion (40 CFR 261.4) applies only to wastes mixed with domestic sewage in a sewer leading to a publicly owned treatment works and not to mixtures of hazardous wastes and sewage or septage delivered to the treatment plant by truck.

18. Reopener Clause [R18-9-A905(A)(3)(d) which incorporates 40 CFR 122.44(c)]

This permit shall be modified or revoked and reissued to incorporate any applicable effluent standard or limitation or standard for sewage sludge use or disposal under sections 301(b)(2)(C), and (D), 304(b)(2), 307(a)(2) and 405(d) which is promulgated or approved after the permit is issued if that effluent or sludge standard or limitation is more stringent than any effluent limitation in the permit, or controls a pollutant or sludge use or disposal practice not limited in the permit.

19. Privately Owned Treatment Works [R18-9-A905(A)(3)(d) which incorporates 40 CFR 122.44]

This section applies only to privately owned treatment works as defined at 40 CFR 122.2.

a. Materials authorized to be disposed of into the privately owned treatment works and collection system are typical domestic sewage. Unauthorized material are hazardous waste (as defined at 40 CFR Part 261), motor oil, gasoline, paints, varnishes, solvents, pesticides, fertilizers, industrial wastes, or other materials not generally associated with toilet flushing or personal hygiene, laundry, or food preparation, unless specifically listed under "Authorized Non-domestic Sewer Dischargers" elsewhere in this permit.

b. It is the Permittee's responsibility to inform users of the privately owned treatment works and collection system of the prohibition against unauthorized materials and to ensure compliance with the prohibition. The Permittee must have the authority and capability to sample all discharges to the collection system, including any from septic haulers or other unsewered dischargers, and shall take and analyze such samples for conventional, toxic, or hazardous pollutants when instructed by the permitting authority. The Permittee must provide adequate security to prevent unauthorized discharges to the collection system.

c. Should a user of the privately owned treatment works desire authorization to discharge non-domestic wastes, the Permittee shall submit a request for permit modification and an application, pursuant to 40 CFR 122.44(m), describing the proposed discharge. The application shall, to the extent possible, be submitted using ADEQ Forms 1 and 2C, unless another format is requested by the permitting authority. If the privately owned treatment works or collection system user is different from the Permittee, and the Permittee agrees to allow the non-domestic discharge, the user shall submit the application and the Permittee shall submit the permit modification request. The application and request for modification shall be submitted at least 6 months before authorization to discharge non-domestic wastes to the privately owned treatment works or collection system is desired.

20. Transfers by Modification [R18-9-B905]

Except as provided in section 21, a permit may be transferred by the Permittee to a new owner or operator only if the permit has been modified or revoked and reissued, or a minor modification made under R18-9-B906, to identify the new Permittee and incorporate such other requirements as may be necessary.

21. Automatic Transfers [R18-9-B905]

An altemative to transfers under section 20, any AZPDES permit may be automatically transferred to a new Permittee if:

a. The current Permittee notifies the Director at least 30 days in advance of the proposed transfer date;

b. The notice includes a written agreement between the existing and new Permittee containing a specific date for transfer of permit responsibility, coverage, and liability between them; and

c. The Director does not notify the existing Permittee and the proposed new Permittee of his or her intent to modify or revoke and reissue the permit. A modification under this subparagraph may also be a minor modification under R18-9-B906(B).

22. Minor Modification of Permits [R18-9-B906(B)]

Upon the consent of the Permittee, the Director may modify a permit to make the corrections or allowances for changes in the permitted activity listed in this section, without following public notice procedures under R18-9-A907 or A908. Minor modifications may only:

a. Correct typographical errors;

b. Update a permit condition that changed as a result of updating an Arizona water quality standard;

c. Require more frequent monitoring or reporting by the Permittee;

d. Change an interim compliance date in a schedule of compliance, provided the new date is not more than 120 days after the date specified in the existing permit and does not interfere with attainment of the final compliance date requirement;

e. Allow for a change in ownership or operational control of a facility where the Director determines that no other change in their permit is necessary, provided that a written agreement containing a specific date for transfer of permit responsibility, coverage, and liability between the current and new Permittee has been submitted to the Director.

f. Change the construction schedule for a discharger which is a new source. No such change shall affect a discharger's obligation prior to discharge under 40 CFR 122.29 (which is incorporated by reference in R18-9-A905(A)(1)(e)).

g. Delete a point source outfall when the discharge from that outfall is terminated and does not result in discharge of pollutants from other outfalls except in accordance with the permit limits.

h. Incorporate conditions of a POTW pretreatment program that has been approved in accordance with the procedures in 40 CFR 403.11 and 403.18 as enforceable conditions of the POTW's permit.

i. Annex an area by a municipality.

23. Termination of Permits [R-9-B906(C)]

The following are causes for terminating a permit during its term, or for denying a permit renewal application:

a. Noncompliance by the Permittee with any condition of the permit;

b. The Permittee's failure in the application or during the permit issuance process to disclose fully all relevant facts, or the Permittee's misrepresentation of any relevant facts at any time;

c. A determination that the permitted activity endangers human health or the environment and can only by regulated to acceptable levels by permit modification or termination; or

d. A change in any condition that requires either a temporary or a permanent reduction or elimination of any discharge controlled by the permit (for example, a plant closure or termination of discharge by connection to a POTW).

24. Availability of Reports [Pursuant to A.R.S § 49-205]

Except for data determined to be confidential under A.R.S § 49-205(A), all reports prepared in accordance with the terms of this permit shall be available for public inspection at ADEQ offices. As required by A.R.S. § 49-205(B) and (C), permit applications, permits, and effluent data shall not be considered confidential.

25. Removed Substances [Pursuant to Clean Water Act Section 301]

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering navigable waters.

26. Severability [Pursuant to A.R.S § 49-324(E)]

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and remainder of this permit, shall not be affected thereby.

27. Civil and Criminal Liability [Pursuant to A.R.S § 49-262, 263.01, and 263.02]

Except as provided in permit conditions on "Bypass" (Section 14) and "Upset" (Section 15), nothing in this permit shall be construed to relieve the Permittee from civil or criminal penalties for noncompliance.

28. Oil and Hazardous Substance Liability [Pursuant to Clean Water Act Section 311]

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the Permittee from any responsibilities, liabilities, or penalties to which the Permittee is or may be subject under Section 311 of the Clean Water Act.

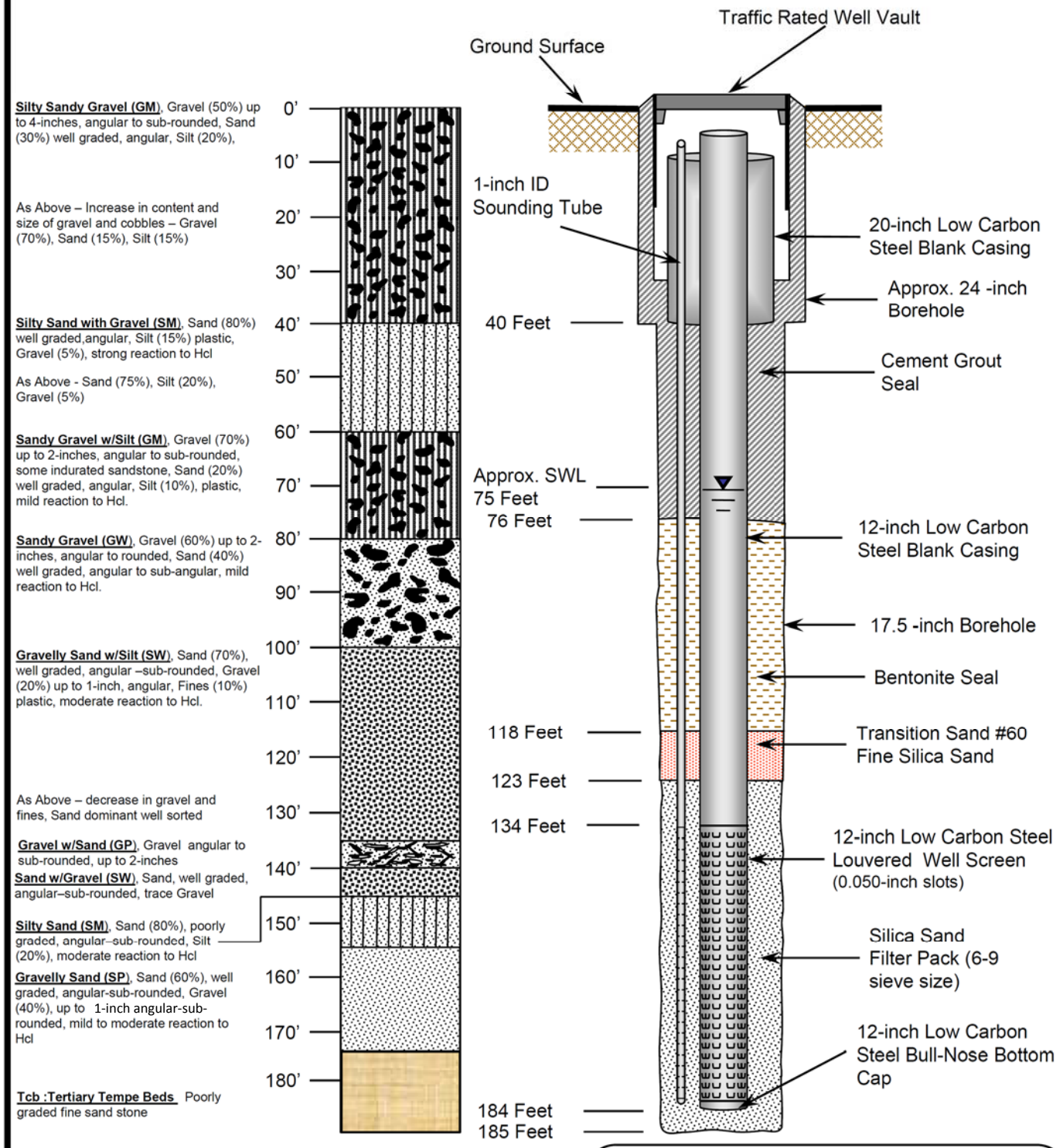
29. State or Tribal Law [Pursuant to R18-9-A904(C)]

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the operator from any responsibilities, liabilities, or penalties established pursuant to any applicable State or Tribal law or regulation under authority preserved by Section 510 of the Clean Water Act.

Appendix C

Well Construction As-Builts

AT-GRADE COMPLETION



Notes:

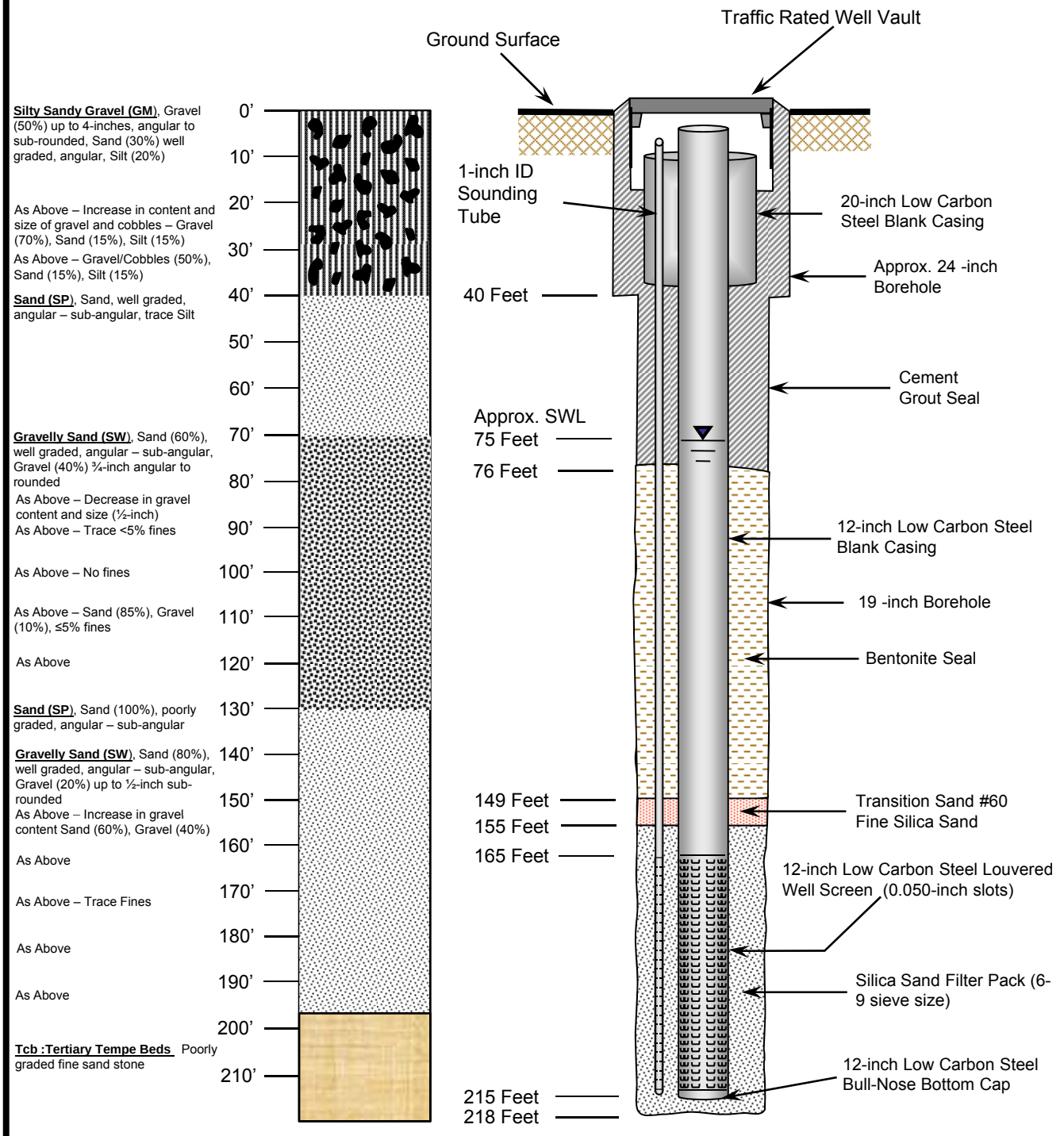
All diameters OD except well screen which is nominal
ID = Inner Casing Diameter
SWL = Static Water Level

CLEAR CREEK ASSOCIATES

FIGURE 6

AS-BUILT DRAWING AND LITHOLOGIC LOG
EXTRACTION WELL DM-39
ADWR Reg. No. 55-219352
56th Street and Earll Drive WQARF Site

AT-GRADE COMPLETION



Notes:

All diameters OD except well screen which is nominal
SWL = Static Water Level
ID = Inner Casing Diameter
Not to Scale

CLEAR CREEK ASSOCIATES

FIGURE 7

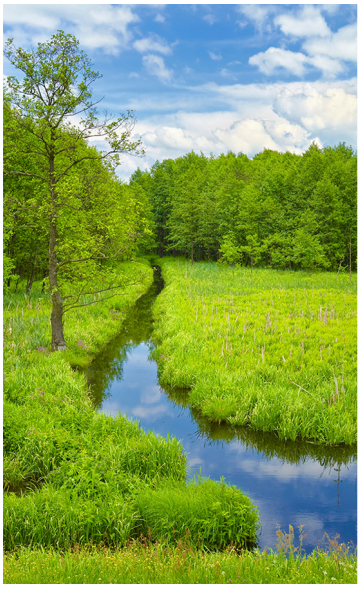
AS-BUILT DRAWING AND LITHOLOGIC LOG
EXTRACTION WELL DM-40
ADWR Reg. No. 55-219351
56th Street and Earll Drive WQARF Site

Appendix D

Quality Assurance Manual

CONESTOGA-ROVERS & ASSOCIATES

www.CRAworld.com



Final Report

Quality Assurance Manual (QA Manual)

56th Street and Earll Drive
WQARF Site Groundwater Treatment System
Phoenix, Arizona

Prepared for: Freescale Semiconductor, Inc.

Conestoga-Rovers & Associates
1801 Old Highway 8 Northwest, Suite #114
St. Paul, Minnesota 55112

December 2013 • 084060 (1)

Partners in Sustainability

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Section 1.0 Project Management

1.1 Purpose of Sample Collection and Sample Frequency

In accordance with Part I. and Part II. of the Standard Arizona Pollution Discharge Elimination System (AZPDES) Permit Conditions, the permitee (Freescale Semiconductor, Inc.) shall monitor the discharge from Outfall 001 of the Treatment Facility to the Salt River Project (SRP) Grand Canal as well as the receiving water in the Grand Canal. The water samples collected as part of the discharge and receiving water monitoring shall be collected at frequencies specified in the Standard AZPDES Permit Conditions. A copy of the permit is provided as Appendix A to this QA Manual. A summary of the sampling and analysis program is presented in Table 1.1.

1.2 Where Samples Will Be Collected

Samples of the treated effluent from the treatment facility will be collected from Outfall 001 and analyzed for the parameters listed in Part I of the Standard AZPDES Permit Conditions, at the frequency presented in Part I of the Standard AZPDES Permit Conditions.

Grab samples of the water in the SRP Grand Canal will be collected both upstream from the discharge location and downstream from the discharge location and analyzed for the parameters listed in Part I of the Standard AZPDES Permit Conditions, at the frequency presented in Part I of the Standard AZPDES Permit Conditions.

1.3 How Samples Will Be Collected

Samples collected from Outfall 001 will be collected from the sampling port located inside the SRP meter vault.

The sampling port consists of a ball valve and nozzle. The sample collection procedures are as follows:

i) The valve is in the closed position when the valve handle is perpendicular to the pipe centerline.

ii) Slowly turn the valve clockwise and allow the water to discharge into a suitable container for at least 2 minutes. Dispose of the collected purge water in the purge water holding tank.

iii) Fill the sample bottle and/or vials (VOCs). Return the valve to the closed position.

Grab samples collected from the SRP Canal will be collected by placing a pre-cleaned container into the water stream, rinsing the container five times, and then collecting the sample. The sample will then be transferred to the appropriate laboratory-provided sample containers.

1.4 Who Will Collect Samples and Their Qualifications

The samples will be collected by a sampling technician with a minimum of two years process sampling experience.

1.5 Laboratory That Will Perform Analyses

The laboratory that will perform the analysis of water samples for this project is:

TestAmerica - Phoenix
4625 East Cotton Center Blvd., Suite 189
Phoenix, Arizona 85040
(602) 437-3340

The laboratory project manager is Tina Paulauskas and her direct line is 602-659-7617.

1.6 Field Tests to Be Conducted

Concurrent with sample collection, field parameters will be determined by the field sampling personnel. The tests to be conducted in the field include pH and flow measurements. The pH measurements will be made using a pH meter, Hanna HI 991300 or equivalent. A standard operating procedure (SOP) for pH measurement is included in Appendix B. Calibration procedures are detailed in the pH SOP.

1.7 Analytes and Permit Limits

Required analytes to be analyzed are listed in the permit (Appendix A). A summary of the permit required analytes, reporting limits, method detection limits and maximum allowable discharge limits are listed in Table 1.2. Analyses will be performed using the methods listed in the permit. A summary of the analytical methods for this sampling is listed in Table 1.3.

Section 2.0 Sample Collection Procedures

2.1 Equipment to Be Used

PH of the sample collected from Outfall 001 shall be measured using a pH meter. Grab samples collected from the SRP Canal will be collected using a pre-cleaned container to collect the samples and transfer the samples to the laboratory provided sample containers.

2.2 Type and Number of Samples to Be Collected

The type and number of samples to be collected under the permit are presented in the permit in Appendix A. A summary of sample collection including QA/QC samples is located in Table 1.1. Quality Assurance/Quality Control (QA/QC) samples will consist of trip blanks, field blanks, rinsate blanks, MS/MSD samples and field duplicate sample sets.

Trip blanks are used to assess the potential for contamination during sample storage and shipment. The trip blank consists of purified water that has been provided by the laboratory along with the sample containers to be used for the sampling of VOCs. Trip blanks will be preserved and handled in the same manner as the investigation samples; however, it should be noted that trip blanks will not be opened in the field. One trip blank will be included along with each shipment cooler containing project samples to be analyzed for VOCs.

Field blanks will be collected along with discharge samples once per year. Distilled (or deionized) water will be used for field blank water. Sample bottles for field blanks will be filled by pouring the distilled (or deionized) water directly into sample containers in the field.

Equipment rinsate blanks will be collected by passing laboratory purified water over and/or through the respective field equipment utilized during each sampling effort. One rinsate blank will be collected once per year if equipment cleaning is conducted. Rinsate blanks will be analyzed for each target parameter for the respective sampling effort for which environmental media have been collected. (Note: If dedicated or disposable sampling equipment is used, equipment rinsate samples will not be collected as part of that field effort.)

One (1) set of MS/MSD analyses will be performed for each analytical parameter once (1x) per year. MS/MSD samples are used to assess the accuracy of identification and quantification of analytes within the site-specific sample matrices. Additional sample volume will be collected at sample locations selected for MS/MSD analyses so that MDLs can be met.

Field duplicate samples are analyzed to check for sampling and analytical reproducibility. One field duplicate will be collected once (1x) per year.

2.3 Sample Bottle Types, Sizes, Preservatives and Holding Times

Sample container type, preservation, holding times, and packing/shipping requirements for the sampling program are listed in Table 2.1.

2.4 Chain of Custody Procedures

i) A chain-of-custody (COC) record will be completed during sample collection and will accompany each shipment identifying the contents of the shipment. The COC record will accompany the samples to the laboratory. The field personnel collecting the samples will be responsible for the custody of the samples until the samples are relinquished to the laboratory. Sample transfer will require the individuals relinquishing and receiving the samples to sign, date and note the time of sample transfer on the COC record. As few people as possible should handle the samples.

ii) Samples will be shipped or delivered in a timely fashion to the laboratory so that holding-times and/or analysis times as prescribed by the methodology can be met.

iii) Samples will also be transported in containers (coolers) packed with ice to maintain the temperatures prescribed in Table 2.1. Samples will be packaged for shipment and shipped to the laboratory for analysis. VOC samples will be placed in foam sleeves or bubble wrap to prevent breakage. All samples will be placed in an upright position and limited to one layer of samples per each cooler. Additional bubble wrap or packaging material will be added to fill the cooler. Shipping containers will be secured with strapping tape and custody tape for shipment to the laboratory, unless hand-delivered to the laboratory.

iv) If samples are sent by a commercial carrier, a bill of lading will be used. A copy of the bill of lading will be retained as part of permanent documentation. Commercial carriers are not required to sign the custody record as long as the custody record is sealed inside the sample cooler and the custody tape remains intact.

v) Samples will be picked up by a laboratory courier or transported overnight by a courier to the laboratory within 48 hours of sample collection unless collected on a weekend or holiday. In these cases, the samples will be stored in a secure location until delivery to the lab. Additional ice will be added to the cooler as needed to maintain proper preservation temperatures.

2.5 Laboratory Chain-of-Custody Procedures

A full-time sample receiving group leader supervises the sample receiving group who are assigned the responsibility of sample control. It will be the responsibility of the sample receiving group to receive all incoming samples. Once received, the custodian will document that the custody tape on the coolers is unbroken (if applicable), that each sample is received in good condition (i.e., unbroken, cooled, etc.), that the associated paperwork, such as chain-of-custody forms have been completed and will sign the chain-of-custody forms. In special cases, the custodian will document from appropriate sub-samples that chain-of-custody with proper preservation has been accomplished. The custodian will also document that sufficient sample volume has been received to complete the analytical program. The sample custodian will then place the samples into secure, limited access storage (refrigerated storage, if required). The sample custodian will assign a unique number to each incoming sample for use in the

laboratory. The unique number will then be entered into the sample-receiving log. The laboratory date of receipt will also be noted.

Consistent with the analyses requested on the chain-of-custody form, analyses by the laboratory's analysts will begin in accordance with the appropriate methodologies. Samples will be removed from secure storage only after internal chain-of-custody sign-out procedures have been followed.

Section 3.0 Analytical Methods

3.1 Limits of Detection (LOD) and Limits of Quantitation (LOQ)

Table 1.2 summarizes the reporting limits (RL) and method detection limits (MDL) for the sampling program.

3.2 Required QC To Be Reported

Analytical reports from the laboratory will consist of the following items:

- Title Page (with project name/number, date, signature)
- Case Narrative
- Method Summary
- Sample Summary
- Sample Results with reporting limits
- Method blank results
- Surrogate spike recoveries and control limits (where appropriate)
- Laboratory Control Sample recoveries and control limits
- Matrix Spike/Matrix Spike recoveries and Relative Percent Difference of the recoveries (for project related samples) and control limits
- Fully executed Chain of Custody with receiving documents

Current acceptance criteria for LCS and MS/MSD samples are presented in the laboratory reference data provided in Table 3.1.

The acceptance criteria for VOC surrogate recoveries is presented in Table 3.2.

3.3 Corrective Actions

3.3.1 Field Corrective Action

Corrective action is intended to address problems that arise by identification, recommendation, approval, and implementation of measures that counter unacceptable procedures or deficient quality control performance. The Sample technician and/or CRA Chemist and/or CRA Project manager will be responsible for ensuring the quality of the sampling procedures and environmental data and as such, will be responsible for initiating corrective action when appropriate.

The corrective action procedures will be as follows:

i) Identify/define the problem

ii) Assign responsibility for investigating the problem

iii) Investigate/determine the cause of the problem

iv) Determine an appropriate corrective action to eliminate the problem

v) Implement the corrective action

vi) Evaluate the effectiveness of the corrective action

vii) Verify that the corrective action has eliminated the problem

viii) Prepare a written record detailing the problem, corrective action utilized, and solution of the problem

ix) Submit the Corrective Action Record (CAR) to the Task Coordinator who initiated the corrective action and the Project QA Officer, and Project Manager

Any Field Team member of the project may initiate corrective action procedures by reporting in writing the nature of the suspected problem to the CRA Project Manager or CRA QA Chemist. The CRA Project Manager will begin corrective action by relating the problem to appropriate personnel.

3.3.2 Laboratory Corrective Action

Corrective actions will be initiated by the laboratory QA personnel and will be implemented by laboratory staff chemists under the oversight of the laboratory QA personnel. As with field corrective actions, the laboratory QA personnel will document the problem, the corrective action undertaken and the resolution of the problem. The corrective actions will be performed prior to release of the data from the laboratory.

Documentation will be provided to the laboratory QA Officer, CRA Chemist, and the CRA Project Manager.

Section 4.0 Data Review and Reporting

4.1 How Will the Permitee Complete DMR Forms and Records Used to Report Results to ADEQ

In accordance with Part II. B. of the Standard AZPDES Permit Conditions, the permitee shall report monitoring results on the Discharge Monitoring Report (DMR) forms supplied by ADEQ, to the extent that the results may be entered on the forms, along with copies of the original lab results for all parameters monitored during the reporting period.

4.2 Procedures Used to Evaluate Field Data

Procedures to evaluate field data for this project will include review of field logbooks and checking for transcription errors to project specific documents. This task will be the responsibility of the Sample technician.

4.3 Procedures Used to Evaluate Laboratory Data

Procedures to evaluate laboratory data for this project will include a compliance check on the analytical data. This will consist of a review of laboratory reports against the analyses requested on the COC as well as the analytical and reporting limit requirements of the permit. This task will be the responsibility of the CRA Chemist or his designee.

TABLE 1.1

SUMMARY OF SAMPLING AND ANALYSIS PROGRAM
56TH STREET AND EARLL DRIVE - WQARF SITE GROUNDWATER TREATMENT SYSTEM
PHOENIX, ARIZONA

Investigation Activity	*Sample Matrix*	*Field Parameters*	*Laboratory Parameters*	*Investigative Samples*	*Quality Control Samples* [1]			*Total*
					Field/Rinse Blanks [2]	*Field Duplicates*	*MS/MSD* [3]	
Monthly Discharge Sampling	water	pH, Flow	VOC	1	1/12 samples	1/12 samples	1/12 samples	1[4]
			Metals (B, Se)	1	N/A	N/A	N/A	1
Mixing Zone (Grand Canal Sampling Upstream and Downstream)	water	-	Boron	3	N/A	N/A	N/A	3
Monthly Grand Canal Sampling (Upstream and Downstream)	water	-	VOC	2	N/A	N/A	N/A	2
Semi-Annual Discharge Sampling	water	pH	VOC	1	N/A	N/A	N/A	1
			Metals (As, Cd, Cu, Pb, Hg)	1	N/A	N/A	N/A	1
Semi-Annual Grand Canal Sampling Water	water	-	Hardness	1	N/A	N/A	N/A	1
One time discharge sampling in 2014	water	pH	Cyanide, total	1	N/A	N/A	N/A	1
			Metals (Cr, Zn)	1	N/A	N/A	N/A	1

Notes:

[1] - A laboratory trip blank will be submitted with each shipment of samples for VOC analysis.

[2] - Rinse blank samples will not be required if dedicated or disposable sampling equipment is used.

[3] - Matrix Spike/Matrix Spike duplicate (MS/MSD) analyses are required for samples submitted for organic and inorganic.
analyses are to be analyzed at a frequency of one per group of twenty (20) or fewer investigative samples for the activities detailed above.

[4] - The frequency of Field Blanks and Field Duplicates will be one per 12 investigative samples (1 per year).
The total sample quantity will vary depending on which activity the QC samples are collected from.

VOC = Volatile Organic Compounds

TABLE 1.2

ANALYTICAL PARAMETER, REPORTING LIMITS, AND DISCHARGE LIMITS
56TH STREET AND EARLL DRIVE - WQARF SITE GROUNDWATER TREATMENT SYSTEM
PHOENIX, ARIZONA

Compound	*Targeted Reporting Limits (RL)* [1] *Water*	*Method Detection Limits (MDL)* [2] *Water*	*Maximum Discharge Limits* [2] *Water*
VOC EPA 624	***µg/L***	***µg/L***	***µg/L***
Chloroform	0.500	0.130	80
cis-1,2-Dichloroethene	0.500	0.210	70
Tetrachloroethene	0.500	0.180	5.0
Toluene	0.500	0.280	1000
Trichloroethene	0.500	0.240	5.0
Benzene	0.500	0.120	-
1,2-Dichloroethane	0.500	0.310	-
1,1-Dichloroethene	0.500	0.230	-
trans-1,2-Dichloroethene	0.500	0.290	-
Ethylbenzene	0.500	0.320	-
1,1,1-Trichloroethane	0.500	0.150	-
Vinyl chloride	0.500	0.180	-
Xylenes, Total	1.50	0.860	-
Metals- ICP EPA 200.7	***mg/L***	***mg/L***	***mg/L***
Boron	0.200	0.0232	1.0
Calcium (for Hardness calc.)	2.00	0.0896	-
Magnesium (for Hardness calc.)	2.00	0.0500	-
Metals- ICP/MS EPA 200.8	***mg/L***	***mg/L***	***mg/L***
Arsenic	0.00300	0.00180	-
Cadmium	0.00100	0.000400	-
Chromium	0.00200	0.000500	-
Copper	0.00300	0.00190	-
Lead	0.00100	0.000400	-
Selenium	0.00200	0.000600	0.0292/0.0200[3]
Zinc	0.0100	0.00290	-
Mercury EPA 245.1	***mg/L***	***mg/L***	***mg/L***
Mercury	0.000200	0.0000700	-
Hardness SM 2340B	***mg/L***	***mg/L***	***mg/L***
Hardness as CaCO3 (calculation)	13	-	-
Cyanide SM 4500_CN-E	***mg/L***	***mg/L***	***mg/L***
Cyanide, Total	0.0500	0.00620	-

Notes:

[1] - Please note that these are targeted reporting limits and are presented for guidance only. Actual reporting limits are highly matrix dependent and may be elevated due to matrix effects, QA/QC problems and/or high concentrations of target and non-target analytes.

[2] - Method Detection Limits (MDL) are also presented for guidance only. Actual MDLs will vary depending on sample specific preparation factors. The MDLs are also highly matrix dependent and may be elevated due to matrix effects, QA/QC problems and/or high concentrations of target and non-target analytes. Laboratory MDLs are updated on a periodic basis and the MDLs in effect when the samples are analyzed will be used for reporting purposes.

[3] - Daily Maximum for selenium is 0.0292 mg/L/monthly average maximum is 0.0200 mg/L.

TABLE 1.3

SUMMARY OF ANALYTICAL METHODS
ANALYTICAL PARAMETER LIST
QUALITY ASSURANCE MANUAL
56TH STREET AND EARLL DRIVE - WQARF SITE GROUNDWATER TREATMENT SYSTEM
PHOENIX, ARIZONA

Parameter	*Preparation Method* [2]	*Analytical Method* [2]
Water Samples		
VOC	EPA 624	EPA 624
Metals[3]		
ICP Metals	EPA 200.7	EPA 200.7
ICP/MS Metals	EPA 200.8	EPA 200.8
Mercury	EPA 245.1	EPA 245.1
Cyanide, total	SM 4500_CN-E	SM 4500_CN-E
Hardness	SM2340B	SM2340B

Notes:

[2] Analytical Method References:
EPA - "Methods for Organic Analysis of Municipal and Industrial Wastewater",
40 CFR, Part 136 Appendix A, October 26, 1984.
SM - "Standard Methods for the Examination of Water and Wastewater",
18th Edition, 1992, with subsequent revisions.

[3] Metals by Method

ICP:	Boron, Calcium, Magnesium
ICP/MS:	Arsenic, Cadmium, Chromium, Copper, Lead, Selenium, Zinc
CVAA	Mercury

TABLE 2.1

CONTAINER, PRESERVATION, SHIPPING AND PACKAGING REQUIREMENTS
56TH STREET AND EARLL DRIVE - WQARF SITE GROUNDWATER TREATMENT SYSTEM
PHOENIX, ARIZONA

Analyses	*Sample Containers*	*Preservation*	*Maximum Holding Time from Sample Collection* [1]	*Volume of Sample*	*Shipping*	*Normal Packaging*
WATER						
Volatile Organic Compounds (VOC)	Three 40 mL teflon-lined septum vials per analysis	HCl to pH < 2 Iced, 4 ± 2° C	14 days for analysis	Fill completely, no air bubbles	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
Metals, Hardness	One 1 liter plastic bottle	HNO_3 to pH < 2 Iced, 4 ± 2° C	180 days (mercury-28 days) for analysis	Fill to neck of bottle	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
Cyanide, total	One 250 ml plastic bottle	NaOH to pH>12 Iced, 4 ± 2° C	14 days for analysis	Fill to neck of bottle	Overnight or Hand Deliver	Foam Liner or Bubble-wrap

Notes:

[1] - Technical holding times are based on time elapsed from time of sample collection.

TABLE 3.1

ANALYTICAL QUALITY CONTROL LIMITS
56TH STREET AND EARLL DRIVE - WQARF SITE GROUNDWATER TREATMENT SYSTEM
PHOENIX, ARIZONA

	LCS Control Limits (%) [1]	*LCS RPD Limit*	*MS/MSD Control Limit (%)* [1]	*MS/MSD RPD Limit* [1]
VOC EPA 624 List				
1,1,1,2-Tetrachloroethane	70 - 130	20	70 - 130	30
1,1,1-Trichloroethane	52 - 162	20	52 - 162	20
1,1,2,2-Tetrachloroethane	46 - 157	20	46 - 157	20
1,1,2-Trichloroethane	52 - 150	20	52 - 150	20
1,1-Dichloroethane	59 - 155	20	59 - 155	20
1,1-Dichloroethene	5 - 234	20	5 - 234	20
1,1-Dichloropropene	70 - 130	20	64 - 134	34
1,2,4-Trichlorobenzene	80 - 137	20	74 - 138	26
1,2,4-Trimethylbenzene	70 - 130	20	63 - 135	31
1,2,3-Trichlorobenzene	79 - 139	20	74 - 139	26
1,2,3-Trichloropropane	70 - 130	20	68 - 130	32
1,2-Dibromo-3-Chloropropane	63 - 146	22	53 - 145	35
1,2-Dibromoethane (EDB)	70 - 130	20	70 - 130	33
1,3-Dichlorobenzene	59 - 156	20	59 - 156	20
1,3-Dichloropropane	70 - 130	20	68 - 129	33
1,2-Dichlorobenzene	18 - 190	20	18 - 190	20
1,2-Dichloroethane	49 - 155	20	49 - 155	20
1,2-Dichloropropane	5 - 210	20	5 - 210	20
1,3,5-Trimethylbenzene	70 - 130	20	66 - 137	30
1,4-Dichlorobenzene	18 - 190	20	18 - 190	20
2,2-Dichloropropane	69 - 139	20	60 - 146	35
2-Butanone (MEK)	53 - 150	35	31 - 143	35
2-Chlorotoluene	70 - 130	20	71 - 131	29
2-Hexanone	55 - 150	35	40 - 142	35
4-Chlorotoluene	70 - 130	20	70 - 130	28
4-Methyl-2-pentanone (MIBK)	64 - 142	25	52 - 143	35
Acetone	38 - 150	35	29 - 139	35
Benzene	37 - 151	20	37 - 151	20
Bromobenzene	70 - 130	20	70 - 130	28
Bromochloromethane	70 - 130	20	64 - 132	35
Bromodichloromethane	35 - 155	20	35 - 155	20
Bromoform	45 - 169	20	45 - 169	20
Bromomethane	5 - 242	20	5 - 242	20
Carbon disulfide	64 - 145	33	45 - 150	35
Carbon tetrachloride	70 - 140	20	70 - 140	20
Chlorobenzene	37 - 160	20	37 - 160	20
Chloroethane	14 - 230	20	14 - 230	20
Chloroform	51 - 138	20	51 - 138	20
Chloromethane	5 - 273	20	5 - 273	20
cis-1,2-Dichloroethene	70 - 130	20	65 - 127	34
cis-1,3-Dichloropropene	5 - 227	20	5 - 227	20
Dibromochloromethane	53 - 149	20	53 - 149	20
Dibromomethane	70 - 130	20	66 - 136	35
Dichlorodifluoromethane	46 - 144	23	40 - 148	35
Ethylbenzene	37 - 162	20	37 - 162	20
Hexachlorobutadiene	76 - 145	20	69 - 150	32
Iodomethane	70 - 130	20	53 - 150	35
Isopropylbenzene	88 - 141	20	80 - 146	32
m,p-Xylenes	70 - 130	20	58 - 138	29
Methylene Chloride	5 - 221	20	5 - 221	20

TABLE 3.1

ANALYTICAL QUALITY CONTROL LIMITS
56TH STREET AND EARLL DRIVE - WQARF SITE GROUNDWATER TREATMENT SYSTEM
PHOENIX, ARIZONA

	LCS Control Limits (%) [1]	*LCS RPD Limit*	*MS/MSD Control Limit (%)* [1]	*MS/MSD RPD Limit* [1]
Methyl tert-butyl ether	63 - 129	21	46 - 139	35
Naphthalene	78 - 143	20	67 - 146	29
n-Butylbenzene	70 - 130	20	69 - 140	32
n-Propylbenzene	70 - 130	20	74 - 140	32
o-Xylene	70 - 130	20	66 - 137	26
p-Isopropyltoluene	70 - 130	20	70 - 133	32
sec-Butylbenzene	70 - 130	20	72 - 136	33
Styrene	70 - 130	20	43 - 144	35
tert-Butylbenzene	70 - 130	20	74 - 135	32
Tetrachloroethene	64 - 148	20	64 - 148	20
Toluene	47 - 150	20	47 - 150	20
trans-1,2-Dichloroethene	54 - 156	20	54 - 156	20
trans-1,3-Dichloropropene	17 - 183	20	17 - 183	20
Trichloroethene	71 - 157	20	71 - 157	20
Trichlorofluoromethane	17 - 181	20	17 - 181	20
Vinyl chloride	5 - 251	20	5 - 251	20
Vinyl acetate	67 - 148	22	47 - 150	35
Xylenes, Total	70 - 130	20	68 - 131	31
Metals- ICP EPA 200.7				
Boron	85 - 115	20	70 - 130	20
Calcium	85 - 115	20	70 - 130	20
Magnesium	85 - 115	20	70 - 130	20
Metals- ICP/MS EPA 200.8				
Arsenic	85 - 115	20	70 - 130	20
Cadmium	85 - 115	20	70 - 130	20
Chromium	85 - 115	20	70 - 130	20
Copper	85 - 115	20	70 - 130	20
Lead	85 - 115	20	70 - 130	20
Selenium	85 - 115	20	70 - 130	20
Zinc	85 - 115	20	70 - 130	20
Mercury EPA 245.1				
Mercury	85 - 115	20	70 - 130	20
Hardness SM 2340B				
Hardness as CaCO3 (calculation)	NA	NA	NA	NA
Cyanide SM 4500_CN-E				
Cyanide, Total	90 - 110	20	80 - 120	20

Notes:

NA - Not applicable. Hardness is a calculation based on Calcium and Magnesium results.

RPD - Relative percent difference

[1] - Laboratory control limits are updated on a periodic basis. The most current laboratory control limits will be used for data quality assessment p

TABLE 3.2

SURROGATE COMPOUND PERCENT RECOVERY CONTROL LIMITS
56TH STREET AND EARLL DRIVE - WQARF SITE GROUNDWATER TREATMENT SYSTEM
PHOENIX, ARIZONA

Analyses	*Surrogate Compound*	*% Recovery Control Limits*
VOC - EPA 624	Dibromofluoromethane	70-130
	Toluene-d8	70-130
	4-Bromofluorobenzene	70-130

Appendix A

AZPDES Permit #AZ0025861

Janice K. Brewer
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Henry R. Darwin
Director

1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.azdeq.gov

Decision to Grant AZPDES Permit #AZ0025861

February 28, 2011

LTF ID: 51093
Place ID: 138082

Jenn McCall, Remediation Programs Specialist
Freescale Semiconductor, Inc.
2100 E. Elliot Road, MD EL-614
Tempe, AZ 85284

RE: AZPDES Permit Application No. AZ0025861
56th Street and Earll Drive WQARF Site Groundwater Treatment System (GWTS)
Phoenix, AZ 85008

Dear Ms. McCall:

The Arizona Department of Environmental Quality (ADEQ) has completed the public participation and comment period for the above-referenced facility. Comments were received from Freescale Semiconductor, Inc. during the 30-day comment period. A copy of the comments and ADEQ's response is attached to this letter. ADEQ has made a final decision to issue the AZPDES permit for discharge from the 56th Street and Earll Drive WQARF Site GWTS in Phoenix, Arizona.[1] A copy of the fact sheet and signed permit is enclosed. Please note the effective date and expiration date for your permit. If you wish to renew this permit, a complete and accurate application must be submitted no later than 180 days prior to the permit expiration date.

The review of your AZPDES application was subject to the licensing timeframes statute under Arizona Revised Statutes A.R.S. §§ 41-1072 through 41-1079. Therefore, this letter is the written notification of ADEQ's licensing decision required under A.R.S. § 41-1076 and Arizona Administrative Code (A.A.C.) R18-1-507(A).

This decision was made prior to expiration of the licensing time frames governing your application. Please contact me at (602) 771- 4593 if you have any questions regarding this notice or your permit.

Sincerely,

M. Reza Azizi

M. Reza Azizi
Permits Unit
Surface Water Section
Water Quality Division

Enclosures: Signed AZPDES Permit No. AZ0025861
Fact Sheet
Freescale Comments and ADEQ's Response to Comments

SWSPU11:0017

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[1]This determination is an appealable agency action under A.R.S. § 41-1092. You have the right to request a hearing and file an appeal under A.R.S. § 41-1092.03. To do this you must file a Request for Hearing or Notice of Appeal **within thirty (30) days of receipt of this notice**. A request for Hearing or Notice of Appeal is filed when it is received by ADEQ's Hearing Administrator as follow:

Hearing Administrator
Office of Administrative Counsel
Arizona Department of Environmental Quality
1110 W. Washington Street
Phoenix, AZ 85007

The Request or Notice must contain the following:

1. The name of the party that is filing the appeal;
2. The address of the party that is filing the appeal;
3. The action being appealed; and
4. A concise statement of the reasons for the appeal.

Upon proper filing of a Request for Hearing or Notice of Appeal, ADEQ will serve a Notice of Hearing on all parties to the appeal. If you file a timely Request for Hearing or Notice of Appeal, you have the right to request an informal settlement conference with ADEQ under A.R.S § 41-1092.06. This request must be made in writing no later than 20 days before a scheduled hearing and must be filed with the Hearing Administrator at the above address.

RESPONSE TO COMMENTS

Permit No.	AZ0025861 / 56th St. & Earll Dr. WQARF Site Groundwater Treatment System (facility)
Applicant:	Freescale Semiconductor, Inc. 2100 E. Elliot Rd., MD EL-614, Tempe, AZ 85284
Permit Action:	Final permit decision and response to comments received on the draft permit public noticed on December 9, 2010. Following is ADEQ's response to comments received on the subject draft permit.
Prepared By:	M. Reza Azizi, AZPDES Permit Writer Surface Water Section/ Permits Unit Arizona Department of Environmental Quality 1110 W. Washington St., 5415A-1 Phoenix, AZ 85007 602-771-4593
Date:	1/19/2011

Comments were received on the preliminary draft permit from Freescale Semiconductor, Inc. (Freescale). Following is a description of comments received and ADEQ's responses.

Comments received on December 9, 2010 from Freescale:

COMMENT NO. 1

Freescale requested discharge limitation for chloroform be increased from 6 ug/L to 80 ug/L in the permit. Freescale noted that there are no numeric surface water quality standards for chloroform and four other organic compounds in the receiving water with AgI and AgL designated uses. Freescale further stated that with the exception of chloroform, the proposed limits are based on the Safe Drinking Water Maximum Contaminant Levels (MCLs). ADEQ has, on the other hand, used its best professional judgment to set the limit for chloroform on a much lower level than the MCL. The MCL for disinfection by-products including chloroform is 80 ug/L. Freescale has recommended that the MCL of 80 ug/L be set as the discharge limit for chloroform to be consistent with the other four volatile organic compounds.

RESPONSE NO. 1.

ADEQ concurs with Freescale. The discharge limit for chloroform has been changed from 6 ug/L to 80 ug/L in the final permit. In order to be consistent with this permit change, minor changes were also made to Part VII of the final fact sheet.

COMMENT NO. 2

Freescale stated that the Consent Order between ADEQ and Freescale is now expected to be signed in 2011 and not 2010 as stated in the Part I of the public noticed fact sheet.

RESPONSE NO. 2

The anticipated date for the Consent Order has been changed to 2011 in the final fact sheet as requested.

COMMENT NO. 3

Freescale stated that the facility is now planned for design and construction in 2011 and not 2010 as stated in the Part II of the public noticed Fact Sheet.

RESPONSE NO. 3

The anticipated date for facility design and construction has been changed to 2011 in the final Fact Sheet as requested.

COMMENT NO. 4

Freescale identified a typographical error in Part I.B of the permit. The public noticed permit lists Tables 2.a-2.c while the correct listing should be Tables 2.a-2.b. Also, the public notice erroneously listed the address for Freescale as containing MD EL-6141. The correct number is MD EL 614.

RESPONSE NO. 4

The listing of Tables 2.a-2.b in Part I.B has been corrected in the final permit. The typographical error in the public notice has been noted.

Additionally, the public noticed fact sheet (front page) erroneously listed the permit number as AZ0028861. The final fact sheet has been changed to list the correct permit number of AZ0025861.

ARIZONA POLLUTANT DISCHARGE ELIMINATION SYSTEM (AZPDES)

FACT SHEET

This document gives pertinent information concerning the issuance of the AZPDES permit listed below. This facility is a groundwater remediation system and is considered to be a minor facility under the NPDES program. The effluent limitations contained in this permit will maintain the Water Quality Standards listed in Arizona Administrative Code (A.A.C.) R18-11-101 et. seq. This permit is proposed to be issued for a period of 5 years.

Facility Name:	**56th Street and Earll Drive WQARF Site Groundwater Treatment System**
Permittee's Name:	Freescale Semiconductor, Inc.
Mailing Address:	2100 E. Elliot Road, MD EL-614 Tempe, AZ 85284
Facility Location:	North Side of SRP Grand Canal near 34th Street, North of Loop 202 Phoenix, AZ 85008
Contact Person:	Jenn McCall, Remediation Programs Specialist 480-413-3290; Jenn.mccall@freescale.com
AZPDES Permit No.:	**AZ0025861**
Inventory No.:	106170

I. STATUS OF PERMIT(s)

Freescale Semiconductor, Inc. (Freescale) has applied for a new Arizona Pollutant Discharge Elimination System (AZPDES) permit to allow the discharge of effluent from the proposed 56th Street and Earll Drive Water Quality Assurance Revolving Fund (WQARF) Site Groundwater Treatment System (facility) in Phoenix, Arizona to the Salt River Project (SRP) Grand Canal west of 34th Street and north of State Route Loop 202 in Phoenix, Arizona. This application was received by the Arizona Department of Environmental Quality (ADEQ) on November 6, 2009 and was determined to be administratively complete on January 28, 2010 when the additional information was received. It is anticipated that a Consent Order will be signed between ADEQ (Remedial Project Unit within the Waste Programs Division) and Freescale in 2011 which will contain a Scope of Work regarding groundwater remediation at this WQARF site. A draft Consent Order has already been prepared and is currently under review by both parties. Freescale does not currently have or need an Aquifer Protection Permit (APP) for discharges from this facility. Pursuant to A.R.S. § 49-250(B)(18)(d), a remedial action such as this which has been reviewed and will be approved by ADEQ prior to start of the discharge is exempt from the APP requirement.

II. GENERAL FACILITY INFORMATION

The 56th Street and Earll Drive facility is part of a WQARF, a.k.a. State Superfund, remediation site. As proposed, contaminated groundwater containing certain volatile organic compounds (VOCs) in concentrations higher than aquifer water quality standards will be extracted from two wells, DM-39 and DM-40, and treated via a treatment system with granular activated carbon (GAC). The proposed facility will be located on the north side bank of Grand Canal near 34th Street, north of the State Route Loop 202

Maricopa County, Arizona. Freescale has an agreement with SRP for the extraction wells, and will enter into additional agreements with SRP to include the facility, and the discharge of treated groundwater to the Grand Canal. Freescale will own and operate both the facility and the two extraction wells.

Construction of the two extraction wells was completed in January 2010, and the facility is planned for design and construction in 2011. The facility will treat the contaminated groundwater at an average rate of 1,000 gpm (1.44 mgd).

III. RECEIVING WATER

The State of Arizona has adopted water quality standards to protect the designated uses of its surface waters. Streams have been divided into segments and designated uses assigned to these segments. The water quality standards vary by designated use depending on the level of protection required to maintain that use.

The receiving water for the facility is the SRP Grand Canal, a Phoenix Area Canal below municipal water treatment plant intakes and all other locations, in the Middle Gila River Basin.

Outfall 001 is located at: Township 1 N, Range 3 E, Section 1
Latitude 33° 27' 39.0" N, Longitude 112° 00' 32.6" W

The Grand Canal is not on the 303(d) list and there are no Total Maximum Daily Load (TMDL) issues associated. The outfall discharges to, or the discharge may reach, a surface water listed in Appendix B of A.A.C. Title 18, Chapter 11, Article 1.

The Grand Canal has the following designated uses:

Agricultural Irrigation (AgI)
Agricultural Livestock watering (AgL)

Given the uses stated above, the applicable narrative water quality standards are described in A.A.C. R18-11-108 and the applicable numeric water quality standards are listed in A.A.C. R18-11-109, and in Appendix A thereof. In developing AZPDES permits, the standards for all applicable designated uses are compared and limits that will protect for all applicable designated uses are developed based on the standards.

IV. DESCRIPTION OF DISCHARGE

Since this facility has not been designed, constructed, or placed in operation, and no discharge has been made to the Grand Canal, no discharge monitoring data is available.

V. STATUS OF COMPLIANCE WITH THE EXISTING AZPDES PERMIT

N/A - This is a new permit and as such this section is not applicable

VI. PROPOSED PERMIT CHANGES

N/A - This is a new permit and as such this section is not applicable

VII. DETERMINATION OF DISCHARGE LIMITATIONS AND CHARACTERIZATION

When determining what parameters need monitoring and/or limits included in the draft 56th Street and Earll Drive WQARF Site Groundwater Treatment System permit, both technology-based and water quality-based criteria were compared and the more stringent criteria applied.

Technology-based Limitations: As outlined in 40 CFR Part 133

There are no promulgated technology-based limits for a groundwater treatment system such as the 56th Street and Earll Drive facility. However, it has been demonstrated that this technology allows for efficient removal of volatile organic compounds (VOCs), and the discharge can be sampled with low detection limits. Based on a review of the groundwater data submitted by the applicant and using best professional judgment (BPJ), technology-based limits have been set for **chloroform, 1,2-cis-dichloroethylene (c-DCE), tetrachloroethylene (PCE), toluene, and trichloroethylene (TCE)** in the draft permit. All these parameters have been detected in the groundwater. The proposed limits are based on Safe Drinking Water Act Maximum Contaminant Levels (MCLs) which are the clean-up levels routinely required for groundwater remediation projects of this type.

Water Quality-based Limitations: As outlined in A.A.C. R18-11-109 and Appendix A

Per 40 CFR 122.44(d)(1)(ii), (iii) and (iv), discharge limits must be included in the permit for parameters with "reasonable potential" (RP), that is, those known to be or expected to be present in the effluent at a level that could potentially cause any applicable numeric water quality standard to be exceeded. "Reasonable potential" refers to the possibility, based on the statistical calculations using the data submitted, or consideration of other factors to determine whether the discharge may exceed the Water Quality Standards. RP may also be determined from BPJ based on knowledge of the treatment facilities and other factors. The basis for the RP determination for each parameter with a limit is shown in the table below. Since no effluent (discharge) data was available, groundwater data was used for RP calculation. As a result, RP was calculated for **boron** and **selenium**. The permittee submitted an application for and received a mixing zone for boron. Boron will be monitored with limitations within the mixing zone while selenium will be monitored with limitations at or prior to discharge point (Outfall 001).

The procedures used to determine reasonable potential are outlined in the *Technical Support Document for Water Quality-based Toxics Control (TSD)* (EPA/505/2-90-001). In most cases, the highest reported value for a parameter is multiplied by a factor (determined from the variability of the data and number of samples) to determine a "highest estimated value". This value is then compared to the lowest applicable Water Quality Standard for the receiving water. If the value is greater than the standard, RP exists and a limit is required in the permit.

The proposed permit limits were established using a methodology developed by EPA. Long Term Averages (LTA) were calculated for each designated use and the lowest LTA was used to calculate the average monthly limit (AML) and maximum daily limit (MDL) necessary to protect all uses. This methodology takes into account criteria, effluent variability, and the number of observations taken to determine compliance with the limit and is described in Chapter 5 of the TSD. When the limit is based on human health criteria, the monthly average was set at the level of the applicable standard and a daily maximum limit was determined as specified in Section 5.4.4 of the TSD.

The limits for all parameters except for **boron** in this permit were determined without the use of a mixing

zone. Arizona state water quality rules require that water quality standards be achieved without mixing zones unless the permittee applies for and is approved for a mixing zone. A mixing zone was applied for and granted for boron, and the permit limits will be applied at the edge of the mixing zone. Since a mixing zone was not applied for or granted for any other parameters, all other water quality criteria are applied at end-of-pipe.

Discharge Characterization Testing: As outlined in 40 CFR 122.43(a), 40 CFR 122.44(i), 40 CFR 122.48(b), and A.R.S. 49-203(A)(7)

In addition to monitoring for parameters assigned a permit limit, sampling is required to assess the presence of pollutants in the discharge at certain minimum frequencies for additional suites of parameters. The purpose of *Discharge Characterization Testing* is to characterize the discharge and determine if the parameters of concern are present in the discharge and at what levels. This monitoring will be used to assess RP per 40 CFR 122.44(d)(1)(iii)). If pollutants are noted at levels of concern during the permit term, this permit may also be reopened to add related limits or conditions. The following trace substances and VOCs will be monitored without limitations or assessment levels for discharge characterization in the draft permit: **arsenic, cadmium, chromium (total), copper, cyanide, hardness, lead, mercury, zinc, 1,1,1-trichloroethane (TCA), 1,1-dichloroethylene (1,1-DCE), 1,2-trans-dichloroethylene (t-DCE), 1,2-dichloroethane (1,2-DCA), vinyl chloride, benzene, ethylbenzene,** and **xylene.** Analysis of data showed no RP for the trace substances with applicable water quality standards except for total chromium and cyanide for which no data were submitted. However, they will be monitored without limitations or assessment levels for discharge characterization based on BPJ. Although the groundwater data submitted to ADEQ showed all VOCs as less than the laboratory reporting limits, they are pollutants of concern which are known to be present in similar contaminated WQARF sites around the Metropolitan Phoenix area and are required to be monitored with limitations by SRP who owns and operates the receiving water (Grand Canal). Based on BPJ, **manganese** and **oil & grease** will not be monitored during the term of this permit. The discharge is not expected to contain manganese and oil & grease at levels exceeding the applicable numeric or narrative standards, respectively.

NOTE: In the event the facility does not discharge to a water of the U.S. during any monitoring period (e.g., a calendar month, quarter, year, etc.), no monitoring otherwise required during that period will be required.

Permit Limitations and Monitoring Requirements

The table that follows summarizes parameters that will be monitored with limitations or assessment levels in the permit and the rationale for that decision. Also included are parameters that require monitoring without any limitations or assessment levels, or that have not been included in the permit at all and the basis for that decision. The corresponding monitoring requirements are shown for each parameter. In general, the regulatory basis for monitoring requirements is per 40 CFR §122.44(i) *Monitoring requirements*; and 40 CFR §122.48(b), *Required monitoring*; all of which have been adopted by reference in A.A.C. R18-9-A905, *AZPDES Program Standards*.

Parameter	Lowest Standard/ Designated Use	Maximum Reported Daily Value (Groundwater Extraction Wells)	No. of Samples	Estimated Maximum Value (1)	RP Determination	Proposed Monitoring Requirement/ Rationale (2) (3)
Flow	- - -	- - -	- - -	- - -	- - -	Monitoring of discharge flow is required on a continuous basis using a flow meter.
Benzene	No applicable standards	<1 ug/L	2	N/A	N/A	Discharge monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Chloroform	Technology-based limit based on BPJ	1.4 ug/L	2	N/A	N/A	**Discharge monitoring with limitation is required once per month.**
1,2-Dichloroethane (1,2-DCA)	No applicable standards	<1 ug/L	2	N/A	N/A	Discharge monitoring without limitations or assessment levels is required once per six months for discharge characterization.
1,1-Dichloroethylene (1,1-DCE)	No applicable standards	<0.5 ug/L	2	N/A	N/A	Discharge monitoring without limitations or assessment levels is required once per six months for discharge characterization.
1,2-cis-dichloroethylene (c-DCE)	Technology-based limit based on BPJ	0.64 ug/L	2	N/A	N/A	**Discharge monitoring with limitation is required once per month.**
1,2-trans-Dichloroethylene (t-DCE)	No applicable standards	<0.5 ug/L	2	N/A	N/A	Discharge monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Ethyl benzene	No applicable standards	<2 ug/L	2	N/A	N/A	Discharge monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Tetrachloroethylene (PCE) (Perchloroethylene)	Technology-based limit based on BPJ	1.7 ug/L	2	N/A	N/A	**Discharge monitoring with limitation is required once per month.**
Toluene	Technology-based limit based on BPJ	5.5 ug/L	2	N/A	N/A	**Discharge monitoring with limitation is required once per month.**
1,1,1-Trichloroethane (1,1,1-TCA)	1,000 ug/L / AgI	<0.5 ug/L	2	3.3 ug/L	No RP	Discharge monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Trichloroethylene (TCE)	Technology-based limit based on BPJ	46 ug/L	2	N/A	N/A	**Discharge monitoring with limitation is required once per month.**
Vinyl chloride	No applicable standards	<0.5 ug/L	2	N/A	N/A	Discharge monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Xylene	No applicable standards	<3 ug/L	2	N/A	N/A	Discharge monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Antimony	No applicable standards	<2 ug/L	2	N/A	N/A	No monitoring is required.
Arsenic	200 ug/L / AgL	10.7 ug/L	2	79.2 ug/L	No RP	Monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Barium	No applicable standards	No data	0	N/A	N/A	No monitoring is required.

Parameter	Lowest Standard/ Designated Use	Maximum Reported Daily Value (Groundwater Extraction Wells)	No. of Samples	Estimated Maximum Value (1)	RP Determination	Proposed Monitoring Requirement/ Rationale (2) (3)
Beryllium	No applicable standards	<1.0 ug/L	2	N/A	N/A	No monitoring is required.
Boron	1,000 ug/L / AgI	5,600 ug/L	2	41,440 ug/L	RP exists	**Monitoring with limitations is required once per month. Samples shall be taken within mixing zone approximately 1,400 feet downstream of the discharge point in the receiving water (Grand Canal) (5).** Discharge monitoring without limitations or assessment levels is also required once per month.
Cadmium	50 µg/L/ AgI & AgL	<2 ug/L	2	1.85 µg/L	No RP	Monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Chlorine, total residual (TRC)	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Chromium III	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Chromium VI	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Chromium, total	1,000 ug/L / AgI & AgL	No data	0	N/A	No RP (BPJ)	Monitoring without limitations or assessment levels is required once in 2014 for discharge characterization.
Copper	500 µg/L / AgL	23.6 µg/L	2	174.6 µg/L	No RP	Monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Cyanide	200 µg/L / AgL	No data	0	N/A	No RP (BPJ)	Monitoring without limitations or assessment levels is required once in 2014 for discharge characterization.
E. coli	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Fluoride	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Hardness (Receiving water in Grand Canal) (6)	No Applicable Standard. Hardness is used to determine standards for specific metal parameters.	No data	0	N/A	N/A	A&W standards for cadmium, chromium III, copper, lead, nickel, silver and zinc used for RP determinations were based on the default hardness value of 120 mg/ L since no data was available. Receiving water (Grand Canal) monitoring for hardness is required whenever monitoring for hardness dependent metals is required.
Hydrogen Sulfide	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Iron	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Lead	100 µg/L / AgL	4.1 µg/L	2	30.3 ug/L	No RP	Monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Manganese	10,000 µg/L / AgI	No data	0	N/A	N/A	No monitoring is required based on BPJ.
Mercury	10 µg/L / AgL	<0.2 ug/L	2	0.74 ug/L	No RP	Monitoring without limitations or assessment levels is required once per six months for discharge characterization.
Nickel	No applicable standards	<5 ug/L	2	N/A	N/A	No monitoring is required.
Nitrate, nitrite, total nitrogen	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Oil & grease	No applicable standards	No data	0	N/A	N/A	No monitoring is required.

Parameter	Lowest Standard/ Designated Use	Maximum Reported Daily Value (Groundwater Extraction Wells)	No. of Samples	Estimated Maximum Value (1)	RP Determination	Proposed Monitoring Requirement/ Rationale (2) (3)
pH (7)	Min. 6.5; Max.: 9.0 / AgL A.A.C.R 18-11-109 (B)	No data	0	N/A	Limit is always included.	**Monitoring with limitations is required once per month.**
Phosphorus	No applicable standards	No data	0	N/A	N/A	No monitoring is required.
Selenium	20 µg/L / AgI	6.4 µg/L	2	47.4 µg/L	RP exists	**Monitoring with limitations is required once per month.**
Silver	No applicable standards	<5 ug/L	2	N/A	N/A	No monitoring is required.
Thallium	No applicable standards	<0.5 ug/L	2	N/A	N/A	No monitoring is required.
Zinc	10,000 µg/L / AgI	72 µg/L	2	532.8 µg/L	No RP	Monitoring without limitations or assessment levels is required once in 2014 for discharge characterization.
Whole effluent toxicity (WET)	No applicable standards (AgI & AgL)	No data	0	N/A	N/A	No monitoring is required.

Footnotes:

(1) Estimated maximum value is the product of the maximum observed/reported value and the RP multiplier.
(2) Discrete (grab) samples shall be taken for all parameters except for flow which requires continuous measurement using a flow meter. Groundwater quality is not expected to fluctuate sufficiently during a 24-hour period to justify composite sampling.
(3) The monitoring frequencies above are required when the facility is discharging through Outfall 001. If the facility is not discharging during a monitoring period, no sampling is required during that period.
(4) BOD_5 = Biochemical oxygen demand; COD = Chemical oxygen demand; TOC = Total organic carbon; TSS = Total suspended solids
(5) Receiving water (Grand Canal) samples for boron shall be taken from the approximate midpoint of the 32nd Street Bridge over the Grand Canal, approximately 1,400 feet downstream of the discharge point (within Mixing Zone).
(6) Grand Canal (receiving water) samples for hardness shall be taken at the time discharge samples are taken for cadmium, copper, lead, and zinc. They shall be taken from approximately 50 feet upstream of the 56th Street and Earll Drive WQARF Site Groundwater Treatment System.
(7) pH and temperature shall be measured at the time of sampling and do not require use of a certified laboratory.

III. NARRATIVE WATER QUALITY STANDARDS

All narrative limitations in A.A.C. R18-11-108 that are applicable to the receiving water are included in Part I, Sections C and D of the draft permit.

IX. MONITORING AND REPORTING REQUIREMENTS (Part II of Permit)

Section 308 of the Clean Water Act and 40 CFR Part 122.44(i) require that monitoring be included in permits to determine compliance with effluent limitations. Additionally, monitoring may be required to gather data for future effluent limitations or to monitor effluent impacts on receiving water quality. The permittee has the responsibility to determine that all data collected for purposes of this permit meets the requirements specified in this permit and is collected, analyzed, and properly reported to ADEQ.

Monitoring frequencies are based on the nature and effect of the pollutant, as well as a determination of the minimum sampling necessary to adequately monitor the facility's performance. The permittee is responsible for conducting and reporting results to ADEQ on Discharge Monitoring Reports (DMRs) or as otherwise specified in the permit.

Monitoring locations are specified in the permit (Parts I.A, I.B, and I.E) in order to ensure that representative samples of the effluent (discharge) and receiving water are consistently obtained. Surface water (SRP Grand Canal) monitoring for boron shall be conducted within the mixing zone as specified under the Special Conditions (Part III.A) of the proposed permit while surface water samples for hardness shall be taken within 50 feet upstream of the 56th Street and Earll Drive WQARF Site Groundwater Treatment System.

The permit (Part II.A.2) requires the permittee to keep a Quality Assurance (QA) manual at the facility, describing sample collection and analysis processes; the required elements of the QA manual are outlined.

Only discrete (i.e., grab) samples are specified in the permit for all parameters (except for flow) since the quality of groundwater is not expected to fluctuate sufficiently during a 24-hour period to justify composite sampling. Discharge flow shall be measured continuously using a flow meter.

The requirements in the draft permit pertaining to Part II Monitoring and Reporting are included to ensure that the monitoring data submitted under this permit is accurate in accordance with 40 CFR 122.41(e).

Reporting requirements for monitoring results are detailed in Part II, Sections B.1 and 2 of the permit, including completion and submittal of DMRs and AZPDES Flow Record forms. Requirements for retention of monitoring records are detailed in Part II.D of the permit.

X. BIOSOLIDS REQUIREMENTS (Part III in Permit)

N/A – This is not a domestic wastewater treatment plant and does not generate biosolids.

XI. SPECIAL CONDITIONS (Part V in Permit)

Mixing Zone for Boron

The permittee submitted an application with supporting documentation to establish a mixing zone for boron as per A.A.C. R18-11-114.B. Pursuant to A.A.C. R18-11-114.A, ADEQ has reviewed the application and approved establishment of the mixing zone for monitoring boron in the receiving water (SRP Grand Canal). Monthly surface water samples for boron shall be taken from the approximate midpoint of the 32nd Street Bridge over the Grand Canal, approximately 1,400 feet downstream of the discharge point (at the downstream edge of the mixing zone).

Permit Reopener

This permit may be modified based on newly available information; to add conditions or limits to address demonstrated effluent toxicity; to implement any EPA-approved new Arizona water quality standard; or to re-evaluate reasonable potential (RP), if Assessment Levels in this permit are exceeded (A.A.C. R18-9-B906, and 40 CFR Part 122.62 (a) and (b)).

XII. ANTIDEGRADATION

Antidegradation rules have been established under A.A.C. R18-11-107 to ensure that existing surface water quality is maintained and protected. Effluent quality limitations and monitoring requirements have been established under the proposed permit to ensure that the discharge will meet the applicable water quality standards. As long as the permittee maintains consistent compliance with these provisions, the designated uses of the receiving wash will be presumed protected, and the facility will be deemed to meet currently applicable antidegradation requirements under A.A.C. R18-11-107.C.

XIII. STANDARD CONDITIONS

Conditions applicable to all NPDES permits in accordance with 40 CFR, Part 122 are attached as an appendix to this permit.

XIV. ADMINISTRATIVE INFORMATION

Public Notice (A.A.C. R18-9-A907)

The public notice is the vehicle for informing all interested parties and members of the general public of the contents of a draft AZPDES permit or other significant action with respect to an AZPDES permit or application. The basic intent of this requirement is to ensure that all interested parties have an opportunity to comment on significant actions of the permitting agency with respect to a permit application or permit. This permit will be public noticed in a local newspaper after a pre-notice review by the applicant and other affected agencies.

Public Comment Period (A.A.C. R18-9-A908)

Rules require that permits be public noticed in a newspaper of general circulation within the area affected by the facility or activity and provide a minimum of 30 calendar days for interested parties to respond in writing to ADEQ. After the closing of the public comment period, ADEQ is required to respond to all significant comments at the time a final permit decision is reached or at the same time a final permit is actually issued.

Public Hearing (A.A.C R18-9-A908(B))

A public hearing may be requested in writing by any interested party. The request should state the nature of the issues proposed to be raised during the hearing. A public hearing will be held if the Director determines there is a significant amount of interest expressed during the 30-day public comment period, or if significant new issues arise that were not considered during the permitting process.

EPA Review (A.A.C. R18-9-A908(C))

A copy of this draft permit and any revisions made to this draft as a result of public comments received, will be sent to EPA Region 9 for review. If EPA objects to a provision of the draft, ADEQ will not issue the permit until the objection is resolved.

XV. ADDITIONAL INFORMATION

Additional information relating to this proposed permit may be obtained from:

ADEQ
Water Quality Division- Surface Water Permits Unit
Attn: M. Reza Azizi
1110 West Washington Street – Mail Code 5415A-1
Phoenix, Arizona 85007

or by contacting M. Reza Azizi at (602) 771- 4593

XVI. INFORMATION SOURCES

While developing effluent limitations, monitoring requirements and special conditions for the draft permit, the following information sources were used:

1. AZPDES Permit Application Forms 1 and 2C, received November 6, 2009, and along with supporting data, facility diagram and maps submitted by the applicant with the application forms.
2. Supplemental information to the application received by ADEQ on December 22, 2009, January 28, and February 26, 2010.
3. ADEQ files on Freescale 56th Street & Earll Drive WQARF Site
4. Arizona Administrative Code (AAC) Title 18, Chapter 11, Article 1, *Water Quality Standards for Surface Waters,* adopted January 31, 2009.
5. A.A.C. Title 18, Chapter 9, Article 9. *Arizona Pollutant Discharge Elimination System* rules.
6. Code of Federal Regulations (CFR) Title 40:
   Part 122, *EPA administered permit programs: The National Pollutant Discharge Elimination System.*
   Part 124, *Procedures for decisionmaking.*
7. EPA Technical Support Document for Water Quality-based Toxics Control dated March, 1991.
8. *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms* (EPA /821-R-02-013).
9. *U.S. EPA NPDES Permit Writers' Manual,* December 1996.

ADEQ Inventory No. 106170
LTF No. 51093

Permit No. AZ0025861

AUTHORIZATION TO DISCHARGE UNDER THE ARIZONA POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of Arizona Revised Statutes (A.R.S.) Title 49, Chapter 2, Article 3.1; the Federal Water Pollution Control Act, (33 USC §1251 et. seq., as amended), and Arizona Administrative Code (A.A.C.) Title 18, Chapter 9, Articles 9 and 10, and amendments thereto,

Freescale Semiconductor, Inc.
56th Street and Earll Drive WQARF Site Groundwater Treatment System
2100 East Elliot Road, MD EL-614
Tempe, Arizona 85284

is authorized to discharge from the groundwater remediation treatment facility located at the north side bank of the Grand Canal near 34th Street, east of 32nd Street, north of State Route Loop 202 in Phoenix, Maricopa County, Arizona to the Salt River Project (SRP) Grand Canal, a Phoenix Area Canal, in the Middle Gila River Basin at:

Outfall No.	Latitude	Longitude	Legal
001	33° 27' 39.0" N	112° 00' 32.6" W	Township 1N, Range 3 E, Section 1

in accordance with discharge limitations, monitoring requirements and other conditions set forth herein, and in the attached "Standard AZPDES Permit Conditions."

This permit shall become effective on March 25, 2011.

This permit and the authorization to discharge shall expire at midnight, March 26, 2016.

Signed this 22nd day of February, 2011.

Michael A. Fulton, Director
Water Quality Division
Department of Environmental Quality

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PART I. DISCHARGE LIMITATIONS & MONITORING REQUIREMENTS

A. Discharge Limitations and Monitoring Requirements

The permittee shall limit and monitor discharges from Outfall 001 as specified in Table 1 below.

TABLE 1: Discharge Limitations and Monitoring Requirements

Parameter	Maximum Allowable Discharge Limitations (1)		Monitoring Requirement	
	Monthly Average	Daily Maximum	Monitoring Frequency	Sample Type
Discharge flow	REPORT (MGD) (2)	REPORT (MGD) (2)	Continuous	Metered
Boron (3) **(Mixing Zone – Grand Canal)**	NA	1,000 ug/L	Once / month	Discrete
Boron (Discharge)	NA	REPORT (2)	Once / month	Discrete
Selenium (4)	20.0 ug/L	29.2 ug/L	Once / month	Discrete
Chloroform	NA	80 ug/L	Once / month	Discrete
1,2-cis-Dichloroethylene (c -1,2-DCE)	NA	70 ug/L	Once / month	Discrete
Tetrachloroethylene (PCE)	NA	5.0 ug/L	Once / month	Discrete
Toluene	NA	1,000 ug/L	Once / month	Discrete
Trichloroethylene (TCE)	NA	5.0 ug/L	Once / month	Discrete
pH (5)	Not less than 6.5 standard units (S.U.) nor greater than 9.0 S.U.		Once / month	Discrete

Footnotes:
(1) MGD = million gallons per day; ug/L = micrograms per liter; NA = not applicable
(2) Monitoring and reporting required. No limit set at this time. In addition to the average and maximum flows reported on the Discharge Monitoring Report (DMR) forms, daily discharge flow shall be recorded on the **Discharge Flow Record** provided in Appendix B. See Part II.B for reporting requirements.
(3) Receiving water samples for boron shall be taken from approximate midpoint of the 32nd Street Bridge over the Grand Canal, approximately 1,400 feet downstream of the discharge point (within mixing zone). See also Part III.A.
(4) Selenium discharge limitations are for total recoverable metals.
(5) pH shall be measured at the time of sampling and does not require use of a certified laboratory

B. Discharge Characterization Testing

The permittee shall monitor to characterize the facility's discharge from Outfall 001 for the parameters listed in Tables 2.a – 2.b. When the facility discharges, monitoring is to be conducted at the frequency indicated in the tables. **In the event the facility does not discharge during a monitoring period, no monitoring will be required in that period.** No limits or assessment levels (ALs) are established, but the limit of quantitation (LOQ) must be low enough to allow comparison of the results to the applicable surface water quality standards (SWQS). If a LOQ below the water quality standards (WQS) cannot be achieved, then the permittee shall use the method expected to achieve the lowest LOQ, as defined in Appendix A of this permit. Samples are to be representative of any seasonal variation in the discharge.

TABLE 2.a: Discharge Characterization Testing – (Selected Metals and Trace Substances)

Parameter (1)	Reporting Units	Monitoring Requirements	
		Monitoring Frequency	Sample Type
Arsenic	ug/L	Once / 6 month	Discrete
Cadmium	ug/L	Once / 6 month	Discrete
Chromium	ug/L	Once in year 2014	Discrete

TABLE 2.a: Discharge Characterization Testing – (Selected Metals and Trace Substances)

Copper	ug/L	Once / 6 month	Discrete
Cyanide	ug/L	Once in year 2014	Discrete
Hardness (as CaCO3) (2)	mg/L	Once / 6 month	Discrete
Lead	ug/L	Once / 6 month	Discrete
Mercury	ug/L	Once / 6 month	Discrete
Zinc	ug/L	Once in year 2014	Discrete

Footnotes:
(1) All metals analyses shall be for total recoverable metals.
(2) Receiving water (Grand Canal) samples for hardness shall be taken at the time samples are taken for cadmium, copper, lead, and zinc. Grand Canal samples shall be taken approximately 50 feet upstream of the 56th Street and Earll Drive WQARF Site Groundwater Treatment System.

TABLE 2.b: Discharge Characterization Testing - Selected Volatile Organic Compounds

Parameter	Reporting Units	Monitoring Requirements	
		Monitoring Frequency	Sample Type
Benzene	ug/L	Once / 6 month	Discrete
1,2-Dichloroethane (1,2-DCA)	ug/L	Once / 6 month	Discrete
1,1-Dichloroethylene (1,1-DCE)	ug/L	Once / 6 month	Discrete
1,2-trans-Dichloroethylene (t-1,2-DCE)	ug/L	Once / 6 month	Discrete
Ethyl benzene	ug/L	Once / 6 month	Discrete
1,1,1-Trichloroethane (1,1,1-TCA)	ug/L	Once / 6 month	Discrete
Vinyl chloride	ug/L	Once / 6 month	Discrete
Xylene	ug/L	Once / 6 month	Discrete

C. The discharge shall be free from pollutants in amounts or combinations that:

1. Settle to form bottom deposits that inhibit or prohibit the habitation, growth or propagation of aquatic life;
2. Cause objectionable odor in the area in which the surface water is located;
3. Cause off-flavor in aquatic organisms;
4. Are toxic to humans, animals, plants or other organisms;
5. Cause the growth of algae or aquatic plants that inhibit or prohibit the habitation, growth or propagation of other aquatic life or that impair recreational uses;
6. Change the color of the surface water from natural background levels of color.

D. The discharge shall be free from oil, grease and other pollutants that float as debris, foam, or scum; or that cause a film or iridescent appearance on the surface of the water; or that cause a deposit on a shoreline, bank or aquatic vegetation.

E. Samples taken for the monitoring requirements specified in Part I shall be collected at the following locations:

1. Discharge samples shall be taken downstream from the last treatment process and prior to mixing with the receiving water in the Grand Canal.

2. Receiving water samples for flow (if necessary) and **boron** downstream of the discharge point ("Downstream Samples") shall be taken from the approximate midpoint of the 32nd Street Bridge over the Grand Canal, approximately 1,400 feet downstream of the discharge point (at the downstream edge of mixing zone).

3. Receiving water samples for flow (if necessary), **boron**, and **hardness** upstream of the discharge point ("Upstream Samples") shall be taken from the Grand Canal approximately 50 feet upstream of the 56th Street and Earll Drive WQARF Site Groundwater Treatment System.

PART II. MONITORING AND REPORTING

A. Sample Collection and Analysis

1. The permittee is responsible for the quality and accuracy of all data required under this permit.

2. Quality Assurance (QA) Manual

The permittee shall keep a QA Manual on-site that describes the sample collection and analyses processes. If the permittee collects samples or conducts sample analyses in-house, the permittee shall develop a QA Manual that addresses these activities. If a third party collects and/or analyzes samples on behalf of the permittee, the permittee shall obtain a copy of the applicable QA procedures. The QA Manual shall be available for review by ADEQ upon request. The QA Manual shall be updated as necessary to reflect current conditions, and shall describe the following:

a. Project Management, including:

- Purpose of sample collection and sample frequency;
- When and where samples will be collected;
- How samples will be collected;
- Who will collect samples and their qualifications;
- Laboratory(s) that will perform analyses;
- Any field tests to be conducted (detail methods and specify equipment, including a description of any needed calibrations); and
- Pollutants or analytes being measured and for each, the permit-specific limits, Assessment Levels, or thresholds, (e.g. the associated detection limits needed.)

b. Sample collection procedures including

- Equipment to be used;
- Type and number of samples to be collected including QA/QC samples (i.e., background samples, duplicates, and equipment or field blanks);
- Types, sizes, and number of sample bottles needed;

- Preservatives and holding times for the samples (see methods under 40 CFR 136 or 9 A.A.C. 14, Article 6 or any condition within this permit that specifies a particular test method); and
- Chain of custody procedures.

c. Specify approved analytical method(s) to be used and include;

- Limits of Detection (LOD) and Limits of Quantitation (LOQs);
- Required quality control (QC) results to be reported (e.g., matrix spike recoveries, duplicate relative percent differences, blank contamination, laboratory control sample recoveries, surrogate spike recoveries, etc.) and acceptance criteria; and
- Corrective actions to be taken by the permittee or the laboratory as a result of problems identified during QC checks.

d. How the permittee will perform data review; complete DMRs and records used to report results to ADEQ; resolve data quality issues; and identify limitations on the use of the data.

3. Sample collection, preservation and handling shall be performed as described in 40 CFR 136 including the referenced Edition of *Standard Methods for the Examination of Water and Wastewater*, or by procedures referenced in A.R.S Title 9, Chapter 14 of the Arizona Department of Health Services (ADHS) Laboratory Licensure rules. The permittee shall outline the proper procedures in the QA Manual, and samples taken for this permit must conform with these procedures whether collection and handling is performed directly by the permittee or contracted to a third-party.

4. Analytical requirements

a. The permittee shall use a laboratory licensed by the ADHS Office of Laboratory Licensure and Certification that has demonstrated proficiency within the last 12 months under R9-14-609, for each parameter to be sampled under this permit. However, this requirement does not apply to parameters which require analysis at the time of sample collection as long as the testing methods used are approved by ADHS or ADEQ. (These parameters may include flow, dissolved oxygen, pH, temperature, and total residual chlorine.)

b. The permittee must utilize analytical methods specified in this permit. If no test procedure is specified, the permittee shall analyze the pollutant using:

i. A test procedure listed in 40 CFR 136 which is also approved under A.A.C. R9-14-610;
ii. An alternative test procedure approved by EPA as provided in 40 CFR 136 and which is also approved under A.A.C. R9-14-610;
iii. A test procedure listed in 40 CFR 136, with modifications allowed by EPA or approved as a method alteration by ADHS under A.A.C. R9-14-610(C); or
iv. If no test procedure for a pollutant is available under (3)(b)(i) through (3)(b)(iii) above, any Method approved under A.A.C. R9-14-610(C) for wastewater may be used, except the use of field kits is not allowed unless otherwise specified in this permit. If there is no approved wastewater method for a parameter, any other method identified in 9 A.A.C. 14, Article 6 that will achieve appropriate detection and reporting limits may be used for analyses.

c. For results to be considered valid, all analytical work shall meet quality control standards specified in the approved methods.

d. The permittee shall use analytical methods with a Limit of Quantitation (LOQ) that is lower than the discharge limitations, Assessment Levels, Action Levels, or water quality criteria specified in this permit. If all methods have LOQs higher than applicable water quality criteria, the Permittee shall use the approved analytical method with the lowest LOQ.

e. The permittee shall use a standard calibration curve when applicable to the method, where the lowest standard point is equal to or less than the LOQ.

f. If requested, the permittee shall participate in the annual NPDES DMR/QA study and submit the results of this study to ADEQ and ADHS for all laboratories used in monitoring compliance with this permit.

5. Metals Analyses

In accordance with 40 CFR 122.45(c), all discharge metals concentrations shall be measured as "total metals". Discharge Limits and Assessment Levels in this permit are for total metals.

B. Reporting of Monitoring Results

1. The permittee shall report monitoring results on Discharge Monitoring Report (DMR) forms supplied by ADEQ, to the extent that the results may be entered on the forms. The permittee shall submit results of all monitoring required by this permit in a format that will allow direct comparison with the limitations and requirements of this permit. If no discharge occurs during a reporting period, the permittee shall specify "No discharge" on the DMR. The results of all discharge analyses conducted during the monitoring period shall be included in calculations of the monthly average and daily maximums reported on the DMRs if the analyses were by methods specified in Part II.A above.

2. DMRs and attachments are to be submitted (see Appendix A- definitions) by the 28th day of the month following the end of a monitoring period. For example, if the monitoring period ends January 31st, the permittee shall submit the DMR by February 28th. The permittee shall submit original copies of these and all other reports required in this Part, signed by an authorized representative, to ADEQ at the following address:

ADEQ Water Quality Compliance Section
Data Unit Mailcode: 5415B-1
1110 W. Washington St.
Phoenix, AZ 85007

or fax to (602) 771-4505.

For each month, the permittee shall complete and submit a copy of the **AZPDES Discharge Flow Record** (found in Appendix B) with the DMR for that month, along with copies of the original lab results for all parameters monitored during the reporting period.

3. If requested, the permittee shall submit results of the NPDES DMR/QA study to ADEQ and ADHS for all laboratories used in monitoring compliance with this permit by December 31st of each year. The permittee shall also participate in the DMR-QA study for any DMR-QA parameters that the permittee analyzes (typically pH and chlorine) and submit the results along with the laboratory results. The results shall be submitted to the following addresses:

Arizona Department of Environmental Quality ADEQ Surface Water Permits Unit Mailcode: 5415A-1 1110 W. Washington St. Phoenix, AZ 85007	Arizona Department of Health Services Attn: DMRQA Coordinator 250 N 17th Avenue Phoenix, AZ 85007

4. For the purposes of reporting, the permittee shall use the Limit of Quantitation.

5. For parameters with Daily Maximum Limits or Daily Maximum Assessment Levels in this permit, the permittee shall review the results of all samples collected during the reporting period and report as follows:

Use the following tables for information on how to report data on the DMR when the LOQ for a parameter is greater than the permit limits or standards:

For Daily Maximum Limits/Assessment Levels	The Permittee shall Report on the DMR
When the maximum value of any analytical result is greater than the LOQ	The maximum value of all analytical results
When the maximum value detected is greater than or equal to the laboratory's LOD but less than the LOQ (1)	The numeric result with E4 or E8 flag as applicable (AZ qualifier)
When the maximum value is less than the laboratory's LOD (2)	"< ND" (specify the LOD level, i.e.,< 10 ug/L)

Footnotes:
(1) Not Quantifiable
(2) Below Detection

6. For parameters with Monthly Average Limits or Monthly Average ALs in this permit, the permittee shall review the results of all samples collected during the reporting period and report:

For Monthly Average Limits/Assessment Levels		The Permittee shall Report on the DMR
If only one sample is collected during the reporting period (monthly, quarterly, annually, etc.) (In this case, the sample result **is** the monthly average.)	When the value detected is greater than the LOQ	The analytical result
	When the value detected is greater than or equal to the laboratory's LOD, but less than the LOQ	The numeric result with E4 or E8 flag as applicable (AZ qualifier)
	When the value is less than the laboratory's LOD	"< LOD" (specify the LOD level, i.e., < 10ug/L)

For Monthly Average Limits/Assessment Levels		The Permittee shall Report on the DMR
If more than one sample is collected during the reporting period	All samples collected in the same calendar month must be averaged. $ When all results are greater than the LOQ, all values are averaged $ If some results are < LOQ, use the LOD value in the averaging $ Use '0' for values less than the LOD	The highest monthly average which occurred during the reporting period

7. If the information below is not included on the laboratory reports required in Part II.B.2, the permittee shall attach a report to each DMR that includes, for all analytical results during the reporting period:

   a. The analytical result.

   b. The number or title of the approved analytical method, preparation and analytical procedure utilized by the laboratory, and LOD and the LOQ for the analytical method for the pollutant.

   c. Any applicable data using Arizona Data Qualifiers Revision 3.0 (9/20/2007).

C. Twenty-four Hour Reporting of Noncompliance

The permittee shall orally report any noncompliance which may endanger the environment or human health within 24 hours from the time the permittee becomes aware of the event to:

ADEQ 24 hour hotline at (602) 771-2330

The permittee shall also notify the Water Quality Compliance Section Manager at (602) 771-2209 by phone call or voice mail by 9 a.m. on the first business day following the noncompliance. The permittee shall also notify the Water Quality Compliance Section in writing within 5 days of the noncompliance event. The permittee shall include in the written notification: a description of the noncompliance and its cause; the period of noncompliance, including dates and times, and, if the noncompliance has not been corrected, the time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

D. Monitoring Records

The permittee shall retain records of the following monitoring information:

1. Date, exact location and time of sampling or measurements performed, preservatives used;

2. Individual(s) who performed the sampling or measurements;

3. Date(s) the analyses were performed;

4. Laboratory(s) which performed the analyses;

5. Analytical techniques or methods used;

6. Chain of custody forms;

7. Any comments, case narrative or summary of results produced by the laboratory. These comments should identify and discuss QA/QC analyses performed concurrently during sample analyses and should specify whether analyses met project requirements and 40 CFR 136. If results include information on initial and continuing calibration, surrogate analyses, blanks, duplicates, laboratory control samples, matrix spike and matrix spike duplicate results, sample receipt condition, or holding times and preservation, these records must also be retained.

8. Summary of data interpretation and any corrective action taken by the permittee.

PART III. SPECIAL CONDITIONS

A. MIXING ZONE

1. Mixing Zone and Point of Compliance

A mixing zone has been granted in the Grand Canal for discharges from the 56th Street and Earll Drive WQARF Site Groundwater Treatment System (M56 Facility) with boron concentrations above the applicable standard of 1,000 ug/L (AgI). The mixing zone for boron has been approved following dilution of the M56 Facility discharges with canal flows which include discharges from the Operable Unit 2 (OU2). Outfall 001 and the subsequent mixing zone will be located immediately downstream of the discharges from OU2 and the corresponding mixing zone in the Grand Canal. The receiving water samples to assess compliance with boron limitation of the 56th Street and Earll Drive WQARF Site Groundwater Treatment System permit shall be collected from the approximate midpoint of the 32nd Street Bridge over the Grand Canal, approximately 1,400 feet downstream of the discharge point (Outfall 001).

2. Blending OU2 and 56th Street & Earll Drive Discharges with Grand Canal Flow

The following formulas will be used to calculate the minimum flow of Grand Canal (F_G) above the facility (M56) and OU2 discharges to meet the mixing zone permit limit for boron of 1,000 ug/L (or 1 mg/L).

$$C_D = (F_{OU2} * C_{OU2} + F_{M56} * C_{M56} + F_G * C_G) \div (F_{OU2} + F_{M56} + F_G)$$
$$C_D (F_{OU2} + F_{M56} + F_G) = (F_{OU2} * C_{OU2} + F_{M56} * C_{M56} + F_G * C_G)$$
$$C_D F_{OU2} + C_D F_{M56} + C_D F_G = F_{OU2} * C_{OU2} + F_{M56} * C_{M56} + F_G * C_G$$
$$C_D F_G - F_G * C_G = F_{OU2} * C_{OU2} + F_{M56} * C_{M56} - C_D F_{OU2} - C_D F_{M56}$$
$$F_G (C_D - C_G) = (F_{OU2} * C_{OU2} + F_{M56} * C_{M56} - C_D F_{OU2} - C_D F_{M56})$$
$$\mathbf{F_G = (F_{OU2} * C_{OU2} + F_{M56} * C_{M56} - C_D F_{OU2} - C_D F_{M56}) \div (C_D - C_G)}$$

Where:

F_{OU2} = Flow from OU2
F_{M56} = Flow from M56 (56th Street & Earll Dr.) Facility
F_G = Flow in Grand Canal above OU2 and M56 Facility discharges ("Upstream Sample")
C_{OU2} = Maximum boron concentration in OU2 discharge
C_{M56} = Maximum boron concentration in M56 Facility discharge
C_G = Maximum boron concentration in Grand Canal above OU2 and M56 Facility discharges ("Upstream Sample")
C_D = Boron concentration in Grand Canal Mixing Zone downstream of OU2 and M56 Facility discharges ("Downstream Sample")

All flows and concentrations must be in the same units.

B. REOPENER

This permit may be modified per the provisions of A.A.C. R18-9-B906, and R18-9-A905 which incorporates 40 CFR Part 122. This permit may be reopened based on newly available information; to add conditions or limits to address demonstrated discharge toxicity; to implement any EPA-approved new Arizona water quality standard; or to re-evaluate reasonable potential (RP), if Assessment Levels in this permit are exceeded.

APPENDIX A PART A: ACRONYMS

A.A.C.	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
EQ	Exceptional Quality (biosolids)
AZPDES	Arizona Pollutant Discharge Elimination System
A.R.S.	Arizona Revised Statutes
CFR	Code of Federal Regulations
CFU	Colony Forming Units
Director	The Director of ADEQ or any authorized representative thereof
DMR	Discharge Monitoring Report
EPA	The U.S. Environmental Protection Agency
kg/day	kilograms per day
MGD	Million Gallons per Day
mg/L	milligrams per Liter, also equal to parts per million (ppm)
MPN	Most Probable Number
NPDES	National Pollutant Discharge Elimination System
PFU	Plaque-Forming Unit
QA	Quality Assurance
SSU	Sewage Sludge Unit
ug/L	micrograms per Liter, also equal to parts per billion (ppb)

APPENDIX A PART B: DEFINITIONS

BASE FLOOD means a flood that has a one percent chance of occurring in any given year (or a flood that is likely to occur once in 100 years).

DAILY MAXIMUM CONCENTRATION LIMIT means the maximum allowable discharge of a pollutant in a calendar day as measured on any single discrete sample.

DISCRETE or GRAB SAMPLE means an individual **sample of at least 100 mL** collected from a single location, or over a period of time not exceeding 15 minutes.

HARDNESS means the sum of the calcium and magnesium concentrations, expressed as calcium carbonate ($CACO_3$) in milligrams per liter.

LIMIT OF QUANTITATION (LOQ) means the minimum levels, concentrations, or quantities of a target variable such as an analyte that can be reported with a specific degree of confidence. The calibration point shall be at or below the LOQ. The LOQ is the concentration in a sample that is equivalent to the concentration of the lowest calibration standard analyzed by a specific analytical procedure, assuming that all of the method-specified sample weights, volumes, and processing steps have been followed.

LIMIT OF DETECTION (LOD) means an analyte and matrix-specific estimate of the minimum amount of a substance that the analytical process can reliably detect with a 99% confidence level. This may be laboratory dependent and is developed according to R9014-615(C)(7).

METHOD DETECTION LIMIT (MDL) - See LOD.

MIXING ZONE is an area where a discharge undergoes initial dilution and may be extended to cover the secondary mixing in the ambient water body. A mixing zone is an allocated impact zone where water quality criteria can be exceeded as long as acutely toxic conditions are prevented.

MONTHLY OR WEEKLY AVERAGE CONCENTRATION LIMIT, other than for bacteriological testing, means the highest allowable average calculated as an arithmetic mean of consecutive measurements made during calendar month or week, respectively. The "monthly or weekly average concentration limit" for *E. coli* bacteria means the highest allowable average calculated as the geometric mean of a minimum of four (4) measurements made during a calendar month or week, respectively. The geometric mean is the nth root of the product of n numbers. For either method (CFU or MPN), when data are reported as "0" or non-detect then input a "1" into the calculation for the geometric mean.

PATHOGEN means a disease-causing organism.

SIGNIFICANT DIFFERENCE is defined as statistically significant difference (e.g., 95% confidence level) in the means of two distributions of sampling results.

SUBMIT, as used in this permit, means post-marked, documented by other mailing receipt, or hand-delivered to ADEQ.

APPENDIX B

AZPDES Discharge Flow Record

56th Street and Earll Drive WQARF Site
Groundwater Treatment System- AZ0025861

Discharge to Grand Canal in the Middle Gila River Basin At:

Outfall No.: 001

Location:

Month: **Year:**

DATE	Flow Duration [1] (Total hours per day)	Flow Rate[2] (Total MGD per day)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		

Comment:

Footnotes:

(1) Total time of discharge in hours per day. If actual time is not available, use an estimate of flow duration.

(2) Report flow discharged in MGD. If no discharge occurs on any given day, report 'ND' for the flow for that day

Signature of Authorized Representative:

_____

DMR attachment

APPENDIX C

STANDARD AZPDES PERMIT CONDITIONS & NOTIFICATIONS

(Updated as of February 2, 2004)

1. Duty to Reapply [R18-9-B904(C)]
Unless the Permittee permanently ceases the discharging activity covered by this permit, the Permittee shall submit a new application 180 days before the existing permit expires.

2. Applications [R18-9-A905(A)(1)(c) which incorporates 40 CFR 122.22]

   a. All applications shall be signed as follows:

      1) For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

         A) A president, secretary, treasurer, or vice-president of the corporation in charge of a principle business function, or any other person who performs similar policy- or decision-making functions for the corporation, or

         B) The manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

      2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

      3) For a municipality, State, Federal, or other public agency: By either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes: (i) The chief executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of EPA).

   b. All reports required by permits and other information requested by the Director shall be signed by a person described in paragraph (a) of this Section, or by a duly authorized representative of that person. A person is a duly authorized representative only if:

      1) The authorization is made in writing by a person described in paragraph (a) of this section;

      2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.) and,

      3) The written authorization is submitted to the Director.

   c. Changes to Authorization. If an authorization under paragraph (b) of this section is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph (b) of this section must be submitted to the Director prior to or together with any reports, information, or applications to be signed by an authorized representative.

   d. Certification. Any person signing a document under paragraph (a) or (b) of this section shall make the following certification:

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

3. Duty to Comply [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(a)(i) and A.R.S. §49- 262, 263.01, and 263.02.]

   a. The Permittee shall comply with all conditions of this permit and any standard and prohibition required under A.R.S. Title 49, Chapter 2, Article 3.1 and A.A.C. Title 18, Chapter 9, Articles 9 and 10. Any permit noncompliance constitutes a violation of the Clean Water Act; A.R.S. Title 49, Chapter 2, Article 3.1; and A.A.C. Title 18, Chapter 9, Articles 9 and 10, and is grounds for enforcement action, permit termination, revocation and reissuance, or modification, or denial of a permit renewal application.

   b. The issuance of this permit does not waive any federal, state, county, or local regulations or permit requirements with which a person discharging under this permit is required to comply.

   c. The Permittee shall comply with the effluent standards or prohibitions established under section 307(a) of the Clean Water Act for toxic pollutants and with standards for sewage sludge use or disposal established under section 405(d) of the Clean Water Act within the time provided in the regulation that establish these standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

   d. Civil Penalties. A.R.S. § 49-262(C) provides that any person who violates any provision of A.R.S. Title 49, Chapter 2, Article 3.1 or a rule, permit, discharge limitation or order issued or adopted under A.R.S. Title 49, Chapter 2, Article 3.1 is subject to a civil penalty not to exceed $25,000 per day per violation.

   e. Criminal Penalties. Any a person who violates a condition of this permit, or violates a provision under A.R.S. Title 49, Chapter 2, Article 3.1, or A.A.C. Title 18, Chapter 9, Articles 9 and 10 is subject to the enforcement actions established under A.R.S. Title 49, Chapter 2, Article 4, which may include the possibility of fines and/or imprisonment.

4. Need to Halt or Reduce Activity Not a Defense [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(c)]

   It shall not be a defense for a Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

5. Duty to Mitigate [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(d)]

   The Permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

6. Proper Operation and Maintenance [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(e)]

   The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the Permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a Permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

7. Permit Actions [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(f)]

This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the Permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

8. Property Rights [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(g)]

This permit does not convey any property rights of any sort, or any exclusive privilege.

9. Duty to Provide Information [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(h)]

The Permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee shall also furnish to the Director upon request, copies of records required to be kept by this permit.

10. Inspection and Entry [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(i)]

The Permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and such other documents as may be required by law, to:

a. Enter upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b. Have access to and copy, at reasonable times, any records that must be kept under the terms of the permit;

c. Inspect at reasonable times any facilities, equipment (including monitoring equipment or control equipment), practices or operations regulated or required under this permit; and

d. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by A.R.S. Title 49, Chapter 2, Article 3.1, and A.A.C. Title 18, Chapter 9, Articles 9 and 10, any substances or parameters at any location.

11. Monitoring and Records [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(j)]

a. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

b. The Permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report or application, except for records of monitoring information required by this permit related to the Permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by 40 CFR Part 503). This period may be extended by request of the Director at any time.

c. Records of monitoring information shall include:

1) The date, exact place and time of sampling or measurements;

2) The individual(s) who performed the sampling or measurements;

3) The date(s) the analyses were performed;

4) The individual(s) who performed the analyses;

5) The analytical techniques or methods used; and

6) The results of such analyses.

d. Monitoring must be conducted according to test procedures specified in this permit. If a test procedure is not specified in the permit, then monitoring must be conducted according to test procedures approved under A.A.C. R18-9-A905(B) including those under 40 CFR Part 136 unless otherwise specified in 40 CFR Part 503 (for sludge).

e. The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained in this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two years per violation, or by both for first conviction. For a second conviction, such a person is subject to a fine of not more than $20,000 per day of violation, or imprisonment for not more than four years, or both.

Any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained in this permit is subject to the enforcement actions established under A.R.S. Title 49, Chapter 2, Article 4, which includes the possibility of fines and/or imprisonment.

12. Signatory Requirement [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(k)]

a. All applications, reports, or information submitted to the Director shall be signed and certified. (See 40 CFR 122.22 incorporated at R18-9-A905(A)(1)(c))

b. The CLEAN WATER ACT provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or non-compliance shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two years per violation, or by both for a first conviction. For a second conviction, such a person is subject to a fine of not more than $20,000 per day of violation, or imprisonment of not more than four years, or both.

13. Reporting Requirements [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(l)]

a. Planned changes. The Permittee shall give notice to the Director as soon as possible of any planned physical alterations of additions to the permitted facility. Notice is required only when:

1) The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in 40 CFR 122.29(b) (incorporated by reference at R18-9-A905(A)(1)(e)); or

2) The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under 40 CFR 122.42(a)(1) (incorporated by reference at R18-9-A905(A)(3)(b)).

3) The alteration or addition results in a significant change in the Permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.

b. Anticipated noncompliance. The Permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

c. Transfers. (R18-9-B905) This permit is not transferable to any person except after notice to the Director. The Director may require modification or revocation and reissuance of the permit to change the name of the Permittee and incorporate such other requirements as may be necessary under Arizona Revised Statutes and the Clean Water Act.

d. Monitoring reports. Monitoring results shall be reported at the intervals specified elsewhere in this permit.

1) Monitoring results must be reported on a Discharge Monitoring Report (DMR) or forms provided or specified by the Director for reporting results of monitoring of sludge use or disposal practices.

2) If the Permittee monitors any pollutant more frequently than required by the permit, then the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR, or sludge reporting form specified by the Director.

3) Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Director in the permit.

e. Compliance schedules. Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date.

f. Twenty-four hour reporting.

1) The Permittee shall report any noncompliance which may endanger human health or the environment. Any information shall be provided orally within 24 hours from the time the Permittee becomes aware of the circumstances. A written submission shall also be provided within five days of the time the Permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

2) The following shall be included as information which must be reported within 24 hours under this paragraph.

a) Any unanticipated bypass which exceeds any effluent limitation in the permit. (See 40 CFR 122.41(g) which is incorporated by reference at R18-9-A905(A)(3)(a))

b) Any upset which exceeds any effluent limitation in the permit.

c) Violation of a maximum daily discharge limitation for any of the pollutants listed by the Director in the permit to be reported within 24 hours. (See 40 CFR 122.44(g) which is incorporated by reference at R18-9-A905(A)(3)(d))

g. Other noncompliance. The Permittee shall report all instances of noncompliance not reported under paragraphs (d), (e), and (f) of this section, at the time monitoring reports are submitted. The reports shall contain the information listed in paragraph (f) of this section.

h. Other information. Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Director, it shall promptly submit such facts or information.

14. Bypass [R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(m)]

a. Definitions

1) "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the

absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

b. Bypass not exceeding limitations. The Permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provision of paragraphs (c) and (d) of this section.

c. Notice.

1) Anticipated bypass. If the Permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of bypass.
2) Unanticipated bypass. The Permittee shall submit notice of an unanticipated bypass as required in paragraph (f)(2) of section 13 (24-hour notice).

d. Prohibition of bypass.

1) Bypass is prohibited, and the Director may take enforcement action against a Permittee for bypass, unless:

a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment down time. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

c) The Permittee submitted notices as required under paragraph (c) of this section.

2) The Director may approve an anticipated bypass, after considering its adverse effects, if the Director determines that it will meet the three conditions listed above in paragraph (d)(1) of this section.

15. Upset [A.R.S.§§49-255(8) and 255.01(E), R18-9-A905(A)(3)(a) which incorporates 40 CFR 122.41(n)]

a. Definition. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

b. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of paragraph (c) of this section are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

c. Conditions necessary for a demonstration of upset. A Permittee who wishes to establish the affirmative defenses of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

1) An upset occurred and that the Permittee can identify the cause(s) of the upset;

2) The permitted facility was at the time being properly operated; and

3) The Permittee submitted notice of the upset as required in paragraph (f)(2) of Section 13 (24-hour notice).

4) The Permittee has taken appropriate measure including all reasonable steps to minimize or prevent any discharge or sewage sludge use or disposal that is in violation of the permit and that has a reasonable likelihood of adversely affecting human health or the environment per A.R.S. § 49-255.01(E)(1)(d)

d. Burden of proof. In any enforcement proceeding the Permittee seeking to establish the occurrence of an upset has the burden of proof.

16. Existing Manufacturing, Commercial, Mining, and Silvicultural Dischargers [R18-9-A905(A)(3)(b) which incorporates 40 CFR 122.42(a)]

In addition to the reporting requirements under 40 CFR 122.41(l) (which is incorporated at R18-9-A905(A)(3)(a)), all existing manufacturing, commercial, mining, and silvicultural dischargers must notify the Director as soon as they know or have reason to believe:

a. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

1) One hundred micrograms per liter (100 µg/l);

2) Two hundred micrograms per liter (200 µg/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 µg/l) for 2,4-dinitrophenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/l) for antimony;

3) Five times the maximum concentration value reported for that pollutant in the permit application in accordance with 40 CFR 122.21(g)(7) (which is incorporated at R18-9-A905(A)(1)(b)); or

4) The level established by the Director in accordance with 40 CFR 122.44(f) (which is incorporated at R18-9-A905(A)(3)(d)).

b. That any activity has occurred or will occur which would result in any discharge, on a nonroutine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

1) Five hundred micrograms per liter (500 µg/l);

2) One milligram per liter (1 mg/l) for antimony;

3) Ten (10) times the maximum concentration value reported for that pollutant in the permit application in accordance with 40 CFR 122.21(g)(7)(which is incorporated at R18-9-A905(A)(1)(b));

4) The level established by the Director in accordance with 40 CFR 122.44(f) (which is incorporated at R18-9-A905(A)(3)(d)).

17. Publicly Owned Treatment Works [R18-9-A905(A)(3)(b) which incorporates 40 CFR 122.42(b)]

This section applies only to publicly owned treatment works as defined at ARS § 49-255(5).

a. All POTW's must provide adequate notice to the Director of the following:

1) Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to section 301 or 306 of the CLEAN WATER ACT if it were directly discharging those pollutants; and

2) Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.

3) For the purposes of this paragraph, adequate notice shall include information on (i) the quality and quantity of effluent introduced into the POTW, and (ii) any anticipated impact of the change on the quantity or quality of effluent to be discharge from the POTW.

b. Publicly owned treatment works may not receive hazardous waste by truck, rail, or dedicated pipe except as provided under 40 CFR 270. Hazardous wastes are defined at 40 CFR 261 and include any mixture containing any waste listed under 40 CFR 261.31 - 261.33. The Domestic Sewage Exclusion (40 CFR 261.4) applies only to wastes mixed with domestic sewage in a sewer leading to a publicly owned treatment works and not to mixtures of hazardous wastes and sewage or septage delivered to the treatment plant by truck.

18. Reopener Clause [R18-9-A905(A)(3)(d) which incorporates 40 CFR 122.44(c)]

This permit shall be modified or revoked and reissued to incorporate any applicable effluent standard or limitation or standard for sewage sludge use or disposal under sections 301(b)(2)(C), and (D), 304(b)(2), 307(a)(2) and 405(d) which is promulgated or approved after the permit is issued if that effluent or sludge standard or limitation is more stringent than any effluent limitation in the permit, or controls a pollutant or sludge use or disposal practice not limited in the permit.

19. Privately Owned Treatment Works [R18-9-A905(A)(3)(d) which incorporates 40 CFR 122.44]

This section applies only to privately owned treatment works as defined at 40 CFR 122.2.

a. Materials authorized to be disposed of into the privately owned treatment works and collection system are typical domestic sewage. Unauthorized material are hazardous waste (as defined at 40 CFR Part 261), motor oil, gasoline, paints, varnishes, solvents, pesticides, fertilizers, industrial wastes, or other materials not generally associated with toilet flushing or personal hygiene, laundry, or food preparation, unless specifically listed under "Authorized Non-domestic Sewer Dischargers" elsewhere in this permit.

b. It is the Permittee's responsibility to inform users of the privately owned treatment works and collection system of the prohibition against unauthorized materials and to ensure compliance with the prohibition. The Permittee must have the authority and capability to sample all discharges to the collection system, including any from septic haulers or other unsewered dischargers, and shall take and analyze such samples for conventional, toxic, or hazardous pollutants when instructed by the permitting authority. The Permittee must provide adequate security to prevent unauthorized discharges to the collection system.

c. Should a user of the privately owned treatment works desire authorization to discharge non-domestic wastes, the Permittee shall submit a request for permit modification and an application, pursuant to 40 CFR 122.44(m), describing the proposed discharge. The application shall, to the extent possible, be submitted using ADEQ Forms 1 and 2C, unless another format is requested by the permitting authority. If the privately owned treatment works or collection system user is different from the Permittee, and the Permittee agrees to allow the non-domestic discharge, the user shall submit the application and the Permittee shall submit the permit modification request. The application and request for modification shall be submitted at least 6 months before authorization to discharge non-domestic wastes to the privately owned treatment works or collection system is desired.

20. Transfers by Modification [R18-9-B905]

Except as provided in section 21, a permit may be transferred by the Permittee to a new owner or operator only if the permit has been modified or revoked and reissued, or a minor modification made under R18-9-B906, to identify the new Permittee and incorporate such other requirements as may be necessary.

21. Automatic Transfers [R18-9-B905]

An alternative to transfers under section 20, any AZPDES permit may be automatically transferred to a new Permittee if:

a. The current Permittee notifies the Director at least 30 days in advance of the proposed transfer date;

b. The notice includes a written agreement between the existing and new Permittee containing a specific date for transfer of permit responsibility, coverage, and liability between them; and

c. The Director does not notify the existing Permittee and the proposed new Permittee of his or her intent to modify or revoke and reissue the permit. A modification under this subparagraph may also be a minor modification under R18-9-B906(B).

22. Minor Modification of Permits [R18-9-B906(B)]

Upon the consent of the Permittee, the Director may modify a permit to make the corrections or allowances for changes in the permitted activity listed in this section, without following public notice procedures under R18-9-A907 or A908. Minor modifications may only:

a. Correct typographical errors;

b. Update a permit condition that changed as a result of updating an Arizona water quality standard;

c. Require more frequent monitoring or reporting by the Permittee;

d. Change an interim compliance date in a schedule of compliance, provided the new date is not more than 120 days after the date specified in the existing permit and does not interfere with attainment of the final compliance date requirement;

e. Allow for a change in ownership or operational control of a facility where the Director determines that no other change in their permit is necessary, provided that a written agreement containing a specific date for transfer of permit responsibility, coverage, and liability between the current and new Permittee has been submitted to the Director.

f. Change the construction schedule for a discharger which is a new source. No such change shall affect a discharger's obligation prior to discharge under 40 CFR 122.29 (which is incorporated by reference in R18-9-A905(A)(1)(e)).

g. Delete a point source outfall when the discharge from that outfall is terminated and does not result in discharge of pollutants from other outfalls except in accordance with the permit limits.

h. Incorporate conditions of a POTW pretreatment program that has been approved in accordance with the procedures in 40 CFR 403.11 and 403.18 as enforceable conditions of the POTW's permit.

i. Annex an area by a municipality.

23. Termination of Permits [R-9-B906(C)]

The following are causes for terminating a permit during its term, or for denying a permit renewal application:

a. Noncompliance by the Permittee with any condition of the permit;

b. The Permittee's failure in the application or during the permit issuance process to disclose fully all relevant facts, or the Permittee's misrepresentation of any relevant facts at any time;

c. A determination that the permitted activity endangers human health or the environment and can only by regulated to acceptable levels by permit modification or termination; or

d. A change in any condition that requires either a temporary or a permanent reduction or elimination of any discharge controlled by the permit (for example, a plant closure or termination of discharge by connection to a POTW).

24. Availability of Reports [Pursuant to A.R.S § 49-205]

Except for data determined to be confidential under A.R.S § 49-205(A), all reports prepared in accordance with the terms of this permit shall be available for public inspection at ADEQ offices. As required by A.R.S. § 49-205(B) and (C), permit applications, permits, and effluent data shall not be considered confidential.

25. Removed Substances [Pursuant to Clean Water Act Section 301]

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering navigable waters.

26. Severability [Pursuant to A.R.S § 49-324(E)]

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and remainder of this permit, shall not be affected thereby.

27. Civil and Criminal Liability [Pursuant to A.R.S § 49-262, 263.01, and 263.02]

Except as provided in permit conditions on "Bypass" (Section 14) and "Upset" (Section 15), nothing in this permit shall be construed to relieve the Permittee from civil or criminal penalties for noncompliance.

28. Oil and Hazardous Substance Liability [Pursuant to Clean Water Act Section 311]

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the Permittee from any responsibilities, liabilities, or penalties to which the Permittee is or may be subject under Section 311 of the Clean Water Act.

29. State or Tribal Law [Pursuant to R18-9-A904(C)]

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the operator from any responsibilities, liabilities, or penalties established pursuant to any applicable State or Tribal law or regulation under authority preserved by Section 510 of the Clean Water Act.

Appendix B

Field SOP

FIELD S.O.P. NO. 1

PROCEDURES FOR MEASURING pH

1.0 Calibration Procedure

The pH meter will be calibrated daily.

1. Switch the unit on by pressing the ON/OFF key.
2. Immerse the electrode in a pH 7 buffer. Stir gently and wait for approximately 20 seconds.
3. Press "CAL" button, display will blink.
4. When reading stabilizes, press "HOLD/CON" button. This will calibrate meter to pH 7.0. Display will stop blinking.
5. If an error message appears, the calibration was not performed correctly. Try using fresh pH solution, changing batteries, or replacing pH sensor, if applicable.
6. Rinse electrode in water and repeat steps for pH 4.0 and/or pH 10.0 buffer solutions.
7. Rinse electrode in distilled/deionized water and then immerse probe in pH 7.0 solution again to check calibration.
8. Rinse electrode with distilled/deionized water. The meter is calibrated and ready for use.

2.0 Operation Procedure

1. Calibrate pH meter.
2. Rinse probe in distilled/deionized water.
3. Fill plastic disposable beaker with water from the sample.
4. Insert probe into sample beaker. Stir gently and wait for approximately 20 seconds and obtain a reading. The meter will read between 0 and 14, in 0.1 increments.
5. Log results in field notebook.
6. Rinse probe off in distilled/deionized water.
7. If the electrodes become coated with foreign compounds, the probe should be cleaned with a detergent solution and then rinsed with distilled/deionized water.

3.0 Maintenance Procedure

1. Rinse probe free of white crystals or dirt with water.
2. Replace batteries on a regular basis.
3. When batteries are low, the unit will display an error message. Remove the cover with its O-ring and replace all batteries paying attention to their polarity. Reinsert the cover with the O-ring and close. Recalibrate the instrument.

4. Keep records of usage, maintenance, calibration, problems, and repairs.
5. A replacement meter will be available onsite or ready for overnight shipment.
6. Store electrode in wet, protective cap.
7. pH meter will be sent back to manufacturer for service when needed.

4.0 Quality Control

1. Duplicate 1 out of 12 samples. If less than 12 samples are analyzed, a duplicate is still required. Duplicates must be ±0.2 pH units.

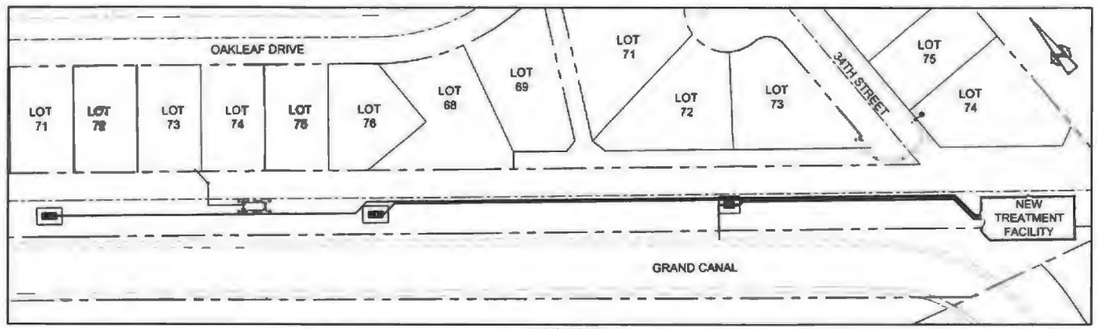
   If the results are outside of the control limits, rinse electrodes and repeat analysis. If results are still outside of the control limits, recollect samples and repeat analysis. If the results are still outside of the control limits, check calibration and recalibrate if necessary (see item 2, below). If drift is suspected to be the cause of the problem, clean the electrode and recalibrate. If drift is still apparent, replace electrode.

2. Calibration check results must be ±0.1 pH unit of the true value. If the result is outside of ±0.1 pH unit, rinse electrodes and check solution again. If still outside the control limit, recalibrate the meter and reanalyze all samples analyzed since the last in-control calibration.

Appendix E

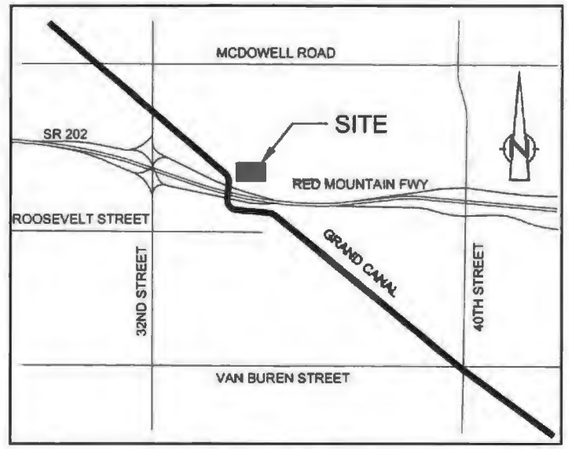
Record Drawings

GROUNDWATER TREATMENT SYSTEM
56TH STREET AND EARLL DRIVE WQARF SITE
PHOENIX, ARIZONA



LOCATION MAP
NTS

PROJECT ADDRESS:
1091 N. 34TH STREET
PHOENIX, AZ, 85008



VICINITY MAP
NOT TO SCALE

DESIGN COORDINATE BASIS

SURVEY DATA USED IN THE DESIGN IS BASED ON THE SURVEY CONDUCTED BY ENTELLUS, JOB NUMBER 704.003, DATA 01/06/09, TITLED "RESULTS OF TOPOGRAPHIC SURVEY OF GRAND CANAL."

CITY OF PHOENIX SITE BENCHMARKS

34th Street & Roosevelt Street (North)
CITY OF PHOENIX BRASS CAP FLUSH
ELEVATION = 1132.241

36th Street & McDowell Road
CITY OF PHOENIX BRASS CAP IN HAND HOLE
ELEVATION = 1148.209

32nd Street & McDowell Road
CITY OF PHOENIX BRASS CAP IN HAND HOLE
ELEVATION = 1138.786

32nd Street & Roosevelt
CITY OF PHOENIX BRASS CAP IN HAND HOLE
ELEVATION = 1127.898

36th Street & Van Buren
TRIANGLE CHISELED IN SOUTH RIM OF CITY OF PHOENIX SANITARY SEWER MANHOLE IN SIDEWALK ON SOUTH SIDE OF VAN BUREN, APPROXIMATELY 25-FEET EAST OF THE CENTERLINE OF 36TH STREET.
ELEVATION = 1127.818

40th Street and Roosevelt
A.D.O.T. BRASS CAP IN HAND HOLE IN THE INSIDE NORTHBOUND LANE.
ELEVATION = 1151.197

HORIZONTAL AND VERTICAL CONTROL STATEMENT

LINEAR UNIT: INTERNATIONAL FOOT
GEODETIC DATUM: NAD83(EPOCH 2002)
VERTICAL DATUM: CITY OF PHOENIX DATUM UTILIZING BENCHMARKS SHOWN
ELEVATIONS AS SHOWN ARE MODELED USING GEOID 03.
MAP PROJECTION: STATE PLANE COORDINATES, ARIZONA CENTRAL ZONE.
SCALED TO GROUND
GROUND SCALE FACTOR: 1.0001483086
FALSE NORTHING OFFSET: 800,000.00
FALSE EASTING OFFSET: 800,000.00

CONTROL POINTS:

SURVEY PERFORMED UTILIZING THE AZGPS VRS CONTROL NETWORK. THE FOLLOWING POINTS WERE UTILIZED AS CONTROL:

POINT AZPE (BASE POINT)

NORTHING 136892.012
EASTING -3240.429

NGS CORS STATION, L1 ANTENNA PHASE CENTER MOUNTED ON TOP OF THE BIG O TIRES LOCATED ON THE WEST SIDE OF 91ST AVENUE BETWEEN PEORIA AND OLIVE.

THE JOB SITE WAS SCALED ABOUT THE FOLLOWING POINT:

POINT JR606

NORTHING 94378.358
EASTING 70647.631

3-INCH CITY OF PHOENIX BRASS CAP FOUND IN HANDHOLE. NO ADDITIONAL MARKINGS. POINT IS AT THE INTERSECTION OF 32ND STREET AND ROOSEVELT AND IS ACCEPTED AS THE WEST QUARTER CORNER OF SECTION 1, TOWNSHIP 1 NORTH, RANGE 3 EAST OF THE GILA AND SALT RIVER BASE AND MERIDIAN. MARICOPA COUNTY GDACS POINT # 65584-1.

BASIS OF BEARINGS.

THE ARIZONA STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, AS DEFINED BY THE NORTH AMERICAN DATUM OF 1983, 2002.0 EPOCH [NAD83(2002)]. NO ROTATION WAS APPLIED.

ENGINEER

CONESTOGA-ROVERS & ASSOCIATES, INC.
4050 EAST COTTON CENTER BOULEVARD, SUITE 49
PHOENIX, AZ 85040
PH: 602 749-9400
F: 602 749-9500
CONTACT: PRASHANT KUMAR, P.E.

OWNER

FREESCALE SEMICONDUCTOR,INC
2100 E. ELLIOT RD
TEMPE, AZ 85284
PH: 480-413-3290
FAX: 480-413-5170
CONTACT: JENN McCALL

SOILS REPORT

THE GEOTECHNICAL REPORT USED TO IN PREPARATION OF THE DESIGN WAS PERFORMED BY NINYO AND MOORE TITLED "GEOTECHNICAL EVALUATION GAC VESSEL PROJECT 34TH STREET AND LOOP 202 PHOENIX ARIZONA" DATED APRIL 15, 2011 AND REFERENCED AS PROJECT 603410001

SITE DATA

PROJECT ADDRESS: 1091 N. 34TH STREET, PHOENIX, AZ, 85008
GROSS AREA: 0.09 ACRES
NET AREA: 0.09 ACRES
EXISTING ZONING: CITY OF PHOENIX R1-6, R-4
PROPOSED ZONING: CITY OF PHOENIX R1-6, R-4
EXISTING LAND USE: USA FEE PROPERTY
PROPOSED LAND USE: GROUNDWATER TREATMENT SYSTEM
SCHOOL DISTRICT: CREIGHTON SCHOOL DISTRICT
OVERLAY ZONES: ASSESSOR ZONE CODE R-6, M-H
PROVIDED PARKING: N/A
LOT COVERAGE; N/A
LOT COVERAGE PERCENTAGE: N/A

UTILITY COMMITMENT TABLE

SEWAGE DISPOSAL:	CITY OF PHOENIX
WATER SERVICE:	CITY OF PHOENIX
POLICE SERVICE:	CITY OF PHOENIX
FIRE PROTECTION:	CITY OF PHOENIX
ELECTRICAL SERVICE:	SRP
REFUSE REMOVAL:	ALLIED WASTE SERVICES
TELEPHONE SERVICE:	QWEST

DRAWING INDEX

FREESCALE SEMICONDUCTOR, INC	PROJECT NO.	DATE
SALT RIVER PROJECT AGRICULTURAL DISTRICT (SRP)	SRP NO.	DATE
ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY (ADEQ)	ADEQ NO.	DATE

IN ACCORDANCE WITH AAC R18-4-119, ALL MATERIALS INSTALLED AFTER JANUARY 1, 1993 WHICH MAY COME IN CONTACT WITH DRINKING WATER SHALL CONFORM TO THE NATIONAL SANITATION FOUNDATION STANDARDS 60 & 61.

AS BUILT CERTIFICATION

I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION, OR PROVIDED TO ME BY THE CONSTRUCTION CONTRACTOR, OR AS NOTED AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

PRASHANT KUMAR
REGISTERED CIVIL ENGINEER

05/12/2014
DATE

46527
REGISTRATION #

CERTIFICATE NO. 46527 PRASHANT KUMAR 05/12/14 REGISTERED ARIZONA U.S.A.

GK 12/30/2013

REV	DESCRIPTION	DATE
A	30% SUBMITTAL	11/30/11
B	90% SUBMITTAL	12/30/13
C	CONSTRUCTION	1/30/14
D	AS-BUILT	4/2/14
1	ADDENDUM #1	5/12/14

56TH STREET AND EARLL DRIVE
WQARF SITE
GROUNDWATER TREATMENT SYSTEM
PHOENIX, AZ

freescale semiconductor

COVER SHEET

Sheet Number 1 OF 32
Drawing Number GN-01

602-263-1100

Conestoga-Rovers & Associates, Inc.
4050 East Cotton Center Blvd. Suite 49
Phoenix, AZ 85040

NOTICE OF EXPIRED CERTIFICATION AND APPROVAL PERIOD PROVISION
THIS CONTRACT ALLOWS THE OWNER TO CERTIFY AND APPROVE BILLINGS AND RETAINAGE WITHIN 45 DAYS AFTER THE BILLING AND RETAINAGE ARE RECEIVED FROM THE CONTRACTOR.

PRIMARY ELEMENT SYMBOLS

- TURBINE FLOW METER
- MAGNETIC FLOW METER
- POSITIVE DISPLACEMENT FLOW METER
- WEIR
- VORTEX FLOW METER
- ROTAMETER
- ULTRASONIC LEVEL TRANSMITTER
- FLOAT
- OPEN DRAIN OR SEWER
- CLOSED DRAIN OR SEWER
- SPECIFICATION CHANGE
- CAP
- HOSE CONNECTION
- BLIND FLANGE
- STRAINER
- INLINE MIXER
- FLEXIBLE PIPE

PUMP AND COMPRESSOR SYMBOLS

- CENTRIFUGAL PUMP (DRY PIT)
- CENTRIFUGAL WET PIT PUMP OR TURBINE PUMP
- CHEMICAL FEED PUMP
- DIAPHRAGM PUMP
- GEAR PUMP OR BLOWER (POSITIVE DISPLACEMENT)
- PISTON PUMP
- PROGRESSIVE CAVITY PUMP
- SUBMERSIBLE SUMP PUMP
- COMPRESSOR (CENTRIFUGAL) BLOWER OR TURBINE
- COMPRESSOR (PISTON)
- EJECTOR

NOTE:

ON LOSS OF PRIMARY POWER (PNEUMATIC, ELECTRICAL, OR HYDRAULIC)
XX: AS = ADJUSTABLE SPEED
CS-1 = CONSTANT SPEED (SINGLE SPEED)
CS-2 = CONSTANT SPEED (TWO SPEED)

ACTUATOR SYMBOLS

- ELECTRIC
- ELECTROHYDRAULIC
- HYDRAULIC
- PNEUMATIC WITH VOLUME BOOSTER
- SOLENOID
- MANUAL

NOTE:

ELECTRICAL OR HYDRAULIC)
XX: FD = FAIL OPEN
FC = FAIL CLOSED
FLP = FAIL TO LAST POSITION

INTERFACE SYMBOLS

- PROCESS INTERFACE
- SIGNAL INTERFACE
- A INTERFACE LETTER
- D
- S SOURCE DRAWING NUMBER

INTERFACE TO/FROM PROCESS EXTERNAL TO PROJECT

INSTRUMENTATION SYMBOLS

- PROGRAMMABLE LOGIC CONTROL FIELD MOUNTED
- PROGRAMMABLE LOGIC CONTROL NORMALLY ACCESSIBLE (BOARD MOUNTED)
- PROGRAMMABLE LOGIC CONTROL BEHIND BOARD MOUNTED
- PROGRAMMABLE LOGIC CONTROL AUX. LOCATION
- DISCRETE INSTRUMENT/ELECTRICAL DEVICE FIELD MOUNTED
- DISCRETE INSTRUMENT/ELECTRICAL DEVICE NORMALLY ACCESSIBLE (BOARD MOUNTED)
- DISCRETE INSTRUMENT/ELECTRICAL DEVICE BEHIND BOARD MOUNTED
- DISCRETE INSTRUMENT/ELECTRICAL DEVICE AUX. LOCATION
- SHARED DISPLAY/CONTROL DEVICE FIELD MOUNTED
- SHARED DISPLAY/CONTROL DEVICE NORMALLY ACCESSIBLE (BOARD MOUNTED)
- SHARED DISPLAY/CONTROL DEVICE BEHIND BOARD MOUNTED
- SHARED DISPLAY/CONTROL DEVICE AUX. LOCATION
- LOCAL INDICATOR LIGHT R - RED, Y - YELLOW, G - GREEN
- INDICATOR LIGHT NORMALLY ACCESSIBLE
- UNDEFINED COMPLEX INTERCONNECTING LOGIC

INSTRUMENTATION LINES

- ELECTRIC ANALOG SIGNAL
- ELECTRIC BINARY SIGNAL
- PNEUMATIC SIGNAL
- PNEUMATIC BINARY SIGNAL
- INTERNAL SYSTEM LINK

MISCELLANEOUS SYMBOLS

- PRESSURE RELIEF WITH FLOW SWITCH
- REDUCER
- FLEXIBLE PIPE EXPANSION JOINT
- BLIND FLANGE
- HOSE CONNECTION
- SCREWED CAP, CLEANOUT, SCREEN
- Y-LINE STRAINER
- SPECIFICATION CHANGE
- FUNNEL DRAIN
- STATIC MIXER
- FILTER/REGULATOR/LUBRICATOR
- ANNUNCIATOR HORN
- FILTER/REGULATOR
- EQUIPMENT INSULATED WITH X" OF INSULATION
- RESET FOR LATCH-TYPE ACTUATOR
- OPEN VENT TO ATMOSPHERE
- INLINE BLANK
- RESTRICTION ORIFICE
- AIR EJECTOR
- TRAP
- PULSATION DAMPER
- BLOCK & BLEED ASSEMBLY
- SPECIALITY PART
- AIR RELIEF VAVLE
- SAMPLE PORT (WATER)

ISA LETTER COMBINATIONS

First-Letters	Initiating or Measured Variable	Controllers: Recording	Controllers: Indicating	Controllers: Blind	Controllers: Self-Actuated Control Valves	Readout Devices: Recording	Readout Devices: Indicating	Switches and Alarm Devices *: High **	Switches and Alarm Devices *: Low	Switches and Alarm Devices *: Comb	Transmitters: Recording	Transmitters: Indicating	Transmitters: Blind	Extension, Relays, Computing Devices	Primary Element	Test Point	Well or Probe	Viewing Device Glass	Safety Device	Final Element
A	Analysis	ARC	AIC	AC		AR	AI	ASH	ASL	ASHL	ART	AIT	AT	AY	AE	AP	AW			AV
B	Burner/Combustion	BRC	BIC	BC		BR	BI	BSH	BSL	BSHL	BRT	BIT	BT	BY	BE		BW	BG		BZ
C	User's Choice																			
D	User's Choice																			
E	Voltage	ERC	EIC	EC		ER	EI	ESH	ESL	ESHL	ERT	EIT	ET	EY	EE					EZ
F	Flow Rate	FRC	FIC	FC	FCV, FICV	FR	FI	FSH	FSL	FSHL	FRT	FIT	FT	FY	FE	FP		FG		FV
FQ	Flow Quantity	FQRC	FQIC			FQR	FQI	FQSH	FQSL			FQIT	FQT	FQY	FQE					FQV
FF	Flow Ratio	FFRC	FFIC	FFC		FFR	FFI	FFSH	FFSL						FE					FFV
G	User's Choice																			
H	Hand		HIC	HC						HS										HV
I	Current	IRC	IIC			IR	II	ISH	ISL	ISHL	IRT	IIT	IT	IY	IE					IZ
J	Power	JRC	JIC			JR	JI	JSH	JSL	JSHL	JRT	JIT	JT	JY	JE					JV
K	Time	KRC	KIC	KC	KCV	KR	KI	KSH	KSL	KSHL	KRT	KIT	KT	KY	KE					KV
L	Level	LRC	LIC	LC	LCV	LR	LI	LSH	LSL	LSHL, LSHH	LRT	LIT	LT	LY	LE		LW	LG		LV
M	User's Choice																			
N	User's Choice																			
O	User's Choice																			
P	Pressure/Vacuum	PRC	PIC	PC	PCV	PR	PI	PSH	PSL	PSHL	PRT	PIT	PT	PY	PE	PP			PSV, PSE	PV
PD	Pressure, Differential	PDRC	PDIC	PDC	PDCV	PDR	PDI	PDSH	PDSL		PDRT	PDIT	PDT	PDY	PE	PP				PDV
Q	Quantity	QRC	QIC			QR	QI	QSH	QSL	QSHL	QRT	QIT	QT	QY	QE					QZ
R	Radiation	RRC	RIC	RC		RR	RI	RSH	RSL	RSHL	RRT	RIT	RT	RY	RE		RW			RZ
S	Speed/Frequency	SRC	SIC	SC	SCV	SR	SI	SSH	SSL	SSHL	SRT	SIT	ST	SY	SE					SV
T	Temperature	TRC	TIC	TC	TCV	TR	TI	TSH	TSL	TSHL	TRT	TIT	TT	TY	TE	TP	TW		TSE	TV
TD	Temperature, Differential	TDRC	TDIC	TDC	TDCV	TDR	TDI	TDSH	TDSL		TDRT	TDIT	TDT	TDY	TE	TP	TW			TDV
U	Multivariable					UR	UI							UY						UV
V	Vibration/Machinery Analysis					VR	VI	VSH	VSL	VSHL	VRT	VIT	VT	VY	VE					VZ
W	Weight/Force	WRC	WIC	WC	WCV	WR	WI	WSH	WSL	WSHL	WRT	WIT	WT	WY	WE					WZ
WD	Weight/Force, Differential	WDRC	WDIC	WDC	WDCV	WDR	WDI	WDSH	WDSL		WDRT	WDIT	WDT	WDY	WE					WDZ
X	Unclassified																			
Y	Event/State/Presence		YIC	YC		YR	YI	YSH	YSL				YT	YY	YE					YZ
Z	Position/Dimension	ZRC	ZIC	ZC	ZCV	ZR	ZI	ZSH	ZSL	ZSHL	ZRT	ZIT	ZT	ZY	ZE					ZV
ZD	Gauging/Deviation	ZDRC	ZDIC	ZDC	ZDCV	ZDR	ZDI	ZDSH	ZDSL		ZDRT	ZDIT	ZDT	ZDY	ZDE					ZDV

Note: This table is not all-inclusive.

* A. alarm, the annunciating device, may be used in the same fashion as S, switch, the actuating device.

** The letters H and L may be omitted in the undefined case.

Other Possible Combinations:

FD	(Restriction Orifice)	PFR	(Ratio)
FRK, HIK	(Control Stations)	KQI	(Running Time Indicator)
FX	(Accessories)	QQI	(Indicating Counter)
TJR	(Scanning Recorder)	WKIC	(Rate-of-Weight-Loss Controller)
LLH	(Pilot Light)	HMS	(Hand Momentary Switch)
LCH	(Level Control High)	LCL	(Level Control Low)

SELF-ACTUATED REGULATOR, VALVES AND OTHER DEVICES

- RUPTURE DISC FOR PRESSURE RELIEF
- RUPTURE DISC FOR VACUUM RELIEF
- PRESSURE RELIEF VALVE
- VACUUM RELIEF VALVE
- COMBINATION AIR/VACUUM RELIEF VALVE

VALVE SYMBOLS

- BA-* BALL VALVE
- BU-* BUTTERFLY VALVE
- CH-* CHECK VALVE
- GA-* GATE VALVE
- GL-* GLOBE VALVE

PROJECT SPECIFIC SYMBOLS

- FLAP GATE

AS BUILT CERTIFICATION

I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION, OR PROVIDED TO ME BY THE CONSTRUCTION CONTRACTOR, OR AS NOTED AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

PRASHANT KUMAR
REGISTERED CIVIL ENGINEER

05/12/2014
DATE

41527
REGISTRATION #

Professional Engineer Expiration Date CERTIFICATE NO 41527 PRASHANT KUMAR 05/31/15 PHOENIX, ARIZONA, U.S.A.

Prashant Kumar 5/29/2014

NOTES:

1. THIS IS A STANDARD LEGEND LIST, THEREFORE SOME SYMBOLS OR ABBREVIATIONS MAY APPEAR ON THIS LIST AND NOT ON THE DRAWINGS.
2. CONTACT ENGINEER FOR ABBREVIATIONS AND SYMBOLS NOT LISTED.
3. OTHER SYMBOLS NOT SHOWN ON THIS LEGEND MAYBE SHOWN ON ANOTHER LEGEND SHEETS IN THIS DRAWING PACKAGE

ISSUED FOR CONSTRUCTION

602-263-1100

Cornerstone-Rovers & Associates, Inc
4050 East Cotton Center Blvd., Suite 48
Phoenix, AZ 85040

NOTICE OF EXTENDED CERTIFICATION AND APPROVAL PERIOD PROVISION.

THIS CONTRACT ALLOWS THE OWNER 90 CENTS AND APPROVE BILLINGS AND REPAIRS WITHIN 45 DAYS AFTER THE BILLING AND REPAIRS ARE RECEIVED FROM THE CONTRACTOR.

REV	DESCRIPTION	DATE
A	100% SUBMITTAL	5/30/11
B	100% SUBMITTAL	5/30/12
C	ADDENDUM #1	5/30/13
D	AS-BUILT REVISION	05/14

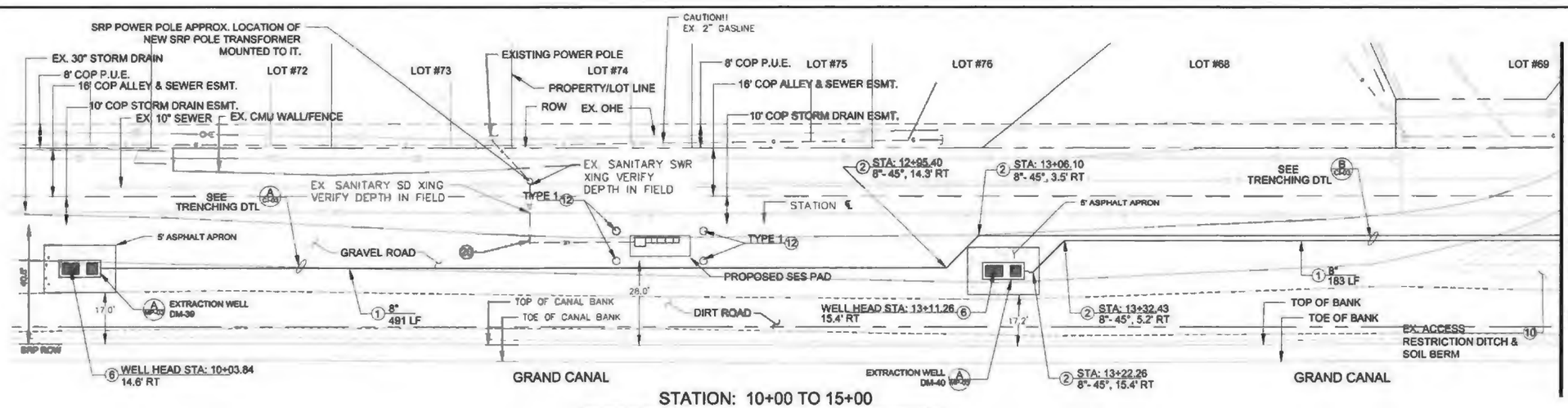
56TH STREET AND EARLL DRIVE
WQARF SITE
GROUNDWATER TREATMENT SYSTEM
PHOENIX, AZ

freescale semiconductor

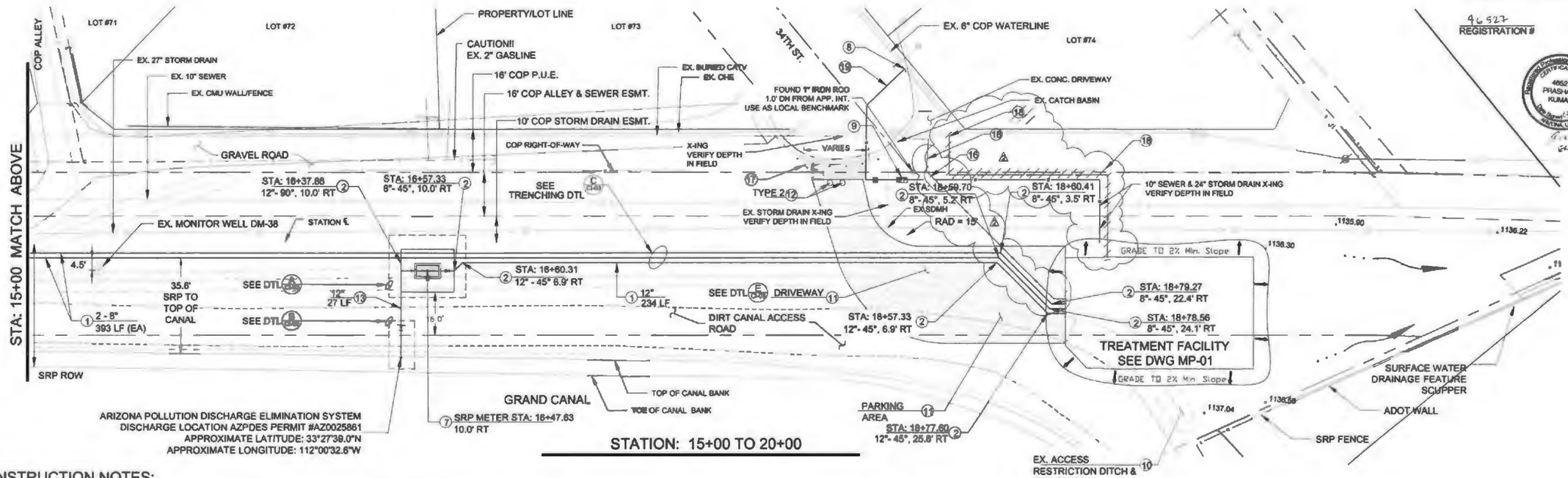
PROCESS & INSTRUMENTATION DIAGRAM LEGEND

GN-06

070386-30(04)GN-PX006 SEPT 27/2011



STATION: 10+00 TO 15+00



STATION: 15+00 TO 20+00

AS BUILT CERTIFICATION

I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION, OR PROVIDED TO ME BY THE CONSTRUCTION CONTRACTOR, OR AS NOTED AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

Prashant Kumar
REGISTERED CIVIL ENGINEER

02/05/2014
DATE

46527
REGISTRATION #

40527 PRASHANT KUMAR — Date Signed 2-5-14

CONSTRUCTION NOTES:

1. INSTALL HDPE (SDR 9) WATERLINE PER M.A.G. SPEC. 603 AND 3-FT MIN. COVER. PIPE SIZE SHOWN ON PLAN. MAINTAIN 1-FT MIN. HORIZONTAL O.D. SEPARATION BETWEEN PARALLEL INSTALLATIONS. (MAG 603)
2. INSTALL BEND - LONG SWEEPING RADIUS. BEND ANGLE SHOWN ON PLAN.
7. INSTALL SRP METER & VAULT PER (A SRP)
8. INSTALL WATER SERVICE CONNECTION PER COP DETAIL P1342. PER APPROVED PLUMBING PERMIT. CUT & RESTORE CONCRETE PER APPROVED PLUMBING PERMIT.
9. INSTALL 1" WATER METER PER COP DETAIL P1315 (NO. 1) WITH "WATER" INSCRIBED ON THE LID. PER APPROVED PLUMBING PERMIT.
10. FILL WITH NATIVE MATERIAL & COMPACT AND GRADE TO MATCH EXISTING SURROUNDING GROUND ELEVATIONS PER SRP REQUIREMENTS.
11. INSTALL 2" (3/4 MINUS) DECOMPOSED GRANITE ON 6" ABC COMPACTED TO 95%.
12. INSTALL BOLLARDS . SEE DETAIL (F C403)
15. INSTALL CHAINLINK FENCE SEE DETAIL (B C405)
16. INSTALL BACK FLOW PREVENTER WITH CAGE PER APPROVED COP PLUMBING PERMIT.
17. INSTALL DRIVEWAY PER APPROVED CITY OF PHOENIX DRIVEWAY PERMIT. CUT & RESTORE ASPHALT PER COP DETAIL P1200 TYPE B.
18. TRENCH AND LAY NEW 1" SCHEDULE 40 PVC CONDUIT FOR CABLE INSTALLATION AND JUNCTION TERMINAL PER COX COMMUNICATION OR OTHER INTERNET PROVIDER SPECIFICATIONS.
19. INSTALL POTABLE WATERLINE. PER APPROVED PLUMBING PERMIT
20. UNDERGROUND ELECTRICAL FROM NEW SRP POLE TO NEW SES. PER APPROVED ELECTRICAL PLANS.

TEMPORARY BENCHMARK

NAVD 27
ELEVATION: 1135.16 FEET
JUST SOUTH OF 34TH STREET
FOUND 1" IRON ROD 1.0 FOOT DOWN
FROM APP.INT

LEGEND

- MONUMENT HOLE
- BRASS CAP FLUSH (BCFL)
- BRASS CAP IN HH (BCHH)
- CATCH BASIN EDGE
- CABLE J-BOX
- FIRE HYDRANT
- REBAR
- GAS MARKER
- POWER POLE
- TREE-PALO VERDE
- STREET LIGHT EAST
- STREET LIGHT WEST
- SEWER MANHOLE
- IRON ROD
- CATCH BASIN LID
- BFP BACKFLOW PREVENTOR
- M WATER METER
- MONITOR/EXTRACTION WELL
- SIGN REFLECTOR
- GUY ANCHOR
- WATER METER
- WATER VALVE
- ROW
- OE OVER HEAD ELECTRICAL
- UE UNDERGROUND ELECTRICAL
- W WATER
- DRAINAGE TOP
- DRAINAGE BOTTOM
- GRAVEL
- DITCH SOIL BERM
- SOIL BERM CENTERLINE
- EXIST. TELEPHONE QWEST
- EXIST. UNDERGROUND ELECTRIC SRP
- EXIST. IRRIGATION SRP
- EXIST. SANITARY SEWER
- EXIST. STORM DRAIN
- EXIST. FENCE
- EXIST. GAS LINE
- EXIST. OVERHEAD ELECTRIC
- EXIST. UNDERGROUND ELECTRICAL
- EXIST. CABLE TV
- EXIST. STORM DRAIN
- 1136.56 EXIST. ELEVATION POINT
- EXIST. SURFACE DRAINAGE

NOTE:
FOR ALL ABBREVIATIONS SEE SHEET GN-03

602-263-1100

Converge-Rowes & Associates, Inc
4050 East Cotton Center Blvd., Suite 49
Phoenix, AZ 85040

NOTICE OF EXTENDED CERTIFICATION AND APPROVAL PERIOD PROVISION

THIS CONTRACT ALLOWS THE OWNER TO CERTIFY AND APPROVE BILLINGS AND ESTIMATES WITHIN 45 DAYS AFTER THE BILLING AND ESTIMATES ARE RECEIVED FROM THE CONTRACTOR.

REV	DESCRIPTION	DATE
A	PRE-CONSTRUCTION	3-9-11
1	ISSUED FOR CONSTRUCTION	3-30-12
2	AS-BUILT	2-5-14

56TH STREET AND EARLL DRIVE
WQARF SITE
GROUNDWATER TREATMENT SYSTEM
PHOENIX, AZ

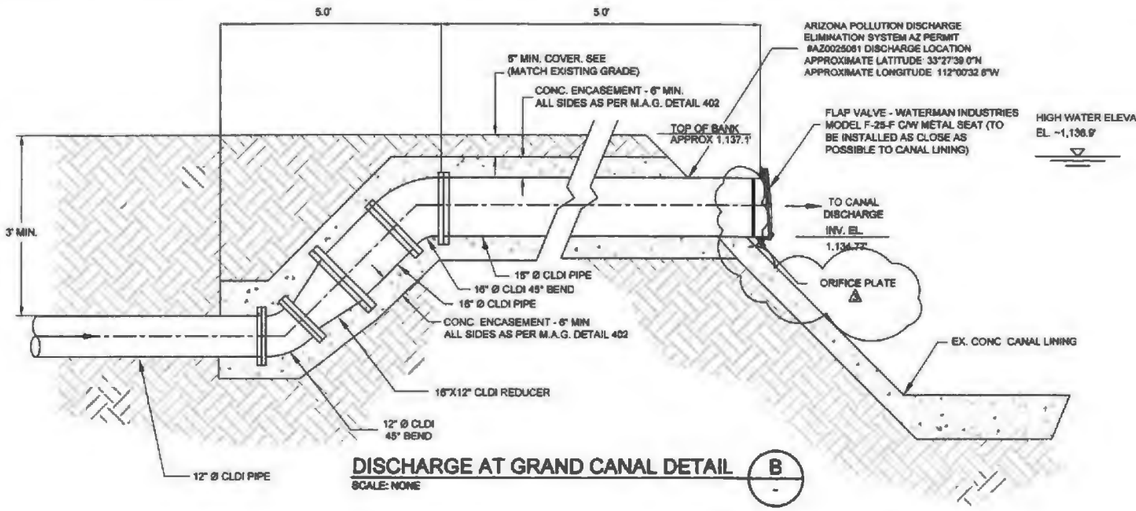
freescale semiconductor

Project Number 7 OF 32
Service Request Number 6R4
Date 12/15/11
Drawn By PS
Checked By
Verified
Work Order

SYSTEM SITE PLAN

Drawing Number CI-01

070386-30(C3004)CI-PX001AS-BUILT JAN 24/2014



DISCHARGE AT GRAND CANAL DETAIL B

SCALE: NONE

*HIGH WATER ELEVATION OF GRAND CANAL OBTAINED FROM BOB GOOCH OF SRP WATER ENGINEERING DEPARTMENT IN AN EMAIL DATED SEPTEMBER 20,2011. ADDITIONAL NOTES FOR THE PROVIDED VALUE ARE AS FOLLOWS:

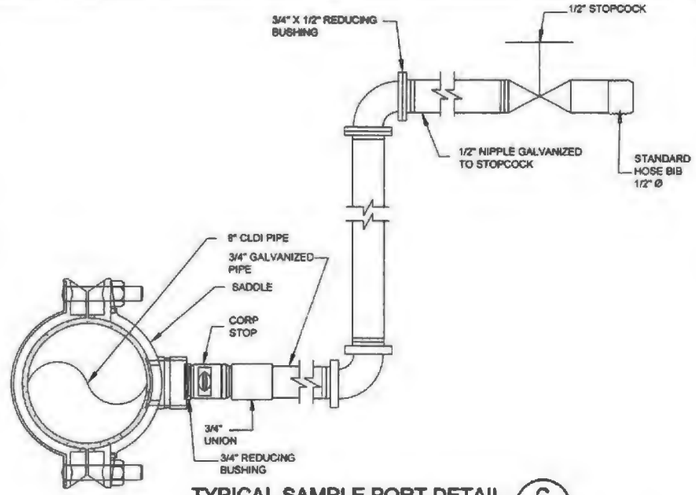
NOTES:

(1) ELEVATIONS ARE BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD-29)

(2) ANY SRP BENCHMARK REFERENCE DATA SUPPLIED WAS ESTABLISHED IN THE EARLY 1990'S AND IT IS THE RESPONSIBILITY OF THE REQUESTOR TO VERIFY ITS ADEQUACY AND ACCURACY. IF THE ORIGINAL SRP MONUMENTS HAVE BECOME DISTURBED OR DESTROYED, OR IF LAND SUBSIDENCE HAS OCCURRED IN THE AREA, THEN IT IS THE RESPONSIBILITY OF THE REQUESTOR TO SUPPLEMENT THE SUPPLIED ELEVATION DATUM AS NECESSARY. CONTACT SRP LAND, SURVEY DIVISION, AT (602) 236-4235 OR SURVEY@SRPNET.COM IF YOU NEED MORE INFORMATION.

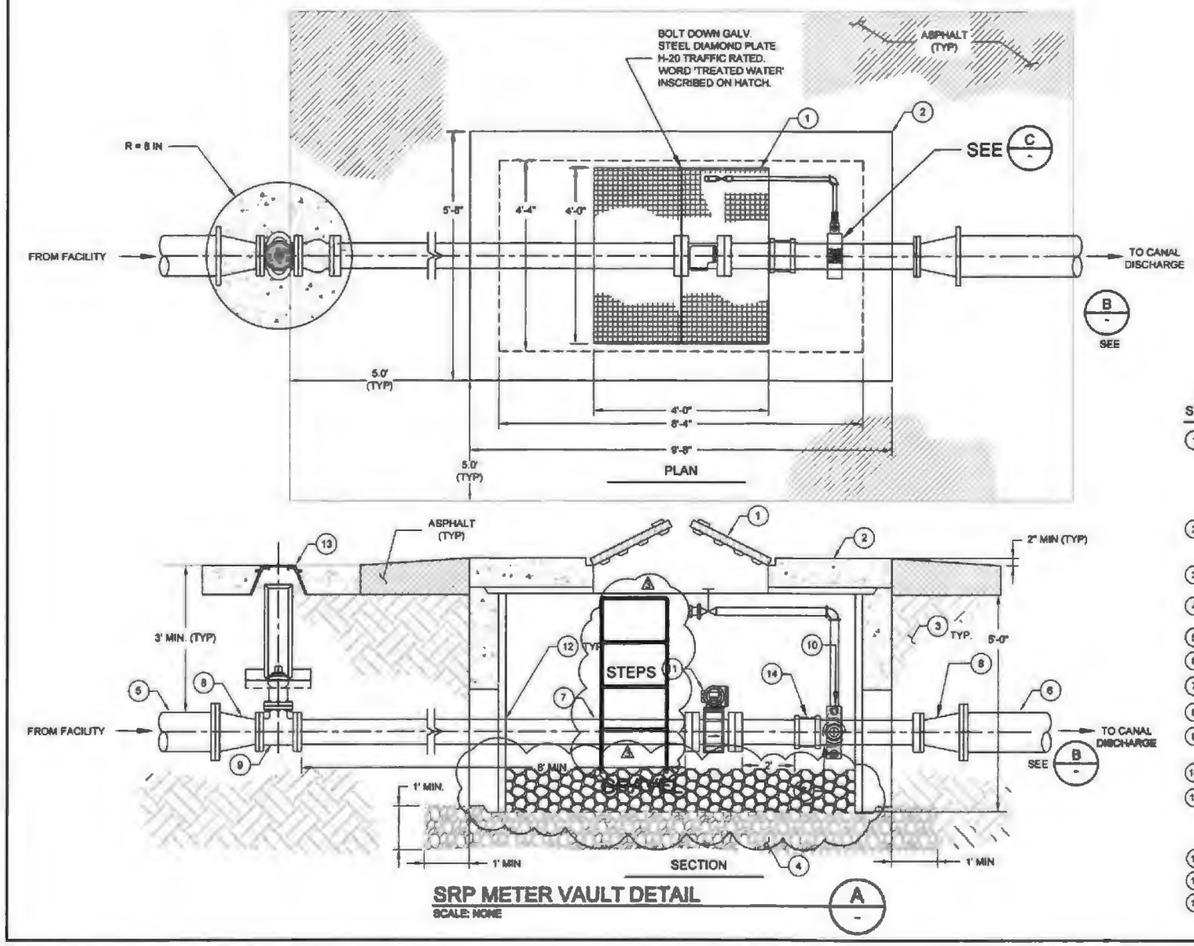
(3) HIGH WATER ELEVATIONS ARE DETERMINED BY HEC RAS BACKWATER ANALYSIS USING MAXIMUM OPERATIONAL FLOW CAPACITY AND HIGH OPERATING LEVEL. WATER LEVELS CAN REACH HIGHER ELEVATIONS DURING STORMS OR EMERGENCY EVENTS.

(4) PLEASE BE SURE TO EITHER SHOW THE ELEVATIONS USING SRP DATUM ON YOUR PLANS, OR PROVIDE AN EQUATION ON THOSE SHEETS WITH ELEVATIONS SO WE CAN CONVERT BACK TO SRP DATUM, AND SRP STATIONING AT THE FOUR CORNERS OF THE BRIDGE FOR ROAD BRIDGES AND AT THE CENTERLINE OF THE BRIDGE FOR PEDESTRIAN BRIDGES.



TYPICAL SAMPLE PORT DETAIL C

SCALE: NONE



SRP METER VAULT DETAIL A

SCALE: NONE

SRP METER VAULT NOTES

1. VAULT COVER: H20 TRAFFIC RATED DIAMOND PLATE STEEL, TORSION HINGED WATER TIGHT COVER WITH MASTIC INSERT BETWEEN VAULT BASE & COVER. OLDCASTLE UTILITY VAULT TM (UV®) 4648 OR APPROVED EQUIVALENT. WORD "TREATED WATER" INSCRIBED ON COVER.
2. VAULT: OLDCASTLE UTILITY VAULT TM (UV®) 4484-WA OR APPROVED EQUIVALENT, PRECAST CONCRETE.
3. NATIVE SOIL
4. VAULT BASE, CRUSHED ROCK, 3/4"Ø, 12" THICK, 95% RELATIVE COMPACTION
5. 12-INCH HDPE (SDR 11). SEE A CI-01 FOR BEDDING.
6. 12-INCH CLDI. SEE A CI-01 FOR BEDDING.
7. 6-INCH CLDI
8. 12 X 6-INCH CLDI REDUCER.
9. 6-INCH GATE VALVE: AWWA 509, CLASS 125, ANSI B16.1, FLANGE X FLANGE, MUELLER A-2360 OR APPROVED EQUAL.
10. MUELLER DR1S 6" X ¾" SADDLE MUELLER B-20045 ¾" CORP STOP. C -
11. FLOWMETER/TOTALIZER: ENDRESS + HAUSER PROMAG53. MOUNT FLOW METER AT LEAST 4 FEET DOWN STREAM OF NEAREST FITTING. BOLTED FLANGE & GASKET TYPE CONNECTIONS (IP 68 RATED).
12. SEAL VAULT PERFORATIONS WITH NON-SHRINK FIVE STAR GROUT
13. VALVE BOX & COVER PER COP STANDARD DETAIL P1391 - TYPE A
14. 8" DRESSER FLEX COUPLING STYLE 38

AS BUILT CERTIFICATION

I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION, OR PROVIDED TO ME BY THE CONSTRUCTION CONTRACTOR, OR AS NOTED AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF

PRASHANT KUMAR
REGISTERED CIVIL ENGINEER

05/12/14
DATE

46527
REGISTRATION #

CERTIFICATE NO. 46527 PRASHANT KUMAR REGISTERED PROFESSIONAL ENGINEER STATE OF ARIZONA, U.S.A.

Exp 06/30/14

REV	DESCRIPTION	DATE
A	SRP DWG TO SOCH CO SRP FEB	6-20-11
B	DWG ISSUED FOR BID	8-19-13
	PER REVIEW COMMENTS	1-30-14
	AS-BUILT REVISION	4-2-14

56TH STREET & EARLL DRIVE WQARF SITE
GROUNDWATER TREATMENT SYSTEM
PHOENIX, AZ

freescale semiconductor

Sheet Number 5 OF 32
Scanner Required Number
EAM
Date 12/20/11
Drawn By HD
Checked By
Scale NOTED
Sheet Title

SRP GRAND CANAL DETAILS

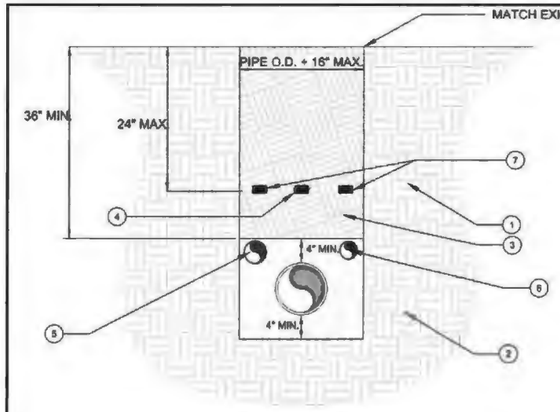
Drawing Number CI-02

602-263-1100

CRA Conestoga-Rovers & Associates, Inc. 4050 East Cotton Center Blvd., Suite 49 Phoenix, AZ 85040

NOTICE OF EXTENDED CERTIFICATION & APPROVAL PERIOD PROVISION

THIS CONTRACT ALLOWS THE OWNER TO CERTIFY & APPROVE BILLINGS & DEFICIENCIES WITHIN 45 DAYS AFTER THE BILLING & SERVICES ARE RECEIVED FROM THE CONTRACTOR

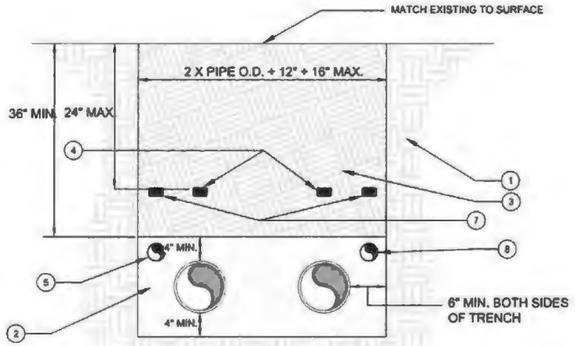


TYPICAL SINGLE WATERLINE TRENCH DETAIL (A)

SCALE: 1" = 1'

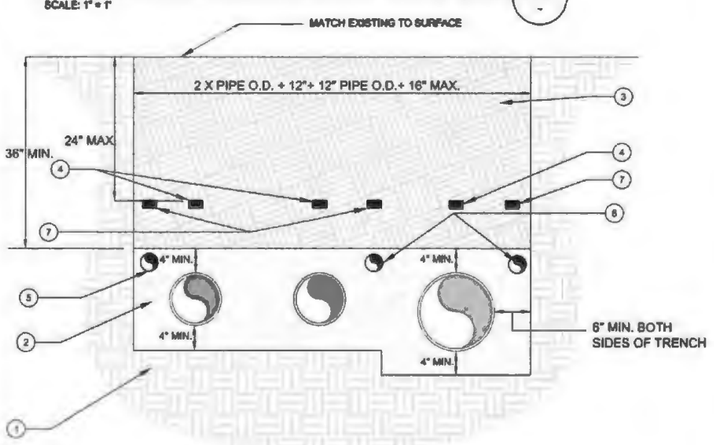
DETAIL NOTES

1. NATIVE SOIL
2. BEDDING PER M.A.G. SPEC 603.4.2
3. BACKFILL PER M.A.G. SPEC 601.4.3
4. 3-INCH MINIMUM WIDTH DETECTABLE METALLIC TAPE LABELED "CAUTION BURIED NON-POTABLE WATERLINE" OR EQUIVALENT
5. SCHEDULE 40 PVC (NOT INCLUDED ON DISCHARGE PIPELINE TRENCH) (ELECTRICAL POWER) PER EL-02
6. 1-INCH DIAMETER SCHEDULE 40 PVC (CONTROL WIRING) PER EL-02
7. 2-INCH MINIMUM WIDTH DETECTABLE METALLIC TAPE LABELED "CAUTION BURIED ELECTRICAL LINE BELOW" OR EQUIVALENT
8. SCHEDULE 40 PVC (TO SRP METER VAULT) PER EL-02



TYPICAL DOUBLE WATERLINE TRENCH DETAIL (B)

SCALE: 1" = 1'



TYPICAL TRIPLE WATERLINE TRENCH DETAIL (C)

SCALE: 1" = 1'

AS BUILT CERTIFICATION

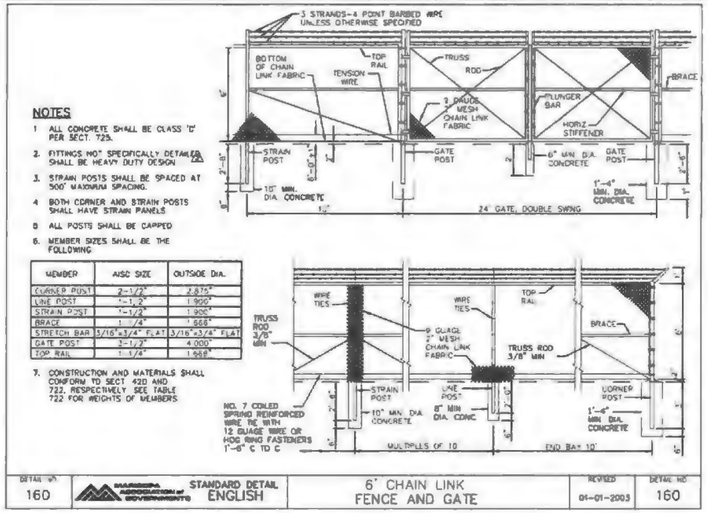
I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION, OR PROVIDED TO ME BY THE CONSTRUCTION CONTRACTOR, OR AS NOTED AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

Prashant Kumar
REGISTERED CIVIL ENGINEER

02/05/14
DATE

46527
REGISTRATION #

Registered Professional Engineer CERTIFICATE NO. 46527 PRASHANT KUMAR Civil State of ARIZONA, U.S.A. 06/30/2016



NOTES

1. ALL CONCRETE SHALL BE CLASS 'C' PER SECT. 725.
2. FITTINGS NOT SPECIFICALLY DETAILED SHALL BE HEAVY DUTY DESIGN
3. STRAIN POSTS SHALL BE SPACED AT 500' MAXIMUM SPACING.
4. BOTH CORNER AND STRAIN POSTS SHALL HAVE STRAIN PANELS
5. ALL POSTS SHALL BE CAPPED
6. MEMBER SIZES SHALL BE THE FOLLOWING

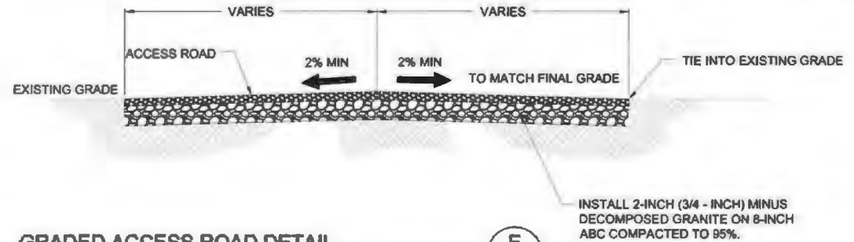
MEMBER	AISC SIZE	OUTSIDE DIA.
CORNER POST	2-1/2"	2.875"
LINE POST	1-1/2"	1.900"
STRAIN POST	1-1/2"	1.900"
BRACE	1 1/4"	1.660"
STRETCH BAR	3/16"x3/4" FLAT	3/16"x3/4" FLAT
GATE POST	2-1/2"	4.000"
TOP RAIL	1-1/4"	1.660"

7. CONSTRUCTION AND MATERIALS SHALL CONFORM TO SECT 420 AND 722, RESPECTIVELY. SEE TABLE 722 FOR WEIGHTS OF MEMBERS.

DETAIL NO.	STANDARD DETAIL		REVISED	DETAIL NO.
160	MARICOPA ASSOCIATION of GOVERNMENTS ENGLISH	6' CHAIN LINK FENCE AND GATE	01-01-2003	160

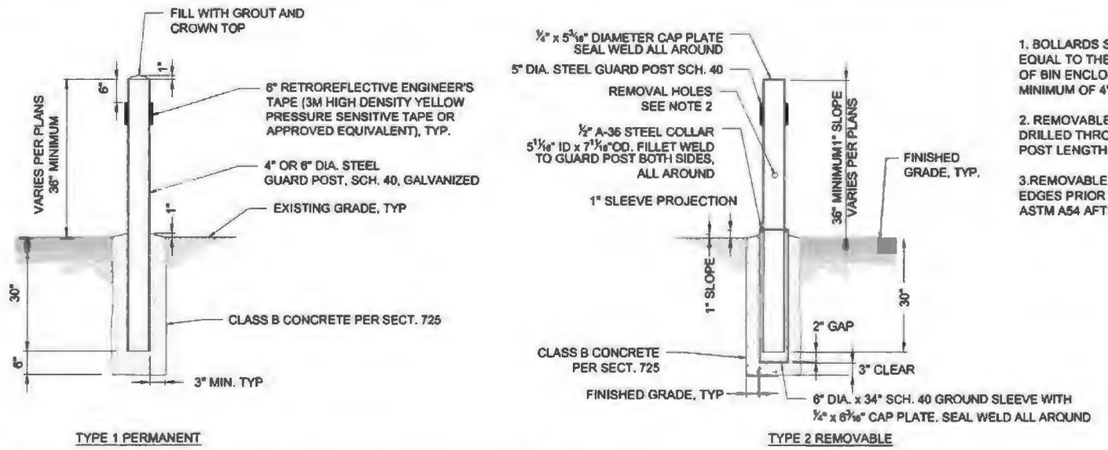
SES/MCC PERIMETER CHAINLINK FENCE (D)

SCALE: NTS



GRADED ACCESS ROAD DETAIL (E)

SCALE: NTS



NOTES

1. BOLLARDS SHALL HAVE A HEIGHT OF 3 FEET OR BE EQUAL TO THE HEIGHT OF THE BACK SCREEN WALL OF BIN ENCLOSURES. POSTS SHALL BE PLACED A MINIMUM OF 4" FROM THE WALL.
2. REMOVABLE POSTS SHALL HAVE 1" DIA. HOLES DRILLED THROUGH AT A DISTANCE 1/3 THE OVERALL POST LENGTH FROM TOP.
3. REMOVABLE POST - GRIND SMOOTH ALL SHARP EDGES PRIOR TO GALVANIZATION. GALVANIZE PER ASTM A54 AFTER FABRICATION.

DETAIL NO.	STANDARD DETAIL		REVISED	DETAIL NO.
140	MARICOPA ASSOCIATION of GOVERNMENTS ENGLISH	BOLLARD	01-01-2009	140

M.A.G. BOLLARD DETAIL (F)

SCALE: NTS

REV	DESCRIPTION	DATE
1	ISSUED FOR CONSTRUCTION	5/30/14
A	50% DRAFT REVIEW	1/30/14

56TH STREET AND EARLL DRIVE WQARF SITE GROUNDWATER TREATMENT SYSTEM PHOENIX, AZ

freescale semiconductor

Sheet Number 4 OF 32
Service Request Number SRQ
Date 12/20/13
Drawn By SJM
Checked By
Equip 407BD
Sheet Title

CIVIL DETAILS

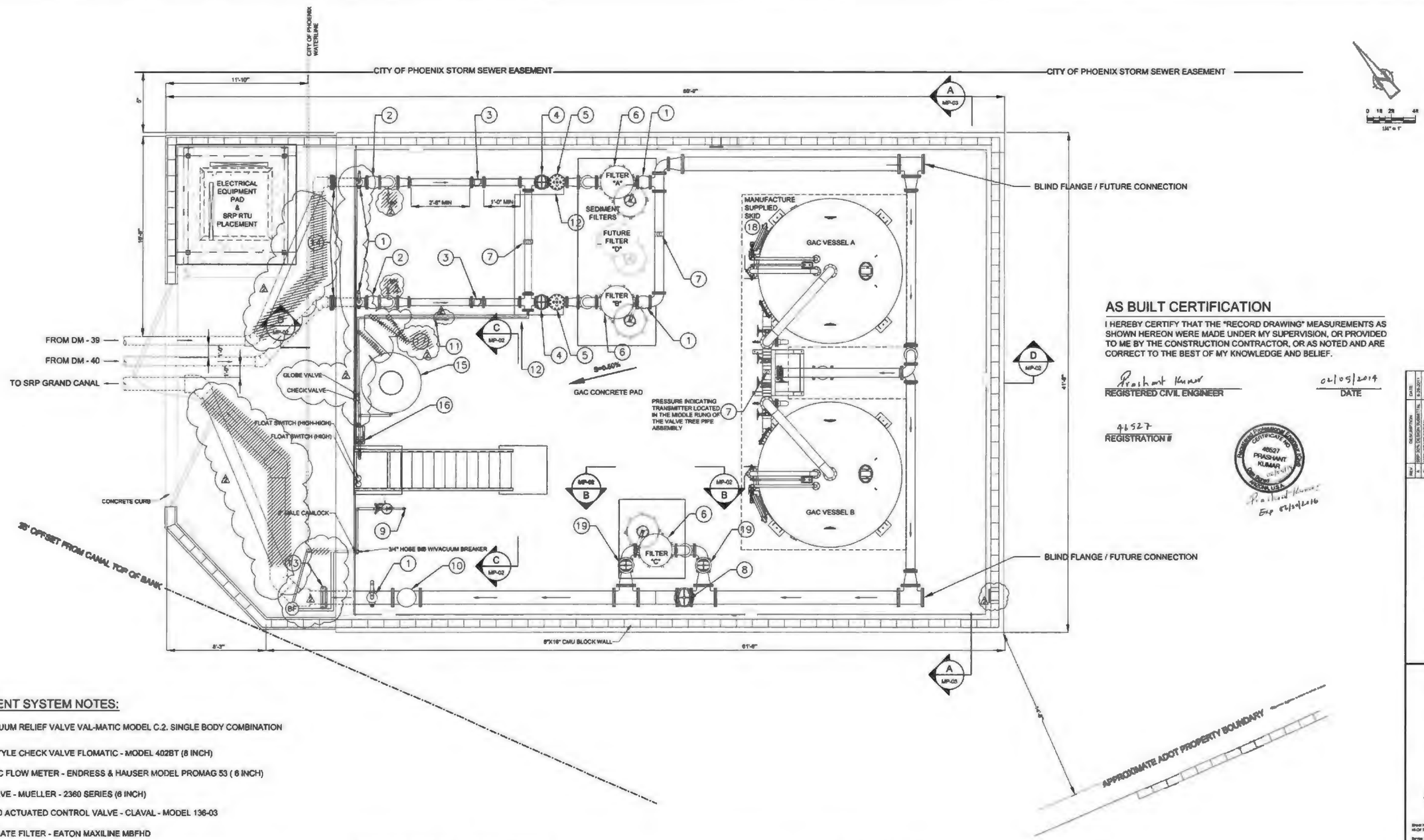
Drawing Number CI-03

602-263-1100

Converse-Rivers & Associates, Inc
4050 East Cotton Center Blvd., Suite 49
Phoenix, AZ 85040

NOTICE OF EXTENDED CERTIFICATION & APPROVAL PERIOD PROVISION

THIS CONTRACT ALLOWS THE OWNER TO CERTIFY & APPROVE BILLINGS & ESTIMATE WITHIN 45 DAYS AFTER THE BILLING & ESTIMATES ARE RECEIVED FROM THE CONTRACTOR.



AS BUILT CERTIFICATION

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Prashant Kumar
REGISTERED CIVIL ENGINEER

02/05/2014
DATE

46527
REGISTRATION #

Professional Engineer CERTIFICATE NO. 46527 PRASHANT KUMAR 01/31/14 State of ARIZONA U.S.A.
Prashant Kumar
Exp 06/30/2016

TREATMENT SYSTEM NOTES:

1. AIR / VACUUM RELIEF VALVE VAL-MATIC MODEL C.2. SINGLE BODY COMBINATION
2. GLOBE STYLE CHECK VALVE FLOMATIC - MODEL 402BT (8 INCH)
3. MAGNETIC FLOW METER - ENDRESS & HAUSER MODEL PROMAG 53 (6 INCH)
4. GATE VALVE - MUELLER - 2360 SERIES (6 INCH)
5. SOLENOID ACTUATED CONTROL VALVE - CLAVAL - MODEL 136-03
6. PARTICULATE FILTER - EATON MAXILINE MBFHD
7. PRESSURE INDICATING TRANSMITTER-ENDRESS & HAUSER-CERABAR 5 PMC 71
8. GATE VALVE- MUELLER-2360 SERIES (12 INCH)
9. SAFTEY SHOWER EYEWASH - BRADLEY S19-310 FSS
10. CHECK VALVE - VALMATIC 500A SWING FLEX (12 INCH)
11. SUMP PUMP DISCHARGE LINE AND CONNECTION POINT - 2 - INCH GALVANIZED PIPE.
12. VALVE OPERATING RELIEF LINE - 1/2 - INCH COPPER TO PURGE TANK.
13. TRANSITION COUPLING - HDPE TO DIP (12 INCH)
14. TRANSITION COUPLING - HDPE TO DIP (8 INCH)
15. PURGE WATER HOLDING TANK - SNYDER INDUSTRIAL - MODEL 1831000N WITH INSTALLED 2 - INCH PVC BULKHEAD FITTING (1,000 GALLONS)
16. SUMP / TRANSFER CENTRIFUGAL PUMP (GOULDS MODEL NPE 3ST 1H5)
17. 1 1/2 INCH CHECK VALVE
18. SEIMENS HP1220 SYS
19. GATE VALVE - MUELLER - 2360 SERIES (8 INCH)

NOTE:
FOR SYSTEM PIPE SIZES SEE P&ID DRAWING: EF-01 AND EF-02.

REV	DESCRIPTION	DATE
A	30% DESIGN SUBMITTAL	10/30/13
B	100% DRAFT DESIGN	12/20/13
1	SUBMITTAL CONSTRUCTION	5/30/14
2	AS-BUILTS	8/26/14

56TH STREET AND EARLL DRIVE
WQARF SITE
GROUNDWATER TREATMENT SYSTEM
PHOENIX, AZ

freescale semiconductor

Sheet Number
MP-01 of 34
Service Request Number
SAP
Date
10/08/11
Drawn By
KMD
Checked By
Scale
1/2"=1'-0"
Drawn Title
MECHANICAL PLAN VIEW

Drawing Number
MP-01

602-263-1100

Conestoga-Rovers & Associates, Inc.
4050 East Cotton Center Blvd., Suite 49
Phoenix, AZ 85040

NOTICE OF EXTENDED CERTIFICATION AND APPROVAL PERIOD PROVISION.
THIS CONTRACT ALLOWS THE OWNER TO CERTIFY AND APPROVE BILLINGS AND ESTIMATE WITHIN 45 DAYS AFTER THE BILLING AND ESTIMATES ARE RECEIVED FROM THE CONTRACTOR.

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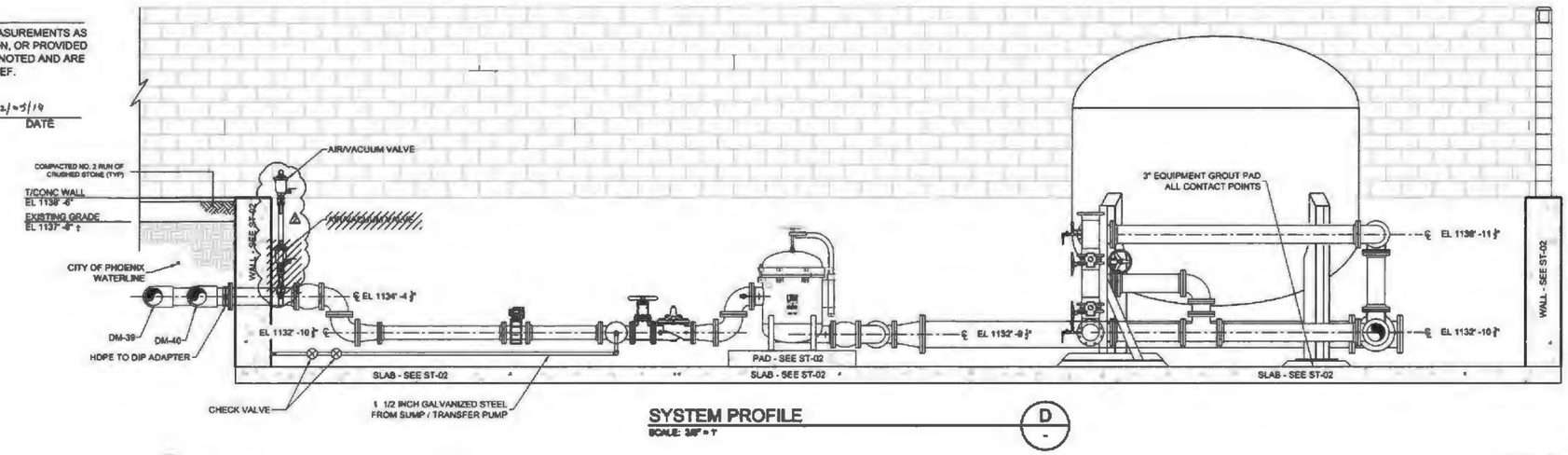
Prashant Kumar
REGISTERED CIVIL ENGINEER

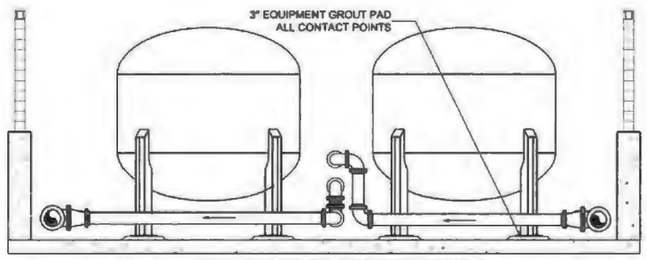
02/03/14
DATE

41527
REGISTRATION #

Exp 09/30/2014

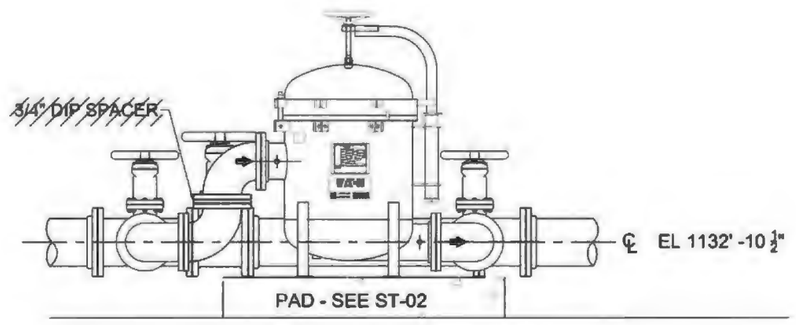


SYSTEM PROFILE — D
SCALE: 3/8" = 1'

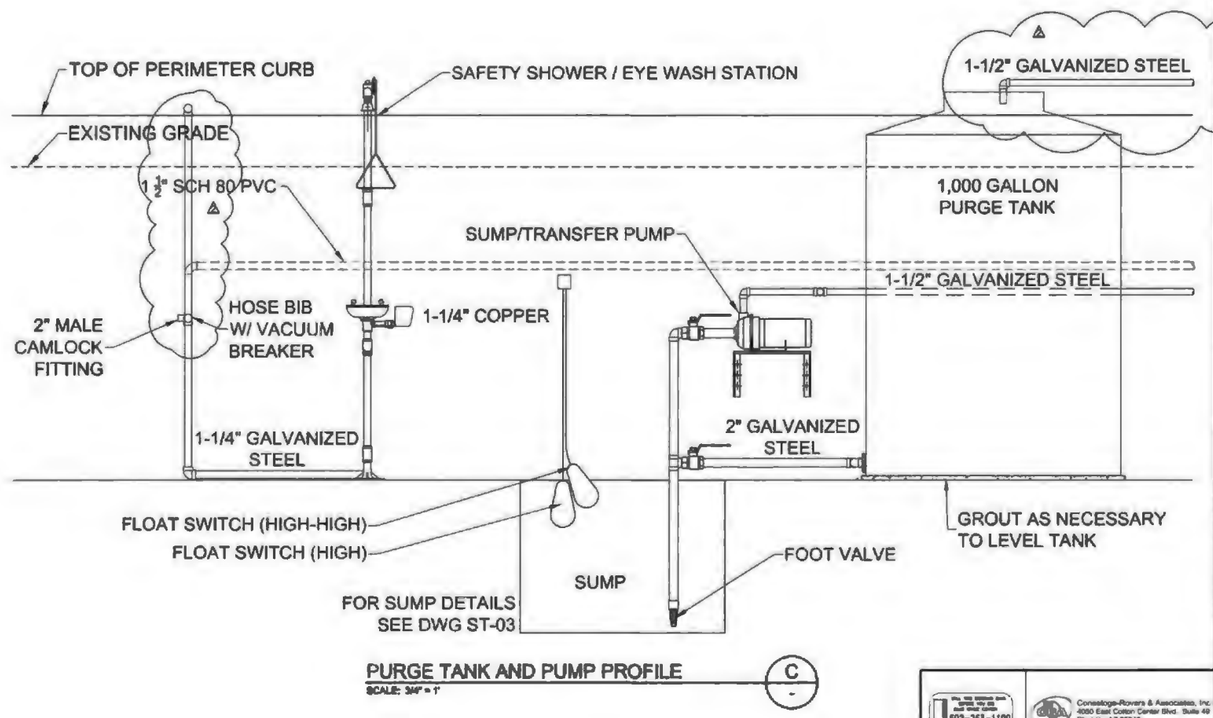


NOTE: DETAIL SHOWN FOR GAC MANIFOLD INFLUENT AND EFFLUENT PIPE ROUTING ONLY.

SYSTEM PROFILE NE TO SW — A
SCALE: 1/4" = 1'



BACKWASH FILTER — B
SCALE: 3/4" = 1'



PURGE TANK AND PUMP PROFILE — C
SCALE: 3/4" = 1'

REV	DESCRIPTION	DATE
1	30% DESIGN SUBMITTAL	9/30/2011
2	60% DESIGN SUBMITTAL	1/30/2012
3	ASBUILTS	1/24/2014

56TH STREET AND EARLL DRIVE
WQARF SITE
GROUNDWATER TREATMENT SYSTEM
PHOENIX, AZ

freescale semiconductor

602-263-1100

Conestoga-Rovers & Associates, Inc.
4050 East Cotton Center Blvd., Suite 49
Phoenix, AZ 85040

MECHANICAL PROFILE VIEWS

MP-02

NOTICE OF EXTENDED CERTIFICATION AND APPROVAL PERIOD PROVISION:
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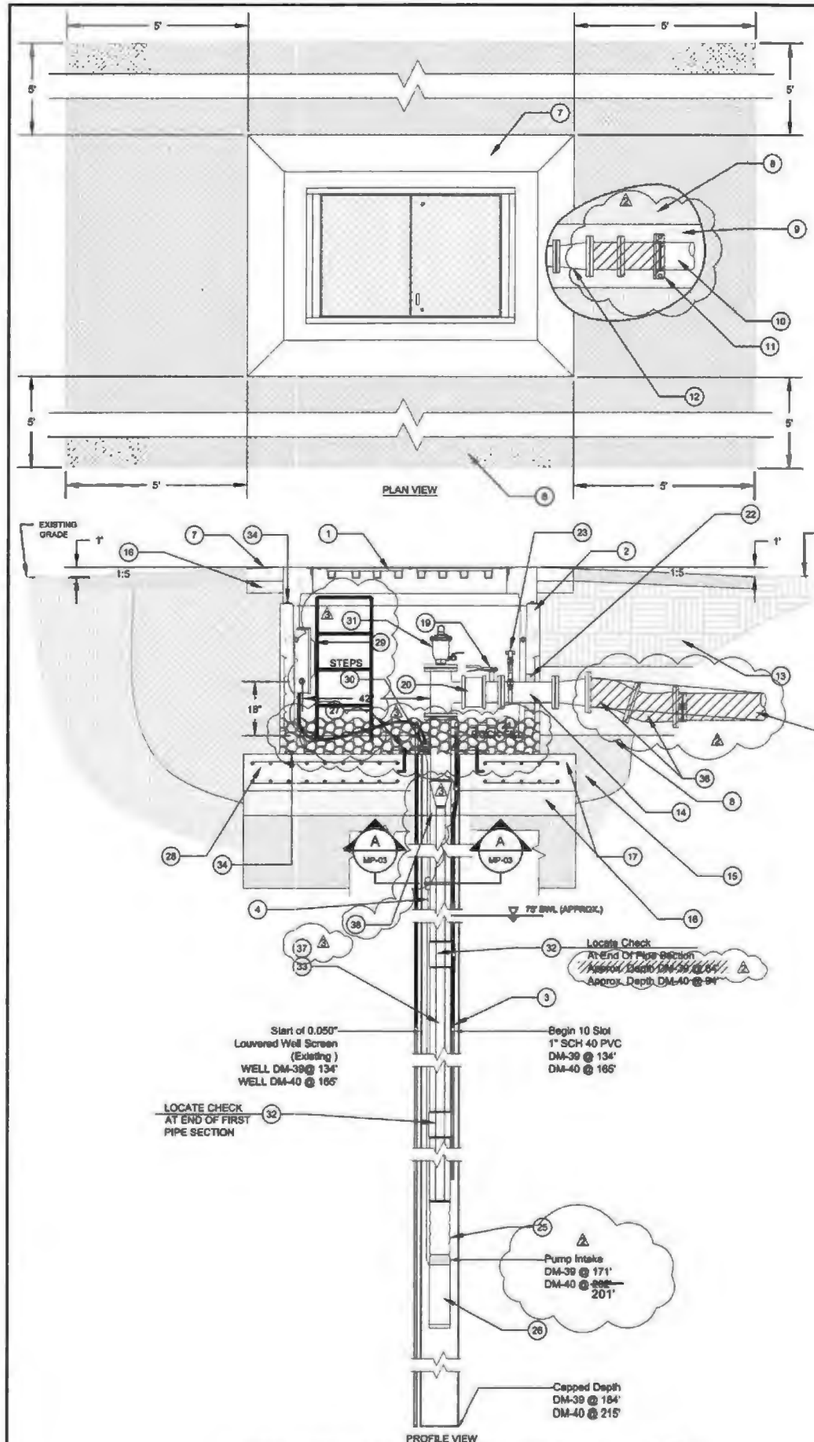
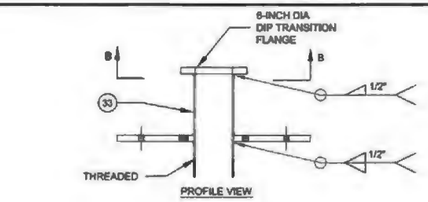
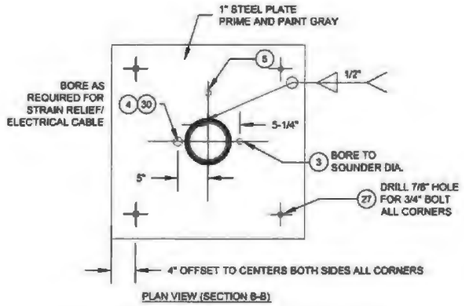


WELL VAULT CONVERSION DETAIL

SCALE: 1/2" = 1'

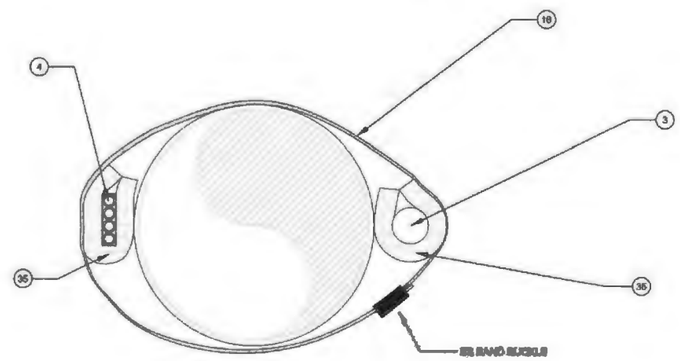




TYPICAL WELLHEAD BASE PLATE

SCALE: 1" = 1'

B



SECTION A SOUNDER/MOTOR WIRE CLAMP

SCALE: 6" = 1'

A

AS BUILT CERTIFICATION

I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION, OR PROVIDED TO ME BY THE CONSTRUCTION CONTRACTOR, OR AS NOTED AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

Prashant Kumar
REGISTERED CIVIL ENGINEER

08/12/19
DATE

Registered Professional Engineer CERTIFICATE NO. 46527 PRASHANT KUMAR 08/12/19 ARIZONA, U.S.A.

46527
REGISTRATION #

Prashant Kumar
Corp 08/12/2019

WELL VAULT NOTES

1. VAULT COVER: H20 TRAFFIC RATED OLD CASTLE MODEL 57-3660
2. VAULT: OLDCASTLE UTILITY VAULT MODEL W6 2-3B 575 WM VAULT DET
3. 1-INCH PVC SCH 40 TRANSDUCER WELL
4. ELECTRICAL FEED CABLE TO PUMP MOTOR (PER VENDOR)
5. SOUNDING WELL (EXISTING - BY OTHERS)
6. ASPHALT APRON EXTENDING 5 FEET BEYOND CONCRETE COLLAR
7. COLLAR: 3,000 PSI MINIMUM COMPRESSIVE STRENGTH @ 28 DAYS ASTM C150 TYPE II CEMENT
8. NATIVE SOIL
9. BEDDING PER M.A.G. SPEC 603.4.2
10. 8-INCH HDPE SDR 11
11. DIP TO HDPE TRANSITION COUPLING
12. 6X8-INCH ASPHALT COATED CLDIP CONCENTRIC REDUCER
13. BACKFILL PER M.A.G. SPEC 601.4.3 COMPACT TO 95%
14. 6-INCH CLDIP ASPHALT COATED
15. RECOMPACTED NATIVE SOIL
16. SAND AND GRAVEL BASE: CLASS II AGGREGATE 95% RELATIVE COMPACTION
17. WELLHEAD PLATFORM BASE: 3,000 PSI MINIMUM COMPRESSIVE STRENGTH @ 28 DAYS ASTM C150 TYPE II CEMENT
18. 3/4-INCH 316 STAINLESS STEEL BAND @ 10' INTERVALS (LOCATE EACH MID-PIPE SECTION) - LENGTH OF BAND AS REQUIRED
19. 6-INCH BUTTERFLY VALVE VALMATIC MODEL 150B (FLG X FLG)
20. FLO-MATIC WAFER STYLE CHECK VALVE MODEL 888
21. 6-INCH STEEL PIPE WELDED TO 1-INCH STEEL BASE PLATE
22. LINK-SEAL ® MODEL S-316
23. PRESSURE TRANSMITTER AND SAMPLING PORT ASSEMBLY:
    (1) PRESSURE TRANSMITTER - ENDERSS & HAUSER (IP 68 RATED)
    (2) BALL VALVES - 1"Ø THREADED X 1"Ø NPT, SS INNERS, 1/4-TURN, WOG, TEFLON SEATS;
    (3) THREADOLET, GVM, NPT OR SADDLE, 1"Ø
    (4) NIPPLES - 1"Ø NPT X 1"Ø NPT, GVM AND
    (2) ELBOW - 1"Ø NPT X 1"Ø NPT, GVM
    (1) REDUCER BUSHING (1" X 1/2")
24. 6-INCH STEEL COUPLING
25. PUMP SIMFLO: DM-39 MODEL 8P4C ⚠ DM-40 MODEL 8E7C
26. PUMP MOTOR: FRANKLIN MOTOR SUBMERSIBLE SERIES 3600 RPM, 480V-3PHASE 3600 RPM
27. 10-INCH LONG - 3/4-INCH DIA THREADED L-ANCHOR BOLT - 304/316 STAINLESS STEEL EMBEDDED 8 INCHES INTO CONCRETE WELLHEAD PLATFORM ALL FOUR CORNERS
28. REBAR #5 (60 G) @ 6-INCH O.C- E.W. -T.B.
29. JUNCTION BOX PER DWG EL-03, NEMA 6P
30. STRAIN RELIEF - SIZED PER ELECTRICAL WIRE DIAMETER
31. AIR RELIEF VALVE - VAL-MATIC MODEL #101T W/THROTTLE DEVICE
32. 6-INCH CHECK VALVE - FLOMATIC -MODEL 80DI VFD
33. 6-INCH DIAMETER GALVANIZED STEEL PIPE - 21 FOOT PIPE SECTIONS
34. SEAL AROUND THE PERIMETER CONTACT POINTS OF THE WELL VAULT COVER AND WELL VAULT AND THE CONCRETE VAULT PAD AND WELL VAULT - SEAL WITH RAM-NEK FR 1-INCH WIDE COIL
35. 4-INCH X 8-INCH X 1/2-INCH - GENERAL RUBBER SEE SECTION A
36. LONG SWEEPING RADIUS 45 DEGREE - 8 INCH DIP FLANGED FITTING
37. 3-INCH BLACK STEEL
38. 8-INCH X 3-INCH REDUCER

REV	DESCRIPTION	DATE
A	WRF 30% DESIGN SUBMITTAL	8-30-17
B	100% DESIGN SUBMITTAL	9-20-12
C	PER AZDEQ COMMENTS	1-24-14
D	AS-BUILT REVISION	4-3-14

56TH STREET AND EARLL DRIVE
WQARF SITE
GROUNDWATER TREATMENT SYSTEM
PHOENIX, AZ

freescale semiconductor

Sheet Number 10 OF 30
Service Request Number SR#
Date 10/05/11
Drawn By SJH
Checked By
Scale NOTED
Sheet Title

WELLHEAD CONVERSION DETAIL

Drawing Number MP-03

602-263-1100
Converse-Rovers & Associates, Inc.
4000 East Camp Carver Blvd., Suite 49
Phoenix, AZ 85040

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I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION, OR PROVIDED TO ME BY THE CONSTRUCTION CONTRACTOR, OR AS NOTED AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

PRASHANT KUMAR
REGISTERED CIVIL ENGINEER

05/12/2014
DATE

46527
REGISTRATION #

Professional Engineer — CERTIFICATE NO. 46527 — PRASHANT KUMAR — 05/12/14 — STATE OF ARIZONA, U.S.A.

Prashant Kumar
Exp: 06/30/2016

FPG-16" · ORIFICE PLATE-16" · SRP CANAL · 16" CLDI · 16" X 12" · 12" CLDI · 12" X 8" · SP · 0-3000 GPM · FY 700 · FIT 700 · FQIT 700 · FQY 700 · TVSS · 8" CLDI · GV-8" · 8" X 12" CLDI · CLDI HDPE · 12" HDPE SDR 11 · HDPE CLDI · CH-12" · FROM GAC EF-02

SRP SYSTEM · SRP RTU · RADIO · BY SRP · MODBUS · FI 700 · FR · FQI 700 · YIC 700 · STOP PROCESS

PAL 300 · PAH 300 · PI 300 · I-1 · DPAH 340 · PI 400 · EF-03 · A

ARV 100 · TO SUMP · SP · FI 100 · FQI 100 · FR · MODBUS · FY 100 · FIT 100 · FQIT 100 · FQY 100 · 0-1500 GPM · PIT 300 · PY 300 · TVSS · BB · ZIC 100 · S · OP/CL · 0-100 PSIG · PIT 400 · PY 400 · TVSS · BB

8" HDPE SDR 9 · HDPE CLDI · RECESSED CONTAINMENT PAD · CH-8" · 8" x 6" · GV-8" · PL-8" · FV 100 · 8" x 8" · CH-8" · 12" CLDI · TO GAC EF-02

ARV 200 · TO SUMP · FY 200 · FIT 200 · FQIT 200 · FQY 200 · 0-1500 GPM · GV-8" · PL-8" · FV 200 · 8" x 8" · CH-8" · GL-1 1/2" · CH-1 1/2" · ZIC 200 · S

SOLENOID CONTROL VALVE DRAIN LINE 1/2" COPPER

1,000 GALLON PURGE WATER HOLDING TANK

I-1 · I-2 · I-3 · HIC 100 · LIC 100 · LR · HOA · LY 100 · TVSS · LT 100 · PI 100 · PAH 100 · PAL 100 · DM-39 WELL VAULT · 0-100 PSIG · PIT 100 · PY 100 · TVSS · BB · ARV · CH-6" BU-6" · 6"X8" · CLDI · HDPE · 3" x 6" · 3" STEEL · 12" STEEL · CH-3" · 2" LCS SCREEN · ETHERNET · SIC 100 · HS 100 · HOA · DM-39 (480V) VFD · 3

I-1 · I-2 · I-3 · HIC 200 · LIC 200 · LR · HOA · LY 200 · TVSS · LT 200 · PI 200 · PAH 200 · PAL 200 · I-4 · DM-40 WELL VAULT · 0-100 PSIG · PIT 200 · PY 200 · TVSS · BB · ARV · CH-6" BU-6" · 6"X8" · CLDI · HDPE · 8" HDPE SDR 9 · 6" STEEL · WATER LEVEL: APPROX 75 FEET BGS · CH-6" · 12" STEEL · 12" LCS SCREEN · ETHERNET · SIC 200 · HS 200 · HOA · DM-40 (480V) VFD · 3

INTERNAL SYSTEM LINK DESCRIPTION

I-1: SHUTS DOWN EXTRACTION WELLS

I-2: VFD CONTROLLED TO MAINTAIN 10 FEET OF STATIC WATER LEVEL ABOVE TRANSDUCER

I-3: HIGH/LOW PRESSURE SHUTS DOWN EXTRACTION WELL DM-39

I-4: HIGH/LOW PRESSURE SHUTS DOWN EXTRACTION WELL DM-40

DESCRIPTION	1	2	3	4	5	6	7	8	9	10	11	12
PLANT ID NAME	SEDIMENT FILTERS	DM-39 WELL PUMP	DM-40 WELL PUMP	CENTRIFUGAL PUMP	FLOW METER	HOLDING TANK		FLOW METER	SOLENOID CONTROL VALVE			
MATERIAL	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL	HDPE		STAINLESS STEEL	DUCTILE IRON			
SIZE	8"	3.062 IMP DIA	3.56" IMP DIA	2" SPS / 1-1/2" DPS	6"	80" DIA x 86-1/2" H		6"	6"			
CAPACITY	1750 GPM	100 GPM @ 285 TDH	550 GPM @ 273 TDH	40 GPM @ 85 TDH	2650 GPM	1000 GALLON		4650 GPM	1800 GPM			
TEMP/PRESS	250°F/150 PSIG	330 PSIG	330 PSIG	212°F	175°F/580 PSIG	-		175° F/580 PSIG	"			
HP/V/RPM	-	10HP/480V/3600 RPM	60HP/480V/3600 RPM	3HP/480V/3600RPM	-	-		-	-			
WEIGHT	-	-	-	-	-	-		-	-			
MANUFACTURE	EATON	SIMFLO	SIMFLOW	GOULDS	ENDRESS+HAUSER	SNYDER IND		ENDRESS + HAUSER	CLA VAL			
MODEL	MAXLINE MBF0802HD	SP4C (14 STAGE)	SE7C (3 STAGE)	3571H5	PROMAG 53W	1831000N-34200015		PROMAG 53W	136-03			
VENDOR	HARRINGTON PLAST.	PUMP SYSTEMS	PUMP SYSTEMS	-	-	HARRINGTON PLAST.		-	ENGINEERED SALES			
OPTION 1	-	-	-	-	-	2" BLKHD PVC/EPDM		-				
OPTION 2	-	-	-	-	-	-		-				

1-1/2" GALVANIZED STEEL · HS 300 · ST/SP · 2" GALVANIZED STEEL · BV-2" · LAHH 300 · I-1 · LSHH 300 · LAH 300 · LSH 300 · GAC PAD · CH-2" · NC · NC · SUMP

ISSUED FOR CONSTRUCTION

602-263-1100

Conestoga-Rovers & Associates, Inc.
4080 East Cotton Center Blvd. Suite 49
Phoenix, AZ 85040

NOTICE OF EXTENDED CERTIFICATION AND APPROVAL PERIOD PROVISION

THIS CONTRACT ALLOWS THE OWNER TO CERTIFY AND APPROVE BILLINGS AND ESTIMATE WITHIN 45 DAYS AFTER R-C BILLING AND ESTIMATES ARE RECEIVED FROM THE CONTRACTOR.

REV.	DESCRIPTION	DATE
A	PER ZC ITEM COMMENTS	5/30/12
B	PER ZC ITEM COMMENTS	6/30/12
1	AS-BUILT REVISIONS	5/5/14

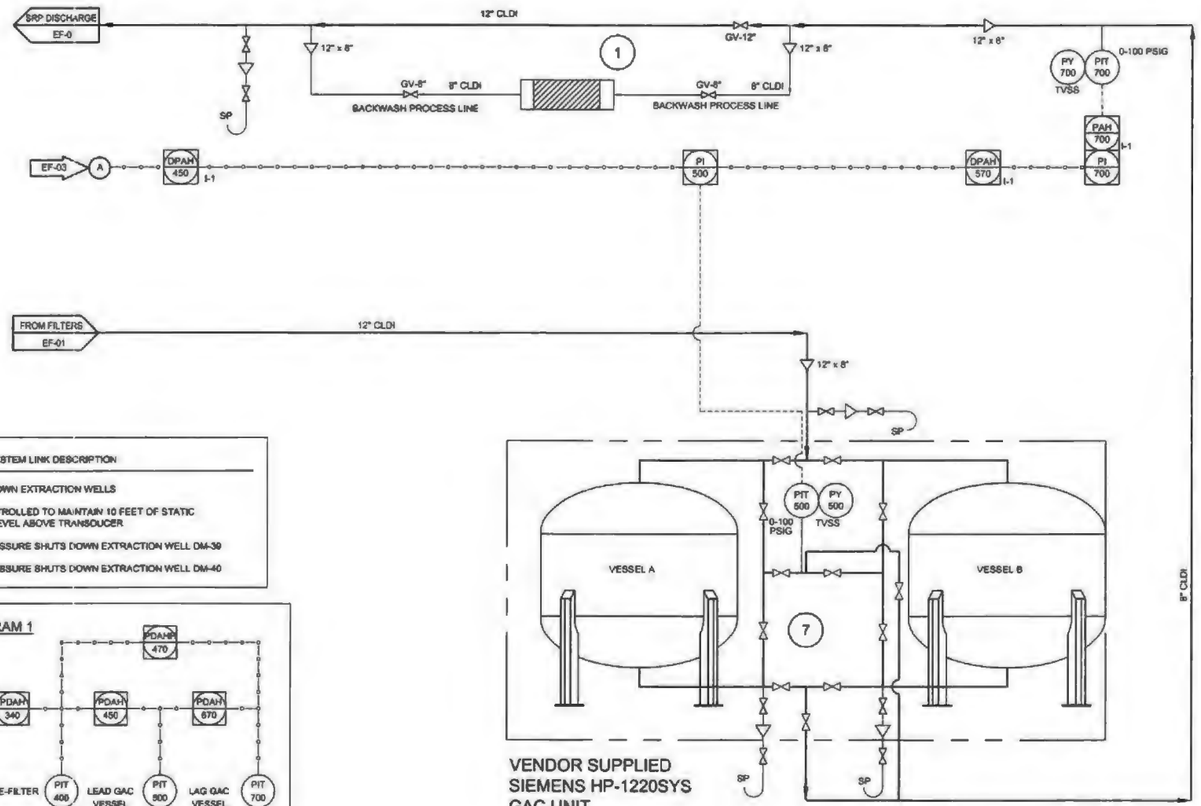
56TH STREET AND EARLL DRIVE
WQARF SITE
GROUNDWATER TREATMENT SYSTEM
PHOENIX, AZ

freescale semiconductor

P & ID SHEET 1 of 2

EF-01

070386-30(04)EF-PX001 EF-01 JAN 23/2012



INTERNAL SYSTEM LINK DESCRIPTION

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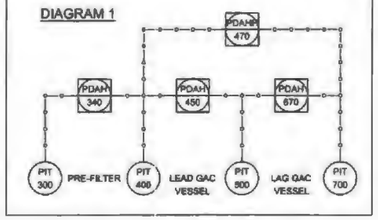
I-3: HIGH PRESSURE SHUTS DOWN EXTRACTION WELL DM-39

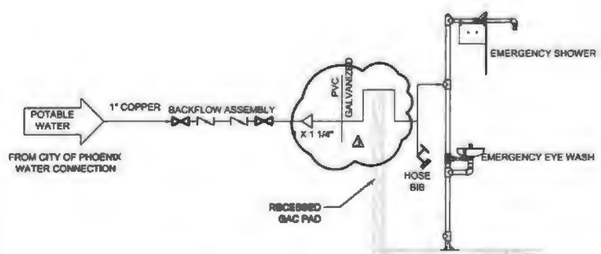
I-4: HIGH PRESSURE SHUTS DOWN EXTRACTION WELL DM-40

DIAGRAM 1



DESCRIPTION

PLANT ID. NAME	1 SEDIMENT FILTERS	2	3	4	5	6	7 SIEMENS GAC VESSELS	8	9	10	11	12
MATERIAL	STAINLESS STEEL						STEEL					
SIZE	8"						8" INLET/OUTLET					
CAPACITY	1750 GPM						1100 GPM					
TEMP/PRESS	250°F/150 PSIG						150°F/125 PSIG					
HP/V/RPM	-						-					
WEIGHT	-						185,000 LBS (MAX)					
MANUFACTURE	EATON						SIEMENS					
MODEL							HP 1220SYS					
VENDOR	HARRINGTON PLAST.						SIEMENS					
OPTION 1	-						-					
OPTION 2	-						-					



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I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION, OR PROVIDED TO ME BY THE CONSTRUCTION CONTRACTOR, OR AS NOTED AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

PRASHANT KUMAR
REGISTERED CIVIL ENGINEER

05/12/2014
DATE

46927
REGISTRATION #

Arizona Professional Engineer
CERTIFICATE NO.
46927
PRASHANT KUMAR
Date Signed 05/12/14
PHOENIX, U.S.A.

Prashant Kumar
EXP: 06/30/2016

REV	DESCRIPTION	DATE
A	AS-BUILT CONDITIONS	5/2014
B		
C		
D		

56TH STREET AND EARLL DRIVE
WQARF SITE
GROUNDWATER TREATMENT SYSTEM
PHOENIX, AZ

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P & ID SHEET 2 of 2

EF-02

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Phoenix, AZ 85040

602-263-1100

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THIS CONTRACT ALLOWS THE OWNER TO CERTIFY AND APPROVE BILLINGS AND RETAINAGE WITHIN 45 DAYS AFTER THE BILLING AND RETAINAGE ARE RECEIVED FROM THE CONTRACTOR

070388-30(04)EF-PX002 EF-02 JAN 23/2012

Appendix F

Siemens Operations and Maintenance Manual

OPERATION & MAINTENANCE MANUAL

FOR

HP1220
GRANULAR ACTIVATED CARBON ADSORPTION SYSTEM

SIEMENS

BY

Siemens Water Technologies
7222 Clinton Drive
Houston, TX 77020

August, 2006

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

1.0 INTRODUCTION

This manual covers a general description of the equipment and operating procedures for a High Pressure Carbon Adsorption Systems. The Carbon System is designed to provide many years of trouble free service. To achieve this, the Carbon System equipment must be properly handled and installed to obtain the desired results. Failure to do so can cause premature equipment malfunctions and/or undesirable System performance.

Siemens Water Technologies shall deliver and install the Carbon system equipment and the activated carbon, and shall insure that quality workmanship practices and construction procedures are followed throughout. Unknown situations or conditions not covered in this manual are the responsibility of the Purchaser.

Section 1.4 provides helpful information for the receiving, unloading, handling and installation of the Carbon System equipment.

1.1 GLOSSARY

Adsorber - A vessel designed to hold activated carbon.

Backwash - Performed prior to placing system on-line to cleanse the carbon bed of fines entrapped air and stratify bed depth. Also used during normal operations to remove particulate build up.

Backflush - Performed during normal operations to remove entrapped air from the carbon bed.

Bulk Transport Trailer - Hopper type trailer used to transport carbon, slurry in fresh carbon, and remove spent carbon from adsorbers.

Carbon Rinse - Plant water used to rinse from the interior surface of the adsorber during carbon change-out.

GAC - Granular Activated Carbon.

Heel - Any spent carbon not removed from an adsorber before adding fresh carbon.

Lead Adsorber - The first bed of carbon through which a process or a waste stream is passed. (Also called Primary Adsorber.)

Polishing Adsorber - The second or last bed of carbon through which a process or a waste stream is passed. (Also called Secondary Adsorber.)

Pneumatic Port – The air and water connection for service and wash-down of vessel.

Pressure Port - The air and water connection for service and wash-down of vessel.

Rupture Disk - A relief disk to prevent over pressurization of a vessel.

Reactivated Carbon - Previously used carbon that has been thermally reactivated.

Spent Carbon - Carbon that has adsorbed the maximum amount of organic material.

Underdrain - Device designed to permit an evenly distributed flow of water but retain carbon in vessel.

Utility Port - The air and water connection for service and wash-down of vessel.

Vent - A line from each adsorber with automatic vacuum/air release valve (APCO).

Water Cushion - The water added to an adsorber before charging it with carbon to protect under drain and lining.

1.2 IMPORTANT MESSAGES AND WARNINGS

This Manual should be in the possession of the personnel who operate and maintain the Carbon System. The purpose of this manual is for instruction and to advise operators and maintenance personnel. This manual will remain a valuable resource for the safe, economical, efficient operation and maintenance of the Carbon System.

Failure to properly follow instructions, failure to take notice of warnings, and failure to take proper precautions and preventive measures may be dangerous and could cause serious injury, equipment damage, and environmental problems.

Mechanical modifications or substitutions of parts on equipment that may affect structural or operational safety shall not be made without prior manufacturer's approval or engineer's advice. Modifications other than those approved may defeat protective features originally designed into the equipment and its controls; and therefore, shall not be made.

Unauthorized personnel should be kept away from this equipment at all times. Only qualified personnel who have been properly instructed in this equipment's proper operation and maintenance requirements and in its potential hazards shall be allowed to operate and maintain it.

IMPORTANT

Siemens Water Technologies makes no warranty of any kind with regard to the material contained in this manual, including, but not limited to, implied warranties or fitness for a particular purpose. Siemens Water Technologies shall not be liable for errors contained herein or for incidental or consequential damages in connection with the performance or use of this material.

This manual contains certain proprietary criteria, ideas and designs as an instrument or professional service and shall not be reprinted in whole or in part without expressed written authorization from Siemens Water Technologies.

1.3 RECEIVING

Immediately upon receipt and prior to removal from the truck trailer, railcar or shipping container, inspect the Carbon System equipment for damage. Claiming any damage that may have occurred in transit should be filed promptly with the delivering carrier. The unloading operation should be delayed until the carrier's representative has completed his inspection of the damaged equipment, otherwise a damage claim may not be honored. The inspection should include as a minimum:

1. External surface damage.
2. Damage such as broken nozzles, valves, pipes, underdrain, etc.
3. Equipment damage at contact points.
4. Unpacking and inspection of all packaged equipment and accessories.
5. Internal lining.

1.4 UNLOADING AND HANDLING

When unloading and handling the Carbon System equipment, extreme care should be taken as not to damage it.

Regardless of the type of equipment being handled, certain precautionary measures must be implemented such as:

1. Insure the lifting equipment can withstand the total intended load.
2. Always use lifting eyes and brackets.
3. Never position the lifting equipment where damage to the equipment load may occur.
4. When using a forklift, make sure the forks are long enough to extend past the intended load. This prevents accidental punctures on the underside of the equipment crates, boxes and skids that may damage the equipment itself.
5. Use spreader bars.
6. Do not slide, drag or push equipment across surfaces. Always lift to move into position.
7. Do not roll, drop or throw equipment or accessories.
8. Lifting cables and/or straps must not be attached to, or permitted to come in contact with nozzles, flanges, gussets, pipes, shafts, painted surfaces, or any other accessory that may be damaged by contact.
9. When equipment is being lifted, proper rigging practices should be observed and a guide- line should be attached to prevent impact damage caused by swinging into contact with other object.
10. Never set on or roll over an equipment fitting and never use a fitting as a lifting point.
11. Prevent tools, hooks, etc. from striking the Carbon System equipment.

1.5 ASSEMBLY INSTRUCTIONS

The Carbon System has been shipped pre-assembled to the greatest extent possible. The attached drawing shows the system after assembly. The piping module skid and vessel skids have drilled holes for placement and mounting. The site foundation should be level, but most importantly flat. Check to see if any bolts that may have come loose during shipment, if so, tighten them. The internal nozzles have been shipped installed. Be sure to use proper flange tightening procedures when assembling the piping.

Each Carbon System should be assembled in the following order:

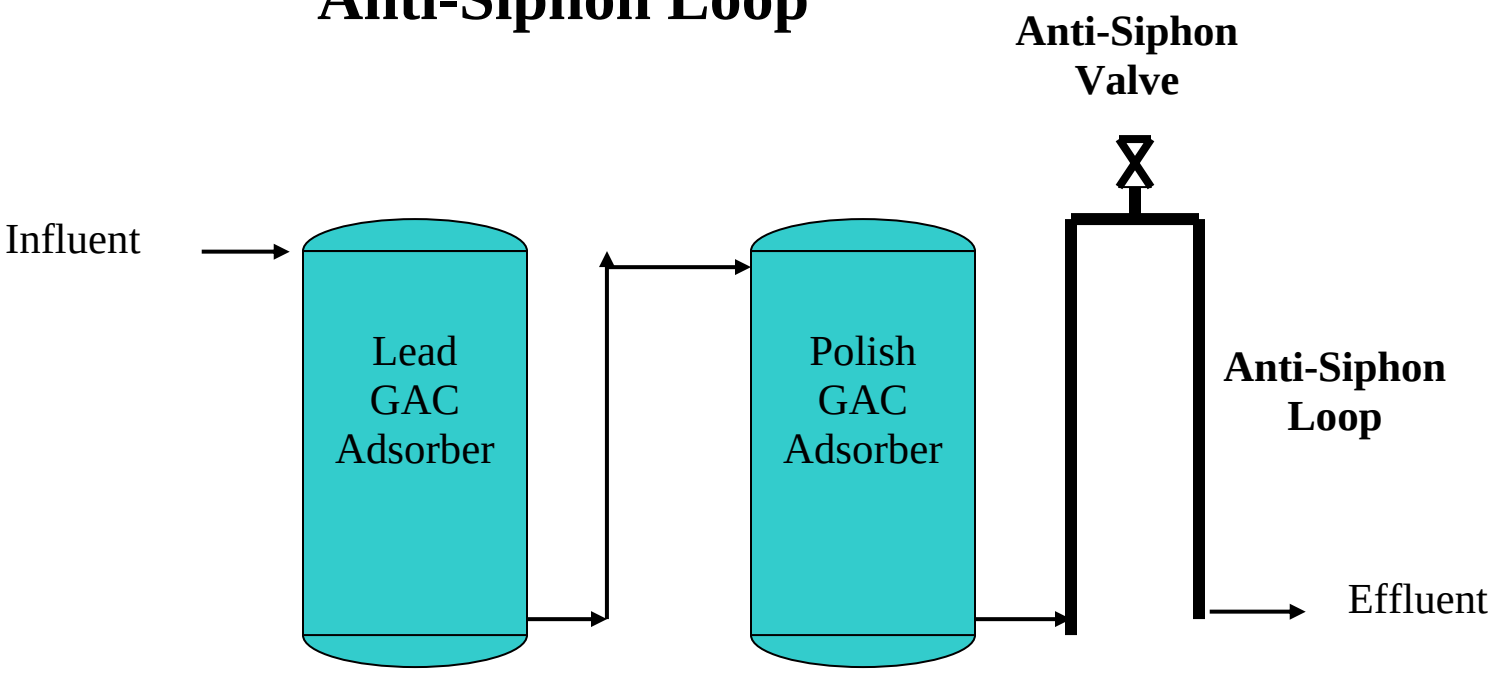
1. Mark the foundation with guide-lines in order to place the vessels in a straight line.
2. Locate the vessels spaced as shown on drawing.
3. Place the piping module appropriately between the face piping connections.
4. If alignment is off, make sure the vessels and piping module are level and in the correct positions. Some shimming of the vessels and piping module may be required.
5. Bolt Tank A to the piping module (bolt loosely until system is fully assembled).
6. Bolt Tank B to the piping module (bolt loosely until system is fully assembled).
7. If alignment is acceptable, tighten all the bolts.
8. Secure the vessels and piping module to the foundation.
9. Assembly is complete.

1.6 ANTI-SIPHON LOOP

The System has been designed for down flow operation. At the top inlet of the vessel a distributor is installed to prevent “rat holing” of the media bed. This phenomenon occurs when the water enters the adsorber at high velocity without any dissipation of energy. The distributor enables the water flow to enter the media bed in a plug flow manner. In addition, the head of water above the media bed distributes the flow across the cross-sectional area of the media bed. As the water passes through the media, additional resistance is encountered. A pressure drop occurs further assisting in the proper distribution of the water. The water is then collected in the underdrain system and sent to the effluent piping.

The carbon adsorbers must be operated completely full of water to provide proper System performance. To insure that the down flow System is under pressure and will not drain, (especially at low flows) an anti-siphon loop must be placed after the final adsorber. This entails installation of a pipe raised to a height greater than the top piping with an anti-siphon/vacuum breaker placed at the top of the “gooseneck”. (See Sketch below). The effluent line should be sized to insure full flow through the pipe. For example, the 8” diameter pipe should be reduced to 3” if the flow through the System is 50 gpm. If the effluent goes directly to gravity drain after exiting the adsorber, the water may drain from the carbon bed and channeling/premature breakthrough and/or excessive pressure drop may occur.

Anti-Siphon Loop



Not to Scale

2.0 EQUIPMENT DESCRIPTION

2.1 GENERAL DESCRIPTION

Each Carbon System consists of (2) two carbon adsorber vessels, face piping, and piping module with support skid. Each piping module comes complete with influent, effluent, backwash, air vent line, carbon fill, carbon removal, compressed air, and sampling connections.

The carbon steel adsorbers are vertical cylindrical pressure vessels with elliptical tops and bottoms manufactured for a maximum operating pressure of 125 PSIG. The adsorbers are designed for down flow operation with a specially designed underdrain collection system to maximize the utilization of carbon as well as allow for efficient and rapid removal of the spent carbon. Three sample valves are used for sampling treated water at various levels through the adsorber.

The adsorbers are designed with sufficient free board volume to allow for full fluidization during back washing of the carbon bed during start up and in the event an unacceptable pressure drop develops across the bed due to any filterable solids entering the vessels.

The process and utility piping to operate the system are mounted on the adsorbers and piping module. The piping options include valving to operate the adsorbers in parallel or series (lead/lag) flow configuration. Each adsorber has its own carbon fill, discharge and vent lines. The process piping is equipped with pressure gauges and sample ports at the inlet and outlet of each adsorber. Compressed air connections are provided for use during carbon transfer.

2.2 PROCESS DESCRIPTION

Each Carbon System is designed to remove dissolved organic compounds from contaminated feed water using granular activated carbon. The feed water to be treated will be pumped by the client at a controlled rate through the adsorbers in a series or parallel configuration.

Each adsorber shall contain 20,000 lbs. of granular activated carbon, which will provide sufficient contact time at the design flow rate to remove the organics in the feed water.

Feed water enters the adsorber from the top and flows down through the carbon bed. The treated water is collected in the underdrain system and discharged through the effluent piping to the ion exchange vessels for further treatment. The operating manual for the ion exchange vessels is separate from this manual.

When piped in the series configuration, and the lead adsorber becomes saturated (exhausted) it's taken off-line for replacement of the spent carbon. The feed water is directed to the second adsorber, allowing the system to remain in service. The lead adsorber is then pressurized up to 30 psig with air. With the addition of utility water, the spent carbon is pneumatically displaced as slurry to a bulk transport trailer. The dewatered spent carbon is reactivated.

To refill the adsorber with fresh carbon, the carbon in the trailer is slurried, using clean water, pressurized up to 15 psig and then transferred to the empty adsorber.

Once the fresh carbon is placed in the vessel, it must be soaked and backwashed before the appropriate valves will be opened, placing the vessel with the fresh carbon in the secondary position, if operated in series configuration.

2.3 DESIGN AND OPERATING CONDITIONS

EACH VESSEL:

Vessel Diameter ..... 144”
Side Shell Height..... 60”
Overall Height (Approx.) ..... …15’3”
Working Pressure ..... 125 psi @ 150 °F
Manway:
Flanged at side shell……..…… … .20”
Elliptical type at head……..…… ..14” x 18”
Vessel Volume ..... 7520 gal.
Vessel Carbon Capacity ..... 20,000 lbs.
Carbon Bed Volume-Typical ..... 714 Ft^3
Maximum Flow Rate Typical ..... 1100 GPM
Empty Bed Contact Time/ Vessel ..... 4.8 min/vessel @ 1100 GPM
Design Criteria ..... ASME
Code Stamping ..... YES
Material ..... Carbon Steel
Supports ..... Wide Flange Legs
Lifting..... Lifting Lugs
Seismic ..... Zone 4
Interior Surface Prep SSPC-SP5
Interior Surface Coating..... Plasite 4110 35 mil dft min
Exterior Surface Primer..... Epoxy 3 mil min dft
Exterior Surface Coating..... Urethane 3mil min dft
Standard Color ..... Federal Blue or Desert Sand

UNDERDRAINS:

External ring header ..... Carbon Steel
Septa Screens ..... 8 ea-316L Stainless Steel V-Wire Screens 4 ½” Dia x 10”

VALVE ASSEMBLY AND PIPING:

Piping:
Process Piping ..... 8” Sch 40 Carbon Steel
GAC Transfer Piping ..... 4” Sch 10 304L Stainless Steel
Valves:
Process..... 8” Butterfly, Cast Iron Body w/AL-Brnz Disk, Gear Operator
GAC Transfer ..... 4” Fanged 316 Stainless Steel Full Port Ball Valve
Vent/Wash ..... 2” Bronze Apollo Ball Valve
Sample Ports (3) ..... 1/2” Bronze Apollo Ball Valve

SYSTEM WEIGHT:

System Shipping weight ..... 45,000 lb
System Carbon Weight..... 40,000 lb
System Operating Weight..... 185,000 lb

2.4 GENERAL PROCESS COMMENTS

OPERATIONAL CHANGES

Optimum operation of the system is obtained if changes to the system occur slowly. Rapid changes in flow will cause upsets to the adsorbers, which could adversely affect the operation. Valves should be turned slowly at all times to prevent hydraulic shock.

3.0 START-UP

3.1 SAFETY

Any piece of equipment can be dangerous if operated improperly. Safety is ultimately the responsibility of those operating and maintaining the equipment. All personnel operating and maintaining the Carbon System and its proper implementation must be familiar with all of the Carbon System components, and observe all OSHA, federal, state and local safety codes and requirements. The personnel should also be active participants in an approved plant-wide health and safety program.

Failure to properly follow instructions and failure to take proper safety precautions is dangerous and can cause serious personal injury, needless equipment damage, and unnecessary environmental harm. Mechanical modifications and/or substitutions of parts on equipment that will affect structural, operational, or environmental safety should not be made. Modifications may defeat protective features originally designed into the equipment and control; and therefore, should not be made.

The following is a partial list of precautions to follow but in no case is the list exhaustive nor is it intended to be. Operators and maintenance personnel should expand on this list after first reviewing the entire Carbon System and its operation with the appropriate health and safety authorities.

- Keep areas clean. A clean work area is a much safer area.
- Keep all equipment guards in place. If removed to service the equipment, make sure the guards are replaced properly.
- Wear eye and face protection around rotating and pumping equipment and whenever working around or handling chemicals. Be especially cautions for splash when disconnecting piping, valves and fittings.
- Wear ear protection if necessary.
- Wear proper apparel. Do not wear loose clothing, or jewelry, which could be caught in machinery.
- Wear a proper respirator around chemicals and in areas where vapors and/or gases may be present.
- Non-skid footwear is recommended and always wear protective gloves when feasible.
- Remove adjusting screws or wrenches. Form a habit of checking to see that all tools are removed from equipment.
- Make sure all personnel are familiar with OSHA approved Material Safety Data Sheets for all hazardous materials they may come in contact with.

STAY ALERT

WATCH WHAT YOU ARE DOING

USE COMMON SENSE

DO NOT PERFORM OPERATION OR MAINTENANCE FUNCTIONS WHEN YOU ARE TIRED OR GROGGY

DO NOT ATTEMPT TO SERVICE OR OPERATE MACHINERY YOU ARE NOT FULLY FAMILIAR WITH

DO NOT TAKE CHANCES

ASK FOR ASSISTANCE IF IN DOUBT

DO NOT TRY TO DO IT ALONE

THINK BEFORE YOU ACT AND BE CAREFUL

3.2 OXYGEN DEMAND CREATED BY ACTIVATED CARBON IN CONFINED VESSELS

Research efforts have confirmed that wet granular activated carbon confined in large vessels creates an oxygen demand, which is hazardous to human health and can cause death unless proper safety precautions are observed.

Studies conducted have shown that low oxygen content exists in vessels containing wet carbon. Laboratory experiments conducted since that time also have revealed that commercial activated carbons in a wet or moist condition will lower the oxygen content of an isolated space. Preliminary indications of this research are:

1. The phenomenon occurs with wet activated carbon of all common types.

2. The rate of oxygen uptake naturally varies with the degree of exposure of the wet carbon to the air. Thus, it is relatively rapid in a drained bed.

3. There is some indication of a limit to carbon's capacity for oxygen, but until more is known, it would be prudent to assume that all carbon (fresh, used, reactivated) will also exhibit this characteristic. Similarly, although these tests were run with water, it should be assumed that the phenomenon will occur in other liquid and vapor systems.

NOTE:

ALL CONFINED SPACES, INCLUDING THOSE CONTAINING ACTIVATED CARBON, SHOULD BE PRESUMED TO BE HAZARDOUS. APPROPRIATE SAFETY MEASURES SHOULD ALWAYS BE TAKEN BEFORE ENTERING, AS WELL AS WHEN WORKERS ARE IN A CONFINED SPACE. OSHA REGULATIONS APPLICABLE TO RESPIRATORY PROTECTION IN OXYGEN-DEFICIENT ATMOSPHERES SHOULD BE STRICTLY FOLLOWED.

3.3 DISINFECTING THE ADSORBERS PRIOR TO FILLING WITH ACTIVATED CARBON

For drinking water applications the adsorbers must be disinfected prior to filling the adsorbers with activated carbon. Refer to Appendix A in Section 8 for equipment disinfection procedure. Refer to Technical Note in Section 8 for additional information regarding disinfecting the activated carbon should it be required.

3.4 FILLING THE ADSORBERS

BULK BAGS

When filling the adsorbers with Bulk Bags the following steps are to be followed:

1. Remove the manway cover in adsorber head (top).
2. Open Vent Valve.
3. Make certain all remaining valves are closed.
4. Fill each adsorber to approximately half capacity with water.
5. Carefully empty the bulk bags into the adsorbers. After emptying eight bags of carbon, check the water level. If carbon is above the water level, add more water as necessary. Carbon should always be placed into the adsorber with a water cushion.
6. After all carbon has been loaded, fill the vessel with water and reinstall the manway cover.
7. With the carbon bed totally covered with water, let carbon bed soak approximately 24 hours to totally dissipate air from the carbon **with vent line open**.

SLURRY

Carbon is transferred into the vessels from a bulk pneumatic trailer as slurry through the carbon slurry inlet transfer lines on the vessels. The vessels must have a water cushion before carbon is transferred. The trailer must be filled with water prior to beginning the transfer sequence. The bulk pneumatic trailer is then pressurized to 15 psig. Slowly fully open the appropriate carbon slurry inlet line. While transferring the carbon, the vent lines shall be fully open. All other valves should be in the closed position. The carbon must be soaked for approximately 24 hours **with the vent line open** to totally dissipate air from the carbon bed.

3.5 INITIAL BACKWASH

The adsorbers should be backwashed after soaking and prior to being placed in service, to remove carbon fines, entrapped air and to fully stratify the carbon bed. To backwash the adsorption tank, the procedure is described below.

The adsorbers should be backwashed after soaking and prior to being placed in service to remove carbon fines, entrapped air and to fully stratify the carbon bed.

The Purchaser is responsible for performing the initial backwash and providing an ample water supply. The water should be **clean** water (free of solids and organics) and the flow rate should be high enough to achieve approximately 25-30% bed expansion. The backwash flow rate is dependent upon carbon type, mesh size and water temperature. Backwash rates can range from 1150-1350 depending upon the temperature of the backwash water. Refer to the Carbon Data Sheet attached for backwash rate.

EACH ADSORBER SHOULD BE BACKWASHED SEPARATELY. (Refer to STANDARD GAC 2 VESSEL P&ID and FLOW DIAGRAM on page 17 and 3-TIER MAIFOLD WITH BACKWASH CONNECTIONS on page 18 of this manual).

At the start of backwash all valves in each adsorption system are closed. To initiate backwash, the valve sequencing is as follows:

1. Engage backwash water supply in reverse flow from effluent pipe.

To Backwash GAC Filter Vessel A:

2. Slowly open valve A4 to allow backwash water into the bottom of Vessel A.

3. Slowly open valve A2 to allow backwash water to exit out of the top of Vessel A.

4. Slowly open valve C1 to adjust backwash flow rate. Backwash the activated carbon up flow for approximately 10-20 minutes or until the water leaving the vessel is clear. (Flow rate may vary depending on water temperature. Refer to GAC Data Sheet in Section 8 of this manual for backwash flow rate).

5. Slowly close valve A2, then close valve A4.

Vessel A has now been successfully backwashed.

To backwash GAC Filter Vessel B:

6. Slowly open valve B4 to allow backwash water into the bottom of Vessel B.

7. Slowly open valve B2 to allow backwash water to exit out of the top of Vessel B.

8. Backwash Vessel B per Step 4 above.

9. Slowly close valve B2 then close valve B4.

10. Slowly close valve C1.

Vessel B has now been successfully backwashed.

11. Disengage backwash water supply.

12. The system is now ready to be put on-line.

NOTE: PROVISIONS SHOULD BE MADE TO PROPERLY DISPOSE OF THE BACKWASH WATER.

3.6 PLACING THE SYSTEM IN OPERATION

Refer to STANDARD GAC 2-VESSEL P&ID and FLOW DIAGRAM on page 17 and 3-TIER MANIFOLD WITH BACKWASH CONNECTIONS on page 18 of this manual.

START-UP PROCEDURE FOR SYSTEM OPERATION IN PARALLEL

Initially, all valves in the adsorption system are closed. The feed to the adsorption system is provided by the user's feed pump. The pump must be started and brought up to approximately ½ of the operating flow rate prior to placing the first carbon adsorber in operation. When this has been accomplished, the pump discharge valve is slowly opened. The pump is then brought up to full flow. The second adsorber is then placed into operation so that the valves are configured for parallel operation. For normal operation through the adsorbers, the valve sequencing is as follows:

With feed pump connected to influent line and all valves closed bring the pump up to 50% flow:

1. Slowly open valve A1.

2. Manually vent air within the adsorber through the vent valve on Vessel A.

3. Once no air is observed discharging through the vent valve, open valve A4.

4. Slowly open valve B1. Slowly bring the feed pump up to 100% flow.

5. Air within the adsorber should vent through the Vent Valve on Vessel B.

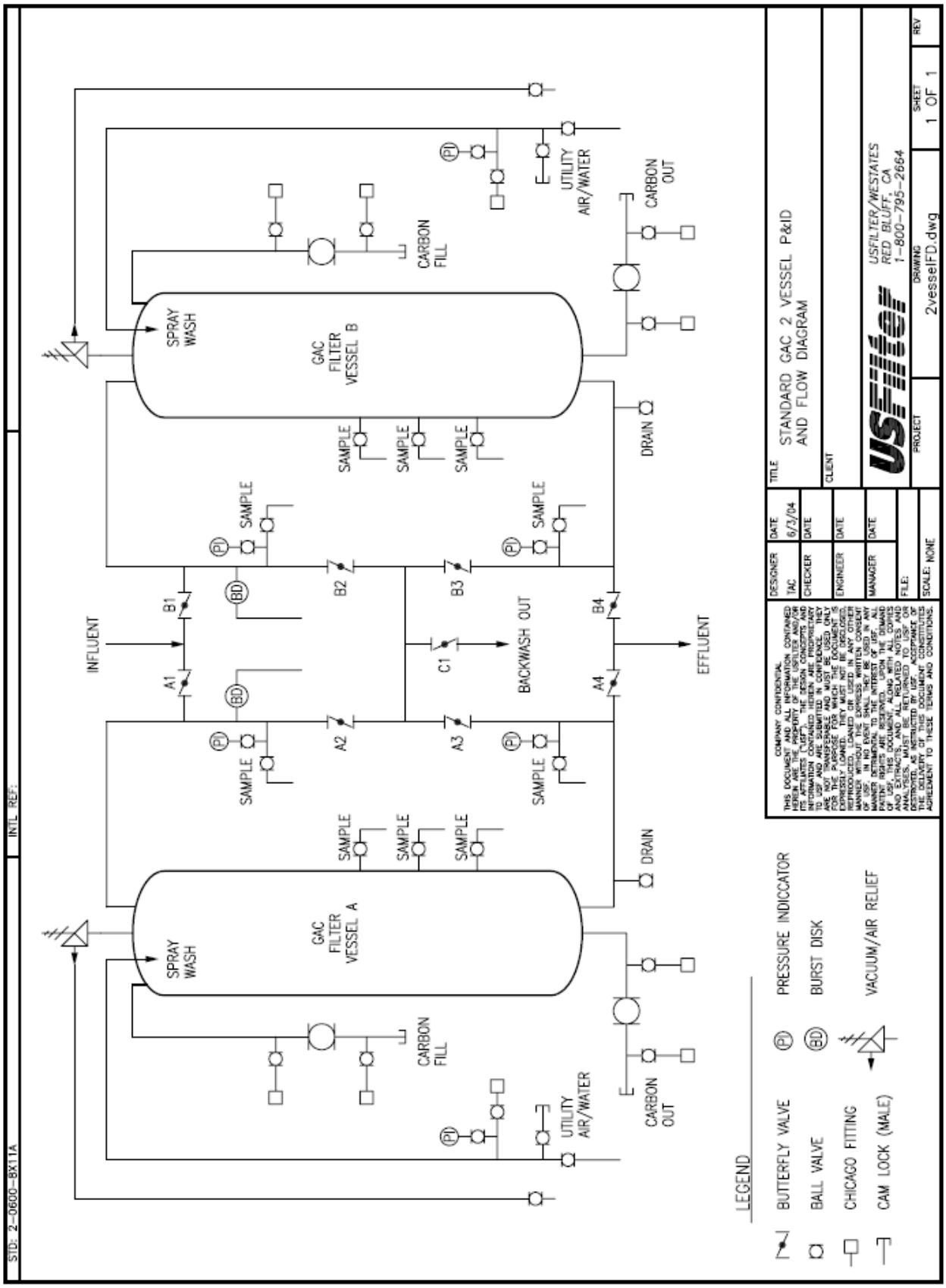
6. Once no air is observed discharging through the vent valve, open valve B4.

START-UP PROCEDURE FOR SYSTEN OPERATION IN SERIES

The same procedure is performed for starting up the system for series operation except that the pump can be ramped up to 100% flow when placing the first adsorber online and the valves are configured for series operation per the **3-TIER MANIFOLD WITH BACKWASH CONNECTIONS Chart on page 18 of this manual.**

Normal operation requires no further changes until breakthrough occurs. When this happens, call **Siemens Water Technologies** Customer Service to schedule a changeout. Refer to Section 6.4 for contact and phone number.

When particulate builds up on the carbon it becomes necessary to backwash the units. Refer to Section 3.7 for Backwash Procedure.


STD: 2-0600-8X11A
INTL REF:
INFLUENT
EFFLUENT
BACKWASH OUT
B1
B2
B3
B4
A1
A2
A3
A4
C1
GAC FILTER VESSEL A
GAC FILTER VESSEL B
SPRAY WASH
SAMPLE
DRAIN
CARBON FILL
CARBON OUT
UTILITY AIR/WATER
LEGEND
BUTTERFLY VALVE
BALL VALVE
CHICAGO FITTING
CAM LOCK (MALE)
PRESSURE INDICCATOR
BURST DISK
VACUUM/AIR RELIEF
COMPANY CONFIDENTIAL
DESIGNER
CHECKER
ENGINEER
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STANDARD GAC 2 VESSEL P&ID
AND FLOW DIAGRAM
CLIENT
USFILTER/WESTATES
RED BLUFF, CA
1-800-795-2664
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2vesselFD.dwg
SHEET
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REV

3-TIER MANIFOLD WITH BACKWASH CONNECTIONS

VALVE SEQUENCE CHART

VALVE NUMBER

OPERATION	A1	A2	A3	A4	B1	B2	B3	B4	C1
PARALLEL “A” AND “B”	O	C	C	O	O	C	C	O	C
VESSEL “A” ONLY	O	C	C	O	C	C	C	C	C
VESSEL “B” ONLY	C	C	C	C	O	C	C	O	C
SERIES FLOW “A” THEN “B”	O	C	O	C	C	O	C	O	C
SERIES FLOW “B” THEN “A”	C	O	C	O	O	C	O	C	C
BACKWASH “A” ONLY	C	O	C	O	C	C	C	C	O
BACKWASH “B” ONLY	C	C	C	C	C	O	C	O	O

O - OPEN C – CLOSED

3.7 BACKWASH

If the pressure drop across an adsorber becomes too high (doubling clean bed pressure drop), backwashing may be necessary. Generally, the cause of high-pressure drop is solids depositing in the carbon bed. This can not only lead to high pressure drop, but can cause channeling in the carbon bed and lead to premature breakthrough of organic contaminants.

It is the Purchaser's responsibility to backwash an adsorber and to provide ample water for backwashing. The water should be **clean** water (free of solids and organics) and the flow rate should be high enough to achieve approximately 25-30% bed expansion.

Backwashing with water containing solids is highly discouraged. If the solids are smaller than the slot opening size of the septa, they will be introduced into the carbon bed via the underdrain septa screens. If the solids are larger than the slot opening size of the septa, then there is a strong possibility that these solids may become trapped in the septa slots resulting in plugging. Plugging of the septa slots will decrease the open area for flow resulting in a high pressure drop. These solids may become so tightly wedged in the septa openings that the only remedy for their removal is to remove the septa screens and either clean them or replace them.

Backwashing with water containing organics is also highly discouraged. Normal operation for organic removal is down flow. In down flow operation, the mass transfer zone (volume of carbon in the bed where organics are being removed) moves down through the bed. The volume of carbon above the mass transfer zone is spent and the volume of carbon below the mass transfer zone is available for adsorption. If the bed is backwashed with water containing organics, then organics are adsorbed below the mass transfer zone. When the bed is placed in normal down flow operating mode, those organics will desorb and premature breakthrough may occur.

The backwash flow rate is dependent upon carbon type, mesh size and water temperature. Backwash rates can range from 1150-1350 gpm depending upon the temperature of the backwash water and the type of GAC. Refer to GAC Carbon Data Sheet in Section 8 for backwash rate.

EACH ADSORBER SHOULD BE BACKWASHED SEPARATELY.

1. Isolate the vessel to be backwashed from the process stream.

2. To initiate backwash, follow the valve sequence chart and the backwash procedure in Section 3.5 above.

3. Backwash for 10 - 20 minutes. Make sure backwash valves are open for entire cycle.

4. If pressure drop is still unacceptable, repeat or call **Siemens Water Technologies** Customer Service. Refer to Section 6.5 for contact and phone number.

NOTE: PROVISIONS SHOULD BE MADE TO PROPERLY DISPOSE OF THE BACKWASH WATER.

3.8 SPENT CARBON REMOVAL

When the activated carbon becomes saturated (exhausted) the system it is taken off-line for replacement of the spent carbon. The first adsorber is then pressurized up to 30 psig with air. With the addition of utility water, the spent carbon is pneumatically displaced as slurry to a bulk transport trailer by slowly opening the slurry outlet valve. To remove 20,000 pounds of carbon approximately 9,000 gallons of water is required to keep the spent GAC in slurry to facilitate removal. This will prevent a line clogging. The procedure is repeated for the second adsorber.

To refill the adsorber with fresh carbon see **Section 3.4**.

4.0 TROUBLESHOOTING

The following tables list malfunctions, probable causes, and in most cases, possible corrective action to take for the problem at hand. By no means is this list complete. It is intended only as a guide for the maintenance personnel to help them in properly identifying and isolating equipment malfunctions. If in doubt as to the actual cause of a malfunction, consult the factory or nearest equipment representative for assistance.

ADSORPTION SYSTEM:

MALFUNCTION	PROBLEM CAUSE	CORRECTION ACTION
High pressure drop across adsorber	Bed not flooded Bed air bound	Check to see that the air release valve is operating. Make sure there is a constant flow before valve closes.
	Feed pump pressure too high	Throttle feed pump
	Improper valving	Check valve sequence (see Figure 1). Check for obstructions in transfer lines.
	Particulate build-up on carbon bed	Backwash per Section 3.6
Leaking flange	Loose bolts	Tighten bolts
Discharge Water From the Backwash/Vent Outlet Line	Broken Rupture Disk	Replace Rupture Disk

MALFUNCTION	PROBLEM CAUSE	CORRECTION ACTION
Leaking Pressure Relief Valve	Leaking or broken Relief Valve	Check to see is carbon has collected on the valve seat. Replace Relief Valve
Carbon in the effluent	Internal mechanical failure	To confirm, open effluent sample valve. Collect 1 qt. Effluent sample to check for carbon. If the test confirms internal failure, call **Siemens Water Technologies. Refer to Section 6.4 for contacts and phone number.**
Premature breakthrough	Change of influent concentrations	Confirm by checking influent and effluent samples before changing carbon
	Siphoning air in	Check Air Release/Vacuum Relief Valve for correct operation
	Background TOC Colloids	Change carbon
Sudden high contamination level in effluent	Check heel due to improper carbon change-out	**Call Siemens Water Technologies. Refer to Section 6.4 for contacts and phone number.**
Frozen lines, broken gauges and valves	Cold weather	Insulate piping and or heat trace process. **Call Siemens Water Technologies. Refer to Section 6.4 for contacts and phone number.**
System bacteria infections	Disinfect System	See Appendix A – Disinfection Procedures and/or Tech Note 11 – Activated Carbon Disinfection.

5.0 SYSTEM MONITORING

It is the responsibility of the Purchaser to monitor the Carbon System during operation. Spent carbon must be properly profiled according to all applicable regulations prior to reactivation.

The following is a suggested format for an operating log. This list is meant as a suggestion only and is by no means complete. Record each day the following items for each individual Carbon System Vessel:

1. Record all equipment maintenance, calibrations, system cleaning, repairing and any parts replacement.

2. Record any unusual occurrences, shutdowns, breakdowns, etc.

3. Record the date and time when each item is logged.

4. Record the pressure drop across the system daily to indicate if any foreign objects have entered the Carbon System.

6.0 GENERAL CARBON SYSTEM INFORMATION

6.1 TEMPORARY SHUTDOWNS:

For shutdown or intermittent operation, the Carbon System should remain completely full of water and the inlet and outlet should be sealed either by a valve or a cap. Prior to restarting the unit, the Carbon System should be backwashed using two to three bed volumes of water. Failure to backwash may result in a temporary presence of contaminated water at the outlet of the adsorber.

6.2 EXTENDED SHUTDOWNS:

If the Carbon System is shutdown for an extended period of time, the following procedure should be followed to reduce potential degradation of bed life.

Backwash the vessels using two - three bed volumes of water. Drain the Carbon System of all water. There should be no free standing water left in the vessel. All valves, manways, and vents shall be tightly sealed for the duration of the shutdown to eliminate any supply of oxygen that would promote biological growth. Prior to re-commissioning the units, follow the start-up instructions included.

6.3 EMERGENCY PROCEDURES

In the event something should occur to cause a shutdown of an adsorber, the operation shall be switched over to the other adsorber and steps shall be taken immediately to remedy the situation.

If a major leak or failure occurs which would cause the Carbon System to be inoperative, then the feed to the system should be shut down immediately. If repairs are beyond the scope of the plant operators, the customer service department at Siemens Water Technologies should be contacted immediately.

6.4 Siemens Water Technologies CONTACTS - HOW TO OBTAIN HELP AND INFORMATION

Red Bluff, CA	**530-527-2664**
Gulf Coast Region	**800-659-1723**
Louisiana	**225-744-3153**
Western Region	**800-659-1771**
Mid-Atlantic Region	**800-659-1717**
Midwest Region	**708-345-7290**
Northwest Region	**800-659-1718**
Southeast Region	**225-744-3153**
New England Region	**800-659-1717**

7.0 MAINTENANCE

7.1 MINOR MAINTENANCE

Minor maintenance is that maintenance to be performed by the plant to ensure continuous and effective operation. This maintenance includes visual check of pressure gauges, rupture disks, and adjustments to valves and regulators, tightening flanges and connections to eliminate leakage, backwashing, etc. During scheduled change-out services vessel internal parts should be inspected (underdrain screens, vessel lining, nozzles, etc.) to ensure they are in good working condition.

7.2 MAJOR MAINTENANCE

Major maintenance is that effort needed to repair or replace equipment in order to continue system operation. The need for major maintenance would result from a major malfunction causing the system to be inoperative. Major maintenance also refers to system design changes and/or maintenance requiring downtime. Siemens Water Technologies can be contacted when any major maintenance is called for.

7.3 SPARE PARTS

- 20” Manway gaskets Siemens Water Technologies Part No. C1031
- 4” 125 psi Grapite Burst Disk Siemens Water Technologies Part No M3030

8.0 SPECIFICATION SHEETS

Appendix A – Disinfection Procedure

GAC Specification Sheets

Material Safety Data Sheets

Technical Note 11 – Activated Carbon Disinfection

HP1220 System General Assembly Drawing

David LaRose
Field Sales Engineer
Westates

11484 Fuerte Farms Road
El Cajon, California 92020

TELEPHONE 619-301-3236
FACSIMILE 707-220-0260
CELLULAR 619-301-3236

APPENDIX A

EQUIPMENT DISINFECTION PROCEDURE

This document summarizes the method prescribed by the American Water Works Association (ANSI/AWWA C653-97) for disinfecting equipment specific to US Filter/Westates'. Equipment includes trailers, pumps, hose and appurtenances utilized for handling and transfer of activated carbon utilized in the production of drinking water.

The disinfection procedure outlined in this document is only for the equipment and piping of the adsorption system. This procedure should be performed prior to utilizing the equipment for granular activated carbon handling. If this procedure is attempted while the activated carbon is in the equipment, the activated carbon will consume the chlorine making the attempt ineffectual. If disinfection is required after the activated carbon is installed then caustic solution should be used.

"The forms of chlorine that may be used for the disinfection operation are liquid chlorine, sodium hypochlorite solution, and calcium hypochlorite granules or tablets."[1] of these forms, calcium hypochlorite is the most readily available and safest form of chlorine disinfection.

Calcium hypochlorite, from such makers as HTH, can be obtained from any local pool supply store. Available in either granules or tablets, calcium hypochlorite requires no special handling other than general safety practices. The amount of calcium hypochlorite used is approximately one (1) pound of $Ca(OCl)_2$ per 3,100 gallons of water.

In order to meet disinfection guidelines, it is necessary to contact the entire system with water containing a free chlorine residual of at least 25 mg/l (25 ppm) prior to carbon fill. Once this is accomplished, the chlorinated water should remain in the system for at least 12 hours. At the end of this 12-hour retention period, the free residual chlorine should be measured. If the free residual is less than 15 mg/l (15 ppm), the entire chlorination procedure should be repeated. Testing should be made at as many points as feasible to ensure that the lowest residual is measured. Once satisfactory residuals are obtained, the system should be thoroughly flushed with fresh water, or drained and refilled with fresh water. The equipment is now ready for carbon.[2]

1AWWA C653-87 – Standard for Disinfection of Water Treatment Plants, Section 3.

2AWWA C653-887 – Standard for Disinfection of Water Treatment Plants, Section 5.2.

USFILTER WESTATES CARBON AQUACARB® 830 AND 1240

Coal based granular activated carbon

(Formerly KG-401 and KG-502)

FOR MUNICIPAL, INDUSTRIAL AND REMEDIAL WATER TREATMENT

Description & Applications

AquaCarb® 830 and AquaCarb® 1240 are high activity granular activated carbons manufactured from selected grades of bituminous coal. Manufactured by direct activation, they exhibit exceptional hardness and attrition resistance and have become a cost effective choice for use in municipal, industrial and remedial water treatment applications. These high surface area microporous carbons have been specifically developed for the removal of a broad range of organic contaminants from potable, waste and process waters.

- ANSI/NSF Standard 61 classified for use in potable water applications
- Fully conforms to physical, performance and leachability requirements established by the current ANSI/AWWA B604 (which includes the Food Chemical Codex requirements)
- A detailed quality assurance program guarantees consistent quality from lot to lot and shipment to shipment

Quality Control

All AquaCarb® activated carbons are extensively quality checked at our State of California certified environmental and carbon testing laboratory located in Los Angeles, CA. USFilter's laboratory is fully equipped to provide complete quality control analyses using ASTM standard test methods in order to assure the consistent quality of all AquaCarb® carbons.

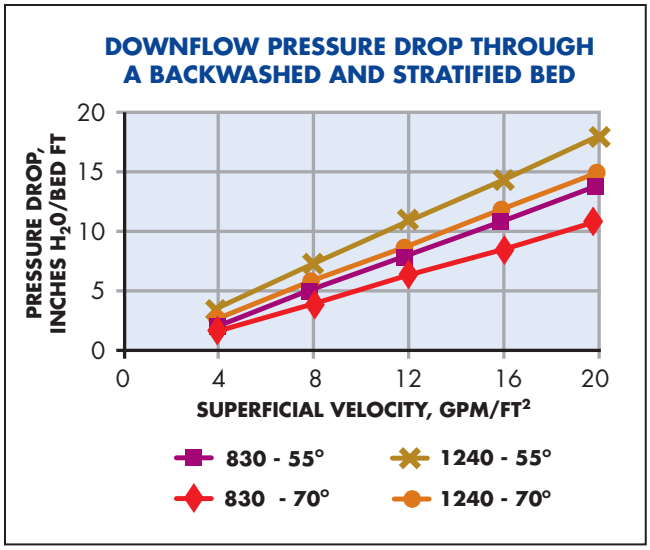
Our technical staff offers hands-on guidance in selecting the most appropriate system, operating conditions and carbon to meet your needs. For more information, contact your nearest USFilter representative.

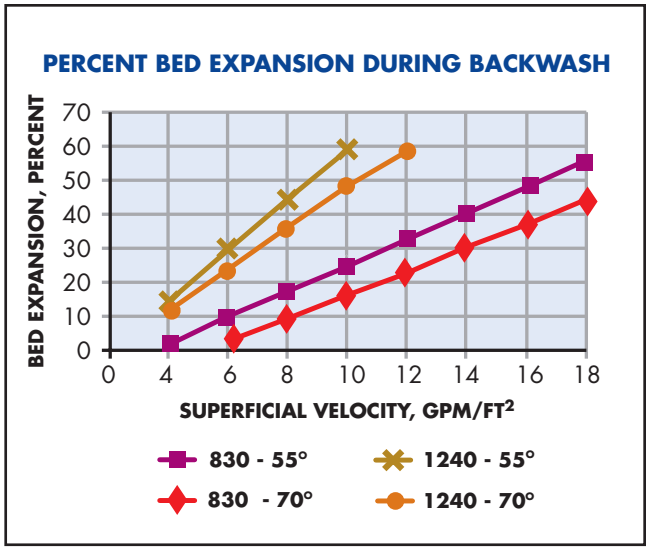
USFilter

AQUACARB® 830
AQUACARB® 1240

Coal based granular activated carbon

(Formerly KG-401 and KG-502)





Safety Note: Wet activated carbon depletes oxygen from the air and therefore dangerously low levels of oxygen may be encountered. Whenever workers enter a vessel containing activated carbon, the vessel's oxygen content should be determined and work procedures for potentially low oxygen areas should be followed. Read Material Safety Data Sheet (MSDS) before using this product.

All information presented herein is believed reliable and in accordance with accepted engineering practices. USFilter makes no warranties as to the completeness of this information. Users are responsible for evaluating individual product suitability for specific applications. USFilter assumes no liability whatsoever for any special, indirect or consequential damages arising from the sale, resale or misuse of its products.

SPECIFICATIONS/TYPICAL PROPERTIES

Specification	AquaCarb® 830	AquaCarb® 1240
Carbon Type	Bituminous Coal	Bituminous Coal
Mesh Size, U.S. Sieve	8 x 30	12 x 40
Effective Size, mm	0.8 - 1.1	0.55 - 0.75
Uniformity Coefficient (max)	2.1	1.9
Iodine No., mgI_2/g (min.)	900	1000
Abrasion No., Wt. % (min.)	80	80
Apparent Density, g/cc	0.46 - 0.54	0.46 - 0.54

USFilter reserves the right to change the specifications referred to in this literature at any time, without prior notice. AquaCarb is a trademark of United States Filter Corporation or its affiliates.

USFilter

Westates
Customer and
Technical Service Network:

Gulf Coast Region 800.659.1723
(Louisiana) 225.744.3153
Western Region 800.659.1771
Mid-Atlantic Region 800.659.1717
Midwest Region 708.345.7290
Northwest Region 800.659.1718
Southeast Region 225.744.3153
New England Region 800.659.1717

www.usfilter.com

WS-AQ83-DS-0704

USFILTER WESTATES CARBON

AQUACARB® 816 AND 820

Coal based granular activated carbon

FOR POTABLE, MUNICIPAL, AND INDUSTRIAL WATER TREATMENT

Description & Applications

AquaCarb® 816 and AquaCarb® 820 are high activity granular activated carbons manufactured from selected grades of bituminous coal. These carbons are utilized in upgrading existing anthracite coal and sand filtration plants. These carbons have been demonstrated to be an excellent media for the adsorption of dissolved organics, taste and odor compounds. Additional applications include biological activated carbon (BAC) water treatment. This carbon media has demonstrated an ability to enhance biodegradation of organics.

- ANSI/NSF Standard 61 classified for use in potable water applications
- Fully conforms to physical, performance and leachability requirements established by ANSI/AWWA B604 (which includes the Food Chemical Codex requirements)
- A detailed quality assurance program guarantees consistent quality from lot to lot and shipment to shipment

Quality Control

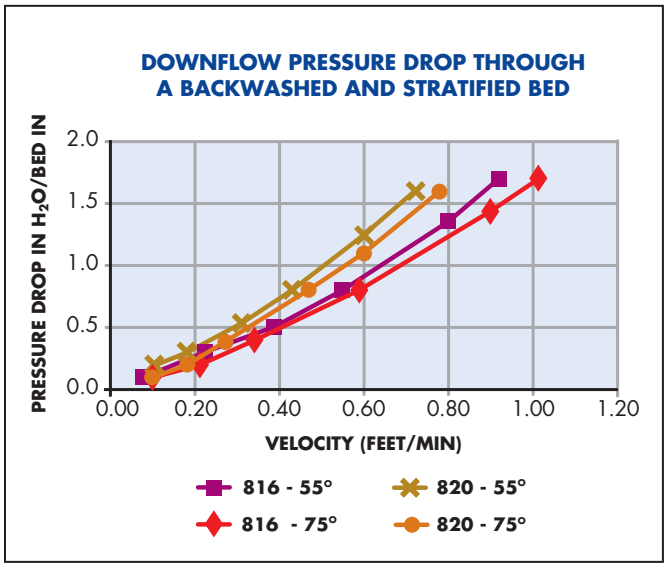
All AquaCarb® activated carbons are extensively quality checked at our State of California certified environmental and carbon testing laboratory located in Los Angeles, CA. USFilter's laboratory is fully equipped to provide complete quality control analyses using ASTM standard test methods in order to assure the consistent quality of all AquaCarb® carbons.

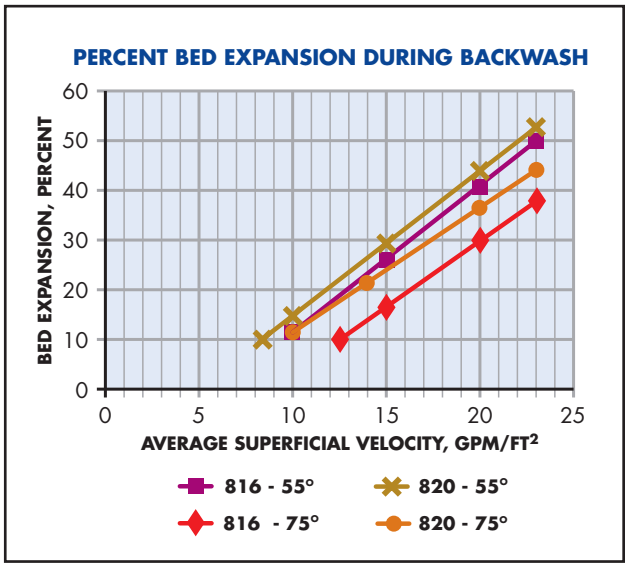
Our technical staff offers hands-on guidance in selecting the most appropriate system, operating conditions and carbon to meet your needs. For more information, contact your nearest USFilter representative.

USFilter

AQUACARB® 816 AND 820

Coal based granular activated carbon





Safety Note: Wet activated carbon depletes oxygen from the air and therefore dangerously low levels of oxygen may be encountered. Whenever workers enter a vessel containing activated carbon, the vessel's oxygen content should be determined and work procedures for potentially low oxygen areas should be followed. Read Material Safety Data Sheet (MSDS) before using this product.

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SPECIFICATIONS/TYPICAL PROPERTIES

Specification	AquaCarb® 816	AquaCarb® 820
Carbon Type	Bituminous Coal	Bituminous Coal
Mesh Size, U.S. Sieve	8 x 16	8 x 20
Effective Size, mm	1.3 - 1.5	1.0 - 1.2
Uniformity Coefficient (max)	1.4	1.5
Iodine No., mgI_2/g (min)	900	900
Abrasion No., Wt. % (min)	80	80
Apparent Density, g/cc	0.46 - 0.54	0.46 - 0.54

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Westates
Customer and
Technical Service Network:

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(Louisiana) 225.744.3153
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Mid-Atlantic Region 800.659.1717
Midwest Region 708.345.7290
Northwest Region 800.659.1718
Southeast Region 225.744.3153
New England Region 800.659.1717

www.usfilter.com

WS-AQ81-DS-0704

USFILTER WESTATES CARBON

AQUACARB® 1230C AND 1230AWC

Coconut shell based granular activated carbon

(Formerly CC-602 and CC-602AW)

FOR USE IN POTABLE, WASTE AND PROCESS WATER APPLICATIONS

Description and Applications

AquaCarb® 1230C and AquaCarb® 1230AWC are high activity coconut shell based granular activated carbons. These hard, attrition resistant high surface area carbons are designed to remove difficult to adsorb organics from potable, waste and process water. They are especially effective for adsorbing chlorine, disinfection by-products, TCE, PCE, MTBE and other trace level organics. AquaCarb® 1230AWC is acid washed yielding a very low ash content, pH neutral carbon that is ideally suited for use in potable water and high purity water systems for the microelectronics and other industries.

- ANSI/NSF Standard 61 classified for use in potable water applications
- Fully conforms to physical, performance and leachability requirements established by the current ANSI/AWWA B604 (which includes the Food Chemical Codex requirements)
- A detailed quality assurance program guarantees consistent quality from lot to lot and shipment to shipment

Quality Control

All AquaCarb® activated carbons are extensively quality checked at our State of California certified environmental and carbon testing laboratory located in Los Angeles, CA. USFilter's laboratory is fully equipped to provide complete quality control analyses using ASTM standard test methods in order to assure the consistent quality of all AquaCarb® carbons.

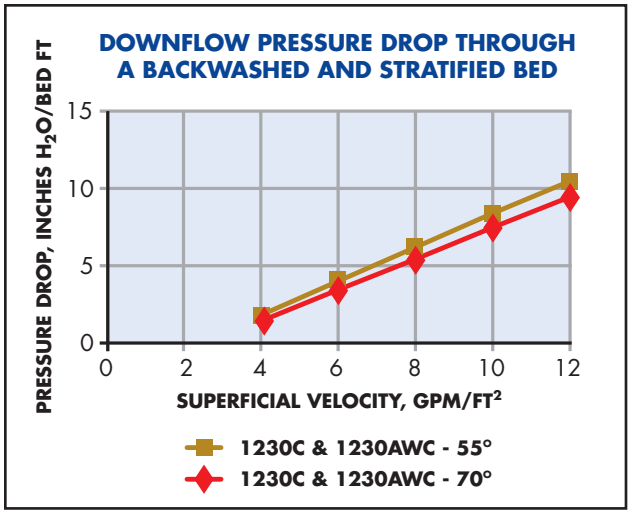
Our technical staff offers hands-on guidance in selecting the most appropriate system, operating conditions and carbon to meet your needs. For more information, contact your nearest USFilter representative.

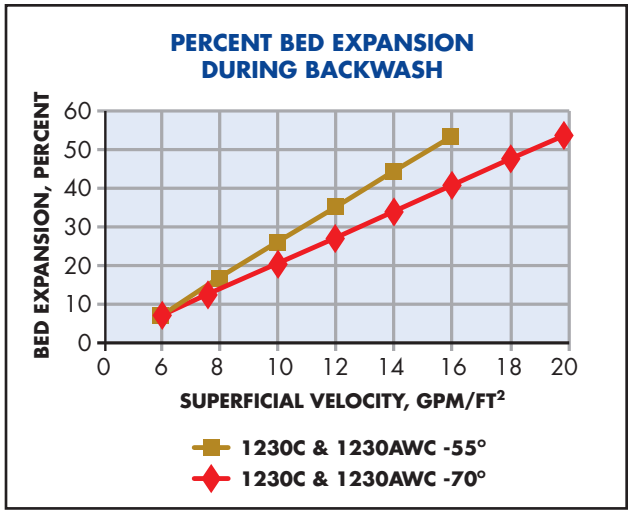
USFilter

AQUACARB® 1230C
AQUACARB® 1230AWC

Coconut shell based granular activated carbon

(Formerly CC-602 and CC-602AW)





Safety Note: Wet activated carbon depletes oxygen from the air and therefore dangerously low levels of oxygen may be encountered. Whenever workers enter a vessel containing activated carbon, the vessel's oxygen content should be determined and work procedures for potentially low oxygen areas should be followed. Read Material Safety Data Sheet (MSDS) before using this product.

All information presented herein is believed reliable and in accordance with accepted engineering practices. USFilter makes no warranties as to the completeness of this information. Users are responsible for evaluating individual product suitability for specific applications. USFilter assumes no liability whatsoever for any special, indirect or consequential damages arising from the sale, resale or misuse of its products.

SPECIFICATIONS/TYPICAL PROPERTIES

Specification	AquaCarb® 1230C	AquaCarb® 1230AWC
Carbon Type	Coconut Shell	Coconut Shell
Mesh Size, U.S. Sieve	12 x 30	12 x 30
Effective Size, mm	0.6 - 0.85	0.6 - 0.85
Uniformity Coefficient (max.)	2.0 (max)	2.0 (max)
Iodine No., mgl_2/g (min.)	1100 (min)	1100 (min)
Hardness No., Wt. % (min.)	98 (min)	98 (min)
Abrasion No., Wt. % (min.)	85 (min)	85 (min)
Apparent Density, g/cc	0.45 - 0.52	0.45 - 0.52
Water Soluble Ash, Wt. % (max)	2.0	0.2
Contact pH	9.0 - 10.0	6.5 - 8.0

USFilter reserves the right to change the specifications referred to in this literature at any time, without prior notice. AquaCarb is a trademark of United States Filter Corporation or its affiliates.

USFilter

Westates
Customer and
Technical Service Network:

Gulf Coast Region 800.659.1723
(Louisiana) 225.744.3153
Western Region 800.659.1771
Mid-Atlantic Region 800.659.1717
Midwest Region 708.345.7290
Northwest Region 800.659.1718
Southeast Region 225.744.3153
New England Region 800.659.1717

www.usfilter.com

WS-AQ12-DS-0704

USFILTER WESTATES CARBON

BEVCARB™ 1240

Coal based granular activated carbon

FOR USE IN PREPARATION OF

HIGH PURITY WATER

Description and Applications

BevCarb™ 1240 is an acid washed bituminous coal based activated carbon that has been specifically developed for the preparation of high purity water for use in the manufacture of beverages. It is especially effective for adsorbing chlorine, chloramines, disinfection by-products, and other trace level organics from municipal water. Being acid washed, BevCarb™ 1240 has a low water soluble ash content, is pH neutral and is free of sulfides.

- ANSI/NSF Standard 61 classified for use in potable water applications
- Fully conforms to physical, performance and leachability requirements established by the current ANSI/AWWA B604 (which includes the Food Chemical Codex requirements).
- A detailed quality assurance program guarantees consistent quality from lot to lot and shipment to shipment.

Quality Control

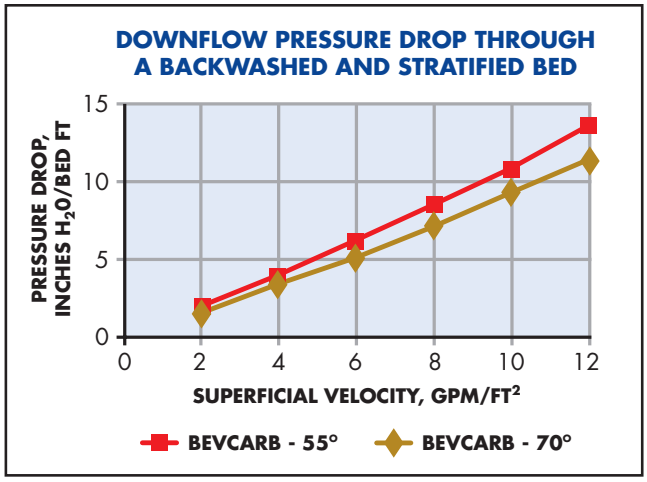
BevCarb™ activated carbons are extensively quality checked at our State of California certified environmental and carbon testing laboratory located in Los Angeles, CA. USFilter's laboratory is fully equipped to provide complete quality control analyses using ASTM standard test methods in order to assure the consistent quality of all BevCarb™ carbons.

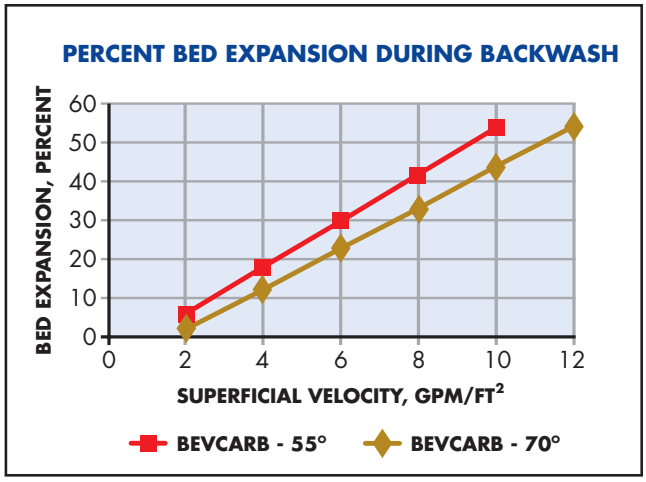
Our technical staff offers hands-on guidance in selecting the most appropriate system, operating conditions and carbon to meet your needs. For more information, contact your nearest USFilter representative.

USFilter

BEVCARB™ 1240

Coal based granular activated carbon





Wet activated carbon readily adsorbs atmospheric oxygen. Dangerously low oxygen levels may exist in closed vessels or poorly ventilated storage areas. Workers should follow all applicable state and federal safety guidelines for entering oxygen depleted areas.

All information presented herein is believed reliable and in accordance with accepted engineering practices. USFilter makes no warranties as to the completeness of this information. Users are responsible for evaluating individual product suitability for specific applications. USFilter assumes no liability whatsoever for any special, indirect or consequential damages arising from the sale, resale or misuse of its products.

SPECIFICATIONS/TYPICAL PROPERTIES

Specification	BevCarb™ 1240
Carbon Type	Bituminous Coal
Mesh Size, U.S. Sieve	12 x 40
Effective Size, mm	0.55 - 0.85
Uniformity Coefficient (max)	2.1
Iodine No., mgI_2/g (typical)	950
Abrasion No., Wt. % (min)	80
Apparent Density, g/cc	0.46 - 0.54
Water Soluble Ash, Wt. % (max)	0.2
Contact pH	6.5 - 8.0

USFilter reserves the right to change the specifications referred to in this literature at any time, without prior notice. BevCarb is a trademark of United States Filter Corporation or its affiliates.

WS-BEVC-DS-0704

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Midwest Region 708.345.7290
Northwest Region 800.659.1718
Southeast Region 225.744.3153
New England Region 800.659.1717

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Material Safety Data Sheet

SECTION 1 – CHEMICAL PRODUCT AND COMPANY INFORMATION

****

Product Name: ACTIVATED CARBON, *AquaCarb Series, VOCarb Series, AC Series, VC Series, BevCarb Series, and UltraCarb Series*
Part Number:100 **Chemical Family**: activated carbon

Manufacturer's Name: U.S. FILTER WESTATES CARBON
Address: 5375 South Boyle Avenue, Los Angeles, CA 90058
Product/Technical Information Phone Number: (323) 277-1500
Medical/Handling Emergency Phone Number: CHEMTREC 1-800-424-9300
Transportation Emergency Phone Number: CHEMTREC 1-800-424-9300

Revision Date/Revision Number: February 13, 2002

SECTION 2 – COMPOSITION INFORMATION

****

Chemical Name	Percent by Weight	CAS#
Activated Carbon	100	7440-44-0

SECTION 3 – HAZARDS IDENTIFICATION

****

Appearance & Odor: black granules without taste or odor
Emergency Overview: Dust that contacts eyes may be irritating or cause mechanical injury. Dust may cause slight skin irritation. Dust may be irritating to the respiratory tract and cause coughing or sneezing. Ingestion of powder may be irritating to the gastrointestinal tract. Warning: Wet activated carbon depletes oxygen from the air and therefore dangerously low levels of oxygen may be encountered. Whenever workers enter a vessel containing activated carbon, the vessel's oxygen content should be determined and work procedures for potentially low oxygen areas should be followed.
Fire &Explosion Hazards: When burned**,** hazardous products of combustion including carbon oxides can occur. Irritating and/or toxic gases due to decomposition of the product may be generated during a fire. Fight fire from a safe distance from a protected location. Contact with strong oxidizers such as ozone or liquid oxygen may cause rapid combustion.
Primary Route(s) of Exposure: Eye contact, skin contact, ingestion, or inhalation are all possible routes of entry.
Inhalation- Acute Effects: Dust may be irritating to the respiratory tract and cause coughing or sneezing.
Skin Contact-Acute Effects: Dust may cause slight skin irritation.

SECTION 3 – HAZARDS IDENTIFICATION (continued)

****

Eye Contact- Acute Effects: Dust that contacts eyes may be irritating or cause mechanical injury.
Ingestion- Acute Effects: Ingestion of powder may be irritating to the gastrointestinal tract.

SECTION 4 – FIRST AID MEASURES

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Inhalation First Aid: Remove affected person from area to fresh air and provide oxygen if breathing is difficult. Give artificial respiration ONLY if breathing has stopped and give CPR ONLY if there is no breathing and no pulse. Obtain medical attention.
Skin Contact First Aid: Wash skin for 5 minutes with flowing water and soap. Clothing should be discarded or washed before reuse. Obtain medical assistance if irritation develops. DO NOT instruct person to neutralize affected skin area.
Eye Contact First Aid: Immediately irrigate eyes with flowing water continuously for 15 minutes while holding eyes open. Contacts should be removed before or during flushing. Seek medical assistance if irritation develops. DO NOT instruct person to neutralize.
Ingestion First Aid: Vomiting may need to be induced if directed by a physician or poison control center. DO NOT have unqualified personnel induce vomiting. Obtain medical attention immediately.
Medical Conditions Aggravated: Respiratory ailments may be aggravated by exposure to this product.
Note to Physician: No specific antidote, treat patient symptomatically.

SECTION 5 – FIRE FIGHTING MEASURES

****

Flash Point/Method: Nonflammable
Auto Ignition Temperature: 840°C (1,710°F)
Upper/Lower Explosion Limits: not applicable

Extinguishing Media: Water spray, carbon dioxide, foam or dry chemical
Fire Fighting Procedures: In the event of a fire, wear full protective clothing and NIOSH approved self-contained breathing apparatus with full face piece, operated in the positive pressure mode.
Fire & Explosion Hazards: When burned**,** hazardous products of combustion including carbon oxides can occur. Irritating and/or toxic gases due to decomposition of the product may be generated during a fire. Fight fire from a safe distance from a protected location. Contact with strong oxidizers such as ozone or liquid oxygen may cause rapid combustion.
Hazardous Products of Decomposition and /or Combustion: Carbon oxides**.**

NFPA Ratings:
HEALTH-1 FLAMMABILITY- 0 REACTIVITY-0 OTHER- none

SECTION 6 – ACCIDENTAL RELEASE MEASURES

****

Clean up spills in a manner that does not disperse dust into the air. Handle in accordance with good industrial hygiene and safety practices. These practices include avoiding unnecessary exposure, and removal of material from eyes, skin, and clothing. Dispose of virgin (unused) carbon (waste or spillage) in a facility permitted for non-hazardous wastes. Spent (used) carbon should be disposed of in accordance with applicable laws. Do not reuse empty bags. Dispose of in facility permitted for non-hazardous wastes. DO NOT DUMP INTO ANY SEWERS, ON THE GROUND OR INTO ANY BODY OF WATER. All disposal methods must be in compliance with all Federal, State, Local and Provincial laws and regulations. Regulations may vary in different locations. Waste characterizations and compliance with applicable laws are the responsibility solely of the waste generator.

SECTION 7 – HANDLING AND STORAGE

****

Handling: Avoid dispersion into air. Keep containers dry and closed. Follow good handling and housekeeping practices to minimize spills, generation of airborne dusts, and accumulation of dusts on exposed surfaces. Use with adequate exhaust ventilation to draw dust away from workers' breathing zones. Prevent or minimize exposures to dusts by using appropriate respirators, gloves, and eye protection. Wash exposed skin areas thoroughly with soap and water. Use caution when pouring, using pneumatic transport, swirling, etc. as this material can become electrostatically charged.

Storage: Avoid breaking bags or spilling media so as to avoid possibly creating residual dust. Store in ambient atmospheric conditions. Product should be stored in a closed dry container. Maintain good housekeeping procedures. Store away from strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc.

General Comments: Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

SECTION 8 –PERSONAL PROTECTION/ EXPOSURE CONTROL

****

Respiratory Protection: Use NIOSH/MSHA approved respiratory protection equipment appropriate to the material and/or its concentration where airborne exposure is likely. If exposures cannot be kept to a minimum with engineering controls, consult manufacturer to determine appropriate type equipment for a given application. Observe respirator use limitations specified by NIOSH/MSHA or the manufacturer.

Skin Protection: Wear appropriate dust resistant clothing and gloves.

Eye Protection: Safety glasses with side shields are recommended for any type of handling. Where eye contact or dusty conditions may be likely, dust tight goggles are recommended.

SECTION 8 –PERSONAL PROTECTION/ EXPOSURE CONTROL (continued)

****

Ventilation Protection: Provide ventilation if necessary to minimize exposure. Dilute ventilation acceptable, but local mechanical exhaust ventilation preferred, if practical, at sources of air contamination such as open process equipment. The following publication offers ventilation guidelines and techniques: "INDUSTRIAL VENTILATION, A MANUAL OF RECOMMENDED PRACTICE" available from the ACGIH.
Other Protection: Safety showers, with quick opening valves which stay open, and eye wash fountains, or other means of washing the eyes with a gentle flow of cool to tepid tap water, should be readily available in all areas where this material is handled or stored. Water should be supplied through insulated and heat-traced lines to prevent freeze-ups in cold weather.

Exposure Limits:
OSHA PEL-TWA: 15 mg/m^3 (total), 5 mg/ m^3 (resp)
OSHA PEL-STEL: 10 mg/m^3

SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

****

Appearance & Odor: black granules without taste or odor
Vapor Pressure: zero
Vapor Density (Air=1): not applicable
Boiling Point: not applicable
Melting Point: not applicable
Specific Gravity: 0.25 - 0.60 g/cc
Solubility in Water: Insoluble
Volatile Percentage: 0%
pH: not determined
Flash Point/method: Nonflammable
Auto Ignition Temperature: 840°C
Upper/Lower Explosion Limits: not applicable
Other: none

SECTION 10 – STABILITY AND REACTIVITY

****

Stability: This product is considered stable under the specified conditions of storage, shipment and use.
Incompatibilities: Contact with strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc. may result in rapid combustion. Avoid contact with strong acids.
Polymerization: Hazardous polymerization will not occur.
Decomposition: Hazardous decomposition will produce carbon oxides.
Conditions to avoid: Store away from strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc. Moist air will reduce the operating life.

SECTION 11 – TOXICOLOGICAL INFORMATION

****

INHALATION – Acute: Inhalation of carbon dust is mildly irritating to the lungs and can immediately give rise to an increased mucociliary transport and airway resistance mediated by the vagus. The inhalation LC50 (Rat) is > 64.4 mg/l.
INHALATION – Chronic: There are no known chronic inhalation effects.
SKIN CONTACT – Acute: Skin contact is expected to be slightly irritating. The primary skin irritation index (rabbit) is 0.

SECTION 11 – TOXICOLOGICAL INFORMATION (continued)

****

SKIN CONTACT – Chronic: There are no known chronic dermal effects.
EYE CONTACT – Acute: Eye contact can cause conjunctivitis, epithelial hyperplasia of the cornea, as well as eczematous inflammation of the eyelids.
INGESTION – Acute: Carbon is practically nontoxic. The probable oral lethal dose (human) is greater than 15 g/kg; more than one quart (2.2 lbs) for a 70 kg (150 lb) person.
INGESTION – Chronic: There are no known chronic ingestion effects.
CARCINOGENICITY/MUTAGENICITY: There are no known carcinogenic/mutagenic effects.
REPRODUCTIVE EFFECTS: There are no known reproductive effects.
NEUROTOXICITY: There are no known neurotoxic effects.
OTHER EFFECTS: No other toxic effects of carbon are known.
TARGET ORGANS: Target organs include the respiratory system and the cardiovascular system**.**

SECTION 12 – ECOLOGICAL INFORMATION

****

This material, in its original state, is not harmful to the environment.

SECTION 13 – DISPOSAL CONSIDERATIONS

****

Clean spills in a manner that does not disperse dust into the air, preferably a wet-down procedure or vacuum. If material is not contaminated, spilled media can be rebagged. Material that cannot be used or chemically reprocessed and empty containers should be disposed of in accordance with all applicable regulations. Product containers should be thoroughly emptied before disposal. Generators of waste material are required to evaluate all waste for compliance with RCRA and any local disposal procedures and regulations. NOTE: State and local regulations may be more stringent than federal regulations.

Warning: Wet activated carbon depletes oxygen from the air and therefore dangerously low levels of oxygen may be encountered. Whenever workers enter a vessel containing activated carbon, the vessel's oxygen content should be determined and work procedures for potentially low oxygen areas should be followed.

SECTION 14 – TRANSPORTATION INFORMATION

****

DOT Shipping Description: Not DOT Regulated

SECTION 15 – REGULATORY INFORMATION

****

CERCLA SECTION 103 (40CFR302.4): no RQ: none
SARA SECTION 302 (40CFR355.30): no
SARA SECTION 304 (40CFR355.40): no
SARA SECTION 313 (40CFR372.65): no
SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40CFR370.21):
ACUTE: yes CHRONIC: no FIRE: no REACTIVE: no SUDDEN RELEASE: no
OSHA PROCESS SAFETY (29CFR1910.119): no
CALIFORNIA PROPOSITION 65: no

SECTION 16 – OTHER INFORMATION

****

Disclaimer: The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the user thereof. It is the buyer's responsibility to ensure that its activities comply with federal, state, provincial and local laws.

Created by: James R. Graham

Tech Notes

US Filter Westates Technical Department
Los Angeles, CA, No. 11

Disinfection of GAC Adsorbers

GENERAL BACKGROUND INFORMATION:

Disinfection of GAC is occasionally required due to the growth of bacteria on the GAC within adsorber vessels. Since both virgin and reactivated carbon have been exposed to extremely high temperature (1600 – 1800°F) during manufacture or processing, it is unusual for bacteria to originate on the carbon.

Nevertheless, once inoculated from a foreign source (such as inlet water or an improperly cleaned vessels) the GAC may encourage subsequent bacteria growth. This growth is enhanced by the presence of air, warm temperatures (i.e. bright sunlight) and stagnant (off-line) conditions. Testing is normally done by evaluating a sample of carbon treated water for heterotropic bacteria plate count (HPC), or more specifically for coliform bacteria or E-coli.

A baseline for this evaluation can be established when the vessel is initially loaded with GAC. Subsequent tests will reveal the need for disinfection if there are higher coliform or plate count readings. HPC levels less than 500 colony-forming units per milliliter (cfu/ml) are usually considered normal. Where applicable, the California Department of Health Services (DOHS) will set testing frequency and format for coliform and HPC discharge compliance.

DISINFECTION METHODS (GENERAL DESCRIPTION):

Disinfection of empty adsorption vessels, piping, and other equipment can normally be accomplished through chlorination standardized AWWA procedures (ANSI/AWWA C653-97). Disinfection of GAC by chlorination, however, is difficult since carbon quickly decomposes the OCL^- (hypochlorite) ion, thereby destroying any disinfection capability. Other methods commonly used to disinfect GAC include:

- Raising the pH of the GAC bed with caustic solution,
- Lowering the pH of the GAC bed with acid,
- Elevating the temperature with steam or near-boiling water, or
- Removing the GAC, disinfecting the system, and reinstalling fresh GAC.

USF Westates recommends raising the pH of the adsorber bed with caustic, most frequently with a NaOH solution. Continuous exposure of the GAC to a pH in excess of 13 for at least 4 hours has proven to be an effective means of disinfection.

Caustic disinfection is accomplished according to the following general procedure for adsorbers containing 10 - 20,000 lbs of carbon:

- Completely drain vessel to remove any free water.
- Pump ~1000 gallons of clean water through the effluent line
- Pump 2-55 gallon drums of 50% NaOH (or equivalent) into the adsorber through the effluent line.

- Fill the Adsorber with clean water through the effluent line at a rate not exceed 5 gpm/ft^2.
- After the filling process is complete, monitor the pH of the water. The pH should be at least 13.
- Establish a recycling water flow through the adsorber using the effluent header and the 4" GAC fill line and a suitable transfer pump. The caustic/water flow should be down flow through the vessel
- Continue recirculation for 1½ - 3 hours to insure exposure of all surfaces and the GAC to the caustic solution. Monitor pH to assure it is a minimum of 13.
    - Stop the recirculation and let vessel remain in a soaking mode for 4 -12 hours.
    - After completing the soak mode, resume recirculation for an additional 45 minutes.
    - Discharge the caustic water (if required, neutralize pH in accord with water discharge limits using muriatic acid) and backwash vessel.

NEUTRALIZATION OF THE CARBON ADSORBER

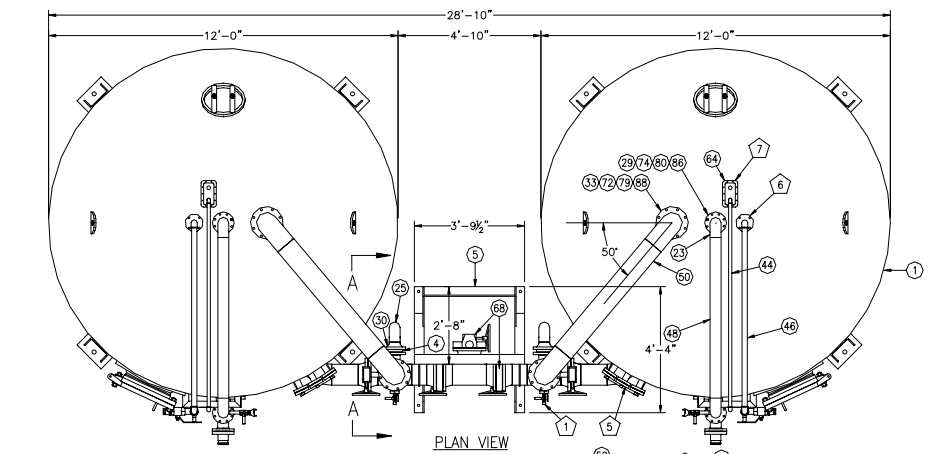
- To facilitate neutralization, add 5 gallons of HCl (37%) through the effluent line of the adsorber.
- Add clean water through the effluent line until the adsorber overflows.
- Soak for at least one hour.
- Check the pH and discharge if appropriate.
- Backwash the adsorber until the discharge water meets your pH criteria.

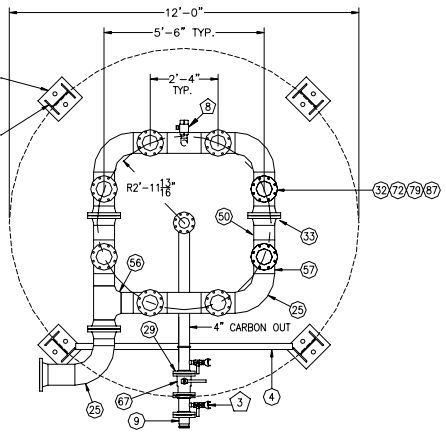
PREVENTION OF BACTERIA GROWTH

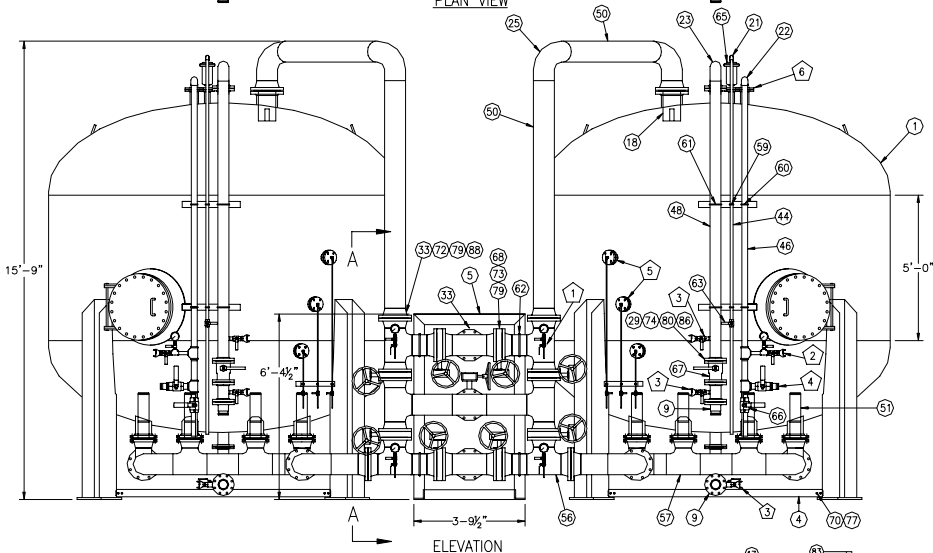
The following suggestions are recommended to reduce or inhibit the likelihood of bacteriological growth:

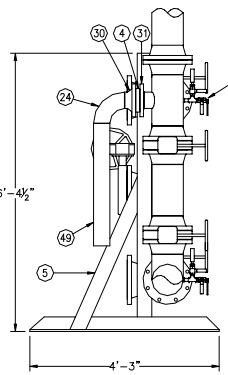
- Chlorinate the well and feed piping using AWWA standard procedures prior to putting system into service.
- Wash interior of GAC vessels with a chlorine solution and flush (per ANSI/AWWA C653-97 procedure) prior to loading fresh GAC.
- Avoid long idle periods (many weeks or months) for vessels filled with wet GAC, especially during warm months. If possible maintain a low flow of water through the vessel to drain when the vessel is not in service.
- If long idle periods are unavoidable, precondition the GAC by soaking with a 1% caustic solution to discourage bioactivity during an extended outage.
- Keep vessels full of water and free of excess air.
- Backwash occasionally as required.
- Evaluate periodic samples for bioactivity to minimize potential fouling.

Dave Jordan
James R. Graham
US Filter Westates
December 1999







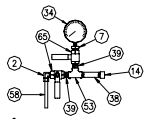


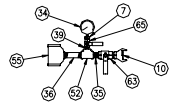
NOTES:

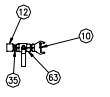
1. THIS DRAWING IS TO SHOW PIPING AND EQUIPMENT FOR CUSTOMER APPROVAL.
2. ALL BUTTERFLY VALVES ARE CAST IRON WITH STAINLESS TRIM, AL/BRNZ DISK.
3. PROVIDE STAINLESS STEEL SCREENS AT SEPTA UNDER DRAIN.
4. VESSELS SHALL BE 125 PSI, ASME CODE.
5. FINISH INTERIOR WITH PLASITE 4110, PREPARE AND APPLY STRICTLY IN ACCORDANCE WITH MANUFACTURERS RECOMENDATIONS.
6. PIPING MATERIALS SHALL MEET: CS PIPE ASTM A-53 GRADE B (ERW); CS FITTINGS SA-234, ASME B16.9; SS THREADED FITTINGS ASTM A-351; SS PIPE ASTM A-312; SS BW FITTINGS ASTM A-403; MI THREADED FITTINGS ASME B-16.3.
7. FINISH EXTERIOR WITH SHERWIN WILLIAMS URETHANE OVER SHERWIN WILLIAMS EPOXY PRIMER APPLIED PER MFG. RECOMMENDATIONS.
8. SYSTEM ESTIMATIED SHIPPING WEIGHT: 40,000 LBS.
8. GROUTING BY OTHERS IF REQUIRED.

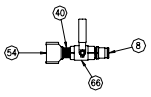
SCHEDULED MATERIALS

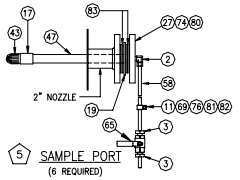
TAG	DESCRIPTION	QTY	PART NUMBER
1	Vessel: HP1220 125 psi Bare Tank(No Coatings)	2	HP1220-BT
2	Adaptor: 90 deg BRS 1/2" Comp x 1/2" MPT	10	M3012
3	Adaptor: Str BRS 1/2" Comp x 1/2" MPT	12	M3011
4	Angle: 2-1/2"x2-1/2"x3/8" A36	15'	A2.5X2.5X3/8
5	Angle: 4"x4"x1/2" A36	32'	A4X4X1/2
6	Burst Disk: 4" Mono Graphite 125 psi Zook	2	M3030
7	Bushing: 1/2" x 1/4" Galv. Sch/40 NPT	6	N/A
8	Cam Lock: 2" Alum Male Cam x 2" MNPT	2	C1003A
9	Cam Lock: 4" Alum Male Cam x 2" Flange	4	C1010
10	Chicago: 1" Pneumatic Fitting AM12	10	C1020
11	Clamp: 1/2" SS & Rubber Tube	6	N/A
12	Coupling: 1" 304 SS Half	8	7011
13	Coupling: 1" Full 3000# A36	2	7006B
14	Coupling: 1/2" CS 3000# Half NPT	4	7002
15	Coupling: 2" 304 SS Full	2	7025
16	Coupling: 2" CS 3000# Half	2	7018
17	Coupling: 3/4" 304 SS Full	6	7031
18	Diffuser: 8" SS	2	S1008
19	Donut: 4" O.D. x 1" I.D. x 1/8" thick 304 SS	6	D1001
20	Donut: 5" O.D. x 2-1/4" I.D. x 1/8" thick 304 SS	2	D1002
21	Elbow: 1" 90 deg Galv. Sch/40 NPT	4	8010
22	Elbow: 2" 90 deg Galv. Sch/40 NPT	6	8013
23	Elbow: 4" 90 deg L/R 304 SS sch/10	6	2048
24	Elbow: 4" 90 deg CS L/R Weld sch/40	2	2046
25	Elbow: 8" 90 deg CS L/R Weld sch/40	14	2058
26	Flange: 2" CS Blind	2	2001
27	Flange: 2"x1/2" CS Reducing FNPT	6	2004
28	Flange: 3"x2" CS Reducing FNPT	2	2103
29	Flange: 4" 304 SS 150# S/O	16	2015
30	Flange: 4" CS 150# W/N	2	2014
31	Flange: 4" CS 150# S/O	2	2013
32	Flange: 6" CS 150# W/N	16	2019
33	Flange: 8" CS 150# W/N	41	2024
34	Gauge: 2-1/2" dia. X 1/4" L 0-160 psi	6	M3040
35	Nipple: 1" x Close 316 SS sch/40	12	N/A
36	Nipple: 1" x 4" 316 SS sch/40	2	N/A
37	Nipple: 1" x Close 316 SS sch/80	2	N/A
38	Nipple: 1/2" x 4" 316 SS sch/40	4	N/A
39	Nipple: 1/2" x Close 316 SS sch/40	10	N/A
40	Nipple: 2" x Close 316 SS sch/40	8	N/A
41	Nozzle: 1" Polypropylene NPT - N8	2	N/A
42	Nozzle: 2" PVC Spray - 2HHSJ PVC 170 1400	2	M3031
43	Nozzle: 3/4" Polypropylene NPT - N5	6	N/A
44	Pipe: 1" Galv. Sch/40	40'	P1-GAL-S40
45	Pipe: 2" 304 SS sch/40	2'	P2-304-S40
46	Pipe: 2" Galv. Sch/40	40'	P2-GAL-S40
47	Pipe: 3/4" 304 SS sch/80	6'	P3/4-304-S80
48	Pipe: 4" 304 SS Sch/10	42'	P4-304-S10
49	Pipe: 4" CS sch/40	7'	P4-CS-S40
50	Pipe: 8" CS sch/40	42'	P8-CS-S40
51	Septa: 4-1/2" O.D. .015 SLOT 304 SS	16	M3037
52	Tee: 1"x1"x1/2" Galv. Sch/40 NPT	2	8008
53	Tee: 1/2" Galv. NPT	4	8002
54	Tee: 2" Galv. Sch/40 NPT	2	8012
55	Tee: 2"x2"x1" Galv. Sch/40 NPT	2	8011
56	Tee: 8" CS Weld sch/40	11	2080
57	Tee: 8"x8"x6" CS Weld sch/40	16	2105
58	Tubing: 1/2" 304 SS .035 Wall	27'	11/2-304X.035
59	U-Bolt: 1" Hot Dipped Galv.	4	N/A
60	U-Bolt: 2" Hot Dipped Galv.	4	N/A
61	U-Bolt: 4" Hot Dipped Galv.	6	N/A
62	U-Bolt: 8" Hot Dipped Galv.	4	N/A
63	Valve: 1" Bronze Chrome Ball	12	1004
64	Valve: 1" Press Air/Vac Vent - Apco 143-C	2	M3032
65	Valve: 1/2" Bronze/Chrome Ball	16	1002
66	Valve: 2" Bronze Chrome Ball	6	1005
67	Valve: 4" Full Port Flanged Ball 316 SS	4	1013
68	Valve: 8" Alum/Bronze Disk Butterfly Gear Op	9	1028
69	Bolt: 1/4" x 1" Hot Dipped Galv.	6	N/A
70	Bolt: 1/2" x 1" Hot Dipped Galv.	4	N/A
71	Bolt: 1-1/8" x 8-1/2" Hot Dipped Galv.	40	N/A
72	Bolt: 3/4" x 3-1/2" Hot Dipped Galv.	224	N/A
73	Bolt: 3/4" x 6" Hot Dipped Galv.	72	N/A
74	Bolt: 5/8"x3" Hot Dip Galv.	168	N/A
75	Bolt: 5/8"x4" Hot Dip Galv.	16	N/A
76	Nut: 1/4" Hot Dipped Galv. Heavy Hex	6	N/A
77	Nut: 1/2" Hot Dipped Galv. Heavy Hex	4	N/A
78	Nut: 1-1/8" Hot Dipped Galv. Heavy Hex	40	N/A
79	Nut: 3/4" Hot Dipped Galv. Heavy Hex	296	N/A
80	Nut: 5/8" Hot Dipped Galv. Heavy Hex	184	N/A
81	Washer: 1/4" Hot Dipped Galv. Flat	6	N/A
82	Washer: 1/4" Hot Dipped Galv. Split Ring Lock	6	N/A
83	Gasket: 2" Red Rubber Ring	14	N/A
84	Gasket: 20" Neoprene 1/8" thick Full Face	2	N/A
85	Gasket: 3" Red Rubber Ring	4	N/A
86	Gasket: 4" Red Rubber Ring	20	N/A
87	Gasket: 6" Red Rubber Ring	32	N/A
88	Gasket: 8" Red Rubber Ring	14	N/A

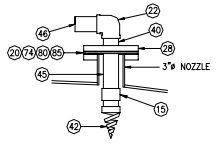


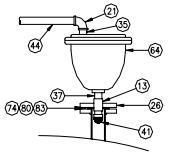


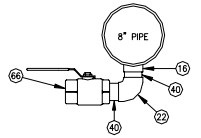












REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN

		DATE
DESIGNER	LLR	6/17/03
CHECKER		DATE
ENGINEER		DATE
MANAGER		DATE
FILE:		
SCALE:	1/2" = 1"	

TITLE: HP1220 SYSTEM GENERAL ASSEMBLY

CLIENT

USFilter — USFILTER/WESTATES, RED BLUFF, CA, 1-800-795-2664

PROJECT	DRAWING	SHEET	REV
	HP1220-SYS.DWG	1 OF 1	

STD: 2-0200-24X36D1 | INTL REF:

Appendix G

Equipment Manuals

HP® Series Liquid Phase Adsorption Systems (ASME code)

Applications

The HP® Series Adsorption Systems are designed to remove dissolved organic contaminants from water. These systems are cost effectively used in applications including:

- Groundwater remediation
- Wastewater filtration
- Tank rinse water treatment
- Pilot testing
- Underground storage tank clean up
- Leachate treatment
- Dechlorination
- Spill cleanup
- Food grade
- Drinking water

Installation, Startup and Operation

The HP® 810, HP® 1020 and HP® 1220 systems are shipped as separate components—two adsorbers and a piping skid module. The piping module allows the adsorbers to operate in series or parallel configurations. The systems require minimal field assembly and site connections.

Siemens can provide a total service package that includes utilizing OSHA trained personnel providing on-site carbon changeouts, packaging and transportation of spent carbon for recycling at our RCRA permitted reactivation facilities, where the contaminants are thermally destroyed.

We can provide instructions on sampling the spent carbon and completion of our spent carbon profile form. Spent carbon acceptance testing can be performed at our certified laboratory.

When requested, a certificate of reactivation will be issued.

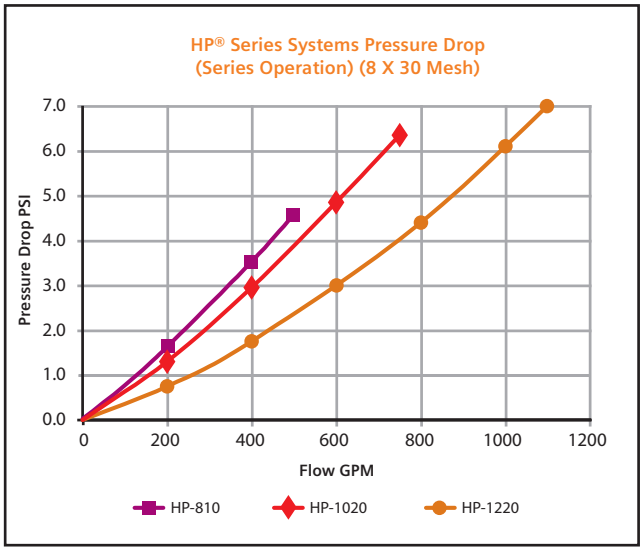
Benefits and Design Features:

- ASME code section VIII (stamped), carbon steel vessel.
- SSPC-SP5 surface preparation, NSF approved Plasite vinyl ester lining; rust preventative epoxy/urethane exterior.
- Uniform, continuous internal lining flange to flange (HP® 1020/1220 Systems).
- Proprietary vertical 316 stainless steel externally removable septa nozzles (HP® 1020/1220 Systems) allows maintenance of underdrain without vessel entry.
- Modular design for easy handling and installation.
- Internal spray nozzle ensures complete removal of all spent carbon.
- Schedule 40 carbon steel pipe, supplied with cast iron gear/wheel operated butterfly valves with EPDM seats.
- Carbon slurry piping made from schedule 10 304 stainless steel.
- In-bed water sample collection ports —25-50-75% bed depths.
- Top and side manway allows for easy internal inspection.

Specifications/Typical Properties			
	HP® 810SYS	HP® 1020SYS	HP® 1220SYS
Dimensions (each adsorber - dia. x sidewall height)	96" x 84"	120" x 96"	144" x 60"
Overall Height	15' 2"	17' 10"	15' 10"
System Length	22' 8"	26'	28' 10"
System Width	10'	12'	13' 2"
Process Piping	6"	8"	8"
Flanged Inlet/Outlet (150# ANSI)	6"	8"	8"
Carbon Fill/Discharge	4"	4"	4"
Flanged Backwash/Vent	6"	8"	8"
Manway (dia., side shell location)	20"	20"	20"
Manway (top)	14" x 18"	14" x 18"	14" x 18"
Utility Water/Air (hose connection)[1]	2"	2"	2"
Interior Coating	Vinyl Ester	Vinyl Ester	Vinyl Ester
Exterior Coating	Urethane	Urethane	Urethane
Empty System Weight (lbs.)	15,500	38,500	42,000
Carbon Weight/Vessel (lbs.)	10,000	20,000	20,000
Operating Weight (lbs.)	85,000	170,000	185,000
Design Pressure (PSIG) @ 140°F	125	125	125
Max. Flow (GPM) Series/Parallel	500/1,000	750/1,500	1,100/2,200
Backwash Rate (GPM) (8 x 30 mesh @ 55°F)	450	710	1,000

[1] *Kamlock type*

For detailed specifications or dimensional information or drawings, contact your local Siemens sales representative.



Safety Note: Wet activated carbon readily adsorbs atmospheric oxygen. Dangerously low oxygen levels may exist in closed vessels or poorly ventilated storage areas. Workers should follow all applicable state and federal safety guidelines for entering oxygen depleted areas.

Siemens makes no warranties as to completeness of information. Users are responsible for evaluating individual product suitability for specific applications. Siemens assumes no liability whatsoever for any special, indirect or consequential damages arising from the sale, resale or misuse of its products. All information presented herein is believed reliable and in accordance with accepted engineering practice.

Siemens
Water Technologies
866.613.5620 phone

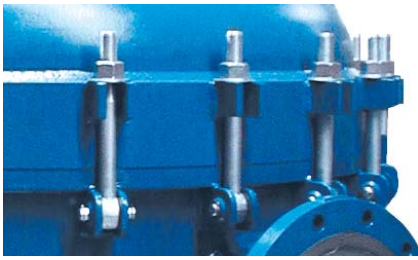
WS-HPdr-DS-0910

MAXILINE™ MBF HD

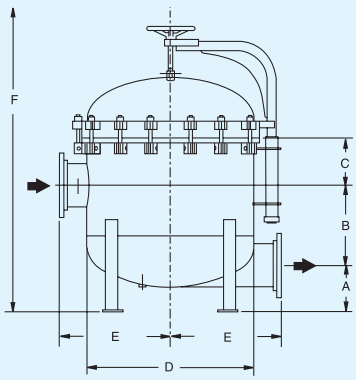
MAXILINE™ MBF HD

The MAXILINE HD multi-bag filter housing features a cost effective, handwheel operated, davit cover. Loosen the swing bolts, turn the davit handwheel and swing the cover aside.

- Standard ASME “U” Code Stamp.
- Tapered, electro-polished stainless steel perforated baskets.
- Unique 3-point hold-down or bayonet fittings ensure high quality of seal between each filter bag and housing body. A special tool (supplied) ensures simple, effective operation.
- Rugged, simple handwheel-operated davit cover makes the HD perfect for cost sensitive applications.
- Hydraulic-assist davit cover is available as an option.
- Positive O-ring sealing provides easy, reliable operation.
- Available in carbon steel and Type 304 stainless steel for high corrosion resistance.
- 7 standard sizes with 3 through to 24 bag housings are available for size 02 filter bags.



These value added features:	Give these benefits
Hand wheel operated davit cover	Rugged, reliable and very cost effective.
Positive bag hold downs	Perfect bag to housing sealing for no by-pass
Up to 24 bags per housing	Can handle very high flow rate / high dirt load applications
Positive O ring seal	No external leakage



See page 5 for dimensions.

TECHNICAL DATA

SERIES	Type*	No. Of Bags	Bag Size	Max. Flow [2] GPM	Material [1]	Max. Allowable Pressure	Max. Allowable Temperature**	Housing Volume	Housing Weight	Inlet Outlet Connection	Type	Vent [4]	Dimensions In Inches					
						PSI	°F	GAL	LBS			IN	A	B	C	D	E	F
MAXILINE VMBF SE	VMBF-0402-AB10-040A-UT-11SE	4	2	400	SS	150	250	69	484	4"	Flanged	1"	6.00	20.00	10.50	22.00	15.75	68.00
	VMBF-0602-AB10-060A-UT-11SE	6	2	900	SS	150	250	139	983	6"	Flanged	1"	7.25	20.00	13.00	31.50	20.75	80.00
	VMBF-0802-AB10-080A-UT-11SE	8	2	1750	SS	150	250	141	1023	8"	Flanged	1"	8.25	19.00	12.80	31.50	20.50	80.00
MAXILINE MBF HE	MBF-0302-AB10-030A-UT-11HE	3	2	230	SS or CS	150	250	40	245	3"	Flanged	1"	6.00	22.50	6.40	18.00	12.75	60.00
	MBF-0402-AB10-040A-UT-11HE	4	2	400	SS or CS	150	250	69	380	4"	Flanged	1"	6.00	22.20	7.40	24.00	16.00	68.40
	MBF-0602-AB10-060A-UT-11HE	6	2	900	SS or CS	150	250	90	440	6"	Flanged	1"	7.50	19.50	9.03	24.00	16.50	68.80
	MBF-0802-AB10-080A-UT-11HE	8	2	1750	SS or CS	150	250	116	644	8"	Flanged	1"	8.25	19.00	6.48	30.00	20.50	79.50
MAXILINE MBF HD	MBF-0302-AB10-030A-UT-11HD	3	2	230	SS or CS	150	250	40	255	3"	Flanged	1"	6.00	22.50	6.40	18.00	12.75	66.00
	MBF-0402-AB10-040A-UT-11HD	4	2	400	SS or CS	150	250	54	390	4"	Flanged	1"	6.00	22.20	7.80	24.00	16.00	68.00
	MBF-0602-AB10-060A-UT-11HD	6	2	900	SS or CS	150	250	95	460	6"	Flanged	1"	7.00	20.00	9.80	26.00	18.50	68.00
	MBF-0802-AB10-080A-UT-11HD	8	2	1750	SS or CS	150	250	140	655	8"	Flanged	1"	8.25	19.00	10.78	30.00	20.50	66.00
	MBF-1002-AB10-100A-UT-11HD	10	2	2600	SS or CS	150	250	215	1400	10"	Flanged	1"	10.00	17.00	13.30	36.00	24.50	70.00
	MBF-1202-AB10-100A-UT-11HD	12	2	2600	SS or CS	150	250	245	1500	10"	Flanged	1"	10.00	17.00	13.80	38.00	24.50	72.00
	MBF-1402-AB10-100A-UT-11HD	14	2	2600	SS or CS	150	250	311	1800	10"	Flanged	1"	11.50	20.00	11.81	42.00	28.00	76.00
	MBF-1602-AB10-120A-UT-11HD	16	2	3500	SS or CS	150	250	317	1875	12"	Flanged	1"	11.50	20.00	11.81	42.00	28.00	76.00
	MBF-1802-AB10-120A-UT-11HD	18	2	3500	SS or CS	150	250	446	2420	12"	Flanged	1"	12.50	22.00	10.69	48.00	31.00	88.00
	MBF-2002-AB10-140A-UT-11HD	20	2	4500	SS or CS	150	250	454	2505	14"	Flanged	1"	12.50	22.00	10.69	48.00	31.00	88.00
	MBF-2202-AB10-140A-UT-11HD	22	2	4500	SS or CS	150	250	570	2730	14"	Flanged	1"	12.50	22.00	13.44	52.00	33.00	92.00
	MBF-2402-AB10-140A-UT-11HD	24	2	4500	SS or CS	150	250	570	2800	14"	Flanged	1"	12.50	22.00	13.44	52.00	33.00	92.00
TOPLINE	TBF-0101-AB10-020A	1	1	90	SS or CS	150	400	3.5	80	2"	Flanged	1/4"	17.70	15.50	1.93	8.62	12.08	53.50
	TBF-0102-AB10-020A	1	2	180	SS or CS	150	400	7.25	93	2"	Flanged	1/4"	17.70	31.00	1.93	8.62	12.08	84.25
	TBF-0102-AB10-020R-M32B0	1	2	180	SS	150	400	7.25	93	2"	Tri-Clamp	1/4"	15.80	32.78	1.93	8.62	12.83	84.25
SIDELINE	SBF-0101-AB10-020A	1	1	90	SS	150	400	4.75	84	2"	Flanged	1/4"	17.70	19.50	3.15	8.62	8.66	54.70
	SBF-0101-AB10-030A	1	1	90	SS	150	400	4.75	84	3"	Flanged	1/4"	17.70	19.50	3.15	8.62	8.66	54.70
	SBF-0102-AB10-020A	1	2	180	SS	150	400	8.5	102	2"	Flanged	1/4"	17.70	35.00	3.15	8.62	8.66	85.50
	SBF-0102-AB10-030A	1	2	180	SS	150	400	8.5	102	3"	Flanged	1/4"	17.70	35.00	3.15	8.62	8.66	85.50
	SBF-0103-AB21-015N	1	3	25	SS	300	225	0.5	26	1 1/2"	NPT	1/4"	na	11.77	2.95	4.50	3.50	21.80
	SBF-0104-AB21-015N	1	4	50	SS	300	225	0.7	29	1 1/2"	NPT	1/4"	na	17.87	2.95	4.50	3.50	33.90
DUOLINE	TOPLINE	2	2	180	SS or CS	150	250	16	240	2"	Flanged	1/4"	17.70	24.50	1.93	8.62	37.45	84.25
	SIDELINE	2	2	180	SS	150	250	16	300	2"	Flanged	1/4"	17.70	27.50	3.15	8.62	30.82	85.50
	SIDELINE	2	2	180	SS	150	250	17	330	3"	Flanged	1/4"	17.70	27.50	3.15	8.62	33.32	85.50
	FLOWLINE	2	2	180	SS or CS	150	250	15	200	2"	Flanged	1/4"	17.70	28.44	3.34	7.68	37.45	85.50
MODULINE	TOPLINE	1+1	2	360	SS or CS	150	250	16	230	2"	Flanged	1/4"	17.70	24.50	1.93	8.62	34.32	84.25
	SIDELINE	1+1	2	360	SS	150	250	16	230	2"	Flanged	1/4"	17.70	27.50	3.15	8.62	27.44	85.50
	SIDLINE	1+1	2	360	SS	150	250	17	300	3"	Flanged	1/4"	17.70	27.00	3.15	8.62	29.70	85.50
	FLOWLINE	1+1	2	360	SS or CS	150	250	15	170	2"	Flanged	1/4"	17.70	28.44	3.34	7.68	26.64	85.50
POLYLINE	PBF-0101-PO10-020A	1	1	50	PPL	150	70	6.6	55	2"	Flanged	1/4"	3.26	20.75	3.38	10.35	8.50	60.00
	PBF-0101-PO10-020N	1	1	50	PPL	150	70	6.6	51	2"	NPT	1/4"	3.26	20.75	3.38	10.35	6.14	60.00
	PBF-0102-PO10-020A	1	2	100	PPL	150	70	9.5	68	2"	Flanged	1/4"	3.26	36.75	3.38	10.35	8.50	76.00
	PBF-0102-PO10-020N	1	2	100	PPL	150	70	9.5	64	2"	NPT	1/4"	3.26	36.75	3.38	10.35	6.14	76.00
	PBF-0102-PF07-020A	1	2	100	PVDF	100	80	9.5	100	2"	Flanged	1/4"	3.26	36.00	3.88	10.35	8.50	75.25
	D-PBF-0101-PO10-020A	1+1	1	50	PPL/CPVC	150	70	14.5	162	2"	Flanged	1/4"	6.10	39.04	3.88	10.35	30.00	75.10
	D-PBF-0101-PO10-020N	1+1	2	100	PPL/CPVC	150	70	20.6	190	2"	Flanged	1/4"	6.10	55.04	3.88	10.35	30.00	91.10
FLOWLINE	FBF-0101-AB10-020A	1	1	90	SS or CS	150	250	4	30	2"	Flanged	1/4"	17.70	20.75	3.34	7.68	6.70	54.90
	FBF-0101-AB10-020N	1	1	90	SS or CS	150	250	4	30	2"	NPT	1/4"	17.70	19.64	3.34	7.68	5.37	54.90
	FBF-0102-AB10-020A	1	2	180	SS or CS	150	250	7	43	2	Flanged	1/4"	17.70	36.31	3.34	7.68	6.70	85.70
	FBF-0102-AB10-020N	1	2	180	SS or CS	150	250	7	43	2"	NPT	1/4"	17.70	35.19	3.34	7.68	5.37	85.70
ECOLINE	EBF-0101-AB10-020N	1	1	90	SS	100	250	4	25	2"	NPT	1/4"	na	19.64	3.24	7.68	5.37	37.00
	EBF-0102-AB10-020N	1	2	180	SS	100	250	7	38	2"	NPT	1/4"	na	35.19	3.24	7.68	5.37	68.00
	EBF-0103-AB10-015N	1	3	25	SS	150	250	0.5	9	1 1/2"	NPT	1/4"	na	11.77	2.78	4.50	3.50	22.45
	EBF-0104-AB10-015N	1	4	50	SS	150	250	0.7	11	1 1/2"	NPT	1/4"	na	17.87	2.78	4.50	3.50	33.84

1) SS = Austenitic Stainless Steel SS 316 and CF8M or better
2) Maximum theoretical flow based on water viscosity, bag specific
3) Dimensions for reference only and approximate. Exact dimensions for installation purposes available on request.
4) For details, see available product specific data sheet

* Type number is for stainless steel construction. Change AB to CS for carbon steel.
** Depending on seal material

Product Codes

D –	MBF –	04	02 –	AC	10 –	050	D
D-DUOLINE M-MODULINE	VMBF-MAXILINE MBF-MAXILINE TBF-TOPLINE SBF-SIDELINE PBF-POLYLINE FBF-FLOWLINE EBF-ECOLINE	No. of bags 01, 02, 04, 08, 12, 16, 20, 24	Bag Size 01-short 7" 02-long 7" 03-short 4" 04-long 4"	Material AB-SS316 CS-Carbon Steel PO-Polypropylene PF-PVDF	Pressure rating 10-150 psi 21-300 psi	Connection Size 050-1/2" 010-1" 012-1 1/4" 015-1 1/2" 020-2" Up to 140-14"	Connection Type A-ANSI Flange N-NPT Female Thread

Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Technical Information

Proline Promag 50W, 53W

Electromagnetic Flow Measuring System
Flow measurement of liquids in water or wastewater applications

Application

Electromagnetic flowmeter for bidirectional measurement of liquids with a minimum conductivity of ≥ 5 µS/cm:
- Drinking water
- Wastewater
- Sewage sludge

- Flow measurement up to 110000 m³/h (484315 gal/min)
- Fluid temperature up to +80 °C (+176 °F)
- Process pressures up to 40 bar (580 psi)
- Lengths in accordance with DVGW/ISO

Application-specific lining of the measuring pipe from polyurethane or hard rubber with the following drinking water permissions:
- KTW
- WRAS
- NSF
- ACS

Approvals for hazardous area:
- ATEX
- IECEx
- FM
- CSA
- NEPSI

Connection to process control system:
- HART
- PROFIBUS DP/PA
- FOUNDATION Fieldbus
- MODBUS RS485

Your benefits

Promag measuring devices offer you cost-effective flow measurement with a high degree of accuracy for a wide range of process conditions.

The uniform Proline transmitter concept comprises:
- Modular device and operating concept resulting in a higher degree of efficiency
- Software options for batching, electrode cleaning and for measuring pulsating flow
- High degree of reliability and measuring stability
- Uniform operating concept

The tried-and-tested Promag sensors offer:
- No pressure loss
- Not sensitive to vibrations
- Simple installation and commissioning

TI046D/06/en/11.09
71106269

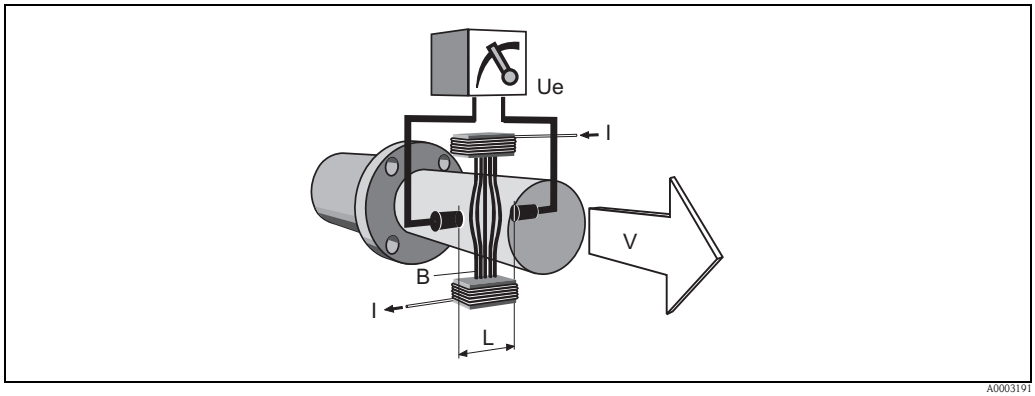
Endress+Hauser
People for Process Automation

Table of contents

Function and system design

Measuring principle

Following *Faraday's law of magnetic induction*, a voltage is induced in a conductor moving through a magnetic field.
In the electromagnetic measuring principle, the flowing medium is the moving conductor.
The voltage induced is proportional to the flow velocity and is supplied to the amplifier by means of two measuring electrodes. The flow volume is calculated by means of the pipe cross-sectional area.
The DC magnetic field is created through a switched direct current of alternating polarity.



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$Ue = B \cdot L \cdot v$
$Q = A \cdot v$

Ue *Induced voltage*
B *Magnetic induction (magnetic field)*
L *Electrode spacing*
v *Flow velocity*
Q *Volume flow*
A *Pipe cross-section*
I *Current strength*

Measuring system

The measuring system consists of a transmitter and a sensor.
Two versions are available:
- Compact version: Transmitter and sensor form a mechanical unit.
- Remote version: Sensor is mounted separate from the transmitter.

Transmitter:
- Promag 50 (user interface with push buttons for operation, two-line display, illuminated)
- Promag 53 ("Touch Control" without opening the housing, four-line display, unilluminated)

Sensor:
- Promag W (DN 25 to 2000 / 1 to 78")

Input

Measured variable

Flow velocity (proportional to induced voltage)

Measuring ranges

Measuring ranges for liquids
Typically v = 0.01 to 10 m/s (0.03 to 33 ft/s) with the specified accuracy

Operable flow range

Over 1000 : 1

Input signal

Status input (auxiliary input)
- U = 3 to 30 V DC, R_i = 5 kΩ, galvanically isolated
- Configurable for: totalizer(s) reset, measured value suppression, error-message reset

Status input (auxiliary input) with PROFIBUS DP and MODBUS RS485
- U = 3 to 30 V DC, R_i = 3 kΩ, galvanically isolated
- Switching level: 3 to 30 V DC, independent of polarity
- Configurable for: totalizer(s) reset, measured value suppression, error-message reset, batching start/stop (optional), batch totalizer reset (optional)

Current input (only Promag 53)
- active/passive selectable, galvanically isolated, full scale value selectable, resolution: 3 µA, temperature coefficient: typ. 0.005% o.r./°C (o.r. = of reading)
- active: 4 to 20 mA, $R_i \leq 150$ Ω, max. 24 V DC, short-circuit-proof
- passive: 0/4 to 20 mA, $R_i < 150$ Ω, max. 30 V DC

Output

Output signal

Promag 50

Current output
active/passive selectable, galvanically isolated, time constant selectable (0.01 to 100 s), full scale value selectable, temperature coefficient: typ. 0.005% o.r./°C (o.r. = of reading), resolution: 0.5 µA
- active: 0/4 to 20 mA, $R_L < 700$ Ω (HART: $R_L \geq 250$ Ω)
- passive: 4 to 20 mA, operating voltage V_S: 18 to 30 V DC, $R_i \geq 150$ Ω

Pulse/frequency output
passive, open collector, 30 V DC, 250 mA, galvanically isolated
- Frequency output: full scale frequency 2 to 1000 Hz (f_{max} = 1250 Hz), on/off ratio 1:1, pulse width max. 10s
- Pulse output: pulse value and pulse polarity selectable, max. pulse width configurable (0.5 to 2000 ms)

PROFIBUS DP interface
- Transmission technology (Physical Layer): RS485 in accordance with ANSI/TIA/EIA-485-A: 1998, galvanically isolated
- Profil version 3.0
- Data transmission rate: 9,6 kBaud to 12 MBaud
- Automatic data transmission rate recognition
- Function blocks: 1 × analog Input, 1 × totalizer
- Output data: volume flow, totalizer
- Input data: positive zero return (ON/OFF), totalizer control, value for local display
- Cyclic data transmission compatible with previous model Promag 33
- Bus address adjustable via miniature switches or local display (optional) at the measuring device

PROFIBUS PA interface
- Transmission technology (Physical Layer): IEC 61158-2 (MBP), galvanically isolated
- Profil version 3.0
- Current consumption: 11 mA
- Permissible supply voltage: 9 to 32 V
- Bus connection with integrated reverse polarity protection
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Function blocks: 1 × analog input, 2 × totalizer
- Output data: volume flow, totalizer
- Input data: positive zero return (ON/OFF), control totalizer, value for local display
- Cyclic data transmission compatible with previous model Promag 33
- Bus address adjustable via miniature switches or local display (optional) at the measuring device

Promag 53

Current output
active/passive selectable, galvanically isolated, time constant selectable (0.01 to 100 s),
full scale value selectable, temperature coefficient: typ. 0.005% o.r./°C (o.r. = of reading), resolution: 0.5 µA
- active: 0/4 to 20 mA, R_L < 700 Ω (HART: $R_L \geq 250$ Ω)
- passive: 4 to 20 mA, operating voltage V_S: 18 to 30 V DC, $R_i \geq 150$ Ω

Pulse/frequency output
active/passive selectable, galvanically isolated (Ex i version: only passive)
- active: 24 V DC, 25 mA (max. 250 mA during 20 ms), R_L > 100 Ω
- passive: open collector, 30 V DC, 250 mA
- Frequency output: full scale frequency 2 to 10000 Hz (f_{max} = 12500 Hz), EEx-ia: 2 to 5000 Hz; on/off ratio 1:1, pulse width max. 10 s
- Pulse output: pulse value and pulse polarity selectable, max. pulse width configurable (0.05 to 2000 ms)

PROFIBUS DP interface
- Transmission technology (Physical Layer): RS485 in accordance with ANSI/TIA/EIA-485-A: 1998, galvanically isolated
- Profil version 3.0
- Data transmission rate: 9,6 kBaud to 12 MBaud
- Automatic data transmission rate recognition
- Function blocks: 2 × analog Input, 3 × totalizer
- Output data: volume flow, calculated mass flow, totalizer 1 to 3
- Input data: positive zero return (ON/OFF), totalizer control, value for local display
- Cyclic data transmission compatible with previous model Promag 33
- Bus address adjustable via miniature switches or local display (optional) at the measuring device
- Available output combination → 📄 8

PROFIBUS PA interface
- Transmission technology (Physical Layer): IEC 61158-2 (MBP), galvanically isolated
- Profil version 3.0
- Current consumption: 11 mA
- Permissible supply voltage: 9 to 32 V
- Bus connection with integrated reverse polarity protection
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Function blocks: 2 × analog input, 3 × totalizer
- Output data: volume flow, calculated mass flow, totalizer 1 to 3
- Input data: positive zero return (ON/OFF), totalizer control, value for local display
- Cyclic data transmission compatible with previous model Promag 33
- Bus address adjustable via miniature switches or local display (optional) at the measuring device

MODBUS RS485 interface
- Transmission technology (Physical Layer): RS485 in accordance with ANSI/TIA/EIA-485-A: 1998, galvanically isolated
- MODBUS device type: Slave
- Adress range: 1 to 247
- Bus address adjustable via miniature switches or local display (optional) at the measuring device
- Supported MODBUS function codes: 03, 04, 06, 08, 16, 23
- Broadcast: supported with the function codes 06, 16, 23
- Übertragungsmodus: RTU oder ASCII
- Supported baudrate: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud
- Response time:
  - Direct data access = typically 25 to 50 ms
  - Auto-scan buffer (data range) = typically 3 to 5 ms
- Available output combination → 📄 8

FOUNDATION Fieldbus interface
- FOUNDATION Fieldbus H1
- Transmission technology (Physical Layer): IEC 61158-2 (MBP), galvanically isolated
- ITK version 5.01
- Current consumption: 12 mA
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Bus connection with integrated reverse polarity protection
- Function blocks:
  - 5 × Analog Input (execution time: 18 ms each)
  - 1 × PID (25 ms)
  - 1 × Digital Output (18 ms)
  - 1 × Signal Characterizer (20 ms)
  - 1 × Input Selector (20 ms)
  - 1 × Arithmetic (20 ms)
  - 1 × Integrator (18 ms)
- Output data: volume flow, calculated mass flow, temperature, totalizer 1 to 3
- Input data: positive zero return (ON/OFF), reset totalizer
- Link Master (LM) functionality is supported

Signal on alarm
- Current output → failure response selectable (e.g. in accordance with NAMUR recommendation NE 43)
- Pulse/frequency output → failure response selectable
- Status output (Promag 50) → non-conductive by fault or power supply failure
- Relay output (Promag 53) → de-energized by fault or power supply failure

Load

see "Output signal"

Low flow cutoff

Switch points for low flow cutoff are selectable.

Galvanic isolation

All circuits for inputs, outputs and power supply are galvanically isolated from each other.

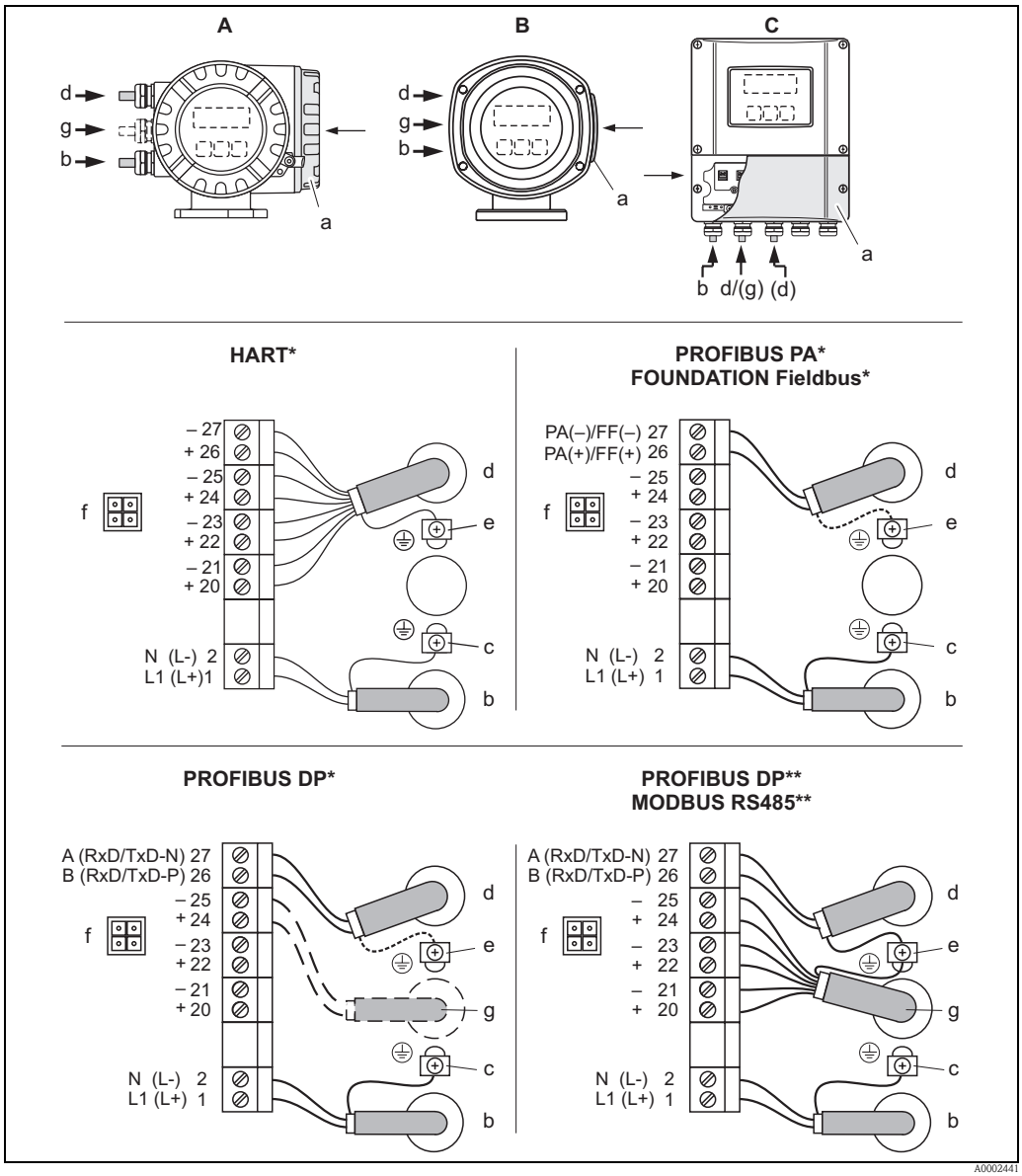
Switching output

Status output (Promag 50, Promag 53)
Open collector, max. 30 V DC / 250 mA, galvanically isolated.
Configurable for: error messages, Empty Pipe Detection (EPD), flow direction, limit values.

Relay outputs (Promag 53)
Normally closed (NC or break) or normally open (NO or make) contacts available
(default: relay 1 = NO, relay 2 = NC), max. 30 V / 0,5 A AC ; 60 V / 0,1 A DC, galvanically isolated.
Configurable for: error messages, Empty Pipe Detection (EPD), flow direction, limit values, batching contacts.

Power supply

Electrical connection, measuring unit



Connecting the transmitter, cable cross-section max. 2.5 mm² (14 AWG)

A View A (field housing)
B View B (stainless steel field housing)
C View C (wall-mount housing)

**)* fixed communication boards
***)* flexible communication boards
a Connection compartment cover
b Cable for power supply: 85 to 260 V AC / 20 to 55 V AC / 16 to 62 V DC
- Terminal No. 1: L1 for AC, L+ for DC
- Terminal No. 2: N for AC, L– for DC

c Ground terminal for protective conductor
d Signal cable: see "Electrical connection, terminal assignment" → 🖹 8
Fieldbus cable:
- Terminal No. 26: DP (B) / PA + / FF + / MODBUS RS485 (B) / (PA, FF: with polarity protection)
- Terminal No. 27: DP (A) / PA – / FF – / MODBUS RS485 (A) / (PA, FF: with polarity protection)

e Ground terminal for signal cable shield / Fieldbus cable / RS485 line
f Service adapter for connecting service interface FXA193 (Fieldcheck, FieldCare)
g Signal cable: see "Electrical connection, terminal assignment" → 🖹 8
Cable for external termination (only for PROFIBUS DP with fixed assignment communication board):
- Terminal No. 24: +5 V
- Terminal No. 25: DGND

Electrical connection, terminal assignment

Terminal assignment, Promag 50

Order variant	Terminal No. (inputs/outputs)			
	20 (+) / 21 (–)	**22 (+) / 23 (–)**	**24 (+) / 25 (–)**	**26 (+) / 27 (–)**
50***-**********W	–	–	–	Current output HART
50***-**********A	–	–	Frequency output	Current output HART
50***-**********D	Status input	Status output	Frequency output	Current output HART
50***-**********H	–	–	–	PROFIBUS PA
50***-**********J	–	–	+5 V (external termination)	PROFIBUS DP
50***-**********S	–	–	Frequency output, Ex i, passive	Current output, Ex i, passive, HART
50***-**********T	–	–	Frequency output, Ex i, passive	Current output, Ex i, passive, HART

Ground terminal → 🖹 7

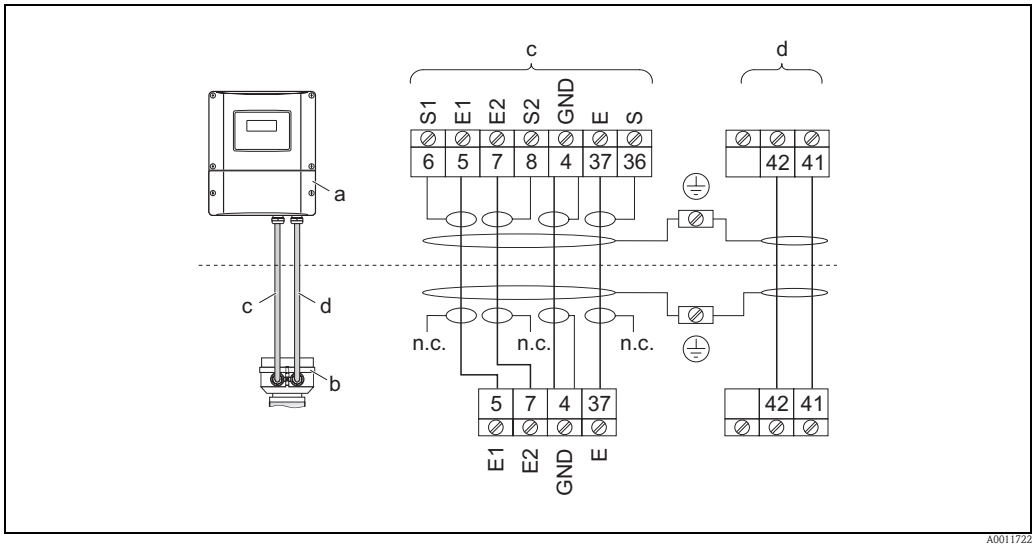
Terminal assignment, Promag 53

The inputs and outputs on the communication board can be either permanently assigned or variable, depending on the version ordered (see table). Replacements for modules which are defective or which have to be replaced can be ordered as accessories.

Order variant	Terminal No. (inputs/outputs)			
	20 (+) / 21 (–)	**22 (+) / 23 (–)**	**24 (+) / 25 (–)**	**26 (+) / 27 (–)**
Fixed communication boards (fixed assignment)				
53***-**********A	–	–	Frequency output	Current output HART
53***-**********B	Relay output 2	Relay output 1	Frequency output	Current output HART
53***-**********F	–	–	–	PROFIBUS PA, Ex i
53***-**********G	–	–	–	FOUNDATION Fieldbus, Ex i
53***-**********H	–	–	–	PROFIBUS PA
53***-**********J	–	–	–	PROFIBUS DP
53***-**********K	–	–	–	FOUNDATION Fieldbus
53***-**********Q	–	–	Status input	MODBUS RS485
53***-**********S	–	–	Frequency output, Ex i	Current output, Ex i, passive, HART
53***-**********T	–	–	Frequency output, Ex i	Current output, Ex i, passive, HART
Flexible communication boards				
53***-**********C	Relay output 2	Relay output 1	Frequency output	Current output HART
53***-**********D	Status input	Relay output	Frequency output	Current output HART
53***-**********L	Status input	Relay output 2	Relay output 1	Current output HART
53***-**********M	Status input	Frequency output	Frequency output	Current output HART
53***-**********N	Current output	Frequency output	Status input	MODBUS RS485
53***-**********P	Current output	Frequency output	Status input	PROFIBUS DP
53***-**********V	Relay output 2	Relay output 1	Status input	PROFIBUS DP
53***-**********2	Relay output	Current output	Frequency output	Current output HART
53***-**********4	Current input	Relay output	Frequency output	Current output HART
53***-**********7	Relay output 2	Relay output 1	Status input	MODBUS RS485

Ground terminal → 🖹 7

Electrical connection, remote version



Connecting the remote version

a Wall-mount housing connection compartment
b Sensor connection housing cover
c Signal cable
d Coil current cable
n.c. Not connected, insulated cable shields
Terminal no. and cable colors: 6/5 = brown; 7/8 = white; 4 = green; 36/37 = yellow

Supply voltage (power supply)

- 85 to 260 V AC, 45 to 65 Hz
- 20 to 55 V AC, 45 to 65 Hz
- 16 to 62 V DC

PROFIBUS PA and FOUNDATION Fieldbus
- Non-Ex: 9 to 32 V DC
- Ex i: 9 to 24 V DC
- Ex d: 9 to 32 V DC

Cable entry

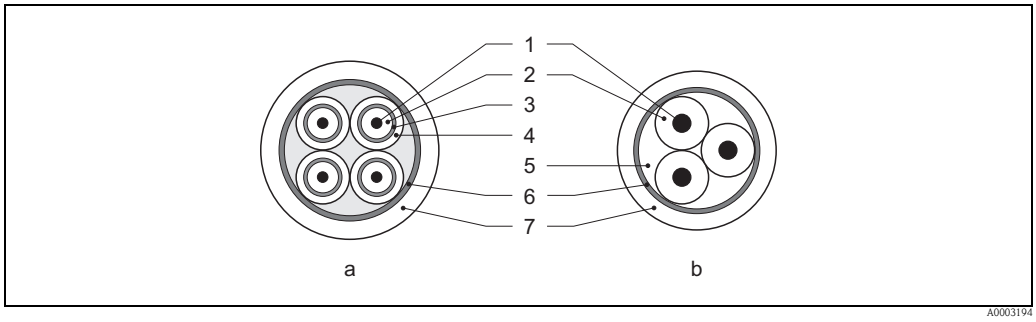
Power supply and signal cables (inputs/ outputs):
- Cable entry M20 × 1.5 (8 to 12 mm / 0.31 to 0.47")
- Sensor cable entry for armoured cables M20 × 1.5 (9.5 to 16 mm / 0.37 to 0.63")
- Thread for cable entries, ½" NPT, G ½"

Connecting cable for remote version:
- Cable entry M20 × 1.5 (8 to 12 mm / 0.31 to 0.47")
- Sensor cable entry for armoured cables M20 × 1.5 (9.5 to 16 mm / 0.37 to 0.63")
- Thread for cable entries, ½" NPT, G ½"

Remote version cable specifications

Coil cable
- 2 × 0.75 mm² (18 AWG) PVC cable with common, braided copper shield (∅ ~ 7 mm / 0.28")
- Conductor resistance: ≤ 37 Ω/km (≤ 0.011 Ω/ft)
- Capacitance core/core, shield grounded: ≤ 120 pF/m (≤ 37 pF/ft)
- Operating temperature: –20 to +80 °C (–68 to +176 °F)
- Cable cross-section: max. 2.5 mm² (14 AWG)
- Test voltage for cable insulation: ≤ 1433 AC r.m.s. 50/60 Hz or ≥ 2026 V DC

Signal cable
- 3 × 0.38 mm² (20 AWG) PVC cable with common, braided copper shield (∅ ~ 7 mm / 0.28") and individual shielded cores
- With empty pipe detection (EPD): 4 × 0.38 mm² (20 AWG) PVC cable with common, braided copper shield (∅ ~ 7 mm / 0.28") and individual shielded cores
- Conductor resistance: ≤ 50 Ω/km (≤ 0.015 Ω/ft)
- Capacitance core/shield: ≤ 420 pF/m (≤ 128 pF/ft)
- Operating temperature: –20 to +80 °C (–68 to +176 °F)
- Cable cross-section: max. 2.5 mm² (14 AWG)



a *Signal cable*
b *Coil current cable*

1 *Core*
2 *Core insulation*
3 *Core shield*
4 *Core jacket*
5 *Core reinforcement*
6 *Cable shield*
7 *Outer jacket*

Operation in zones of severe electrical interference
The measuring device complies with the general safety requirements in accordance with EN 61010 and the EMC requirements of IEC/EN 61326 and NAMUR recommendation NE 21.

Caution!
Grounding is by means of the ground terminals provided for the purpose inside the connection housing. Ensure that the stripped and twisted lengths of cable shield to the ground terminal are as short as possible.

Power consumption

- AC: < 15 VA (incl. sensor)
- DC: < 15 W (incl. sensor)

Switch-on current:
- Max. 3 A (< 5 ms) for 260 V AC
- Max. 13.5 A (< 50 ms) for 24 V DC

Power supply failure

Lasting min. ½ cycle frequency: EEPROM saves measuring system data
- EEPROM or T-DAT (Promag 53 only) retain the measuring system data in the event of a power supply failure
- S-DAT: exchangeable data storage chip which stores the data of the sensor (nominal diameter, serial number, calibration factor, zero point etc.)

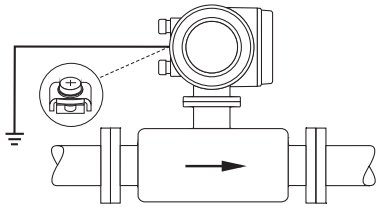
Potential equalization

Warning!
The measuring system must be included in the potential equalization.

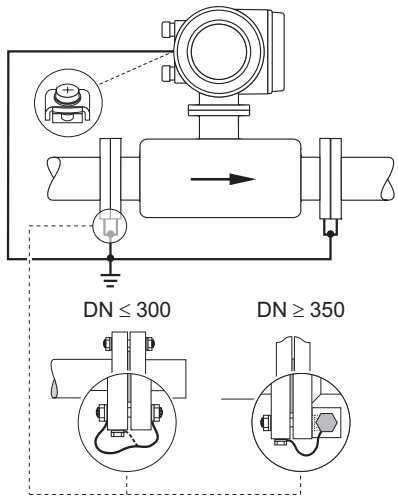
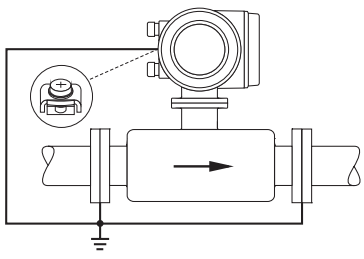
Perfect measurement is only ensured when the fluid and the sensor have the same electrical potential. This is ensured by the reference electrode integrated in the sensor as standard.

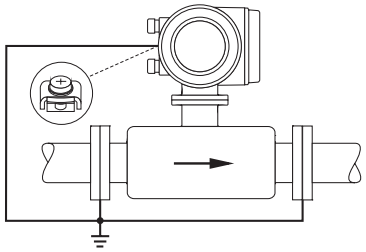
The following should also be taken into consideration for potential equalization:
- Internal grounding concepts in the company
- Operating conditions, such as the material/ grounding of the pipes (see table)

Standard situation

Operating conditions	Potential equalization
When using the measuring device in a: ■ Metal, grounded pipe Potential equalization takes place via the ground terminal of the transmitter. Note! When installing in metal pipes, we recommend you connect the ground terminal of the transmitter housing with the piping.	 A0011892 *Via the ground terminal of the transmitter*

Special situations

Operating conditions	Potential equalization
When using the measuring device in a: ■ Metal pipe that is not grounded This connection method also applies in situations where: ■ Customary potential equalization cannot be ensured. ■ Excessively high equalizing currents can be expected. Both sensor flanges are connected to the pipe flange by means of a ground cable (copper wire, at least 6 mm² / 0.0093 in²) and grounded. Connect the transmitter or sensor connection housing, as applicable, to ground potential by means of the ground terminal provided for the purpose. ■ DN ≤ 300 (12"): the ground cable is mounted directly on the conductive flange coating with the flange screws. ■ DN ≥ 350 (14"): the ground cable is mounted directly on the transportation metal support. Note! The ground cable for flange-to-flange connections can be ordered separately as an accessory from Endress+Hauser.	 A0011893 *Via the ground terminal of the transmitter and the flanges of the pipe*
When using the measuring device in a: ■ Plastic pipe ■ Pipe with insulating lining This connection method also applies in situations where: ■ Customary potential equalization cannot be ensured. ■ Excessively high equalizing currents can be expected. Potential equalization takes place using additional ground disks, which are connected to the ground terminal via a ground cable (copper wire, at least 6 mm² / 0.0093 in²). When installing the ground disks, please comply with the enclosed Installation Instructions.	 A0011895 *Via the ground terminal of the transmitter and the optionally available ground disks*

Operating conditions	Potential equalization
When using the measuring device in a: ■ Pipe with a cathodic protection unit The device is installed potential-free in the pipe. Only the two flanges of the pipe are connected with a ground cable (copper wire, at least 6 mm² / 0.0093 in²). Here, the ground cable is mounted directly on the conductive flange coating with flange screws. Note the following when installing: ■ The applicable regulations regarding potential-free installation must be observed. ■ There should be **no** electrically conductive connection between the pipe and the device. ■ The mounting material must withstand the applicable torques.	 A0011896 *Potential equalization and cathodic protection* *1 Power supply isolation transformer* *2 Electrically isolated*

Performance characteristics

Reference operating conditions

As per DIN EN 29104 and VDI/VDE 2641:
- Fluid temperature: +28 °C ± 2 K (+82 °F ± 2 K)
- Ambient temperature: +22 °C ±2 K (+72 °F ± 2 K)
- Warm-up period: 30 minutes

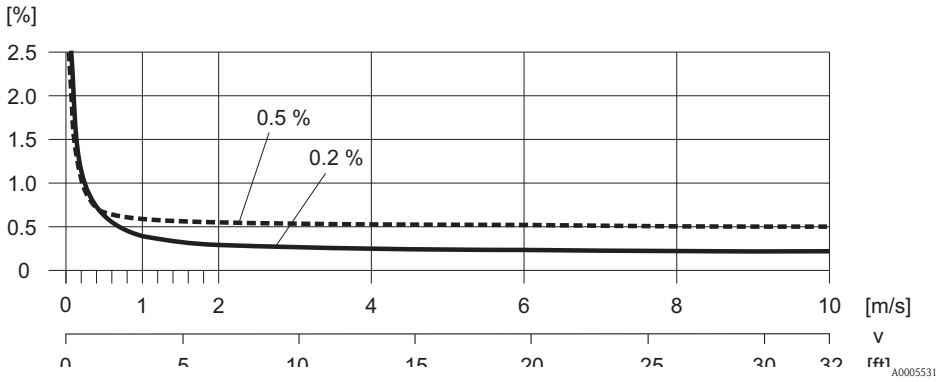
Installation conditions:
- Inlet run > 10 × DN
- Outlet run > 5 × DN
- Sensor and transmitter grounded.
- The sensor is centered in the pipe.

Maximum measured error

Promag 50:
- Current output: also typically ± 5 µA
- Pulse output: ±0.5% o.r. ± 1 mm/s (±0.5% o.r. ± 0.04 in/s)
  optional: ±0.2% o.r. ± 2 mm/s (±0.2% o.r. ± 0.08 in/s) (o.r. = of reading)

Promag 53:
- Current output: also typically ± 5 µA
- Pulse output: ±0.2% o.r. ± 2 mm/s (±0.2% o.r. ± 0.08 in/s) (o.r. = of reading)

Fluctuations in the supply voltage do not have any effect within the specified range.



Max. measured error in % of reading

Repeatability

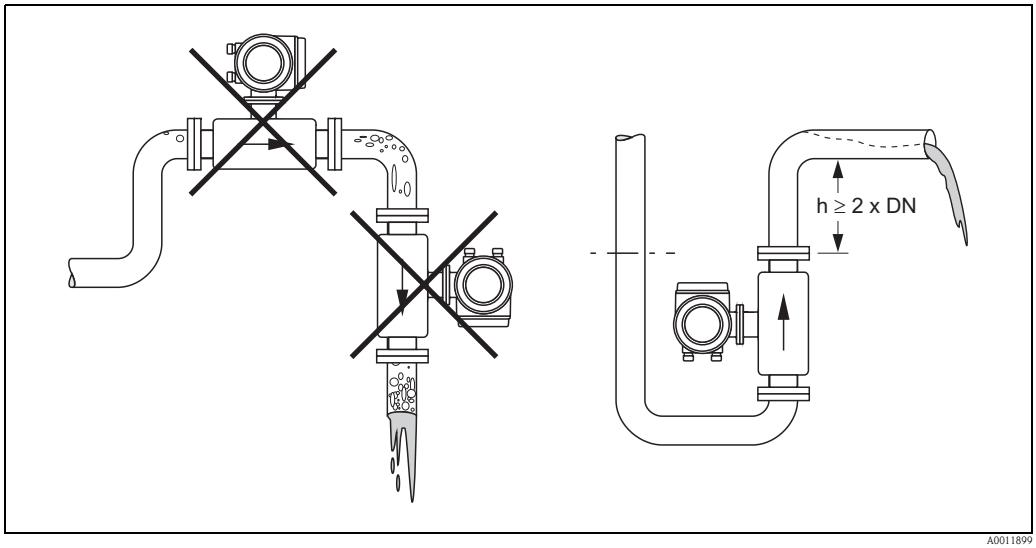
Max. ±0.1% o.r. ± 0.5 mm/s (±0.1% o.r. ± 0.02 in/s) (o.r. = of reading)

Operating conditions: Installations

Installation instructions

Mounting location

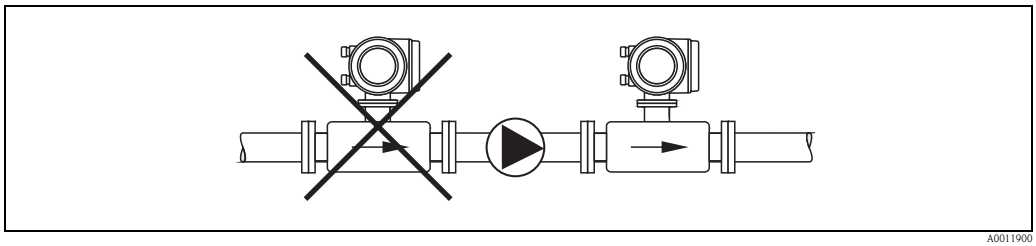
Entrained air or gas bubble formation in the measuring tube can result in an increase in measuring errors.
Avoid the following installation locations in the pipe:
- Highest point of a pipeline. Risk of air accumulating!
- Directly upstream from a free pipe outlet in a vertical pipeline.



Mounting location

Installation of pumps

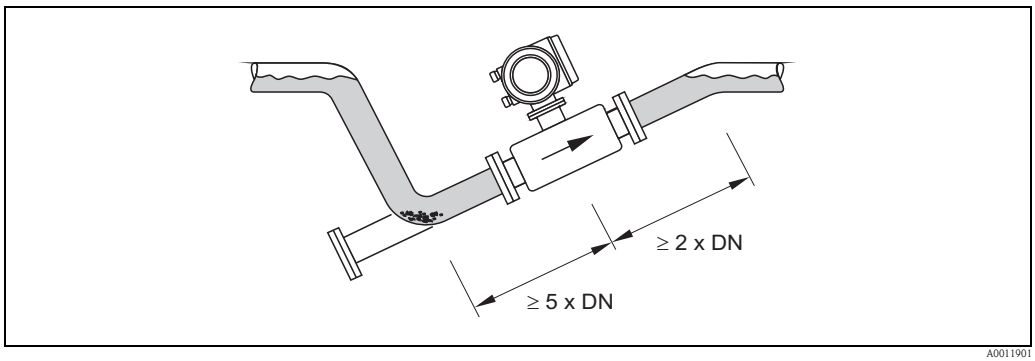
Sensors may not be installed on the pump suction side. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. Information on the pressure tightness of the measuring tube lining → 21, Section "Pressure tightness".
Pulsation dampers may be needed when using piston pumps, piston diaphragm pumps or hose pumps. Information on the shock and vibration resistance of the measuring system → 20, Section "Shock and vibration resistance".



Installation of pumps

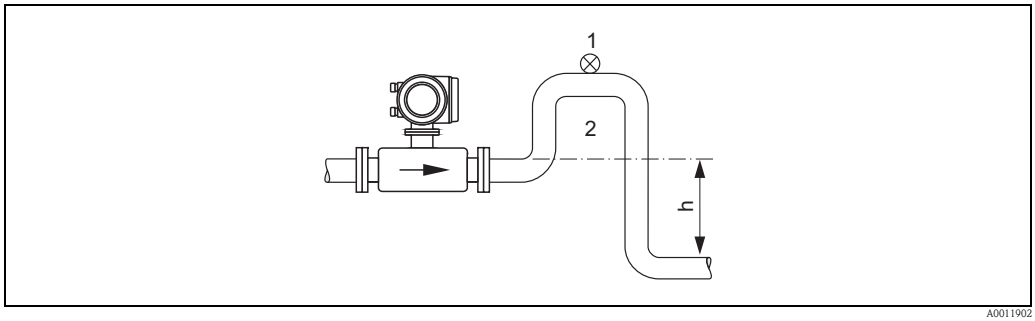
Partially filled pipes
Partially filled pipes with gradients necessitate a drain-type configuration.
The empty pipe detection function (EPD) provides additional security in detecting empty or partially filled pipes.

Caution!
Risk of solids accumulating. Do not install the sensor at the lowest point in the drain. It is advisable to install a cleaning valve.



Installation with partially filled pipes

Down pipes
Install a siphon or a vent valve downstream of the sensor in down pipes h ≥ 5 m (16.4 ft). This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. This measure also prevents the liquid current stopping in the pipe which could cause air locks. Information on the pressure tightness of the measuring tube lining → 21, Section "Pressure tightness".



Installation measures for vertical pipes

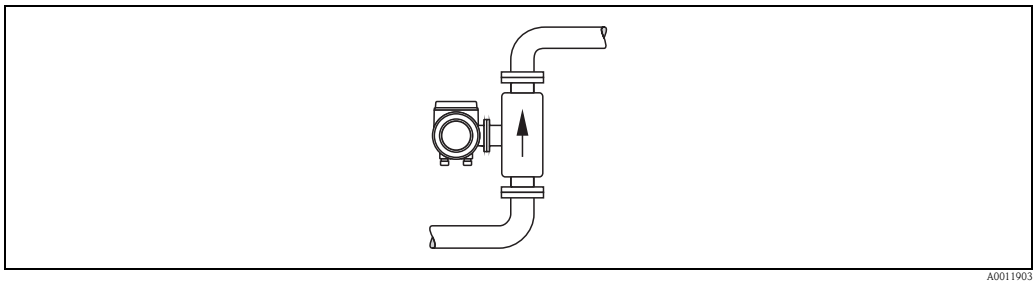
1 Vent valve
2 Pipe siphon
h Length of the down pipe

Orientation

An optimum orientation helps avoid gas and air accumulations and deposits in the measuring tube. However, the measuring device also offers the additional function of empty pipe detection (EPD) for detecting partially filled measuring tubes or if outgassing fluids or fluctuating operating pressures are present.

Vertical orientation

This is the ideal orientation for self-emptying piping systems and for use in conjunction with empty pipe detection.



A0011903

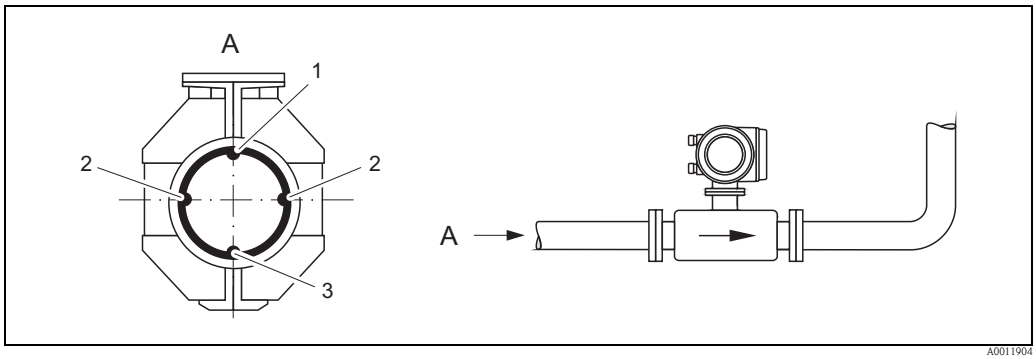
Vertical orientation

Horizontal orientation

The measuring electrode axis should be horizontal. This prevents brief insulation of the two measuring electrodes by entrained air bubbles.

Caution!

Empty pipe detection only works correctly with horizontal orientation if the transmitter housing is facing upwards. Otherwise there is no guarantee that empty pipe detection will respond if the measuring tube is only partially filled or empty.



A0011904

Horizontal orientation

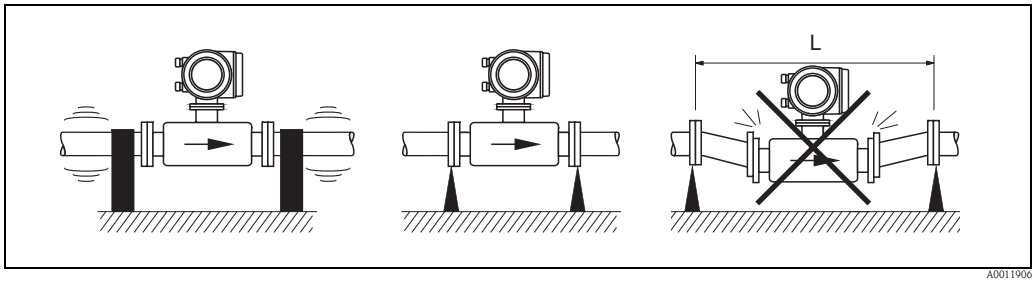
1 EPD electrode for empty pipe detection
2 Measuring electrodes for signal detection
3 Reference electrode for potential equalization

Vibrations

Secure the piping and the sensor if vibration is severe.

Caution!

If vibrations are too severe, we recommend the sensor and transmitter be mounted separately. Information on the permitted shock and vibration resistance → 20, Section "Shock and vibration resistance".



Measures to prevent vibration of the measuring device

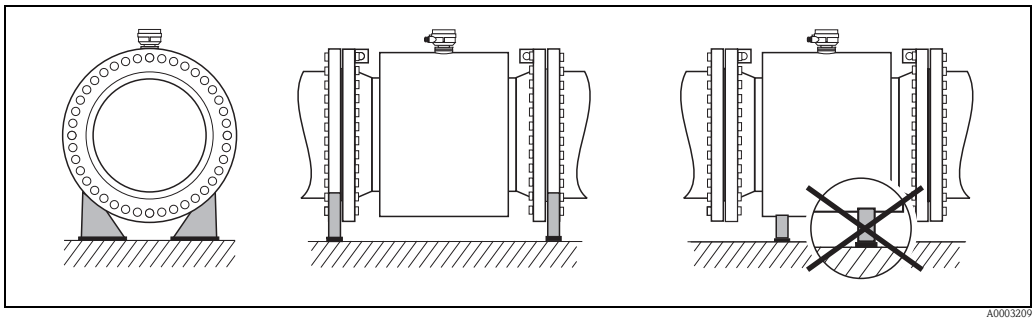
L > 10 m (33 ft)

Foundations, supports

If the nominal diameter is DN ≥ 350, mount the transmitter on a foundation of adequate load-bearing strength.

Caution!

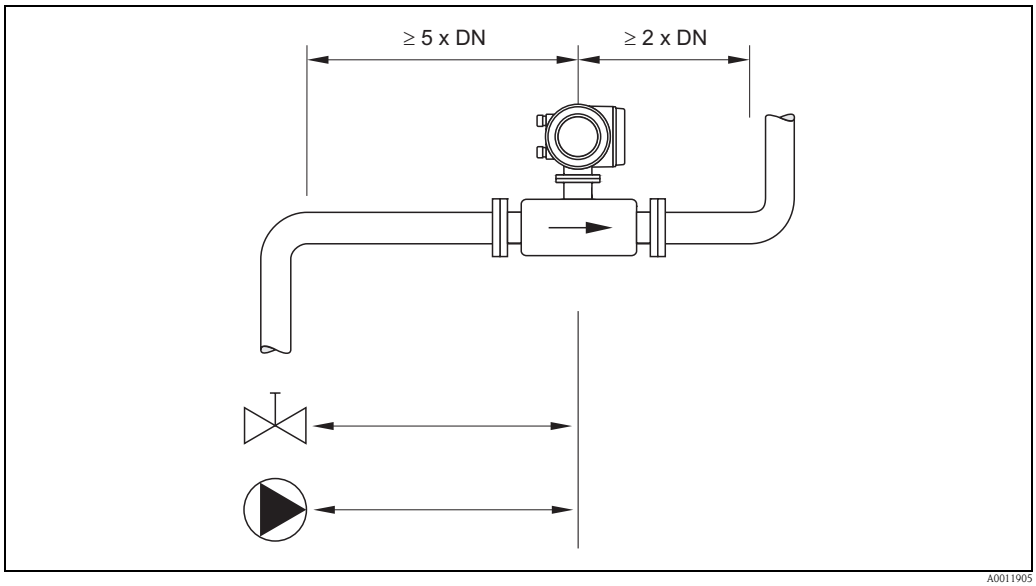
Do not allow the casing to take the weight of the sensor. This would buckle the casing and damage the internal magnetic coils.



Inlet and outlet run

If possible, install the sensor well clear of assemblies such as valves, T-pieces, elbows etc.

Note the following inlet and outlet runs to comply with measuring accuracy specifications:
- Inlet run: ≥ 5 × DN
- Outlet run: ≥ 2 × DN



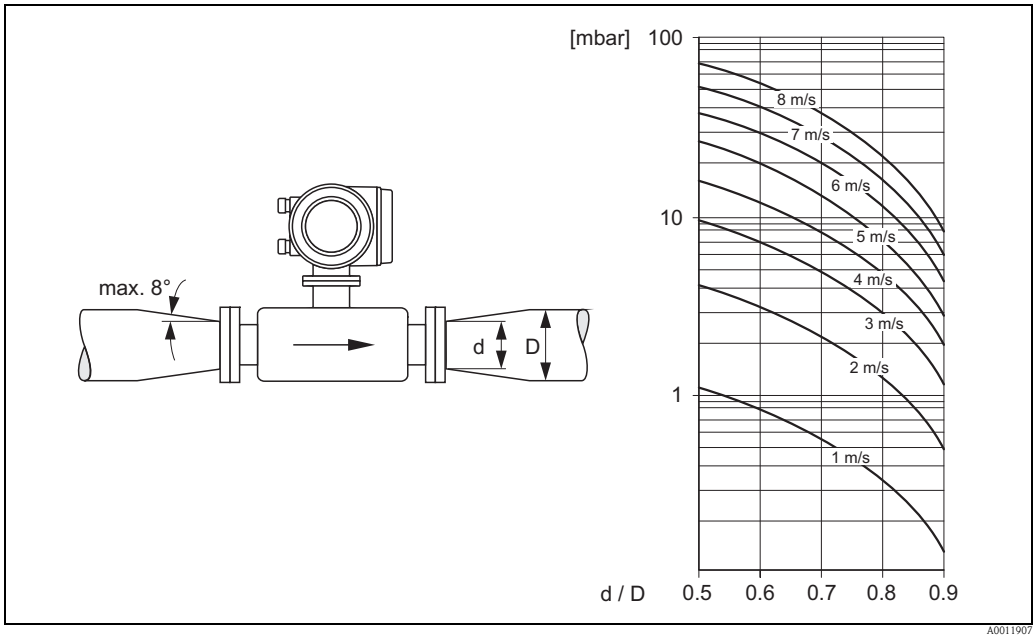
Inlet and outlet run

Adapters

Suitable adapters to DIN EN 545 (double-flange reducers) can be used to install the sensor in larger-diameter pipes. The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids. The nomogram shown here can be used to calculate the pressure loss caused by reducers and expanders.

Note!
The nomogram only applies to liquids of viscosity similar to water.

1. Calculate the ratio of the diameters d/D.
2. From the nomogram read off the pressure loss as a function of flow velocity (downstream from the reduction) and the d/D ratio.

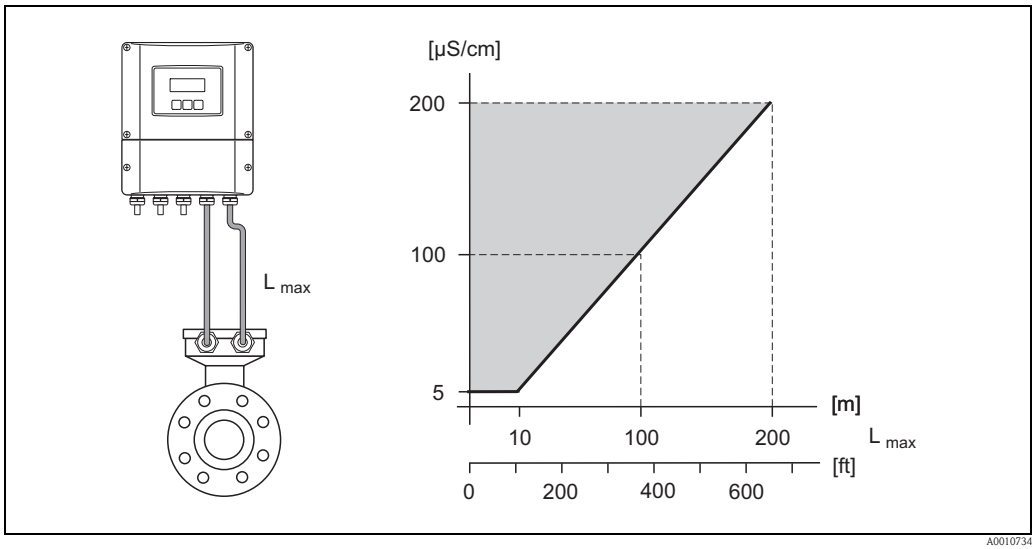


Pressure loss due to adapters

Length of connecting cable

When mounting the remote version, please note the following to achieve correct measuring results:

- Fix cable run or lay in armored conduit. Cable movements can falsify the measuring signal especially in the case of low fluid conductivities.
- Route the cable well clear of electrical machines and switching elements.
- If necessary, ensure potential equalization between sensor and transmitter.
- The permitted cable length L_{max} is determined by the fluid conductivity. A minimum conductivity of 20 µS/cm is required for measuring demineralized water.
- When the empty pipe detection function is switched on (EPD), the maximum connecting cable length is 10 m (33 ft).



Permitted length of connecting cable for remote version
Area marked in gray = permitted range; L_{max} = length of connecting cable in [m] ([ft]); fluid conductivity in [µS/cm]

Operating conditions: Environment

Ambient temperature range

Transmitter
- Standard: –20 to +60 °C (–4 to +140 °F)
- Optional: –40 to +60 °C (–40 to +140 °F)

Note!
At ambient temperatures below –20 °C (–4 °F)the readability of the display may be impaired.

Sensor
- Flange material carbon steel: –10 to +60 °C (14 to +140 °F)
- Flange material stainless steel: –40 to +60 °C (–40 to +140 °F)

Caution!
The permitted temperature range of the measuring tube lining may not be undershot or overshot
→ 21, Section "Medium temperature range".

Please note the following points:
- Install the device in a shady location. Avoid direct sunlight, particularly in warm climatic regions.
- The transmitter must be mounted separate from the sensor if both the ambient and fluid temperatures are high.

Storage temperature

The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.

Caution!
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- A storage location must be selected where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the liner.
- Do not remove the protective plates or caps on the process connections until the device is ready to install.

Degree of protection
- Standard: IP 67 (NEMA 4X) for transmitter and sensor.
- Optional: IP 68 (NEMA 6P) for sensor for remote version.
- For information regarding applications where the device is buried directly in the soil or is installed in a flooded wastewater basin please contact your local Endress+Hauser Sales Center.

Shock and vibration resistance

Acceleration up to 2 g following IEC 600 68-2-6

Electromagnetic compatibility (EMC)
- As per IEC/EN 61326 and NAMUR recommendation NE 21.

Operating conditions: Process

Medium temperature range

The permitted temperature depends on the lining of the measuring tube:
- Polyurethane: –20 to +50 °C (–4 to +122 °F) (DN 25 to 1200 / 1 to 48")
- Hard rubber: ±0 to +80 °C (+32 to +176 °F) (DN 50 to 2000 / 2 to 78")

Conductivity

The minimum conductivity is:
- ≥ 5 µS/cm for fluids generally
- ≥ 20 µS/cm for demineralized water

Note!
In the remote version, the necessary minimum conductivity also depends on the cable length (→ 19, Section "Length of connecting cable").

Medium pressure range (nominal pressure)

- EN 1092-1 (DIN 2501)
  - PN 6 (DN 350 to 2000 / 14 to 78")
  - PN 10 (DN 200 to 2000 / 8 to 78")
  - PN 16 (DN 65 to 2000 / 3 to 78")
  - PN 25 (DN 200 to 1000 / 8 to 40")
  - PN 40 (DN 25 to 150 / 1 to 6")
- ANSI B 16.5
  - Class 150 (DN 1 to 24")
  - Class 300 (DN 1 to 6")
- AWWA
  - Class D (DN 28 to 78")
- JIS B2220
  - 10 K (DN 50 to 300 / 2 to 12")
  - 20 K (DN 25 to 300 / 1 to 12")
- AS 2129
  - Table E (DN 80, 100, 150 to 400, 500, 600 / 3", 4", 6 to 16", 20", 24")
- AS 4087
  - PN 16 (DN 80, 100, 150 to 400, 500, 600 / 3", 4", 6 to 16", 20", 24")

Pressure tightness

Measuring tube lining: Polyurethane

Nominal diameter		Limit values for abs. pressure [mbar] ([psi]) at fluid temperatures:			
		25 °C (77 °F)		50 °C (122 °F)	
[mm]	[inch]	[mbar]	[psi]	[mbar]	[psi]
25 to 1200	1 to 48"	0	0	0	0

Measuring tube lining: Hard rubber

Nominal diameter		Limit values for abs. pressure [mbar] ([psi]) at fluid temperatures:					
		25 °C (77 °F)		50 °C (122 °F)		80 °C (176 °F)	
[mm]	[inch]	[mbar]	[psi]	[mbar]	[psi]	[mbar]	[psi]
50 to 2000	2 to 78"	0	0	0	0	0	0

Limiting flow

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor.
The optimum flow velocity is between 2 to 3 m/s (6.5 to 9.8 ft/s). The velocity of flow (v), moreover, has to be matched to the physical properties of the fluid:

- v < 2 m/s (6.5 ft/s): for abrasive fluids such as potter's clay, lime milk, ore slurry etc.
- v > 2 m/s (6.5 ft/s): for fluids causing build-up such as wastewater sludges etc.

Flow characteristic values (SI units)

Diameter		Recommended flow	Factory settings		
		Min./max. full scale value	Full scale value Current output	Pulse value	Low flow
[mm]	[inch]	(v ~ 0.3 or 10 m/s)	(v ~ 2.5 m/s)	(~ 2 pulses/s)	(v ~ 0.04 m/s)
25	1"	9 to 300 dm³/min	75 dm³/min	0.50 dm³	1 dm³/min
32	–	15 to 500 dm³/min	125 dm³/min	1.00 dm³	2 dm³/min
40	1½"	25 to 700 dm³/min	200 dm³/min	1.50 dm³	3 dm³/min
50	2"	35 to 1100 dm³/min	300 dm³/min	2.50 dm³	5 dm³/min
65	–	60 to 2000 dm³/min	500 dm³/min	5.00 dm³	8 dm³/min
80	3"	90 to 3000 dm³/min	750 dm³/min	5.00 dm³	12 dm³/min
100	4"	145 to 4700 dm³/min	1200 dm³/min	10.00 dm³	20 dm³/min
125	–	220 to 7500 dm³/min	1850 dm³/min	15.00 dm³	30 dm³/min
150	6"	20 to 600 m³/h	150 m³/h	0.025 m³	2.5 m³/h
200	8"	35 to 1100 m³/h	300 m³/h	0.05 m³	5.0 m³/h
250	10"	55 to 1700 m³/h	500 m³/h	0.05 m³	7.5 m³/h
300	12"	80 to 2400 m³/h	750 m³/h	0.10 m³	10 m³/h
350	14"	110 to 3300 m³/h	1000 m³/h	0.10 m³	15 m³/h
375	15"	140 to 4200 m³/h	1200 m³/h	0.15 m³	20 m³/h
400	16"	140 to 4200 m³/h	1200 m³/h	0.15 m³	20 m³/h
450	18"	180 to 5400 m³/h	1500 m³/h	0.25 m³	25 m³/h
500	20"	220 to 6600 m³/h	2000 m³/h	0.25 m³	30 m³/h
600	24"	310 to 9600 m³/h	2500 m³/h	0.30 m³	40 m³/h
700	28"	420 to 13500 m³/h	3500 m³/h	0.50 m³	50 m³/h
–	30"	480 to 15000 m³/h	4000 m³/h	0.50 m³	60 m³/h
800	32"	550 to 18000 m³/h	4500 m³/h	0.75 m³	75 m³/h
900	36"	690 to 22500 m³/h	6000 m³/h	0.75 m³	100 m³/h
1000	40"	850 to 28000 m³/h	7000 m³/h	1.00 m³	125 m³/h
–	42"	950 to 30000 m³/h	8000 m³/h	1.00 m³	125 m³/h
1200	48"	1250 to 40000 m³/h	10000 m³/h	1.50 m³	150 m³/h
–	54"	1550 to 50000 m³/h	13000 m³/h	1.50 m³	200 m³/h
1400	–	1700 to 55000 m³/h	14000 m³/h	2.00 m³	225 m³/h
–	60"	1950 to 60000 m³/h	16000 m³/h	2.00 m³	250 m³/h
1600	–	2200 to 70000 m³/h	18000 m³/h	2.50 m³	300 m³/h
–	66"	2500 to 80000 m³/h	20500 m³/h	2.50 m³	325 m³/h
1800	72"	2800 to 90000 m³/h	23000 m³/h	3.00 m³	350 m³/h
–	78"	3300 to 100000 m³/h	28500 m³/h	3.50 m³	450 m³/h
2000	–	3400 to 110000 m³/h	28500 m³/h	3.50 m³	450 m³/h

Flow characteristic values (US units)					
Diameter		**Recommended flow rate**	**Factory settings**		
[inch]	[mm]	Min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value Current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulses/s)	Low flow (v ~ 0.04 m/s)
1"	25	2.5 to 80 gal/min	18 gal/min	0.20 gal	0.25 gal/min
–	32	4 to 130 gal/min	30 gal/min	0.20 gal	0.50 gal/min
1½"	40	7 to 190 gal/min	50 gal/min	0.50 gal	0.75 gal/min
2"	50	10 to 300 gal/min	75 gal/min	0.50 gal	1.25 gal/min
–	65	16 to 500 gal/min	130 gal/min	1 gal	2.0 gal/min
3"	80	24 to 800 gal/min	200 gal/min	2 gal	2.5 gal/min
4"	100	40 to 1250 gal/min	300 gal/min	2 gal	4.0 gal/min
–	125	60 to 1950 gal/min	450 gal/min	5 gal	7.0 gal/min
6"	150	90 to 2650 gal/min	600 gal/min	5 gal	12 gal/min
8"	200	155 to 4850 gal/min	1200 gal/min	10 gal	15 gal/min
10"	250	250 to 7500 gal/min	1500 gal/min	15 gal	30 gal/min
12"	300	350 to 10600 gal/min	2400 gal/min	25 gal	45 gal/min
14"	350	500 to 15000 gal/min	3600 gal/min	30 gal	60 gal/min
15"	375	600 to 19000 gal/min	4800 gal/min	50 gal	60 gal/min
16"	400	600 to 19000 gal/min	4800 gal/min	50 gal	60 gal/min
18"	450	800 to 24000 gal/min	6000 gal/min	50 gal	90 gal/min
20"	500	1000 to 30000 gal/min	7500 gal/min	75 gal	120 gal/min
24"	600	1400 to 44000 gal/min	10500 gal/min	100 gal	180 gal/min
28"	700	1900 to 60000 gal/min	13500 gal/min	125 gal	210 gal/min
30"	–	2150 to 67000 gal/min	16500 gal/min	150 gal	270 gal/min
32"	800	2450 to 80000 gal/min	19500 gal/min	200 gal	300 gal/min
36"	900	3100 to 100000 gal/min	24000 gal/min	225 gal	360 gal/min
40"	1000	3800 to 125000 gal/min	30000 gal/min	250 gal	480 gal/min
42"	–	4200 to 135000 gal/min	33000 gal/min	250 gal	600 gal/min
48"	1200	5500 to 175000 gal/min	42000 gal/min	400 gal	600 gal/min
54"	–	9 to 300 Mgal/min	75 Mgal/min	0.0005 Mgal	1.3 Mgal/min
–	1400	10 to 340 Mgal/min	85 Mgal/min	0.0005 Mgal	1.3 Mgal/min
60"	–	12 to 380 Mgal/min	95 Mgal/min	0.0005 Mgal	1.3 Mgal/min
–	1600	13 to 450 Mgal/min	110 Mgal/min	0.0008 Mgal	1.7 Mgal/min
66"	–	14 to 500 Mgal/min	120 Mgal/min	0.0008 Mgal	2.2 Mgal/min
72"	1800	16 to 570 Mgal/min	140 Mgal/min	0.0008 Mgal	2.6 Mgal/min
78"	–	18 to 650 Mgal/min	175 Mgal/min	0.001 Mgal	3.0 Mgal/min
–	2000	20 to 700 Mgal/min	175 Mgal/min	0.001 Mgal	3.0 Mgal/min

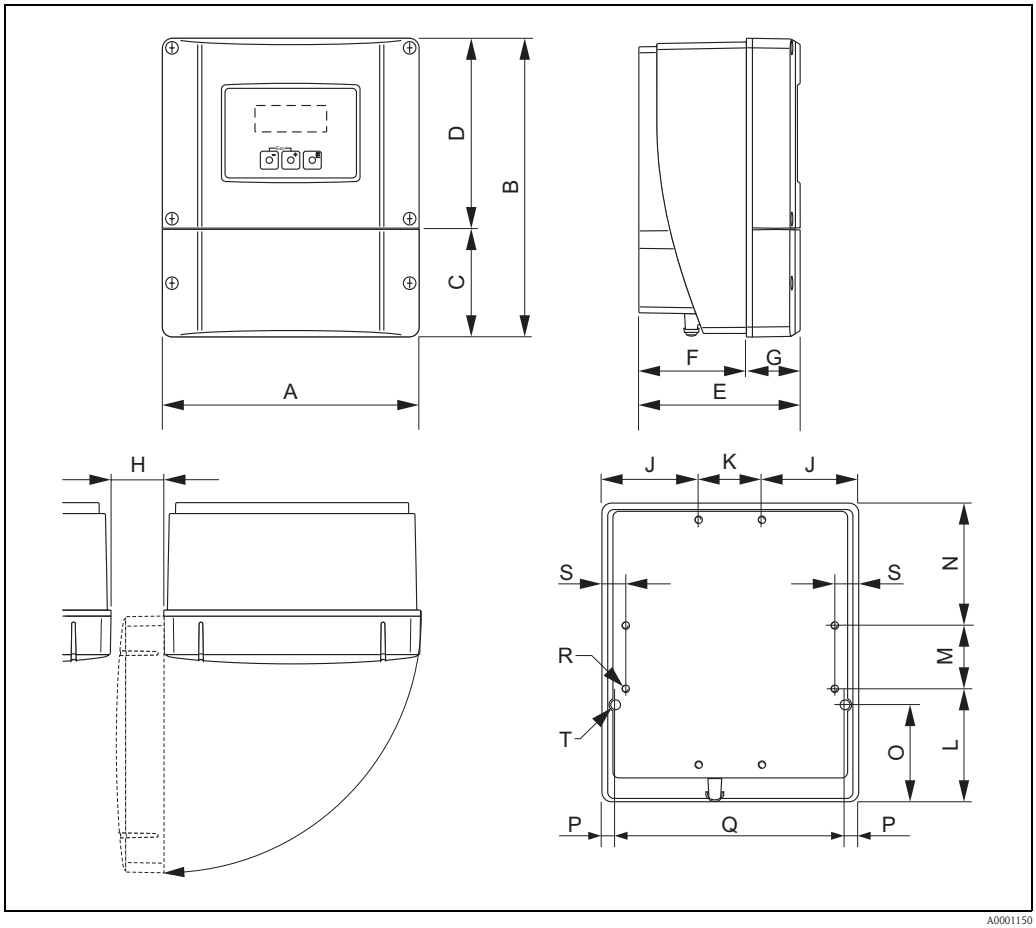
Pressure loss

- No pressure loss if the sensor is installed in a pipe with the same nominal diameter.
- Pressure losses for configurations incorporating adapters according to DIN EN 545 (→ 🖹 18, Section "Adapters").

Mechanical construction

Design, dimensions

Transmitter remote version, wall-mount housing (non Ex-zone and II3G/Zone 2)



Dimensions (SI units)

A	B	C	D	E	F	G	H	J
215	250	90.5	159.5	135	90	45	> 50	81
K	L	M	N	O	P	Q	R	S
53	95	53	102	81.5	11.5	192	8 × M5	20

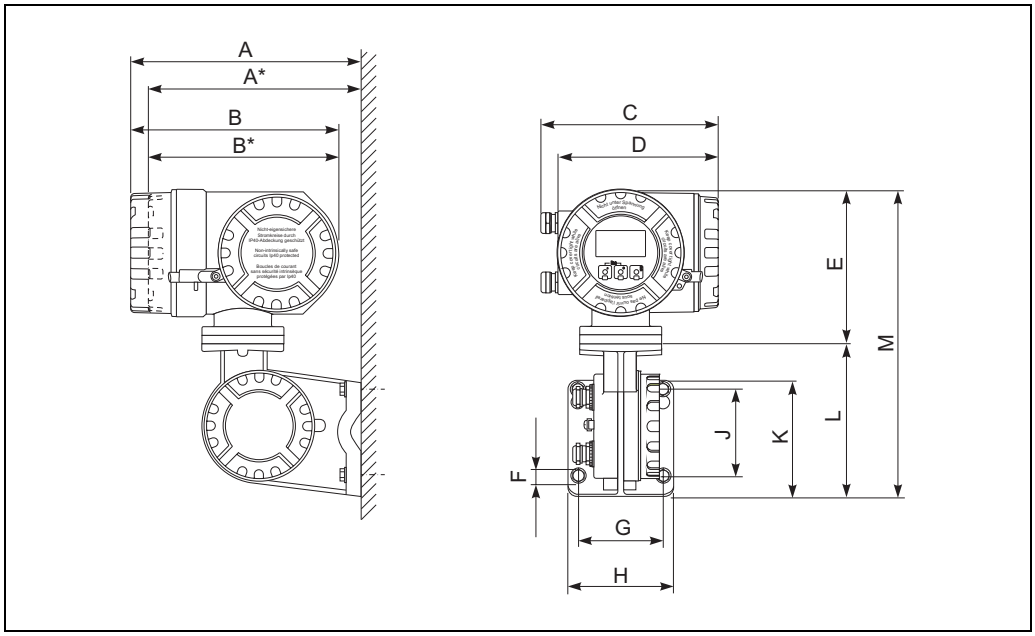
All dimensions in [mm]

Dimensions (US units)

A	B	C	D	E	F	G	H	J
8.46	9.84	3.56	6.27	5.31	3.54	1.77	> 1.97	3.18
K	L	M	N	O	P	Q	R	S
2.08	3.74	2.08	4.01	3.20	0.45	7.55	8 × M5	0.79

All dimensions in [inch]

Transmitter remote version, connection housing (II2GD/Zone 1)



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Dimensions (SI units)

A	A*	B	B*	C	D	E	Ø F	G	H	J	K	L	M
265	242	240	217	206	186	178	8.6 (M8)	100	130	100	144	170	355

All dimensions in [mm]

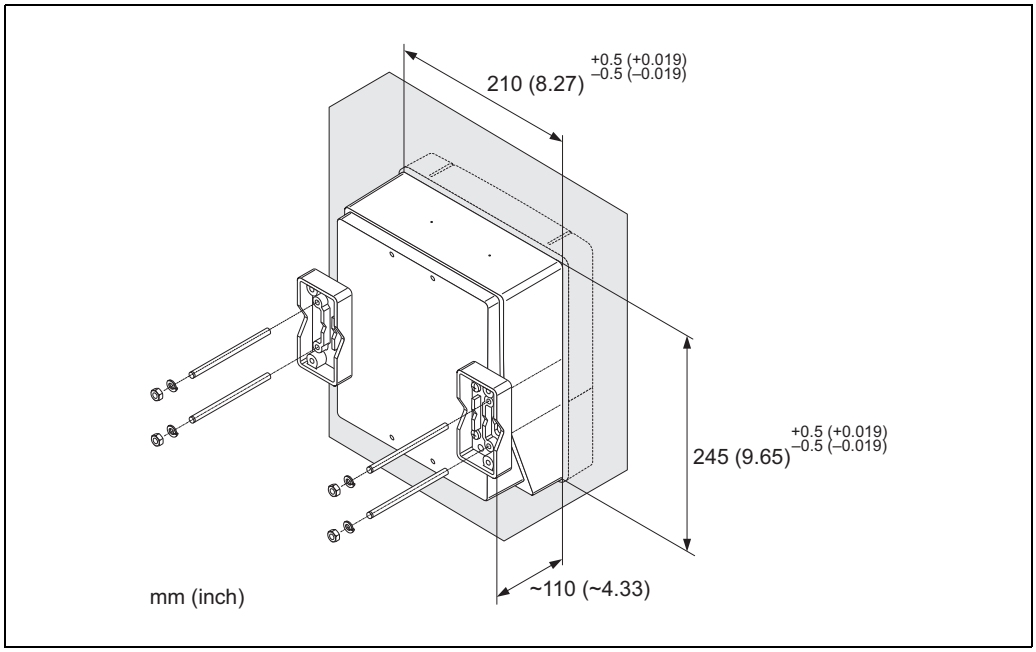
Dimensions (US units)

A	A*	B	B*	C	D	E	Ø F	G	H	J	K	L	M
10.4	9.53	9.45	8.54	8.11	7.32	7.01	0.34 (M8)	3.94	5.12	3.94	5.67	6.69	14.0

All dimensions in [inch]

There is a separate mounting kit for the wall-mounted housing. It can be ordered from Endress+Hauser as an accessory. The following installation variants are possible:
- Panel-mounted installation
- Pipe mounting

Installation in control panel



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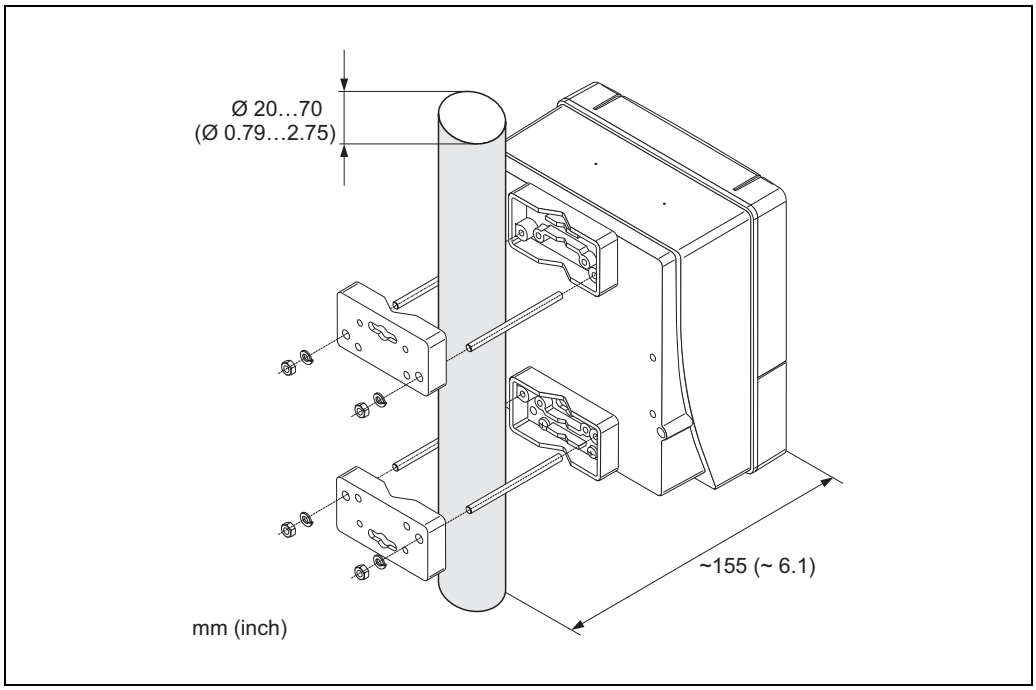
Pipe mounting



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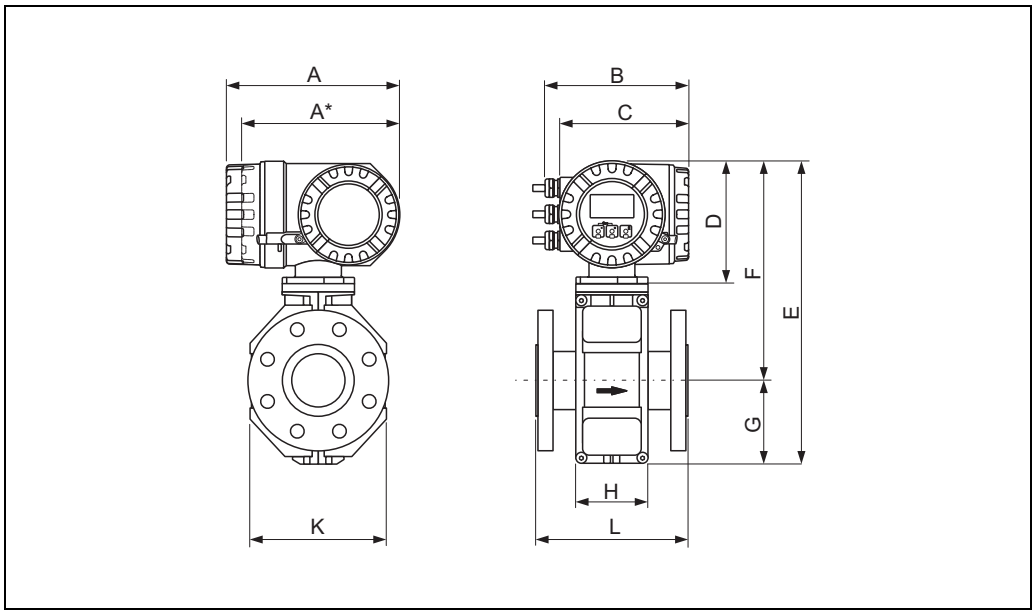
Compact version DN ≤ 300 (12")



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Dimensions (SI units)

DN EN (DIN) / JIS / AS [2]	L [1]	A	A*	B	C	D	E	F	G	H	K
25	200	227	207	187	168	160	341	257	84	94	120
32	200						341	257	84	94	120
40	200						341	257	84	94	120
50	200						341	257	84	94	120
65	200						391	282	109	94	180
80	200						391	282	109	94	180
100	250						391	282	109	94	180
125	250						472	322	150	140	260
150	300						472	322	150	140	260
200	350						527	347	180	156	324
250	450						577	372	205	166	400
300	500						627	397	230	166	460

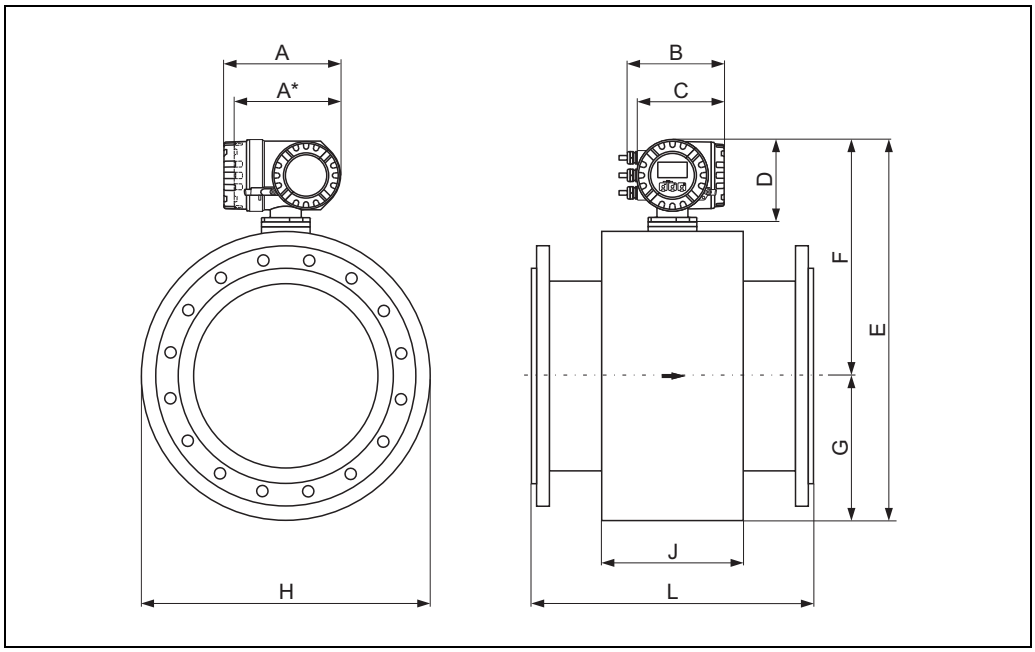
[1] The length is regardless of the pressure rating selected. Fitting length to DVGW.
[2] For flanges to AS, only the nominal diameters DN 80, 100 and 150 to 300 are available.
All dimensions in [mm]

Dimensions (US units)

DN ANSI	L [1]	A	A*	B	C	D	E	F	G	H	K
1"	7.87	8.94	8.15	7.36	6.61	6.30	13.4	10.1	3.31	3.70	4.72
1½"	7.87						13.4	10.1	3.31	3.70	4.72
2"	7.87						13.4	10.1	3.31	3.70	4.72
3"	7.87						15.4	11.1	4.29	3.70	7.09
4"	9.84						15.4	11.1	4.29	3.70	7.09
6"	11.8						18.6	12.7	5.91	5.51	10.2
8"	13.8						20.8	13.7	7.09	6.14	12.8
10"	17.7						22.7	14.7	8.07	6.14	15.8
12"	19.7						24.7	15.6	9.06	6.54	18.1

[1] The length is regardless of the pressure rating selected. Fitting length to DVGW.
All dimensions in [inch]

Compact version DN ≥ 350 (14")



Dimensions (SI units)

DN EN (DIN) / AS [2]	L [1]	A	A*	B	C	D	E	F	G	H	J
350	550	227	207	187	168	160	738.5	456.5	282.0	276	564
375	600						790.5	482.5	308.0	276	616
400	600						790.5	482.5	308.0	276	616
450	650						840.5	507.5	333.0	292	666
500	650						891.5	533.0	358.5	292	717
600	780						995.5	585.0	410.5	402	821
700	910						1198.5	686.5	512.0	589	1024
750	975						1198.5	686.5	512.0	626	1024
800	1040						1241.5	708.5	533.5	647	1067
900	1170						1394.5	784.5	610.0	785	1220
1000	1300						1546.5	860.5	686.0	862	1372
1050	1365						1598.5	886.5	712.0	912	1424
1200	1560						1796.5	985.5	811.0	992	1622
1350	1755						1998.5	1086.5	912.0	1252	1824
1400	1820						2148.5	1161.5	987.0	1252	1974
1500	1950						2196.5	1185.5	1011.0	1392	2022
1600	2080						2286.5	1230.5	1056.0	1482	2112
1650	2145						2360.5	1267.5	1093.0	1482	2186
1800	2340						2550.5	1362.5	1188.0	1632	2376
2000	2600						2650.5	1412.5	1238.0	1732	2476

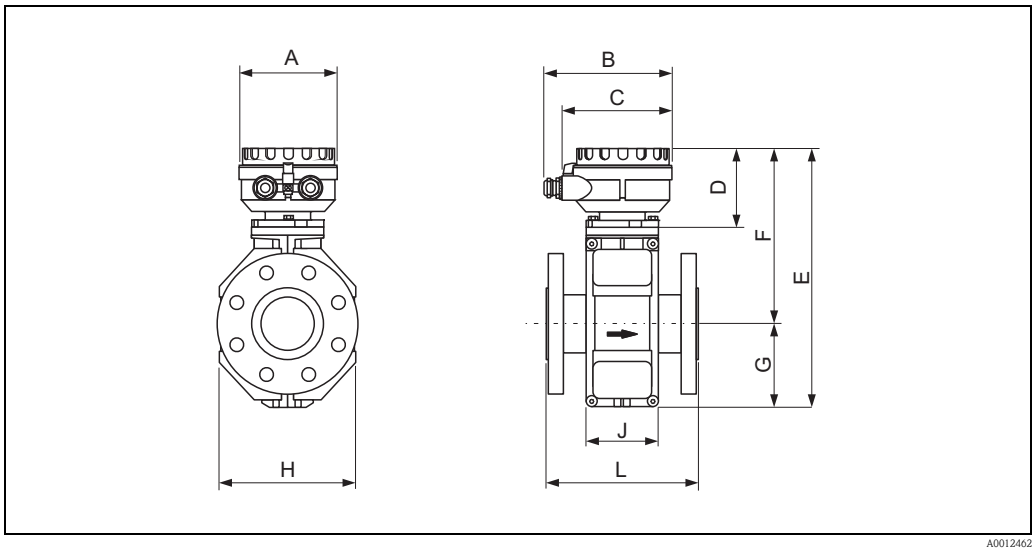
[1] The length is regardless of the pressure rating selected. Fitting length to DVGW.
[2] For flanges to AS, only DN 350, 400, 500 and 600 are available.
All dimensions in [mm]

Dimensions (US units)

DN ANSI / AWWA [2]	L [1]	A	A*	B	C	D	E	F	G	H	J
14"	21.6	8.94	8.15	7.36	6.61	6.30	29.1	17.9	11.1	10.9	22.2
15"	23.6						31.1	18.9	12.1	10.9	24.2
16"	23.6						31.1	18.9	12.1	10.9	24.2
18"	25.6						33.1	19.9	13.1	11.5	26.2
20"	25.6						35.1	20.9	14.1	11.5	28.2
24"	30.7						39.2	23.0	16.2	15.8	32.3
28"	35.8						47.2	27.0	20.1	23.2	40.3
30"	38.4						47.2	27.0	20.1	24.6	40.3
32"	40.9						48.9	27.9	21.0	25.5	42.0
36"	46.0						54.9	30.9	24.0	30.9	48.0
40"	51.2						60.9	33.9	27.0	33.9	54.0
42"	53.7						62.9	34.9	28.0	35.9	56.0
48"	61.4						71.7	38.8	31.9	39.0	63.8
54"	69.1						78.7	42.8	35.9	42.3	71.8
56"	71.7						84.6	45.7	38.9	49.3	77.7
60"	76.8						86.5	46.7	39.8	54.8	79.6
64"	81.9						90.0	48.4	41.6	58.4	83.2
66"	84.4						92.9	49.9	43.0	58.4	86.0
72"	92.1						100.4	53.6	46.8	64.2	93.5
78"	102.3						104.3	55.6	48.7	68.2	97.5

[1] The length is regardless of the pressure rating selected. Fitting length to DVGW.
[2] Flanges ≤ 24" only to ANSI available, ≥ 28" only to AWWA available.
All dimensions in [inch]

Sensor, remote version DN ≤ 300 (12")



Dimensions (SI units)

DN EN (DIN) / JIS / AS [2]	L [1]	A	B	C	D	E	F	G	H	J
25	200	129	163	143	102	286	202	84	120	94
32	200	129	163	143	102	286	202	84	120	94
40	200	129	163	143	102	286	202	84	120	94
50	200	129	163	143	102	286	202	84	120	94
65	200	129	163	143	102	336	227	109	180	94
80	200	129	163	143	102	336	227	109	180	94
100	250	129	163	143	102	336	227	109	180	94
125	250	129	163	143	102	417	267	150	260	140
150	300	129	163	143	102	417	267	150	260	140
200	350	129	163	143	102	472	292	180	324	156
250	450	129	163	143	102	522	317	205	400	166
300	500	129	163	143	102	572	342	230	460	166

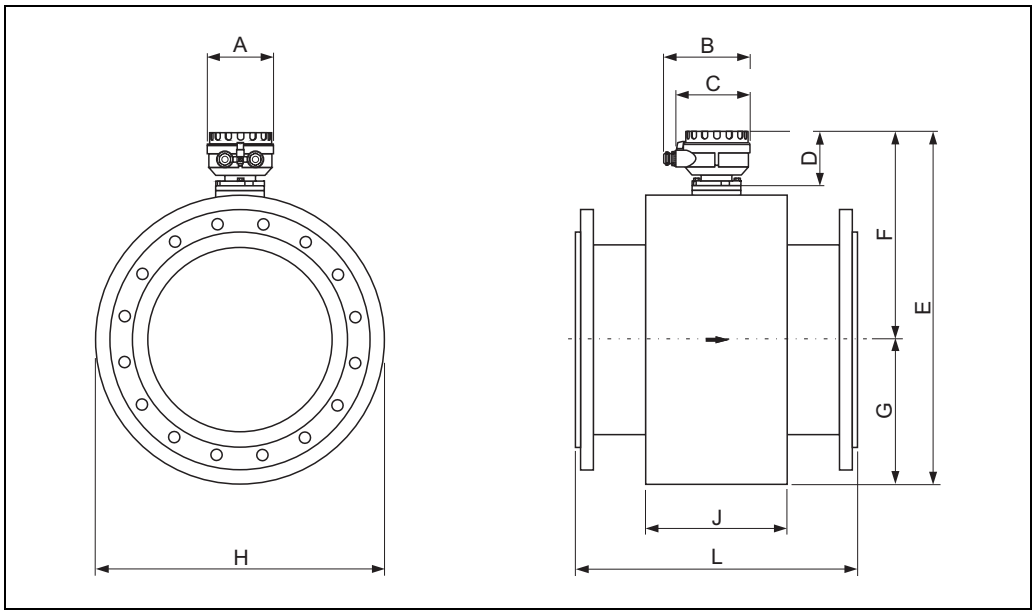
[1] The length is regardless of the pressure rating selected. Fitting length to DVGW.
[2] For flanges to AS, only the nominal diameters DN 80, 100 and 150 to 300 are available.
All dimensions in [mm]

Dimensions (US units)

DN ANSI	L [1]	A	B	C	D	E	F	G	H	J
1"	7.87	5.08	6.42	5.63	4.02	11.3	7.95	3.32	4.72	3.70
1½"	7.87	5.08	6.42	5.63	4.02	11.3	7.95	3.32	4.72	3.70
2"	7.87	5.08	6.42	5.63	4.02	11.3	7.95	3.32	4.72	3.70
3"	7.87	5.08	6.42	5.63	4.02	13.2	8.94	4.30	7.10	3.70
4"	9.84	5.08	6.42	5.63	4.02	13.2	8.94	4.30	7.10	3.70
6"	11.8	5.08	6.42	5.63	4.02	16.4	10.5	5.91	10.2	5.51
8"	13.8	5.08	6.42	5.63	4.02	18.6	11.5	7.10	12.8	6.14
10"	17.7	5.08	6.42	5.63	4.02	20.6	12.5	8.08	15.8	6.14
12"	19.7	5.08	6.42	5.63	4.02	22.5	13.5	9.06	18.1	6.54

[1] The length is regardless of the pressure rating selected. Fitting length to DVGW.
All dimensions in [inch]

Sensor, remote version DN ≥ 350 (14")



Dimensions (SI units)

DN EN (DIN) / AS [2]	L [1]	A	B	C	D	E	F	G	H	J
350	550	129	163	143	102	683.5	401.5	282.0	564	276
375	600					735.5	427.5	308.0	616	276
400	600					735.5	427.5	308.0	616	276
450	650					785.5	452.5	333.0	666	292
500	650					836.5	478.0	358.5	717	292
600	780					940.5	530.0	410.5	821	402
700	910					1143.5	631.5	512.0	1024	589
750	975					1143.5	631.5	512.0	1024	626
800	1040					1186.5	653.0	533.5	1067	647
900	1170					1339.5	729.5	610.0	1220	785
1000	1300					1491.5	805.5	686.0	1372	862
1050	1365					1543.5	831.5	712.0	1424	912
1200	1560					1741.5	930.5	811.0	1622	992
1350	1755					1943.5	1031.5	912.0	1824	1252
1400	1820					2093.5	1106.5	987.0	1974	1252
1500	1950					2141.5	1130.5	1011.0	2022	1392
1600	2080					2231.5	1175.5	1056.0	2112	1482
1650	2145					2305.5	1212.5	1093.0	2186	1482
1800	2340					2495.5	1307.5	1188.0	2376	1632
2000	2600					2595.5	1357.5	1238.0	2476	1732

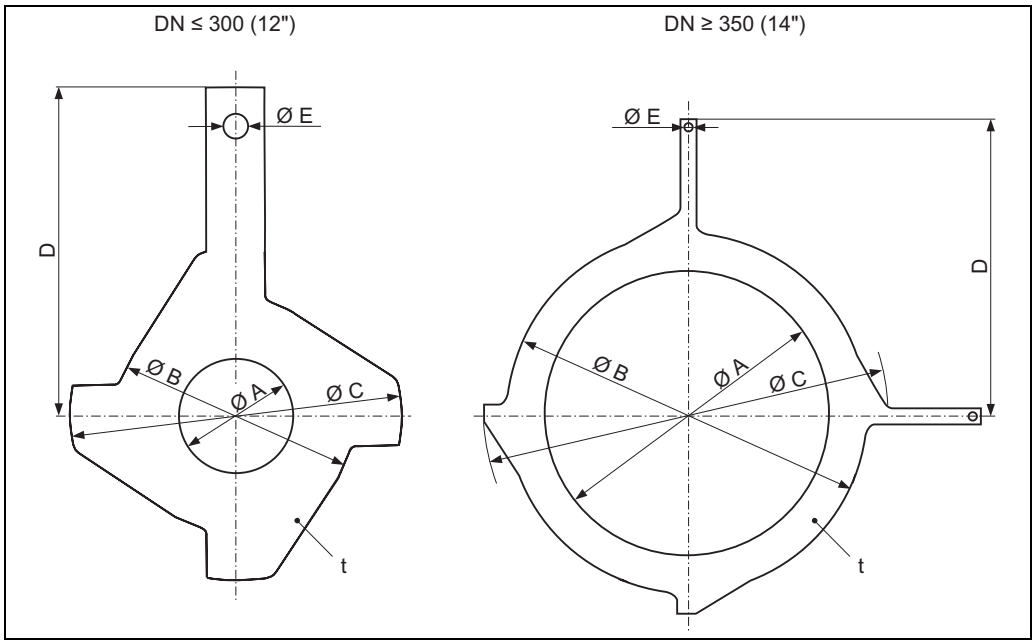
[1] The length is regardless of the pressure rating selected. Fitting length to DVGW.
[2] For flanges to AS, only DN 350, 400, 500 and 600 are available.
All dimensions in [mm]

Dimensions (US units)

DN ANSI / AWWA [2]	L [1]	A	B	C	D	E	F	G	H	J
14"	21.6	5.08	6.42	5.63	4.02	29.1	15.8	11.1	22.2	10.9
15"	23.6					31.1	16.8	12.1	24.2	10.9
16"	23.6					31.1	16.8	12.1	24.2	10.9
18"	25.6					33.1	17.8	13.1	26.2	11.5
20"	25.6					35.1	18.8	14.1	28.2	11.5
24"	30.7					39.2	20.9	16.2	32.3	15.8
28"	35.8					45.0	24.9	20.1	40.3	23.2
30"	38.4					45.0	24.9	20.1	40.3	24.6
32"	40.9					46.7	25.7	21.0	42.0	25.5
36"	46.0					52.7	28.7	24.0	48.0	30.9
40"	51.2					58.7	31.7	27.0	54.0	33.9
42"	53.7					60.7	32.7	28.0	56.0	35.9
48"	61.4					68.5	36.6	31.9	63.8	39.0
54"	69.1					76.5	40.6	35.9	71.8	42.3
56"	71.7					82.4	43.6	38.9	77.7	49.3
60"	76.8					84.3	44.5	39.8	79.6	54.8
64"	81.9					87.9	46.3	41.6	83.2	58.4
66"	84.4					90.8	47.7	43.0	86.0	58.4
72"	92.1					98.2	51.5	46.8	93.5	64.2
78"	102.3					102.2	53.4	48.7	97.5	68.2

[1] The length is regardless of the pressure rating selected. Fitting length to DVGW.
[2] Flanges ≤ 24" only to ANSI available, ≥ 28" only to AWWA available.
All dimensions in [inch]

Ground disk for flange connections



Dimensions (SI units)

DN [1] EN (DIN) / JIS / AS [2]	A	B	C	D	E	t
25	26	62	77.5	87.5	6.5	2
32	35	80	87.5	94.5		
40	41	82	101	103		
50	52	101	115.5	108		
65	68	121	131.5	118		
80	80	131	154.5	135		
100	104	156	186.5	153		
125	130	187	206.5	160		
150	158	217	256	184		
200	206	267	288	205		
250	260	328	359	240		
300 [3]	312	375	413	273		
300 [4]	310	375	404	268		
350 [3]	343	433	479	365	9.0	
375 [3]	393	480	542	395		
400 [3]	393	480	542	395		
450 [3]	439	538	583	417		
500 [3]	493	592	650	460		
600 [3]	593	693	766	522		

[1] Ground disks can be used for all flange standards/pressure ratings that can be delivered, except for DN ≥ 300.
[2] Only DN 32, 40, 65 and 125 are available for flanges according to AS.
[3] PN 10/16
[4] PN 25, JIS 10K/20K
All dimensions in [mm]

Dimensions (US units)

DN [1] ANSI	A	B	C	D	E	t
1"	1.02	2.44	3.05	3.44		
1½"	1.61	3.23	3.98	4.06		
2"	2.05	3.98	4.55	4.25		
3"	3.15	5.16	6.08	5.31		
4"	4.09	6.14	7.34	6.02	0.26	
6"	6.22	8.54	10.08	7.24		
8"	8.11	10.5	11.3	8.07		
10"	10.2	12.9	14.1	9.45		0.08
12"	12.3	14.8	16.3	10.8		
14"	13.5	17.1	18.9	14.4		
15"	15.45	18.9	21.3	15.6		
16"	15.45	18.9	21.3	15.6	0.35	
18"	17.3	21.2	23.0	16.4		
20"	19.4	23.3	25.6	18.1		
24"	23.4	27.3	30.1	20.6		

[1] Ground disks can be used for all flange standards/pressure ratings.
All dimensions in [inch]

Weight

Weight in SI units

Weight data in kg

Nominal diameter		Compact version						Remote version (without cable)						
								Sensor						Transmitter
[mm]	[inch]	EN (DIN) / AS [1]		JIS		ANSI / AWWA		EN (DIN) / AS [1]		JIS		ANSI / AWWA		Wall-mount housing
25	1"	PN 40	7.3	10K	7.3	Class 150	7.3	PN 40	5.3	10K	5.3	Class 150	5.3	6.0
32	–		8.0		7.3		–		6.0		5.3		–	
40	1½"		9.4		8.3		9.4		7.4		6.3		7.4	
50	2"		10.6		9.3		10.6		8.6		7.3		8.6	
65	–	PN 16	12		11.1		–	PN 16	10.0		9.1		–	
80	3"		14		112.5		14.0		12.0		10.5		12.0	
100	4"		16		14.7		16.0		14.0		12.7		14.0	
125	–		21.5		21.0		–		19.5		19.0		–	
150	6"		25.5		24.5		25.5		23.5		22.5		23.5	
200	8"	PN 10	45		41.9		45	PN 10	43		39.9		43	
250	10"		65		69.4		75		63		67.4		73	
300	12"		70		72.3		110		68		70.3		108	
350	14"	PN 6	105				175	PN 6	103				173	
375	15"		120				–		118				–	
400	16"		120				205		118				203	
450	18"		161				255		159				253	
500	20"		156				285		154				283	
600	24"		208				405		206				403	
700	28"		304			Class D	400		302			Class D	398	
–	30"		–				460		–				458	
800	32"		357				550		355				548	
900	36"		485				800		483				798	
1000	40"		589				900		587				898	
–	42"		–				1100		–				1098	
1200	48"		850				1400		848				1398	
–	54"		–				2200		–				2198	
1400	–		1300				–		1298				–	
–	60"		–				2700		–				2698	
1600	–		1700				–		1698				–	
–	66"		–				3700		–				3698	
1800	72"		2200				4100		2198				4098	
–	78"		–				4600		–				4598	
2000	–		2800				–		2798				–	

[1] For flanges to AS, only DN 80, 100, 150 to 400, 500 and 600 are available.

- Transmitter (compact version): 3.4 kg
- Weight data valid for standard pressure ratings and without packaging material.

Weight in US units (only ANSI / AWWA)

Weight data in lbs						
Nominal diameter		Compact version		Remote version (without cable)		
					Sensor	Transmitter
[mm]	[inch]		ANSI /AWWA		ANSI / AWWA	Wall-mount housing
25	1"	Class 150	16.1	Class 150	11.7	13.2
40	1½"		20.7		16.3	
50	2"		23.4		19.0	
80	3"		30.9		26.5	
100	4"		35.3		30.9	
150	6"		56.2		51.8	
200	8"		99.2		94.8	
250	10"		165.4		161.0	
300	12"		242.6		238.1	
350	14"		385.9		381.5	
400	16"		452.0		447.6	
450	18"		562.3		557.9	
500	20"		628.4		624.0	
600	24"		893.0		888.6	
700	28"	Class D	882.0	Class D	877.6	
–	30"		1014.3		1009.9	
800	32"		1212.8		1208.3	
900	36"		1764.0		1759.6	
1000	40"		1984.5		1980.1	
–	42"		2425.5		2421.1	
1200	48"		3087.0		3082.6	
–	54"		4851.0		4846.6	
–	60"		5953.5		5949.1	
–	66"		8158.5		8154.1	
1800	72"		9040.5		9036.1	
–	78"		10143.0		10138.6	

- Transmitter (compact version): 7,5 lbs
- Weight data valid for standard pressure ratings and without packaging material.

Measuring tube specifications

Diameter		Pressure rating						Internal diameter			
		EN (DIN)	AS 2129	AS 4087	ANSI	AWWA	JIS	Hard rubber		Polyurethane	
[mm]	[inch]	[bar]			[lbs]			[mm]	[inch]	[mm]	[inch]
25	1"	PN 40	–	–	Cl. 150	–	20 K	–	–	24	0.94
32	–	PN 40	–	–	–	–	20 K	–	–	32	1.26
40	1½"	PN 40	–	–	Cl. 150	–	20 K	–	–	38	1.50
50	2"	PN 40	Table E	PN 16	Cl. 150	–	10 K	50	1.97	50	1.97
65	–	PN 16	–	–	–	–	10 K	66	2.60	66	2.60
80	3"	PN 16	Table E	PN 16	Cl. 150	–	10 K	79	3.11	79	3.11
100	4"	PN 16	Table E	PN 16	Cl. 150	–	10 K	102	4.02	102	4.02
125	–	PN 16	–	–	–	–	10 K	127	5.00	127	5.00
150	6"	PN 16	Table E	PN 16	Cl. 150	–	10 K	156	6.14	156	6.14
200	8"	PN 10	Table E	PN 16	Cl. 150	–	10 K	204	8.03	204	8.03
250	10"	PN 10	Table E	PN 16	Cl. 150	–	10 K	258	10.2	258	10.2
300	12"	PN 10	Table E	PN 16	Cl. 150	–	10 K	309	12.2	309	12.2
350	14"	PN 6	Table E	PN 16	Cl. 150	–	–	342	13.5	342	13.5
375	15"	–	–	PN 16	–	–	–	392	15.4	–	–
400	16"	PN 6	Table E	PN 16	Cl. 150	–	–	392	15.4	392	15.4
450	18"	PN 6	–	–	Cl. 150	–	–	437	17.2	437	17.2
500	20"	PN 6	Table E	PN 16	Cl. 150	–	–	492	19.4	492	19.4
600	24"	PN 6	Table E	PN 16	Cl. 150	–	–	594	23.4	594	23.4
700	28"	PN 6	–	–	–	Class D	–	692	27.2	692	27.2
–	30"	–	–	–	–	Class D	–	742	29.2	742	29.2
800	32"	PN 6	–	–	–	Class D	–	794	31.3	794	31.3
900	36"	PN 6	–	–	–	Class D	–	891	35.1	891	35.1
1000	40"	PN 6	–	–	–	Class D	–	994	39.1	994	39.1
–	42"	–	–	–	–	Class D	–	1043	41.1	1043	41.1
1200	48"	PN 6	–	–	–	Class D	–	1197	47.1	1197	47.1
–	54"		–	–	–	Class D	–	1339	52.7	–	–
1400	–	PN 6	–	–	–	–	–	1402	55.2	–	–
–	60"	–	–	–	–	Class D	–	1492	58.7	–	–
1600	–	PN 6	–	–	–	–	–	1600	63.0	–	–
–	66"	–	–	–	–	Class D	–	1638	64.5	–	–
1800	72"	PN 6	–	–	–	Class D	–	1786	70.3	–	–
2000	78"	PN 6	–	–	–	Class D	–	1989	78.3	–	–

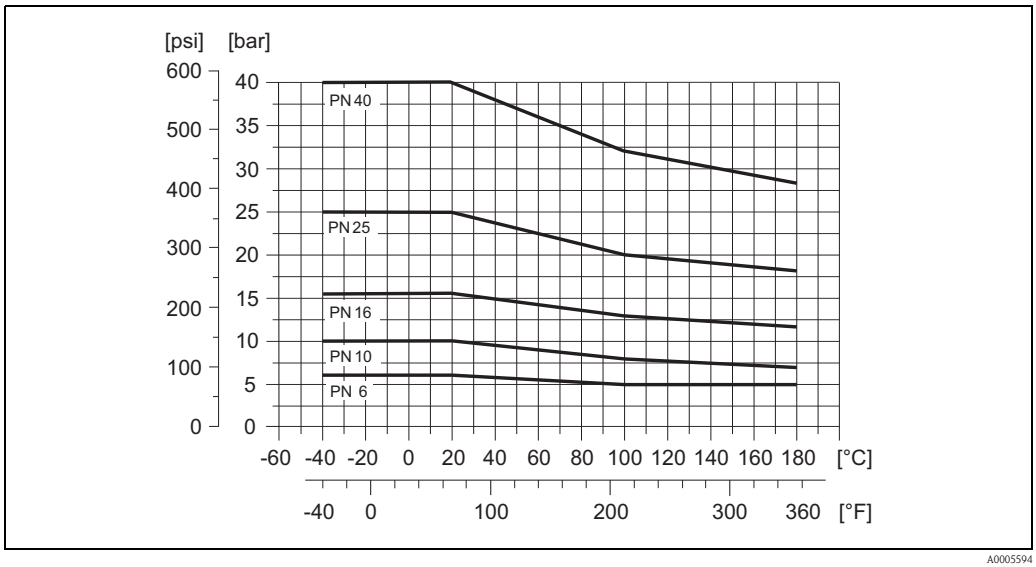
Material

- Transmitter housing
  - Compact housing: powder-coated die-cast aluminum
  - Wall-mount housing: powder-coated die-cast aluminum
- Sensor housing
  - DN 25 to 300 (1 to 12"): powder-coated die-cast aluminum
  - DN 350 to 2000 (14 to 78"): with protective lacquering
- Measuring tube
  - DN ≤ 300 (12"): stainless steel 1.4301 or 1.4306/304L; (for flanges made of carbon steel with Al/Zn protective coating)
  - DN ≥ 350 (14"): stainless steel 1.4301 or 1.4306/304L; (for flanges made of carbon steel with Al/Zn protective coating)
- Electrodes: 1.4435, Alloy C-22, Tantalum
- Flanges
  - EN 1092-1 (DIN 2501): 1.4571/316L; RSt37-2 (S235JRG2); C22; FE 410W B (DN ≤ 300 (12"): with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - ANSI: A105; F316L (DN ≤ 300 (12"): with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - AWWA: 1.0425
  - JIS: RSt37-2 (S235JRG2); HII; 1.0425/316L (DN ≤ 300 (12"): with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - AS 2129
    - DN 150 to 300, 600 (6 to 12", 24"): A105 or RSt37-2 (S235JRG2)
    - DN 50, 80, 100, 350, 400, 500 (2", 3", 4", 14", 16", 20"): A105 or St44-2 (S275JR)
  - AS 4087: A105 or St44-2 (S275JR)
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435/316L, Alloy C-22, Tantalum

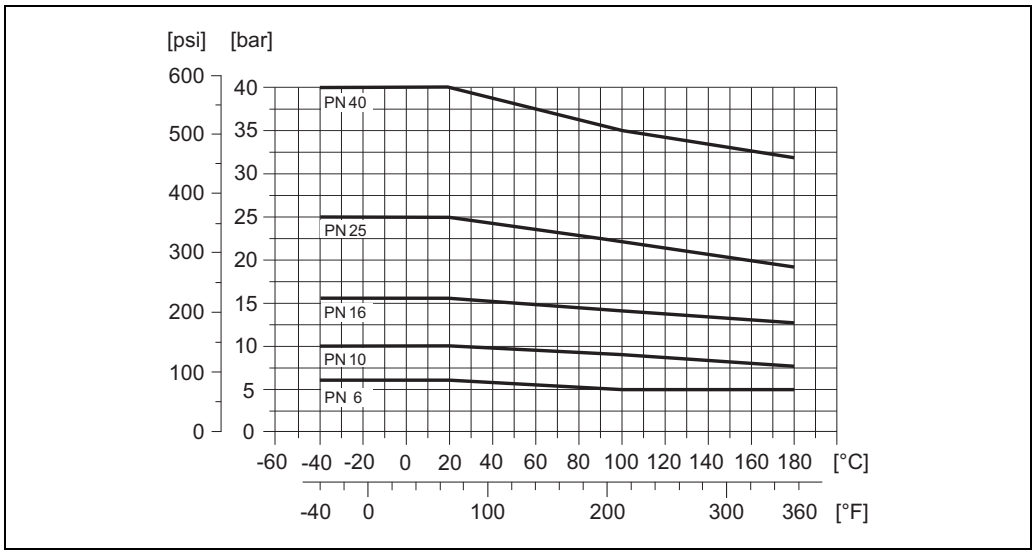
Material load diagram

Caution!
The following diagrams contain material load diagrams (reference curves) for flange materials with regard to the medium temperature. However, the maximum medium temperatures permitted always depend on the lining material of the sensor and/or the sealing material (→ 21).

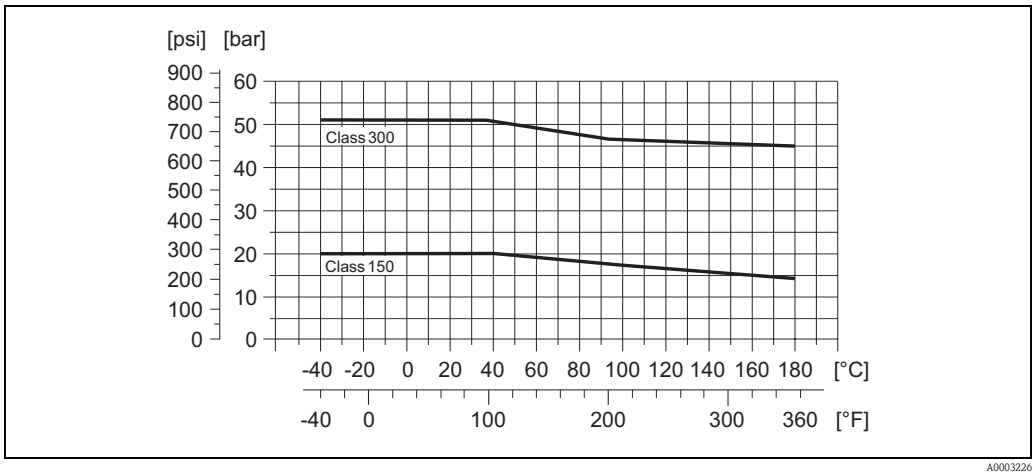
Flange connection to EN 1092-1 (DIN 2501)
Material: RSt37-2 (S235JRG2) / C22 / Fe 410W B



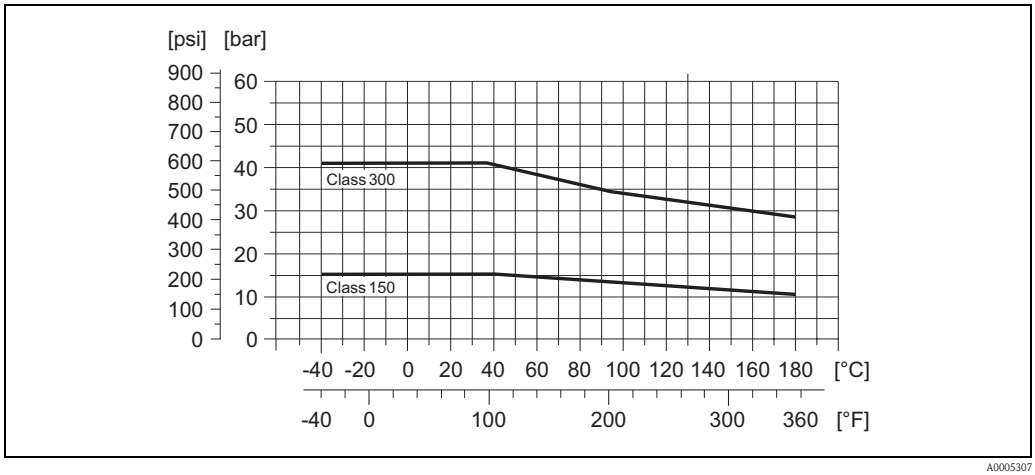
Flange connection to EN 1092-1 (DIN 2501)
Material: 316L / 1.4571



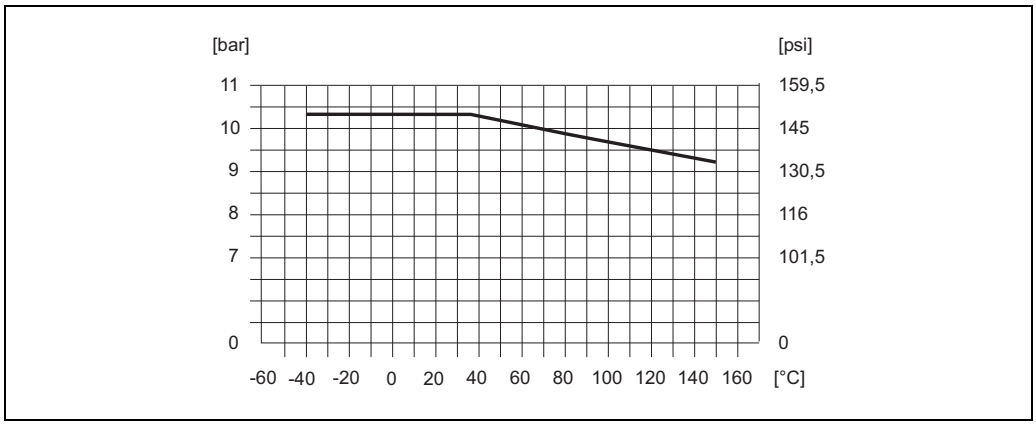
Flange connection to ANSI B16.5
Material: A 105



Flange connection to ANSI B16.5
Material: F316L

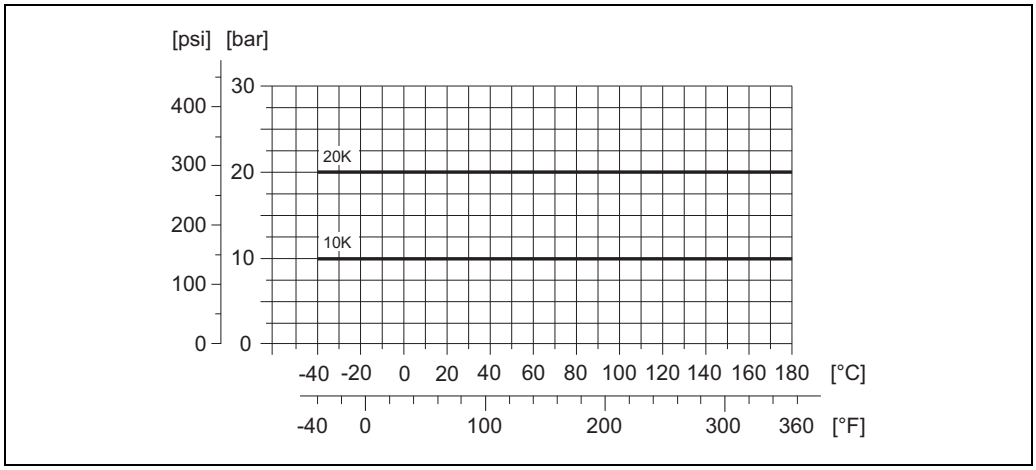


Flange connection to AWWA C 207, Class D
Material: 1.0425



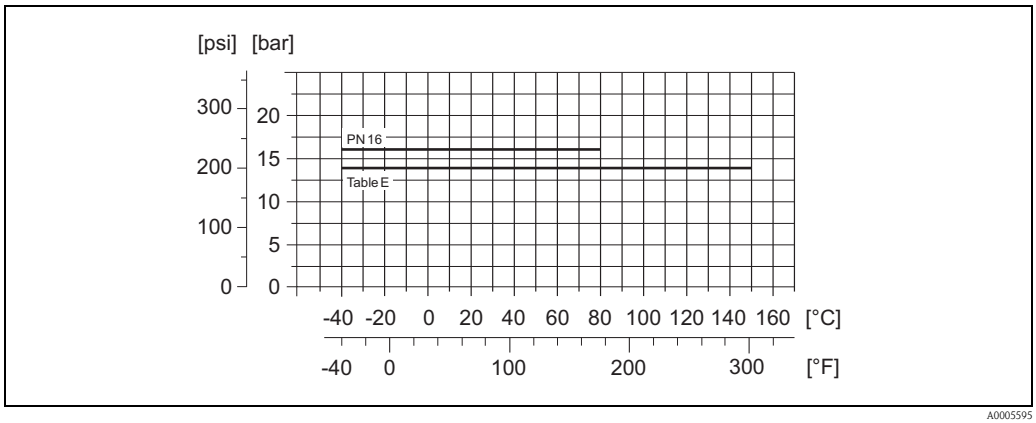
A0005592

Flange connection to JIS B2220
Material: RSt37-2 (S235JRG2) / HII / 1.0425 / 316L



A0003228

Flange connection to AS 2129 Table E or AS 4087 PN 16
Material: A105 / RSt37-2 (S235JRG2) / St44-2 (S275JR)



A0005595

Fitted electrodes

Measuring electrodes, reference electrodes and empty pipe detection electrodes:
- Standard available with 1.4435, Alloy C-22, tantalum
- Optional: exchangeable measuring electrodes made of 1.4435 (DN 350 to 2000 / 14 to 78")

Process connections

Flange connection:
- EN 1092-1 (DIN 2501), DN ≤ 300 (12") form A, DN ≥ 350 (14") form B
  (Dimensions to DIN 2501, DN 65 PN 16 and DN 600 (24") PN 16 exclusively to EN 1092-1)
- ANSI B16.5
- AWWA C 207, Class D
- JIS B2220
- AS 2129 Table E
- AS 4087 PN 16

Surface roughness

- Elektroden
  – 1.4435, Alloy C-22, tantal: ≤ 0.3 to 0.5 µm (≤ 11.8 to 19.7 µin)

(all data refer to parts in contact with medium)

Human interface

Display elements

- Liquid crystal display: backlit, two lines (Promag 50) or four lines (Promag 53) with 16 characters per line
- Custom configurations for presenting different measured-value and status variables
- Totalizer
  - Promag 50: 2 totalizers
  - Promag 53: 3 totalizers

Operating elements

Unified operation concept for both types of transmitter:

Promag 50:
- Local operation via three keys (−, +, E)
- Quick Setup menus for straightforward commissioning

Promag 53:
- Local operation via three keys (−, +, E)
- Application-specific Quick Setup menus for straightforward commissioning

Language groups

Language groups available for operation in different countries:

Promag 50, Promag 53:
- Western Europe and America (WEA):
  English, German, Spanish, Italian, French, Dutch, Portuguese
- Eastern Europe and Scandinavia (EES):
  English, Russian, Polish, Norwegian, Finnish, Swedish, Czech
- South and east Asia (SEA):
  English, Japanese, Indonesian

Promag 53:
- China (CN):
  English, Chinese

You can change the language group via the operating program "FieldCare".

Remote operation

- Promag 50: Remote control via HART, PROFIBUS DP/PA
- Promag 53: Remote control via HART, PROFIBUS DP/PA, MODBUS RS485, FOUNDATION Fieldbus

Certificates and approvals

CE mark

The measuring system is in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

C-tick mark

The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

Pressure measuring device approval

Measuring devices with a nominal diameter smaller than or equal to DN 25 correspond to Article 3(3) of the EC Directive 97/23/EC (Pressure Equipment Directive) and have been designed and manufactured according to good engineering practice. Where necessary (depending on the medium and process pressure), there are additional optional approvals to Category II/III for larger nominal diameters.

Ex approval

Information about currently available Ex versions (ATEX, IECEx, FM, CSA, NEPSI) can be supplied by your Endress+Hauser Sales Center on request. All explosion protection data are given in a separate documentation which is available upon request.

Other standards and guidelines

- EN 60529
  Degrees of protection by housing (IP code)
- EN 61010
  Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures.
- IEC/EN 61326
  “Emission in accordance with requirements for Class A”.
  Electromagnetic compatibility (EMC requirements)
- NAMUR NE 21:
  Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment.
- NAMUR NE 43:
  Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.
- NAMUR NE 53:
  Software of field devices and signal-processing devices with digital electronics.
- ANSI/ISA-S82.01
  Safety Standard for Electrical and Electronic Test, Measuring, Controlling and related Equipment - General Requirements Pollution degree 2, Installation Category II.
- CAN/CSA-C22.2 No. 1010.1-92
  Safety requirements for Electrical Equipment for Measurement and Control and Laboratory Use. Pollution degree 2, Installation Category II

FOUNDATION Fieldbus certification

The flow device has successfully passed all the test procedures carried out and is certified and registered by the Fieldbus Foundation. The device thus meets all the requirements of the following specifications:

- Certified to FOUNDATION Fieldbus Specification
- The device meets all the specifications of the FOUNDATION Fieldbus H1.
- Interoperability Test Kit (ITK), revision status 5.01 (device certification number: on request)
- The device can also be operated with certified devices of other manufacturers
- Physical Layer Conformance Test of the Fieldbus Foundation

MODBUS RS485 certification

The measuring device meets all the requirements of the MODBUS/TCP conformity test and has the “MODBUS/TCP Conformance Test Policy, Version 2.0”. The measuring device has successfully passed all the test procedures carried out and is certified by the “MODBUS/TCP Conformance Test Laboratory” of the University of Michigan.

PROFIBUS DP/PA certification

The flow device has successfully passed all the test procedures carried out and is certified and registered by the PNO (PROFIBUS User Organisation). The device thus meets all the requirements of the following specifications:

- Certified to PROFIBUS PA, profile version 3.0 (device certification number: on request)
- The device can also be operated with certified devices of other manufacturers (interoperability)

Ordering information

Your Endress+Hauser service organization can provide detailed ordering information and information on the order codes on request.

Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. Your Endress+Hauser service organization can provide detailed information on the order codes in question.

Documentation

- Flow Measurement (FA005D/06)
- Operating Instructions Promag Promag 50 (BA046D/06 and BA049D/06)
- Operating Instructions Promag Promag 50 PROFIBUS PA (BA055D/06 and BA056D/06)
- Operating Instructions Promag Promag 53 (BA047D/06 and BA048D/06)
- Operating Instructions Promag Promag 53 FOUNDATION Fieldbus (BA051D/06 and BA052D/06)
- Operating Instructions Promag Promag 53 MODBUS RS485 (BA117D/06 and BA118D/06)
- Operating Instructions Promag Promag 53 PROFIBUS DP/PA (BA053D/06 and BA054D/06)
- Supplementary documentation on Ex-ratings: ATEX, IECEx, FM, CSA, NEPSI

Registered trademarks

HART®
Registered trademark of the HART Communication Foundation, Austin, USA

PROFIBUS®
Registered trademark of the PROFIBUS Nutzerorganisation e.V., Karlsruhe, D

FOUNDATION™ Fieldbus
Registered trademark of the Fieldbus Foundation, Austin, USA

MODBUS®
Registered trademark of the MODBUS Organisation

HistoROM™, S-DAT®, T-DAT™, F-CHIP®, FieldCare®, Fieldcheck®, FieldXpert™, Applicator®
Registered or registration-pending trademarks of Endress+Hauser Flowtec AG, Reinach, CH

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info@ii.endress.com

Endress+Hauser

People for Process Automation

TI046D/06/en/11.09
71106269
FM+SGML6.0 ProMoDo

Hersey Meters

400 Series IIS

Magnetic Drive Positive Displacement Disc Meters
Sizes 5/8" - 3/4" - 1"

Features

APPLICATIONS: Measurement of cold water for residential and small commercial applications where water volumes are low, and low flow sensitivity is important.

CONFORMANCE TO STANDARDS: Hersey Series 400 IIS Water Meters comply with latest version of ANSI/AWWA Standard C700. Meters which are manufactured with the EnviroBrass® maincase option meet the requirements of NSF Standard 61. Each meter is tested to ensure compliance.

CONSTRUCTION: Hersey 400IIS Water Meters consist of three basic parts: maincase; measuring chamber; and permanently sealed register. The maincase is made of bronze for long life. Direction of flow arrows and model are cast into each maincase. The bottom cover is epoxy-coated cast iron with a molded plastic liner separating it from the waterway. Optional plastic and bronze bottom covers are available. The measuring chambers are large for reduced wear during operation. The measuring chamber, integral strainer, nutating disc and thrust roller are thermoplastic, which is dimensionally stable and will not corrode. The thrust roller moves smoothly along a stainless steel wear plate to reduce friction and maintain accuracy. The register box and lid are available in plastic or bronze. The meter is designed so that the register can be replaced without removing the meter from the line.

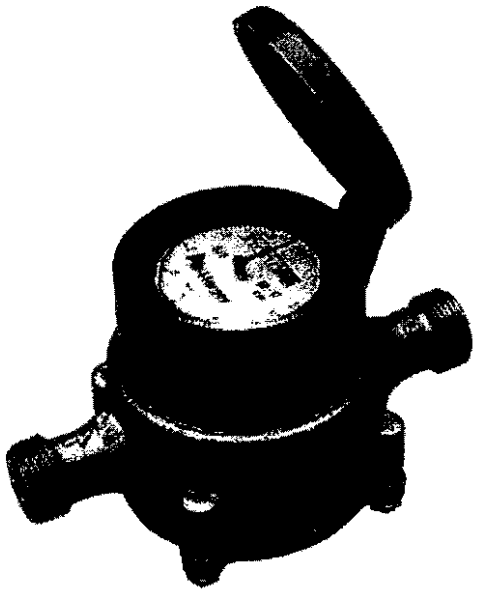
REGISTER: The permanently sealed register has a unique seal and heat-treated glass to eliminate dirt, moisture infiltration and lens fogging. An integral tamper-proof locking feature is provided to resist tampering with the register. The totalizing register has a straight-reading odometer type display, a 360° test circle with center sweep hand and a low flow (leak) detector. Standard gearing is used, making registers interchangeable by size.

All Hersey meter Models have electronic meter reading systems available for increased reading efficiency (see Meter Reading Systems.)

OPERATION: Water flows through the meter's strainer where debris is screened out. The incoming water fills a known volume of the measuring chamber on one or the other side of a movable disc that separates the chamber into two sections. As water enters, it moves the disc (nutates), forcing a known volume of water out of the meter from the opposite side of the disc. The process repeats as the sections refill and empty in turn. The nutating action of the disc is coupled magnetically to the register to indicate the volume of water that passes through the meter. The large capacity measuring chamber requires fewer nutations of the disc for each gallon measured, which helps to limit wear, extend the life of the meter, and reduce pressure loss.

MAINTENANCE: The Hersey Series 400 IIS Water Meters are designed and manufactured to provide long service life with virtually no maintenance required.

CONNECTIONS: Supplied with external straight pipe threads (NPSM) per ANSI B1.20.1.



Materials and Specifications

- **MODEL NUMBER** 430IIS, 442IIS, 452IIS
- **SIZES** ..... 5/8"x1/2", 5/8"x3/4", 3/4"x3/4", 3/4"x1" and 1"x1"
- **STANDARDS** ..... Manufactured and tested to meet or exceed all applicable parts of ANSI/AWWA C700 Standard EnviroBrass options meet requirements of NSF Standard 61.
- **SERVICE** .... cold water measurement with flow in only one direction
- **OPERATING FLOW RANGE** ..... See Chart on page 1.2
- **ACCURACY** ..... See Chart on page 1.2
- **PRESSURE LOSS** ..... See Chart on page 1.2
- **MAXIMUM WORKING PRESSURE** ..... 150 PSI
- **TEMPERATURE RANGE** ..... 33F to 100F Water Temperature
- **MEASURING ELEMENT** ..... Nutating Disc
- **DISC NUTATIONS (per Gallon)** 430IIS: 49.6, 442IIS: 22.4, 452IIS: 11.7
- **REGISTER TYPE** ..... Straight reading, permanently sealed, magnetic drive with low flow indicator. Remote reading units optional.
- **METER CONNECTIONS** ..... 1/2", 3/4", 1" external (NPSM) straight pipe threads per ANSI B1.20.1
- **MATERIALS** ..... Meter case - bronze UNSC84400; Bottom cover - cast iron ASTM A126 CL. B; Chamber top/bottom - thermoplastic; Nutating disc - thermoplastic; Disc pin - stainless steel; Thrust roller - thermoplastic; Wear plate - stainless steel; Coupling - Ceramic magnet; Strainer - thermoplastic; Coupling shaft - stainless steel ANSI B18; Bottom cover bolts - stainless steel ANSI B18; Register box and lid - thermoplastic.
- **OPTIONS** ..... Meter case - EnviroBrass® UNSC89520 Bottom cover - bronze UNSC84400 or thermoplastic; Register box and lid - bronze UNSC85700; AMR Reading Systems

400 Series IIS

Hersey Meters

Magnetic Drive Positive Displacement Disc Meters
Sizes 5/8", 3/4" and 1"

Meter Registration

Meter Size	Initial Dial*	Capacity	Initial Dial*	Capacity
5/8"	10 Gallons	10 Million	1 Cubic Feet	1 Million
3/4"	10 Gallons	10 Million	1 Cubic Feet	1 Million
1"	10 Gallons	10 Million	1 Cubic Feet	1 Million

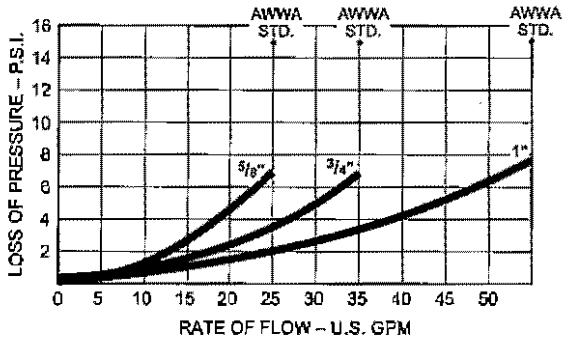
*Registration equal to one full revolution of the sweep hand.

Flow Characteristics

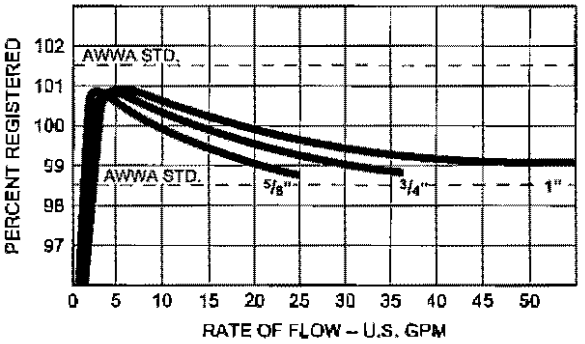
Meter Size	Typical Low Flow (95% Minimum)	Typical Operating Range (100% ± 1.5%)	Maximum Continuous Operation
5/8"	1/4 GPM	1/2 to 25 GPM	15 GPM
3/4"	1/2 GPM	3/4 to 35 GPM	25 GPM
1"	3/4 GPM	2 to 50 GPM	35

Performance

HEAD LOSS - 5/8", 3/4" AND 1" (Figure 1)



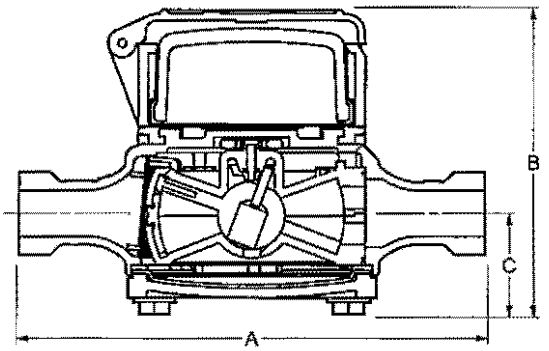
ACCURACY - 5/8", 3/4", AND 1" (Figure 2)



NOTE: Performance curves are typical only and NOT a guarantee of performance.

Dimensions and weights

Meter Size	5/8"	3/4"	3/4" Short	3/4" x 1"	1"
	Ends External (NPSM) straight pipe threads				
Model	430	442	442	442	452
Dimension					
A	7-1/2"	9"	7-1/2"	9"	10-3/4"
B	4-15/16"	5-11/16"	5-11/16"	5-11/16"	6-5/ 8"
C	1-5/8"	1-15/16"	1-15/16"	1-15/16"	2-1/ 8"
Width	4.25"	6.39"	6.39"	6.39"	7.22"
inlet and outlet	1/2" or 3/4"	3/4"	3/4"	1"	1"
Net weight	4-1/2	8-1/2	8	9	11

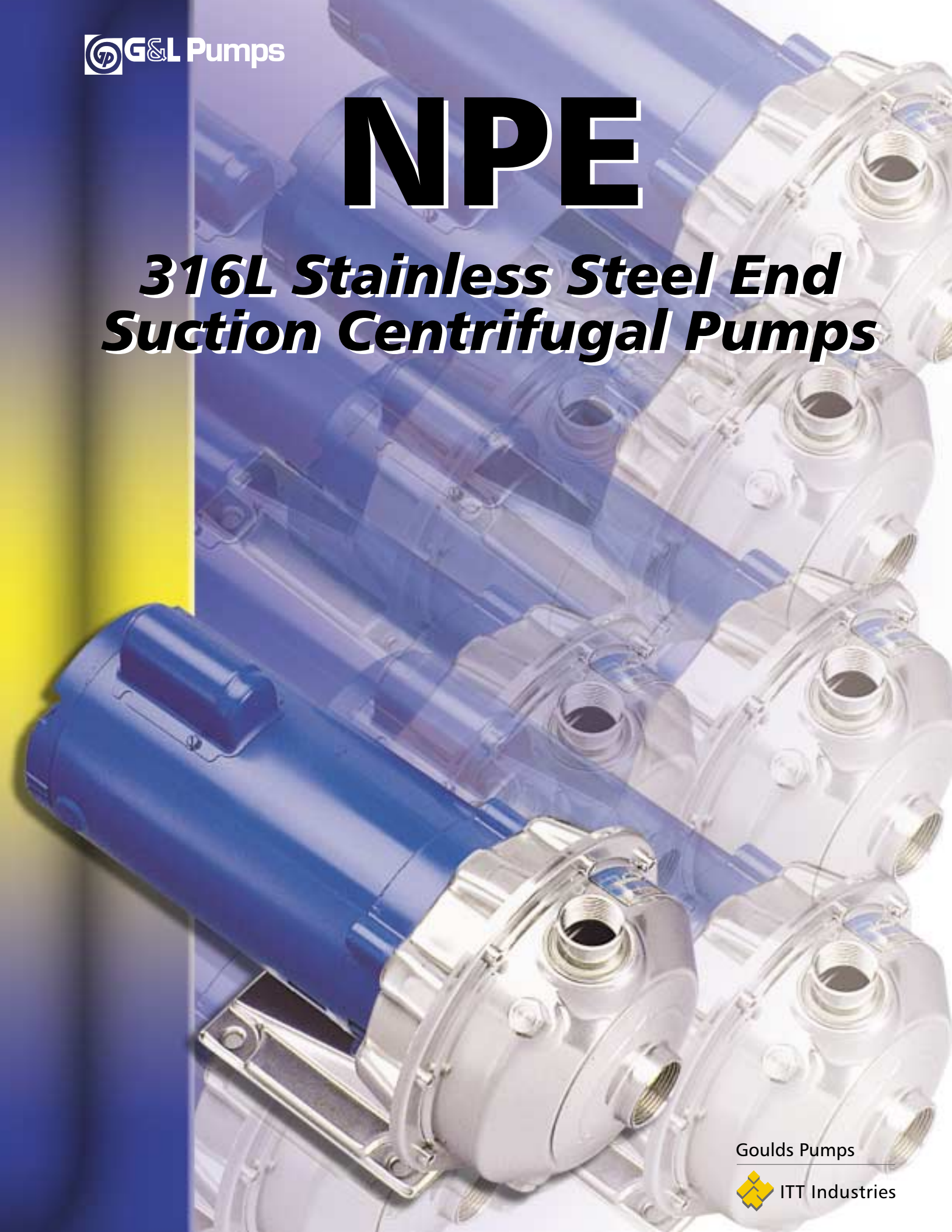


Note: Weights are in pounds and are approximate.

G&L Pumps

NPE

316L Stainless Steel End Suction Centrifugal Pumps



Goulds Pumps

ITT Industries

A FULL RANGE OF PRODUCT FEATURES

- The close coupled compact, flexible design saves space, can be mounted horizontally or vertically, and simplifies maintenance.
- Standard NEMA motors are open drip-proof, totally enclosed fan-cooled or explosion proof enclosure, have stainless steel shaft, and are designed for continuous duty under all conditions with single and three phase available.
- Superior, complete AISI 316L stainless steel liquid handling components for corrosion resistance and improved strength and durability.
- Casing and adapter have NPT threaded centerline connections, easily accessible vent, prime and drain connections with stainless plugs.
- Unique floating O-ring enclosed impeller design maintains maximum efficiencies.
- Standard John Crane mechanical seal of silicon carbide, viton and stainless metal parts with optional high temperature and chemical duty seals available.

TYPICAL APPLICATIONS

Specifically designed for a broad range of general applications traditionally requiring various materials such as all iron, bronze fitted, all bronze or stainless construction.

- Water circulation
- Booster service
- Liquid transfer
- Spray system
- Chillers
- Washing/cleaning systems
- Injection molding cooling
- Reverse osmosis
- Air scrubbers
- Heat exchangers
- Filtration systems
- Jockey pumps
- OEM applications
- General water services

SPECIFICATIONS

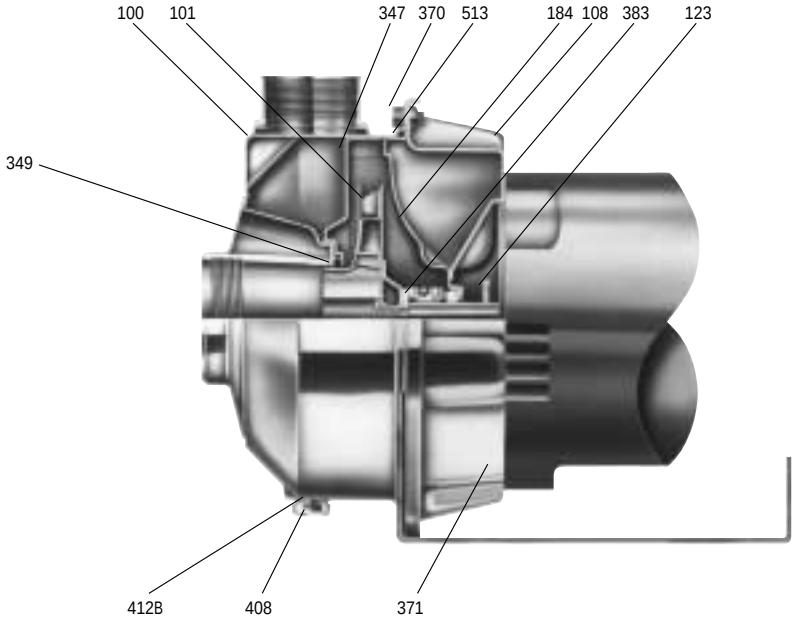
Capacities to:
75 GPM (283L/min) at 1750 RPM
150 GPM (550L/min) at 3500 RPM

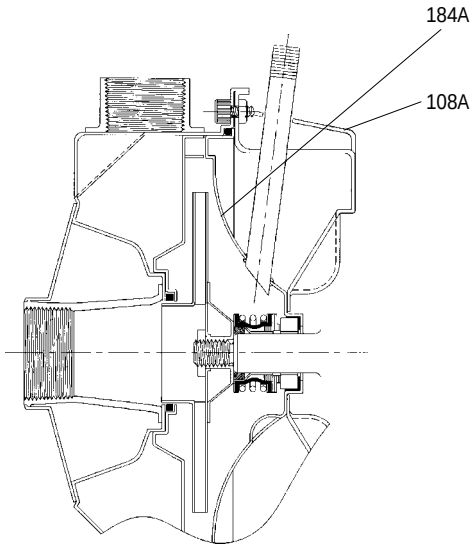
Heads to:
39 feet (11 m) at 1750 RPM
150 feet (50 m) at 3500 RPM

Working pressures to:
125 PSIG (9 bars)

Maximum temperatures to:
212°F (100°C) with standard seal or
250°F (121 °C) with optional high temperature seal.

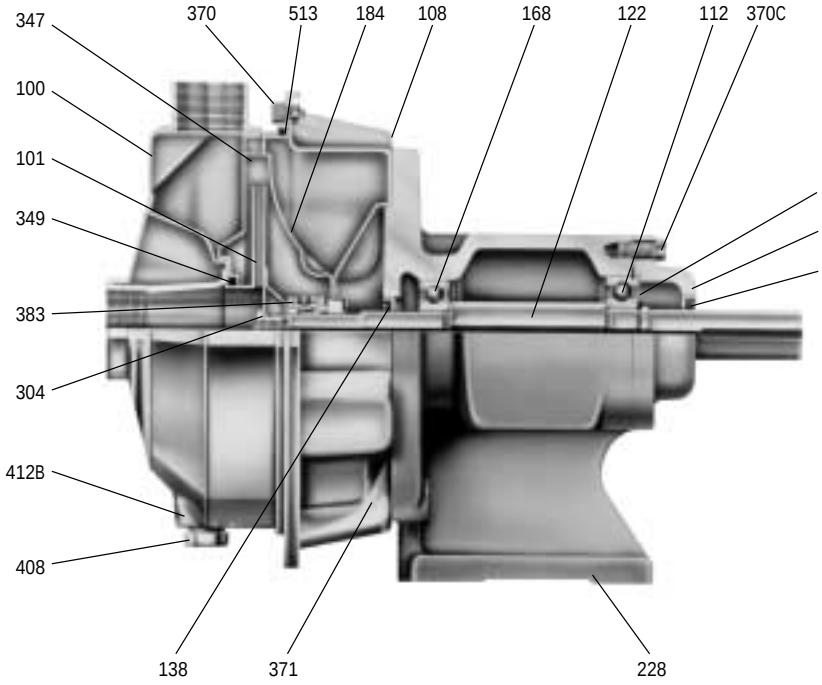
NPE CLOSE COUPLED MAJOR COMPONENTS: MATERIALS OF CONSTRUCTION

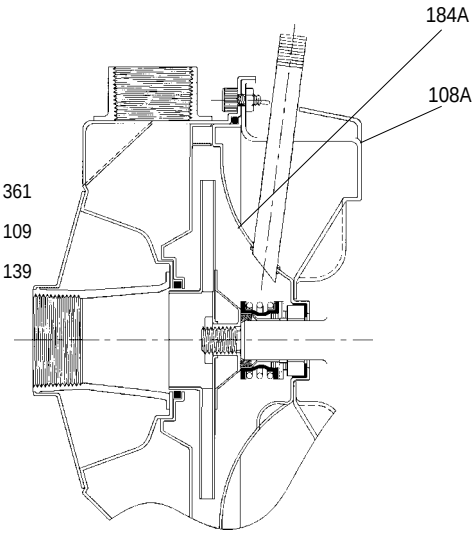




Seal Face Vent/Flush Option

NPE FRAME MOUNTED MAJOR COMPONENTS: MATERIALS OF CONSTRUCTION





Seal Face Vent/Flush Option

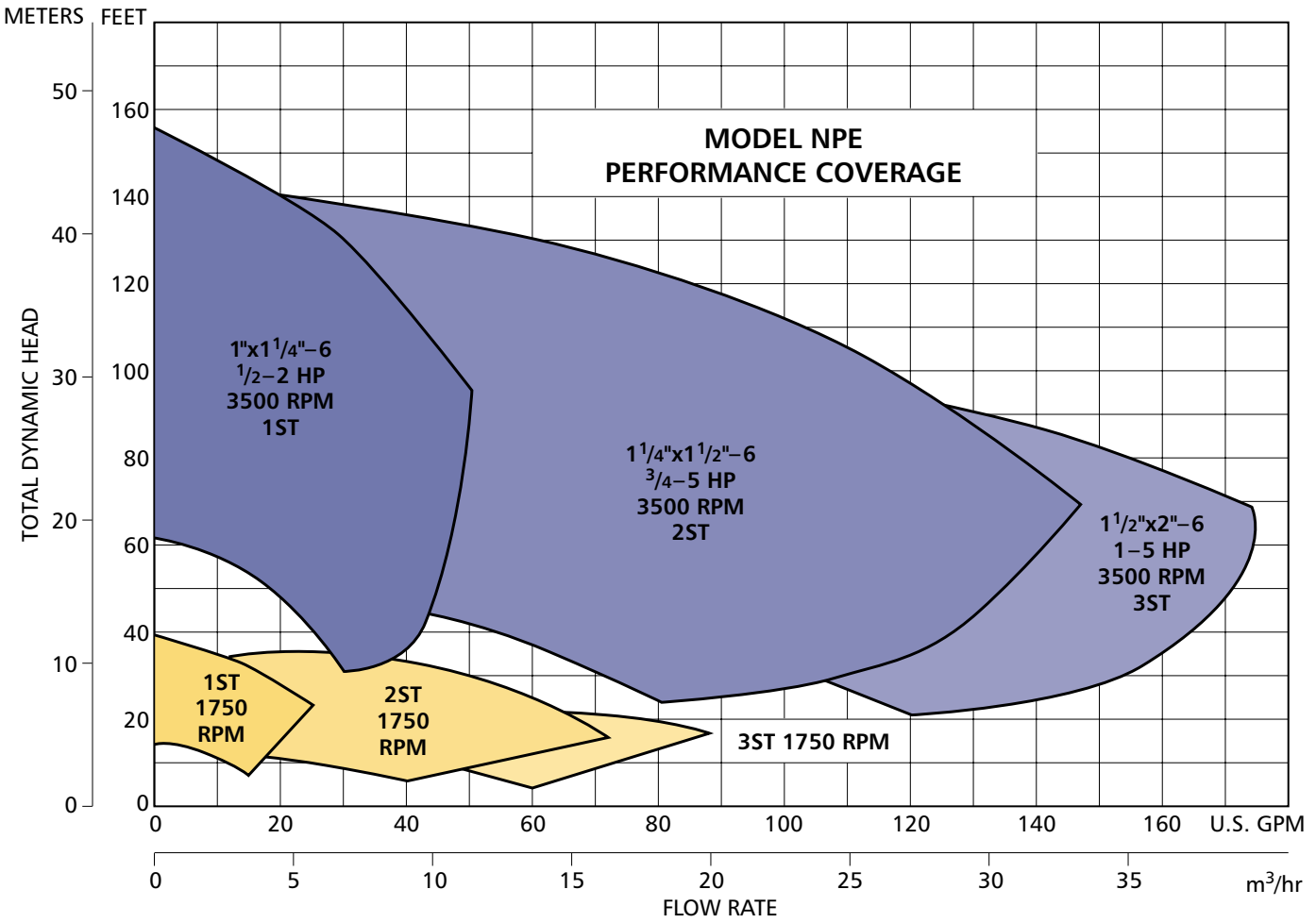
Item No.	Description	Materials
100	Casing	AISI 316 SS
101	Impeller	AISI 316 SS
108	Motor adapter	AISI 304 SS
108A	Motor adapter seal vent/flush	AISI 304 SS
109	Bearing cover	Cast iron
112	Ball bearing (outboard)	Steel
122	Shaft	AISI 316 SS
123	Deflector	BUNA-N
138	Lip-seal (inboard)	BUNA/steel
139	Lip-seal (outboard)	BUNA/steel
168	Ball bearing (inboard)	Steel
184	Seal housing	AISI 316 SS
184A	Seal housing seal vent/flush	AISI 316 SS
228	Bearing frame	Cast iron
304	Impeller locknut	AISI 316 SS
347	Guidevane	AISI 316 SS

Item No.	Description	Materials
349	O-ring	Viton
361	Retaining ring	Steel
370	Socket head screws, casing	AISI 430 SS
370C	Hex head screw, bearing cover	Plated steel
371	Bolts, motor	Plated steel
383	Mechanical seal	Carbon/Sil-Carbide, Viton elastomers, 316 Stainless metal parts*
400	Shaft key	316
408	Drain and vent plug, casing	AISI 316 SS
412B	O-ring, drain and vent plug	Viton
513	O-ring, casing	Viton
Motor	NEMA standard, 56J flange	

**Optional high temperature and chemical duty seals available*

G&L Pumps

NPE PERFORMANCE CURVES 60 Hz USA



www.goulds.com

Goulds Pumps
1 Goulds Drive
Auburn, NY 13021

Goulds Pumps

ITT Industries

A Full Range of Product Features
Una Gama Total de Características del Producto

Superior Materials of Construction: Complete AISI 316L stainless steel liquid handling components and mounting bracket for corrosion resistance, quality appearance, and improved strength and ductility.

High Efficiency Impeller: Enclosed impeller with unique floating seal ring design maintains maximum efficiencies over the life of the pump without adjustment.

Casing and Adapter Features: Stainless steel construction with NPT threaded, centerline connections, easily accessible vent, prime and drain connections with stainless steel plugs. Optional seal face vent/flush available.

Mechanical Seal: Standard John Crane Type 21 with carbon versus silicon-carbide faces, Viton elastomers, and 316 stainless metal parts. Optional high temperature and chemical duty seals available.

Motors: NEMA standard open drip-proof, totally enclosed fan cooled or explosion proof enclosures. Rugged ball bearing design for continuous duty under all operating conditions.

Materiales Superiores de Construcción: *Componentes completos para manejo de líquidos en acero inoxidable AISI 316L y consola para el montaje para resistencia a la corrosión, apariencia de calidad, y fuerza y ductilidad mejoradas.*

Impulsor de Eficiencia Superior: *El impulsor encerrado con un diseño único de anillo del sello flotante, mantiene sin ajustes, la eficiencia máxima sobre la vida de la bomba.*

Características de la Carcasa y del Adaptador: *Construcción en acero inoxidable con NPT roscado, conexiones centrales, válvulas de fácil acceso, conexiones de cebado y drenaje con enchufes de acero inoxidable. Cara del sello válvula/chorro opcional disponible.*

Sello Mecánico: *Estándar John Crane Tipo 21 con carbón en contraste con caras de silicón-carbide, elastómeros de Viton, y partes metálicas de acero inoxidable 316. Sellos de alta temperatura y productos químicos están disponibles.*

Motores: *Estándar NEMA a prueba de goteo, ventilador totalmente encerrado o recintos a prueba de explosión. Diseño robusto de balineras de bolas para trabajo continuo en todas las condiciones de funcionamiento.*

NPE Product Line Numbering System
Línea de Producto NPE Sistema de Numeración

Example Product Code,
Ejemplo Código del Producto

1 ST 2 C 1 A 4 F

Seal Vent/Flush Option,
Opción de Sello Válvula/ChorroSeal Ven

Mechanical Seal and O-ring
4 = Pre-engineered standard
For optional mechanical seal modify catalog order no. with seal code listed below.

Sello Mecánico y Anillo 'O'
4 = Estándar aprobado
Para sello mecánico opcional modificar el número de orden del catálogo con el código del sello anotado abajo.

John Crane Type 21 Mechanical Seal (⅝" seal), *Sello Mecánico John Crane Tipo 21 (sello de ⅝")*

Seal Code, *Código del Sello*	Rotary, *Rotativo*	Stationary, *Estacionario*	Elastomers, *Elastómeros*	Metal Parts, *Partes Metálicas*	Part No., *Pieza Número*
2	Carbon	Silicon Carbide	EPR	316 SS	10K18
4			Viton		10K55
5	Silicon Carbide		EPR		10K81
6			Viton		10K62

Impeller Option . . . No Adder Required
For optional impeller diameters modify catalog order no. with impeller code listed. Select optional impeller diameter from pump performance curve.

Código del Impulsor Opcional
Para impulsores con diámetros opcionales modificar el número de orden del catálogo con el código del impulsor anotado. Escoger el impul con diámetro opcional de la curva de funcionamiento de la bomba.

Impeller Code, *Código del Impulsor*	Pump Size, *Tamaño de la Bomba*		
	1 x 1¼ – 6	1¼ x 1½ – 6	1½ x 2 – 6
	Diameter	Diameter	Diameter
K	–	6⅛	–
G	–	5 15/16	5⅜
H	–	5½	5
A	6⅛	5¼	4¾
B	5¾	5 1/16	4⅝
C	5 3/16	4⅞	4⅜
D	4¾	4⅝	4 1/16
E	4 7/16	4¼	3⅝
F	4 1/16	3⅞	–

Driver, *Conductor*
1 = 1 PH, ODP
2 = 3 PH, ODP
3 = 575 V, ODP
4 = 1 PH, TEFC
5 = 3 PH, TEFC
6 = 575 V, TEFC
7 = 3 PH, XP
8 = 575 V, XP
9 = 3 PH, TEFC Premium Eff.
0 = 1 PH, XP

HP Rating, *HP Potencia*
C = ½ HP E = 1 HP G = 2 HP J = 5 HP
D = ¾ HP F = 1½ HP H = 3 HP

Driver: Hertz/Pole/RPM, *Conductor: Hercios/Polo/RPM*
1 = 60 Hz, 2 pole, 3500 RPM
2 = 60 Hz, 4 pole, 1750 RPM
3 = 60 Hz, 6 pole, 1150 RPM
4 = 50 Hz, 2 pole, 2900 RPM
5 = 50 Hz, 4 pole, 1450 RPM

For frame mounted version, substitute the letters "FRM" in these positions.
Para la versión con el armazón montado, sustituya las letras "FRM" en estas posiciones.

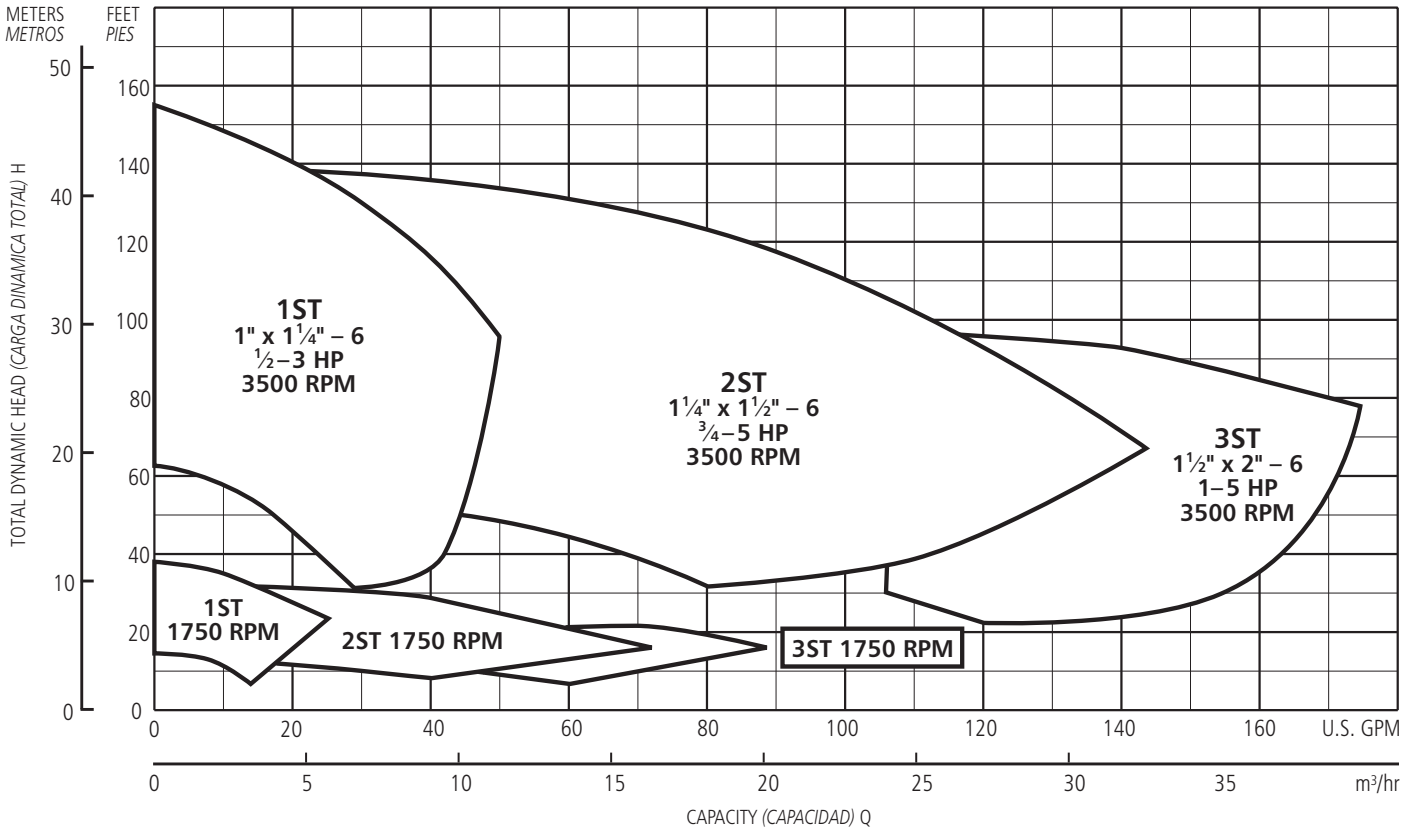
Material
ST = Stainless steel, *Acero inoxidable*

Pump Size, *Tamaño de la Bomba*
1 = 1 x 1¼ – 6 2 = 1¼ x 1½ – 6 3 = 1½ x 2 – 6

The various versions of the NPE are identified by a product code number on the pump label. This number is also the catalog number for the pump. The meaning of each digit in the product code number is shown at left.

Las diferentes versiones de la NPE se identifican con un número de código del producto en la etiqueta de la bomba. Este número es también el número del catálogo para la bomba. El significado de cada dígito en el número de código del producto se muestra a la izquierda.

Performance Coverage (60 Hz)
Alcance de Funcionamiento (60 Hz)



NOTES:

Not recommended for operation beyond printed H-Q curve.

For critical application conditions consult factory.

Not all combinations of motor, impeller and seal options are available for every pump model. Please check with G&L on non-cataloged numbers.

All standard 3500 RPM ODP and TEFC motors supplied by Goulds Pumps, have minimum of 1.15 service factor. Standard catalog units may utilize available service factor. Any motors supplied other than Goulds Pumps check available service factor.

NOTAS:

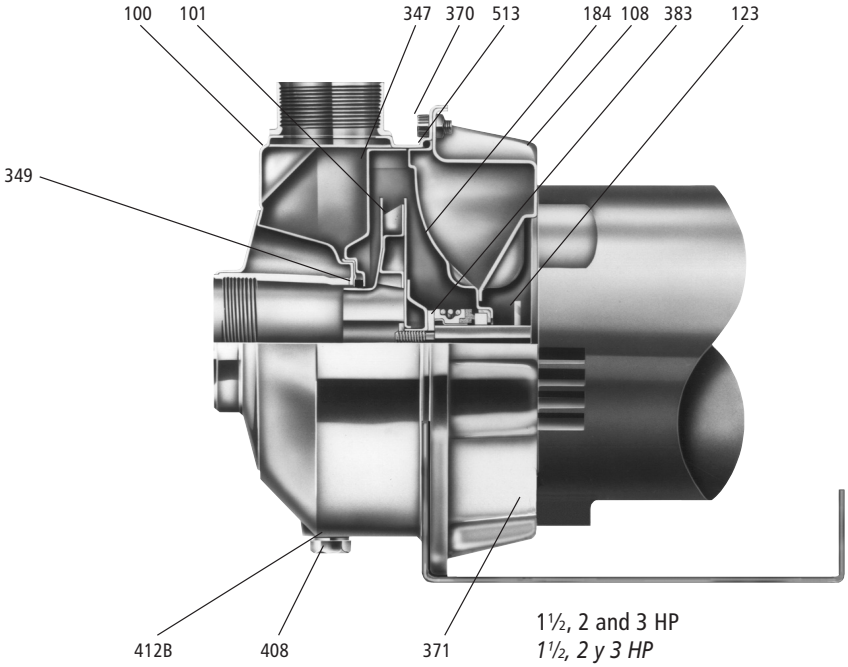
No se recomienda para funcionamiento superior al impreso en la curva H-Q.

Para condiciones de aplicaciones críticas consultar con la fábrica.

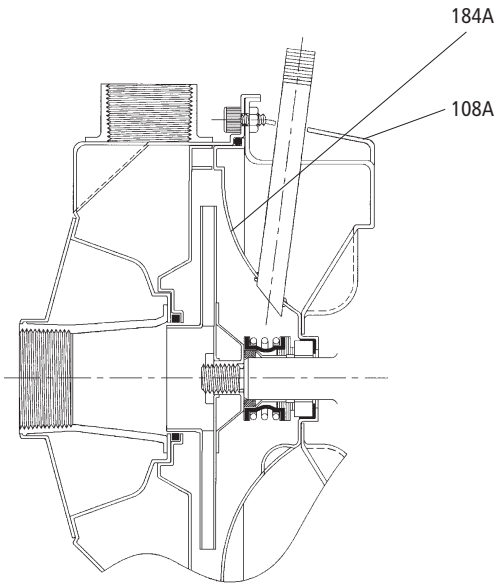
No todas las combinaciones de las opciones de motor, impulsor y sello están disponibles para cada modelo de bombas. Por favor verifique con G&L en los números no catalogados.

Todos los motores estándar de 3500 RPM, ODP (abiertos resguardados) y TEFC (totalmente encerrados con enfriamiento forzado) provistos por Goulds Pumps tienen un factor mínimo de servicio de 1,15. Las unidades estándar de catálogo pueden utilizar el factor de servicio disponible. Verificar el factor de servicio disponible de todo motor no provisto por Goulds Pumps.

NPE Close Coupled Pump Major Components: Materials of Construction
Bomba Cerrada Acoplada NPE Componentes Principales: Materiales de Construcción

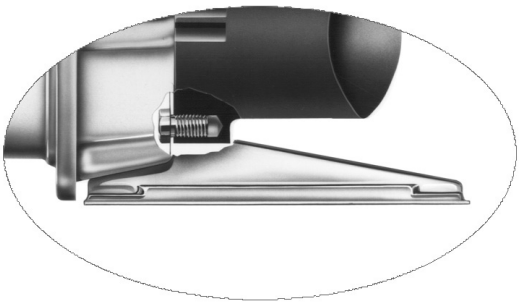


1½, 2 and 3 HP
1½, 2 y 3 HP



Seal Face Vent/Flush Option,
Opción Cara del Sello Válvula/Chorro

Item No., *Parte No.*	Description, *Descripción*	Materials, *Materiales*
100	Casing; *Carcasa*	AISI 316L SS; *AISI 316L Acero inoxidable*
101	Impeller; *Impulsor*	
108	Motor adapter; *Adaptador del motor*	
108A	Motor adapter seal vent/flush; *Sello válvula/chorro del adaptador del motor*	
123	Deflector; *Deflector*	BUNA-N
184	Seal housing; *Alojamiento del sello*	AISI 316L SS; *AISI 316L Acero inoxidable*
184 A	Seal housing seal vent/flush; *Sello válvula/chorro del alojamiento del sello*	
347	Guidevane; *Difusor*	
349	Seal ring, guidevane; *Anillo del sello, difusor*	Viton
370	Socket head screws, casing; *Encajes cabezas de tornillos, carcasa*	AISI 410 SS; *AISI 410 Acero inoxidable*
371	Bolts, motor; *Tornillos, motor*	Plated steel; Acero chapeado
383	Mechanical seal; *Sello mecánico*	**see chart, *ver tabla*
408	Drain and vent plug, casing; *Enchufes de drenaje y válvula, carcasa*	AISI 316L SS; *AISI 316L Acero inoxidable*
412B	O-ring, drain and vent plug; *Anillo 'O', enchufe de drenaje y válvula*	Viton (Standard, *estándar*) EPR (Optional, *Opcional*)
513	O-ring, casing; *Anillo 'O', carcasa*	
Motor *Motor*	NEMA standard, 56J flange; *NEMA estándar, brida 56J*	

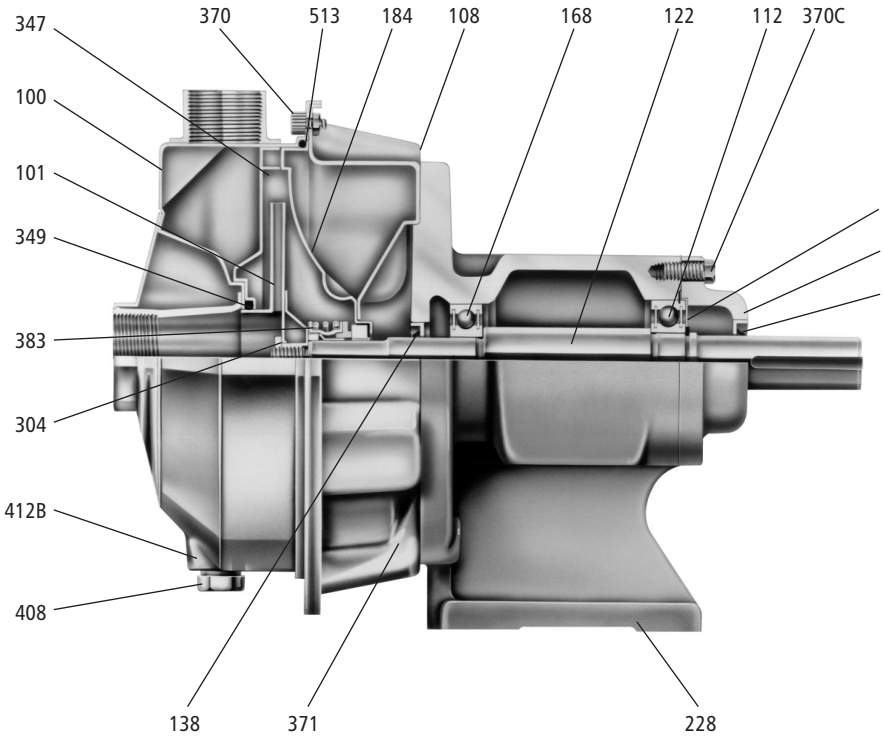


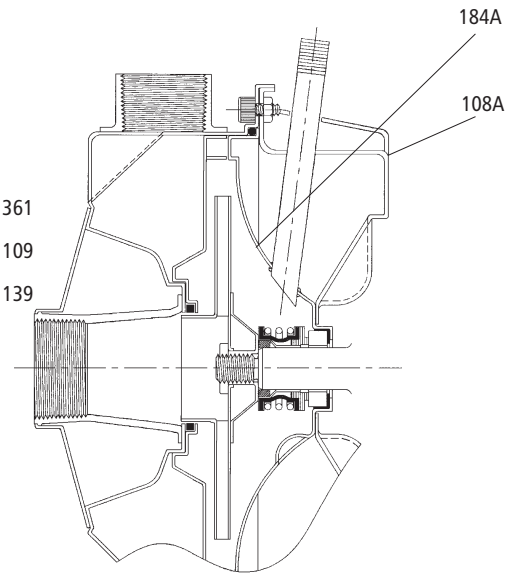
½, ¾ and 1 HP
½, ¾ y 1 HP

Footed motor for 5 HP ODP and TEFC, all explosion proof motors, see page 13.

Motor con pie para 5 HP ODP y TEFC, a prueba de explosiones motores, en la página 13.

NPE Frame Mounted Pump Major Components: Materials of Construction
Bomba NPE de Armazón Montado Componentes Principales: Materiales de Construcción



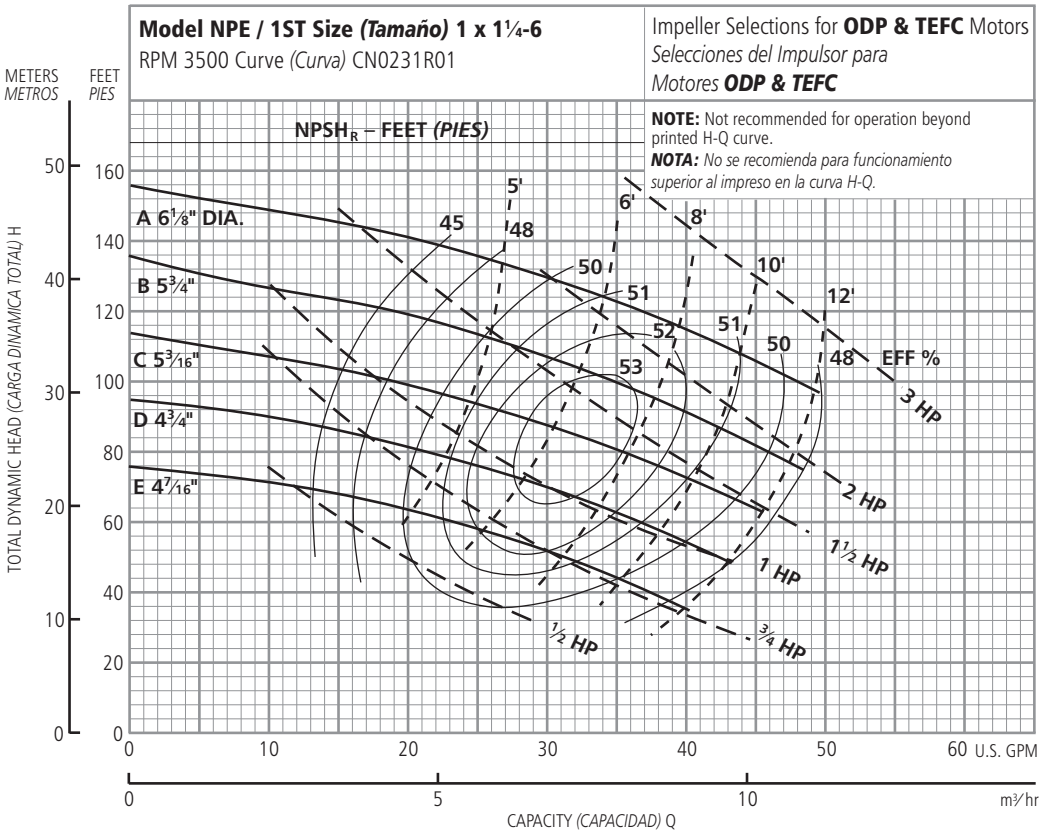


Seal Face Vent/Flush Option,
Opción Cara del Sello Válvula/Chorro

Item No., *Parte No.*	Description, *Descripción*	Materials, *Materiales*
100	Casing; *Carcasa*	AISI 316L SS; *AISI 316L Acero inoxidable*
101	Impeller; *Impulsor*	
108	Adapter; *Adaptador*	
108A	Motor adapter seal vent/flush; *Sello válvula/chorro del adaptador del motor*	
109	Bearing cover; *Cubierta de balineras*	Cast iron; *Hierro fundido*
112	Ball bearing (outboard); *Balineras de bolas (exterior)*	Steel; *Acero*
122	Shaft; *Eje*	AISI 316 SS; *AISI 316 Acero inoxidable*
138	Lip-seal (inboard); *Sello cubierto (interior)*	BUNA/steel; *BUNA/acero*
139	Lip-seal (outboard); *Sello cubierto (exterior)*	BUNA/steel; *BUNA/acero*
168	Ball bearing (inboard); *Balineras de bolas (interior)*	Steel; *Acero*
184	Seal housing; *Alojamiento del sello*	AISI 316L SS; *AISI 316L Acero inoxidable*
184 A	Seal housing seal vent/flush; *Sello válvula/chorro del alojamiento del sello*	
228	Bearing frame; *Armazón de balineras*	Cast iron, *Hierro fundido*

Item No., *Parte No.*	Description, *Descripción*	Materials, *Materiales*
304	Impeller locknut; *Contratuerca del impulsor*	AISI 316 SS; *AISI 316 Acero inoxidable*
347	Guidevane; *Difusor*	
349	Seal ring, guidevane; *Anillo del sello, difusor*	Viton
361	Retaining ring; *Anillo de retención*	Steel; Acero
370	Socket head screws, casing; *Encaje cabeza del tornillo, carcasa*	AISI 410 SS; *AISI 410 Acero inoxidable*
370C	Hex head screw, bearing cover; *Tornillo de cabeza hexagonal, cubierta de balineras*	Plated steel; *Acero chapeado*
371	Hex head screw, bearing frame; *Tornillo de cabeza hexagonal, armazón de balineras*	Plated steel; *Acero chapeado*
383	Mechanical seal; *Sello mecánico*	**see chart; ver tabla
400	Shaft key; *Llave del eje*	Steel; Acero
408	Drain and vent plug, casing; *Enchufes de drenaje y válvula, carcasa*	AISI 316 SS; *AISI 316 Acero inoxidable*
412B	O-ring, drain and vent plug; *Anillo 'O', enchufe de drenaje y válvula*	Viton (Standard, *estándar*) EPR (Optional, *Opcional*)
513	O-ring, casing; *Anillo 'O', carcasa*	

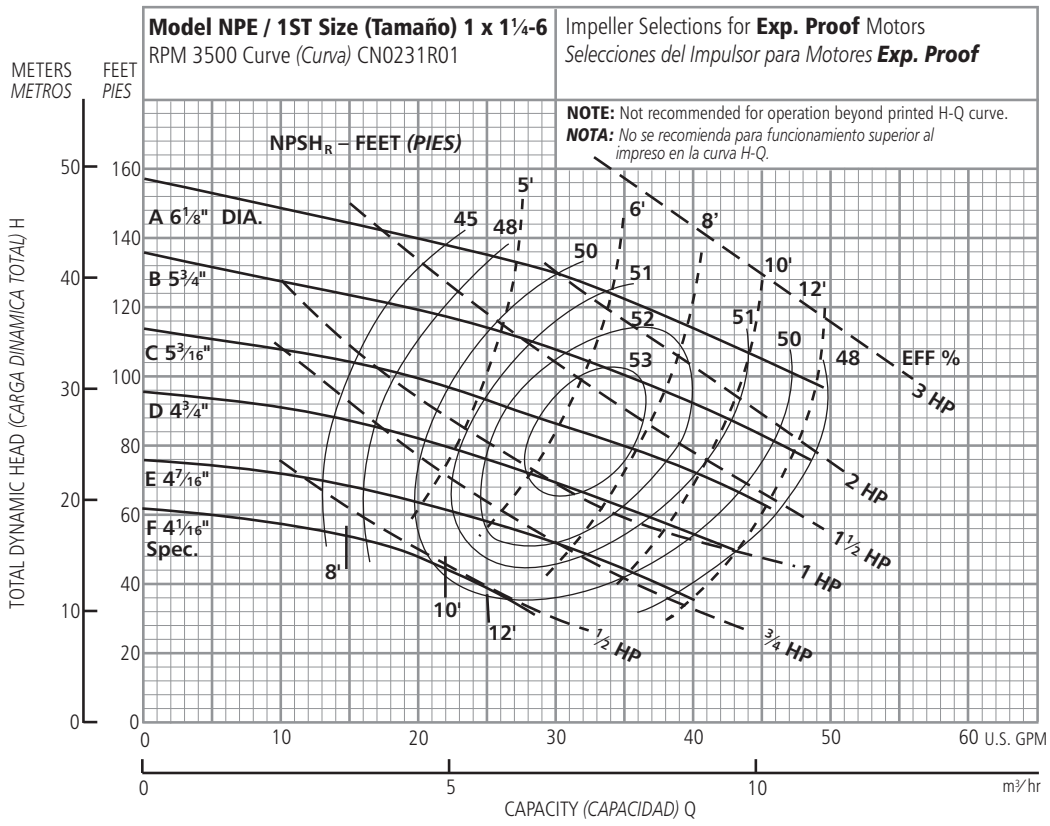
Performance Curves – 60 Hz, 3500 RPM
Curvas de Funcionamiento – 60 Hz, 3500 RPM



Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
E	½	4 7/16"
D	¾	4¾
C	1	5 3/16
B	1½	5¾
A	2	6⅛

NOTE: Although not recommended, the pump may pass a 1/16" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 1/16".*

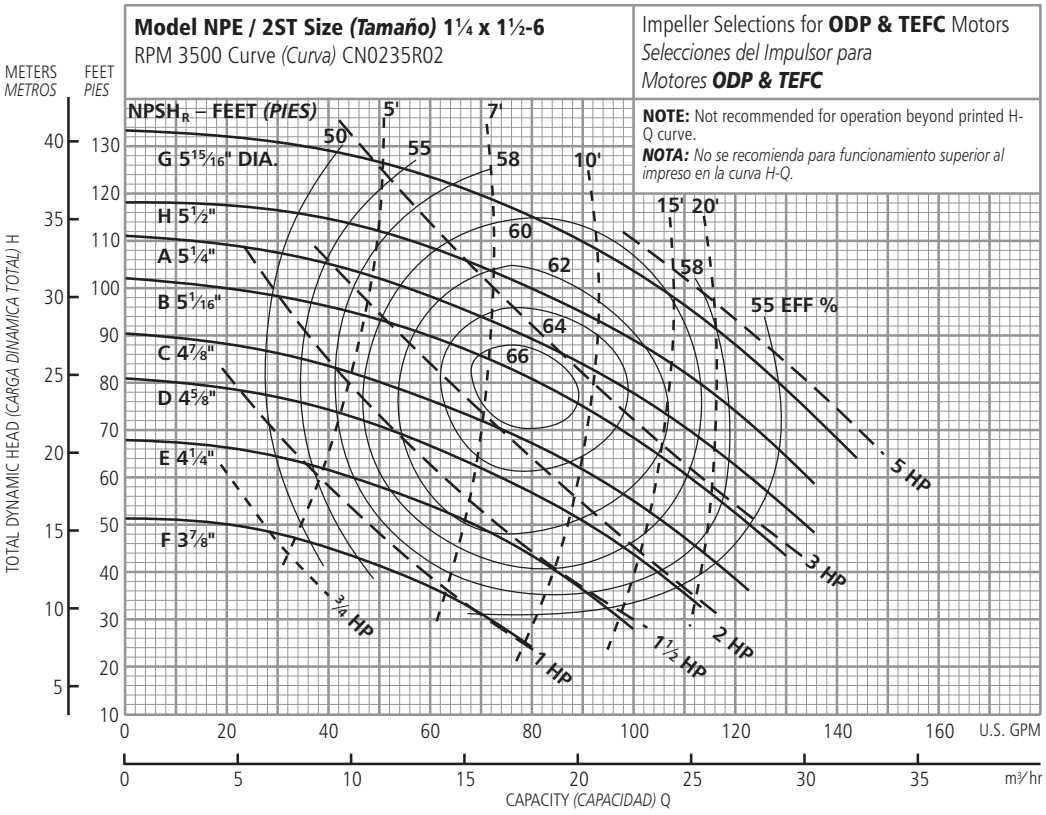


Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
F	½	4 1/16" spec.
E	¾	4 7/16
D	1	4¾
C	1½	5 3/16
B	2	5¾
A	3	6⅛

NOTE: Although not recommended, the pump may pass a 1/16" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 1/16".*

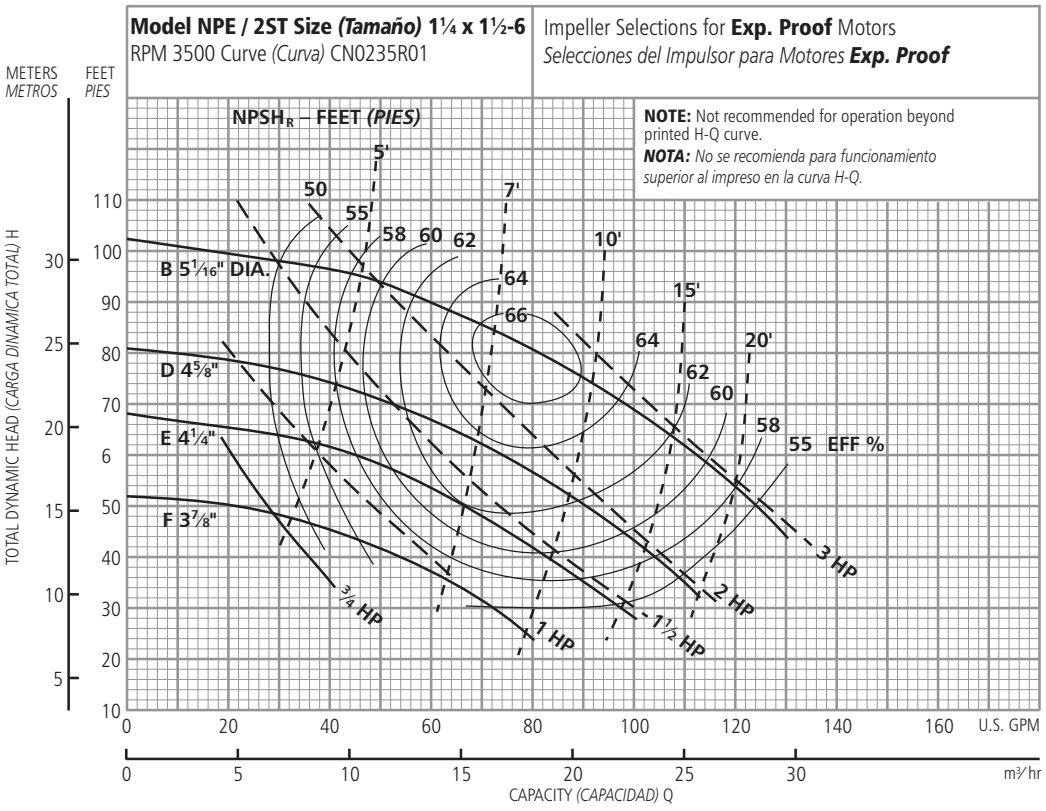
Performance Curves – 60 Hz, 3500 RPM
Curvas de Funcionamiento – 60 Hz, 3500 RPM



Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
F	¾	3 7/8"
E	1	4¼
D	1½	4⅝
C	2	4⅞
B	3	5 1/16
A	3	5¼
H	5	5½
G	5	5 15/16

NOTE: Although not recommended, the pump may pass a 3/16" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 3/16".*

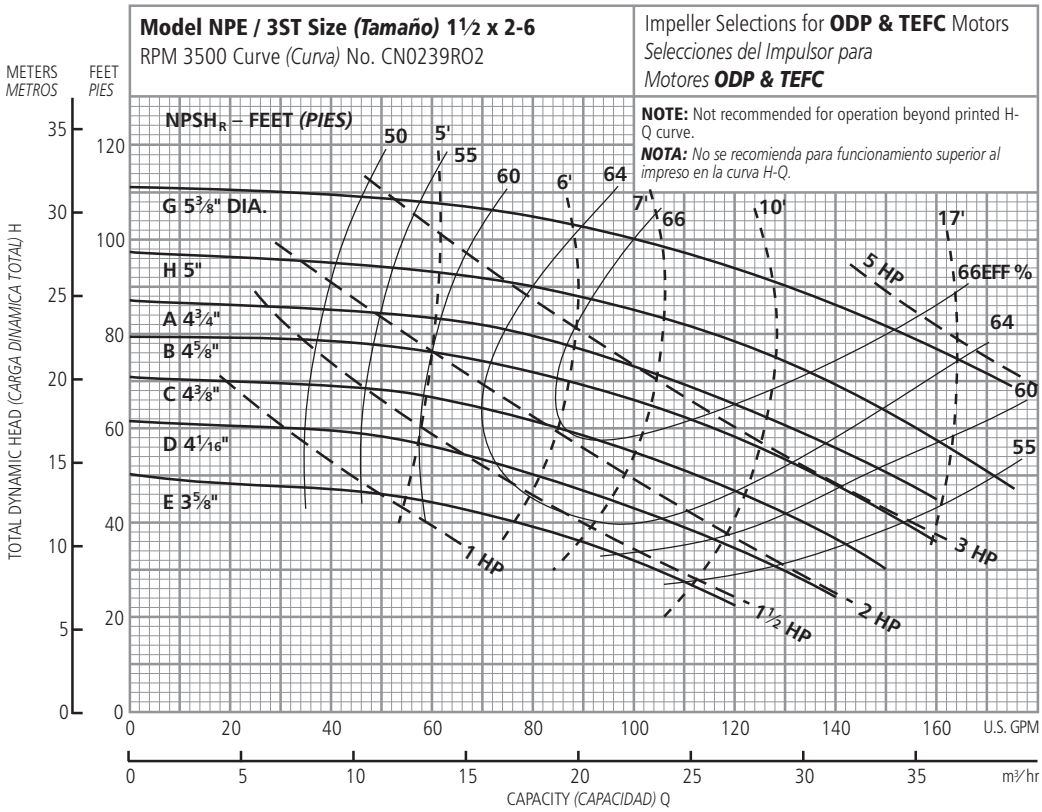


Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
F	1	3 7/8"
E	1½	4¼
D	2	4⅝
B	3	5 1/16

NOTE: Although not recommended, the pump may pass a 3/16" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 3/16".*

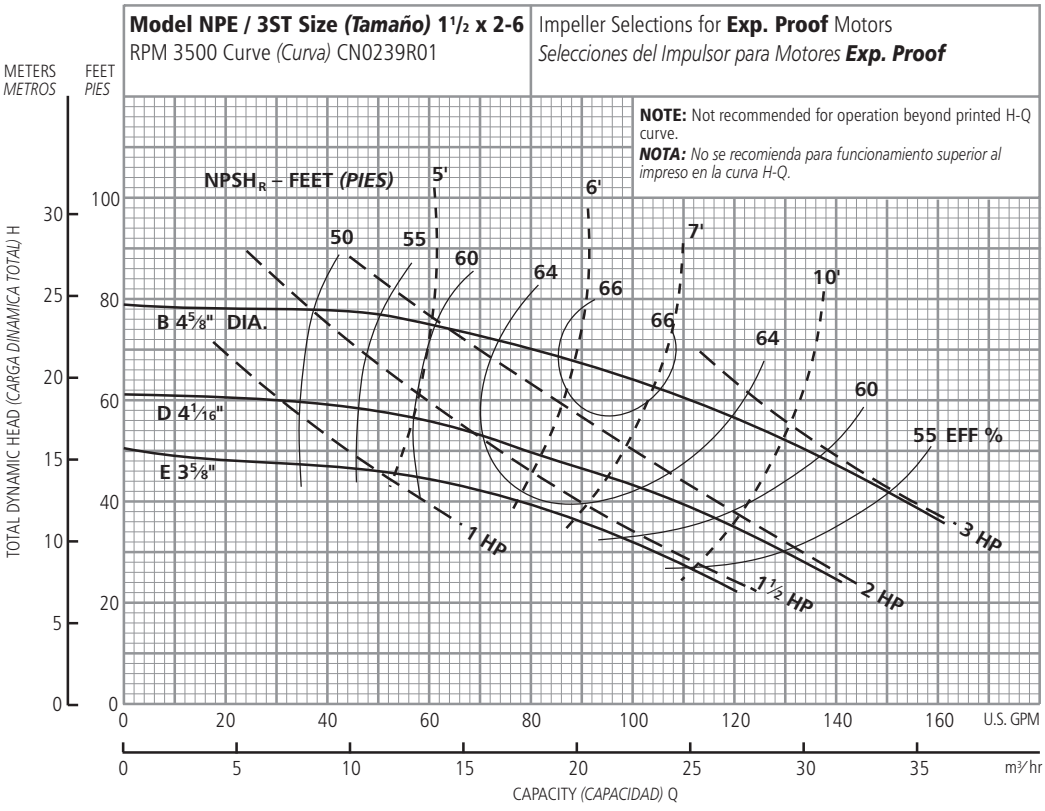
Performance Curves – 60 Hz, 3500 RPM
Curvas de Funcionamiento – 60 Hz, 3500 RPM



Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
E	1	3⅝"
D	1½	4¹⁄₁₆
C	2	4⅜
B	3	4⅝
A	3	4¾
H	5	5
G	5	5⅜

NOTE: Although not recommended, the pump may pass a 11⁄32" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 11⁄32".*

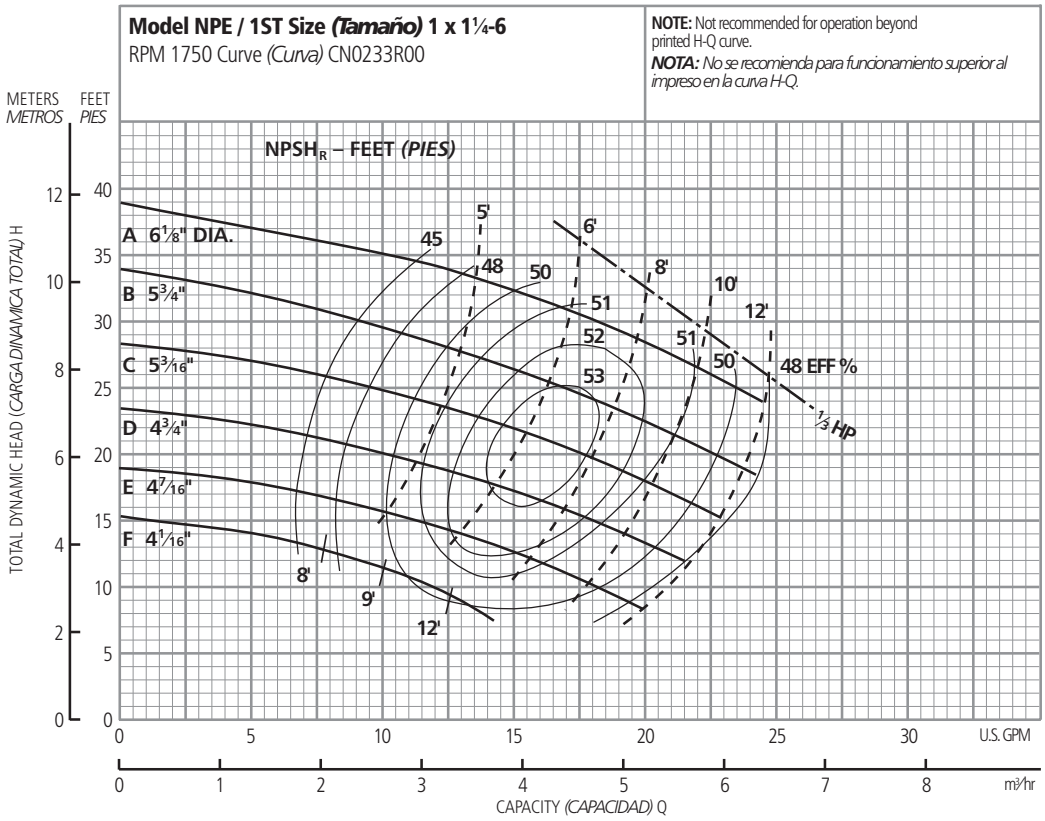


Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
E	1½	3⅝"
D	2	4¹⁄₁₆
B	3	4⅝

NOTE: Although not recommended, the pump may pass a 11⁄32" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 11⁄32".*

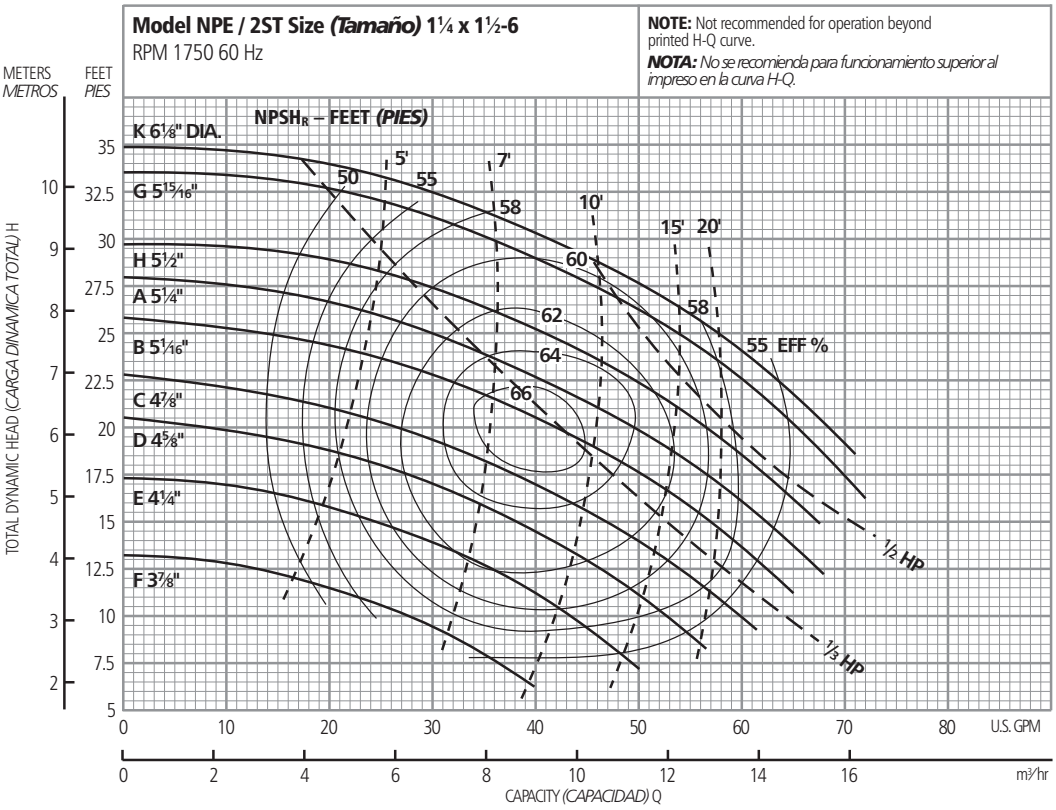
Performance Curves – 60 Hz, 1750 RPM
Curvas de Funcionamiento – 60 Hz, 1750 RPM



Optional Impeller, *Impulsor Opcional*	
Ordering Code, *Código de Pedido*	**Dia.**
A	6⅛"
B	5¾
C	5³⁄₁₆
D	4¾
E	4⁷⁄₁₆
F	4¹⁄₁₆

NOTE: Although not recommended, the pump may pass a ¹⁄₁₆" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de ¹⁄₁₆".*

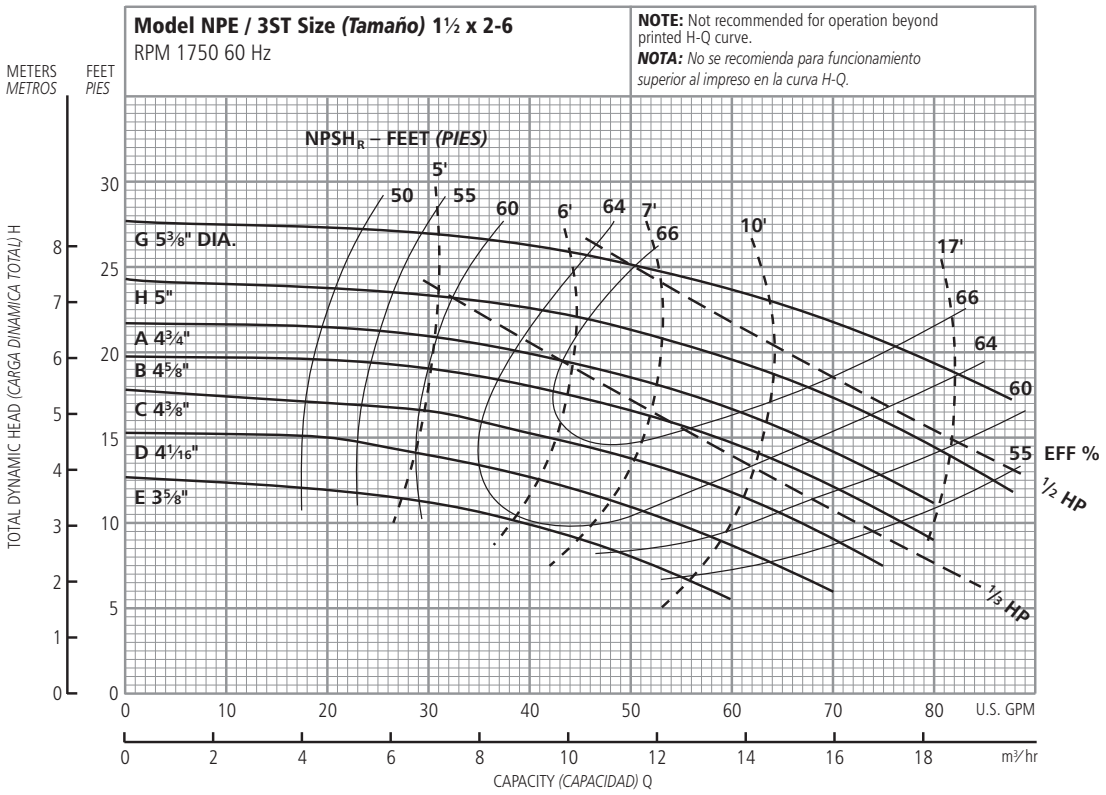


Optional Impeller, *Impulsor Opcional*	
Ordering Code, *Código de Pedido*	**Dia.**
K	6⅛"
G	5¹⁵⁄₁₆"
H	5½
A	5¼
B	5¹⁄₁₆
C	4⅞
D	4⅝
E	4¼
F	3⅞

NOTE: Although not recommended, the pump may pass a ³⁄₁₆" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de ³⁄₁₆".*

Performance Curves – 60 Hz, 1750 RPM
Curvas de Funcionamiento – 60 Hz, 1750 RPM

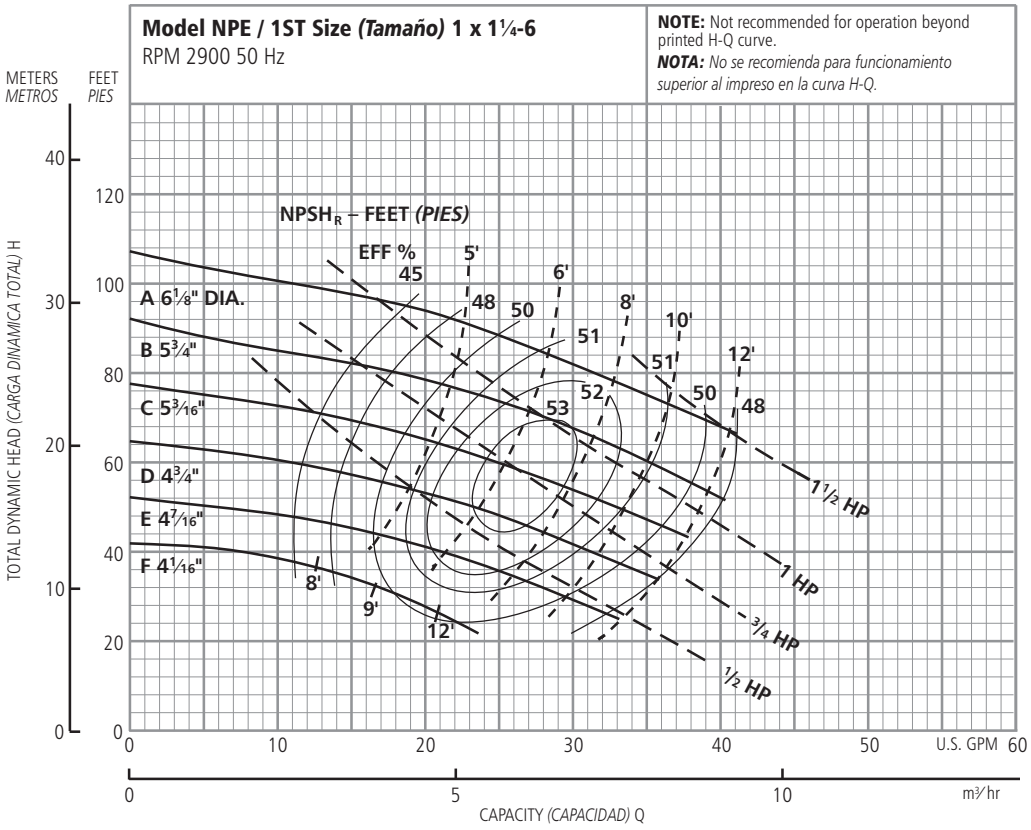


Optional Impeller, *Impulsor Opcional*	
Ordering Code, *Código de Pedido*	**Dia.**
G	5⅜"
H	5
A	4¾
B	4⅝
C	4⅜
D	4 1/16
E	3⅝

NOTE: Although not recommended, the pump may pass a 11/32" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 11/32".*

Performance Curves – 50 Hz, 2900 RPM
Curvas de Funcionamiento – 50 Hz, 2900 RPM

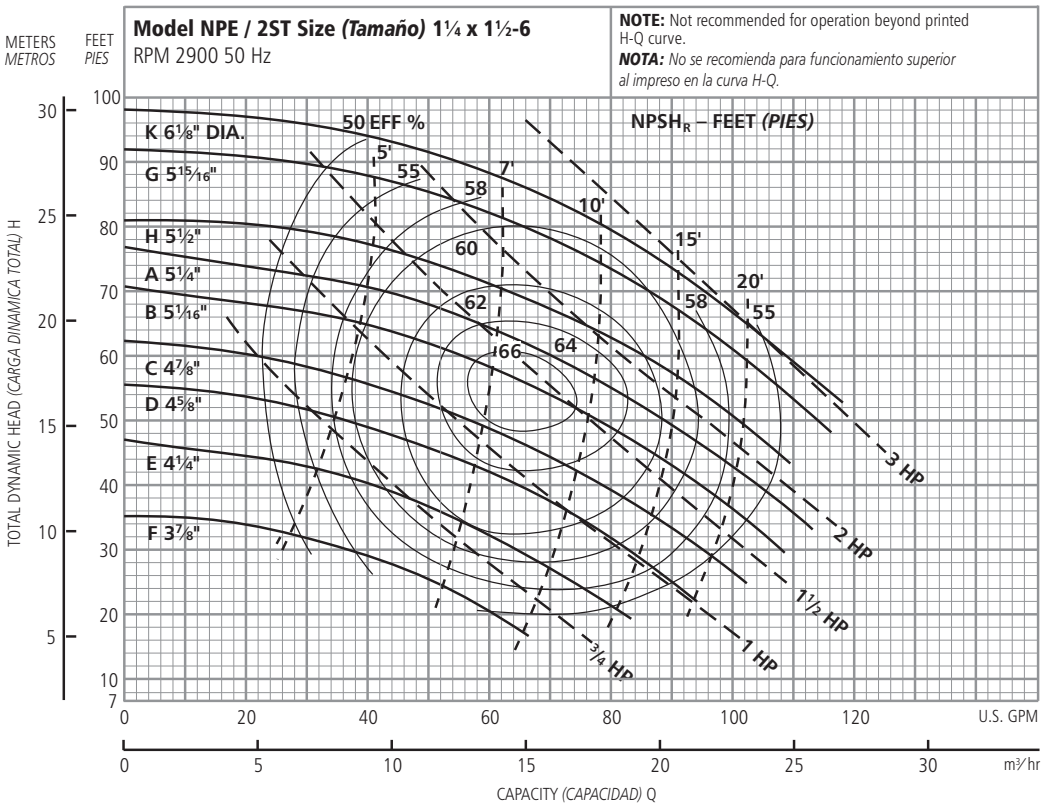


Optional Impeller, *Impulsor Opcional*	
Ordering Code, *Código de Pedido*	**Dia.**
A	6 1/8"
B	5¾
C	5 3/16
D	4¾
E	4 7/16
F	4 1/16

NOTE: Although not recommended, the pump may pass a 1/16" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 1/16".*

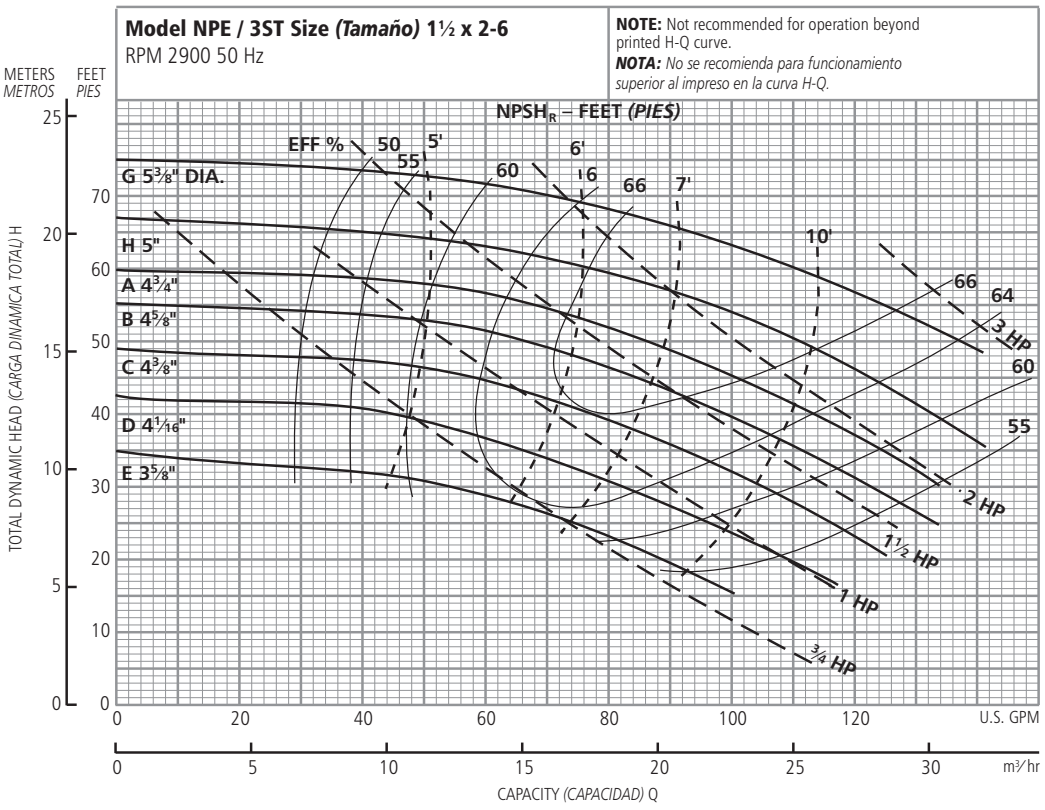
Performance Curves – 50 Hz, 2900 RPM
Curvas de Funcionamiento – 50 Hz, 2900 RPM



Optional Impeller, *Impulsor Opcional*	
Ordering Code, *Código de Pedido*	**Dia.**
K	6⅛"
G	5¹⁵⁄₁₆"
H	5½
A	5¼
B	5¹⁄₁₆
C	4⅞
D	4⅝
E	4¼
F	3⅞

NOTE: Although not recommended, the pump may pass a 3⁄16" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 3⁄16".*



Optional Impeller, *Impulsor Opcional*	
Ordering Code, *Código de Pedido*	**Dia.**
G	5⅜"
H	5
A	4¾
B	4⅝
C	4⅜
D	4¹⁄₁₆
E	3⅝

NOTE: Although not recommended, the pump may pass a 11⁄32" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 11⁄32".*

SUBMERSIBLE PUMP INSTALLATION, OPERATION & MAINTENANCE MANUAL

WARRANTY

Unless otherwise specifically stated, guarantees are limited to the following:

A. All equipment of our manufacture is guaranteed against defective workmanship or material for a period of eighteen (18) months after date of shipment from our plant, or one (1) year from start-up whichever occurs first.

B. If the purchaser claims the equipment or parts are defective within the period stated above, the purchaser shall notify Simflo Pumps Inc in writing immediately to allow Simflo Pumps Inc or its agent to inspect the claimed defect or issue shipping instructions for return of the part(s) to our plant.

C. In the event the equipment or part(s) is found defective, Simflo Pumps Inc shall correct the defect(s) by repair or replacement, at Simflo Pumps Inc's option.

D. The liability of the company arising out of supplying said equipment, or its use, whether on warranties or otherwise, shall not in any case exceed the cost of correcting the defects in our factory. Pulling setting and freight costs are not covered by warranty. Upon the expiration of the warranty period, all liability shall terminate.

E. Simflo Pumps Inc assumes no liability for damages or expenses of any character including those arising out of the installation, use or resale of such equipment.

F. Equipment and accessories not manufactured by Simflo Pumps Inc are warranted only to the extent of the original equipment manufacturer's warranty.

Simflo Pumps Inc
754 East Maley • P.O. Box 849 • Willcox, Az 85644 • www.simflo.com
Willcox (520) 384-2273 • Fax (520) 384-4042

OPERATION & MAINTENANCE MANUAL

A. OPERATION

Normally a unit has been selected and built to operate for a specific set of conditions (head in feet and capacity in gallons) to give maximum efficiency. Some variation, an increase or decrease of head, will not make an appreciable difference in the efficiency. However, a wide variation in head will not only show up as efficiency loss, but possibly as a horsepower, or thrust bearing overload.

1. When a unit is first started, a new well may produce considerable amounts of sand, despite the fact it had been sand pumped after drilling. The discharge should be throttled back to where this is cut down to a minimum, then gradually opened up to full discharge as the sand disappears. This operation may last from a matter of minutes to several days. If the sand flow shows no signs of stopping, the well must be reworked to screen out the sand or smaller capacity unit installed. Continued sand pumping will result in increased pump wear which in turn will show up as increased efficiency loss. Excessive wear can cause the pump bowls to be unrepairable and seriously affect motor performance and longevity.

2. Some wells will always produce a small amount of sand at start-up. Therefore, depending on the operation, it may then be necessary to bypass or trap out this first flow each time, particularly if a closed piping system is used.

3. If the unit is coupled into a hydro-pneumatic pressure system, the set-up must be so designed that it will not become "water-logged" (loss of air through water absorption, without replacement) and yet not receive too much air at each start-up.

4. On any system, automatic or manual, the maximum number of starts on a motor should be controlled to six (6) per hour.

5. A time delay relay must be installed when any type of automatic system is used in order to prevent starting of the motor while it is spinning backwards due to column drain-back through the pump. A three minute time delay relay is normally adequate. This provides a safety measure in the event a failure in the automatic control system creates a rapid recycle series. It also provides a time period for the rotating element of pump and motor to stop, after reverse rotation due to vertical discharge column drain-back.

6. A well should always be provided with means for determining the static water level, and pumping level. A good airline, with depth gauge, is generally the most simple and practical, particularly when installed with the unit.

7. When a unit is known to be set near to the bottom of a well, a close check should be kept to make sure that the well does not sand-up (fill in) around the motor. This is entirely possible without any noticeable effect in pumping or motor operation. However, the motor is dependent on adequate cooling from water, and any sanding up around it would eventually create overheating, resulting in at least shortened life, if not a burnout. There are additional pump features that can be added to cover this problem if it can not be cured by well work.

8. A unit should not be run at closed valve for any long period of time as virtually all the energy created then dissipates in heat in the pump. This condition has been known to have practically "boiled" the water in the well and created an overheating problem for the motor.

B. MAINTENANCE

1. A faithful periodic check test as indicated by the test card will prove beneficial to the prolonged life and satisfactory operation of the unit. Such records will provide the information necessary to determine when preventive maintenance should be undertaken.

2. If the unit has "shut-off" and the reason can not be traced to a POSITIVE external source, DO NOT attempt to start the unit without first "megging" the motor. Shut off the power at the disconnect switch, disconnect the motor cable leads from the starter and "megg" them to ground (the well casing). This should be done whether just the overload or circuit breaker have "kicked" out or a fuse has blown. NEVER just reset or replace fuses and attempt to start without FIRST "megging" the unit.

C. INSTALLATION

I. Inspect Shipment For Damage

1. A physical check of all equipment should be made against the packing list and inspect for obvious damage incurred during shipping.
2. Immediately report any damages to carrier and Simflo Pumps Dealer from whom pump was purchased.

II. Arrange Parts For Orderly Assembly and Installation

1. An orderly arrangement of submersible assemblies will reduce installation time.
2. The part requiring installation first should be laid out nearest the well and others in their order of installation as follows:
   A. Motor w/Sub. Wire
   B. Pump Assembly
   C. Column Pipe
   D. Discharge Head
   E. Pump Panel

III. Location of Check Valves

1. With pump setting of less than 400 feet, install a check valve 20' above pump bowls; a check valve at the top of the well; and an intermediate check valve halfway between the top and bottom valves.
2. With pump setting of 400 feet or greater, follow instructions as above using additional intermediate check valves to provide valve spacing that does not exceed 200 feet.
3. CAUTION: Be sure that check valves are threaded in place so that the flow is going in the upward position.

IV. Installing Pump Assembly

1. Lift motor vertically and lower into well, resting the motor on the "U" plate.
2. Make temporary electrical connection to motor, bump starter to determine correct rotation (counter clockwise as viewed from above). *If power is not available,* ***DO NOT*** *make drive shaft connections (Step 4) until power is available and correct rotation is determined.*
3. With the motor suspended in the well, on the "U" plate attach an elevator or clamps to pump end, lifting it vertically over the motor.

4. Carefully align the motor coupling with the motor shaft, while lowering the pump end onto the motor.
5. Replace all capscrews and lockwashers furnished with the pump and bolt up tightly.

V. Lowering Pump Assembly Into Well

1. The submersible wire should be supported by the column pipe, steel bands should be placed at intervals of 10-12 feet, care should be taken not to pinch the submersible wire.
2. The first piece of column should be attached to the bowl assembly and then lowered into the well, placing steel bands on the submersible wire as indicated in Step 1.
3. Be sure that column pipe joints are not cross threaded and are pulled up tight.
4. Care should be taken not to let the submersible cable drag downward over the edge of the well casing.
5. Check valves should be installed as instructed.
6. The discharge head should then he installed after desired depth has be reached. The submersible cable should then be threaded through the cable hole on the discharge head, care being taken not to pinch the cable.

FIELD TESTS

When a field test of the pump's performance is required, make the following readings: Volume, Total Head and Horsepower Measurements, Rotating Speed and Liquid Temperature. Compare the results of the field test with the performance curve for your pump.

All volume, total head and efficiency guarantees are based on shop test when handling clear, cold, fresh water at a temperature not exceeding 85° F. and under specified suction conditions.

(1) Volume (Capacity) Measurement - Measure the rate of flow from the pump discharge in gallons per minute. The volume measurement may be made using any one of the following pieces of equipment: A calibrated Venturi meter, a thin-plate calibrated orifice, a calibrated pilot tube, or an accurately measured reservoir.

(2) Total Head Measurement - The total pumping head consists of: distance from the water level in the sump (when pumping) to the center of the discharge pressure gauge, plus the discharge gauge reading and the velocity head at the discharge. Convert pressure gauge reading to feet of liquid by multiplying the reading times 2.31 times the Specific Gravity of Liquid.

(3) Horsepower Measurement - Measure horsepower consumption of the pump by a direct reading of a wattmeter and applying the reading to the following formula.

Horsepower Formula: $Bhp = \frac{KW\ Input \times Eff_t}{0.746}$

Where:

Bhp	= brake horsepower delivered
KW Input	= real input power (KW)
Eff_t	= motor efficiency
Sg	= specific gravity of liquid

The motor efficiency can be determined from dynamometer tests.

Pump Efficiency Formula:

$$\text{Pump Eff.} = \frac{TDH \times GPM \times Sg}{3960 \times Bhp}$$

Where:

TDH	= total dynamic head
GPM	= gallons per minute
Sg	= specific gravity of liquid
Bhp	= brake horsepower

SUCTION LIFT - When total suction head is below atmospheric pressure. Suction lift is determined by reading a liquid manometer or gauge in suction line (convert reading to feet of liquid) then subtracting the velocity head at point of gauge attachment.

POSITIVE (TOTAL) SUCTION HEAD - When total suction head is above atmospheric pressure. Total suction head is determined by reading a liquid manometer or gauge at pump suction nozzle (convert reading) then adding the velocity head at point of gauge attachment.

VELOCITY HEAD - Velocity is determined by dividing the flow (express in cubic ft. per second) by actual area of pipe cross section (express in square feet) at point of gauge attachment. Velocity head is the velocity of the liquid squared over 2g.

Formula: $h_v = \frac{V^2}{2g}$

Where:

h_v = velocity head

V = velocity in pipe in ft/sec. $= \frac{Flow\ CFS}{Area\ of\ pipe\ x\ ft^2}$

g = acceleration due to gravity
32.17 ft/sec. at sea level - 45° latitude

DRAWDOWN - Is the difference in water level in sump before and after starting pump operation. The amount of drawdown must be known to make sure the pump bowl is completely submerged below the minimum required pumping level of water in the sump.

SEE FOLLOWING PAGE FOR PERIODIC TEST RECORD SHEET

SIMFLO PUMPS - PERIODIC TEST RECORD

Stage _____ Pump Type _____ HP

Depth of Well _____ Ft.

Depth to Top of Pump _____ Ft.

Duty Capacity of Pump _____ GPM

at _____ Ft. Total Dynamic Head

UNIT SALES ORDER NO. _____

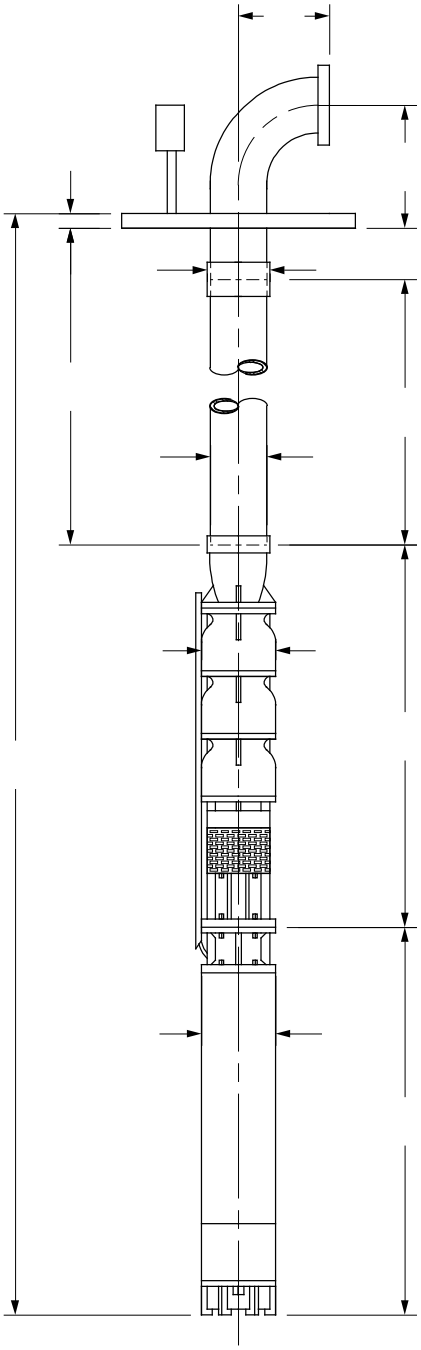
USER REF. _____

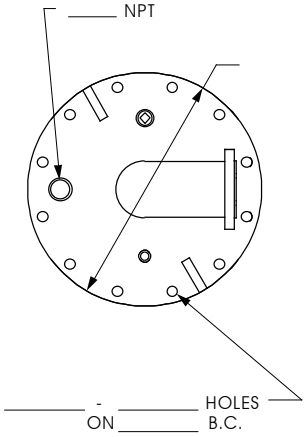
Date of Original Installation ___/___/___

NEXT CHECK DATE									
ACTUAL CHECK DATE									
CHECK PROCEDURE		#1	#2	#3	#4	#5	#6	#7	#8	#9
A) Standing Water Level - Ft.										
B) Open Circuit	A-B v									
Line	B-C v									
Voltage	C-A v									
C) Meg. Reading COLD	M									
D) Running Voltage	A-B v									
	B-C v									
	C-A v									
E) Pumping Level	Ft.									
Pressure Gauge	Ft.									
Capacity	GPM									
F) Running Current	A amp									
at Above Duty	B amp									
	C amp									
G) Shut- off Head	Ft.									
H) Shut-off Current	A amp									
	B amp									
	C amp									
I) Meg. Reading	HOT									
(Meg. 5 minutes after 30 minutes run at Duty)										
J) TEST NOTES										
Indicate when due for maintenance and/ or any change of service.										

SUBMERSIBLE
WITH THREADED COLUMN PIPE

SIMFLO PUMPS





DISCHARGE FLANGE

SUBMERSIBLE MOTOR

MAKE
H.P. **S.F.**
R.P.M.
PHASE **CYCLE**
VOLTAGE

DATE
DISTRIBUTOR

JOB

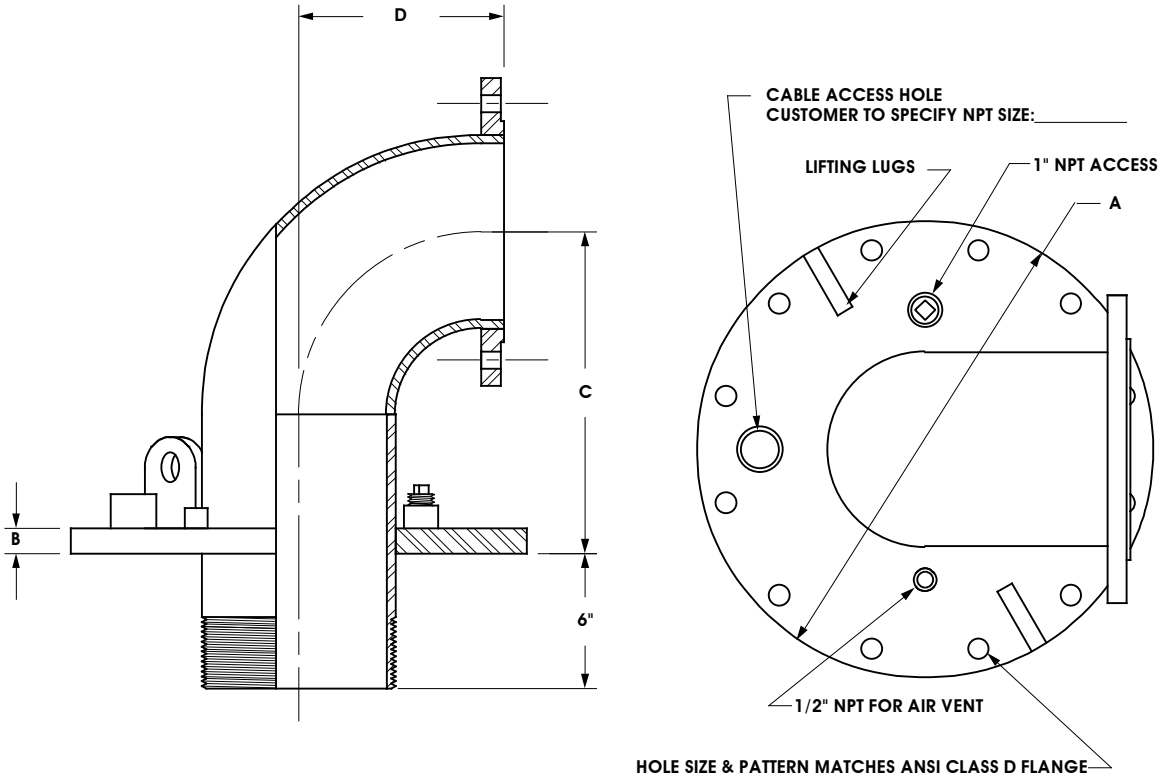
JOB/QUOTE #
QUANTITY

G.P.M.
T.D.H.
BOWL MODEL #
COLUMN ASSY.

CHECK VALVE
FOUNDATION PLATE
DISCHARGE HEAD
IMP. DIA.
IMP. TYPE
SPECIAL

OTHER

SUBMERSIBLE DISCHARGE HEAD



WELL CASING DIAMETER

	6	8	10	12	14	16	18	20
A	11.00	13.50	16.00	19.00	21.00	23.50	25.00	27.50
B	.69	.69	.69	.81	.94	1.00	1.06	1.12

ELBOW & NIPPLE DIAMETER

	2	3	4	5	6	8	10	12
C	5.00	6.50	8.00	10.00	11.50	14.75	17.75	20.75
D	3.75	5.12	7.12	8.62	10.12	12.88	17.62	19.50

STANDARD FEATURES INCLUDE: LIFTING LUGS; 1" NPT ACCESS HOLE; 1/2" NPT FOR AIR VENT; AND 150# RAISED FACE DISCHARGE FLANGE.

NOTE: DIMENSIONS ARE IN INCHES AND ARE SUBJECT TO CHANGE WITHOUT NOTICE.

For Non-Health Hazard Applications

Job Name **56th St. & Earl Dr WQARF**

Job Location _____

Engineer _____

Approval _____

Contractor _____

Approval _____

Contractor's P.O. No. _____

Representative _____

Series 007
Double Check Valve Assemblies

Sizes: ½" – 3" (15 – 80mm)

Series 007 Double Check Valve Assemblies shall be installed at referenced cross-connections to prevent the backflow of polluted water into the potable water supply. Only those cross-connections identified by local inspection authorities as non-health hazard shall be allowed the use of an approved double check valve assembly.

Check with local authority having jurisdiction regarding vertical orientation, frequency of testing or other installation requirements.

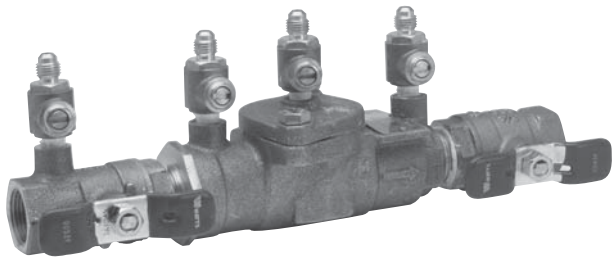
The valve shall meet the requirements of ASSE Std. 1015 and AWWA Std. C510. Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California.

Features

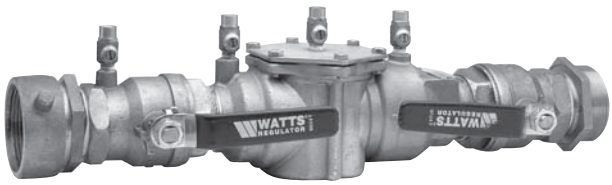
- Ease of maintenance — only one cover
- Top entry
- Replaceable seats and seat discs
- Modular construction
- Compact design
- Cast bronze body construction — ½" – 2" (15 – 50mm)
- Fused epoxy coated cast iron body — 2½" – 3" (65 – 80mm)
- Top mounted ball valve test cocks
- Low pressure drop
- No special tools required for servicing
- ½" – 1" (15 – 25mm) have tee handles

Specifications

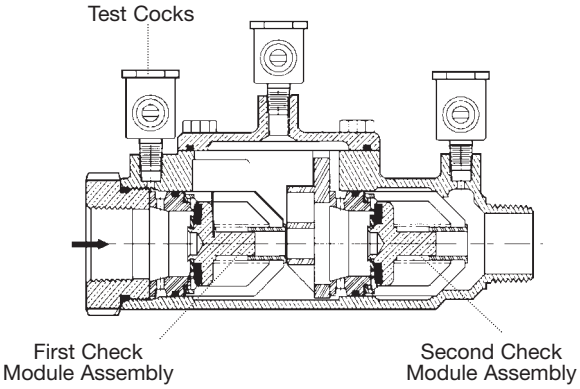
A Double Check Valve Assembly shall be installed at each noted location. The assembly shall consist of two positive seating check modules with captured springs and rubber seat discs. The check module seats and seat discs shall be replaceable. Service of all internal components shall be through a single access cover secured with stainless steel bolts. The assembly shall also include two resilient seated isolation valves; four top mounted, resilient seated test cocks. The assembly shall meet the requirements of ASSE Std. 1015 and AWWA Std. C510. Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California. Assembly shall be a Watts Series 007.



¾" (20mm) 007M3QT



2" (50mm) 007M1QT HC



The 007 Series features a modular design concept which facilitates complete maintenance and assembly by retaining the spring load.

Now Available
WattsBox Insulated Enclosures.
For more information, send for literature ES-WB.

IMPORTANT: *INQUIRE WITH GOVERNING AUTHORITIES FOR LOCAL INSTALLATION REQUIREMENTS*

Pressure — Temperature

½" – 2" (15 – 50mm)

Temperature Range: 33°F – 180°F (0.5°C – 82°C).

Maximum Working Pressure: 175psi (12.1 bar).

2½" – 3" (65 – 80mm)

Temperature Range: 33°F – 110°F (0.5°C – 43°C) continuous, 140°F (60°C) intermittent.

Maximum Working Pressure: 175psi (12.1 bar).

Standards

ASSE Std. 1015, AWWA Std. C510

IAPMO PS31, CSA B64.5

Approvals

† ASSE, AWWA, IAPMO, CSA, UPC

▲ Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California.

• Models LF and S are not listed.

◆ UL Classified (LF models only) ¾" – 2" (20 – 50mm) (except 007M3LF)

◆ UL Classified with OSY gate valves (2½" and 3" horizontal only.)

* Horizontal and vertical "flow up" approval on all sizes

Suffix:

S - bronze strainer

LF - without shutoff valves

LH - locking handle ball valves (open position)

SH - stainless steel ball valve handles

HC - 2½" inlet/outlet fire hydrant fittings (2" valve)

Prefix:

U - Union connections

2½" – 3" (65 – 80mm)

Suffix:

NRS - non-rising stem resilient seated gate valves

OSY - UL/FM outside stem and yoke resilient seated gate valves

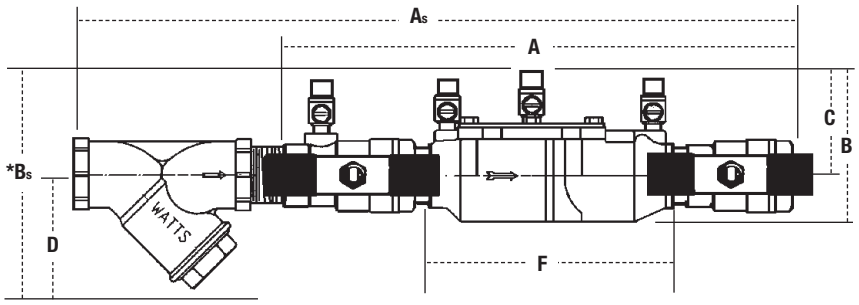
LF - without shutoff valves

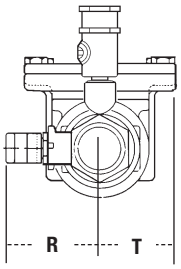
QT-FDA - FDA epoxy coated quarter-turn ball valves

Dimensions – Weights

Models

Sizes: ½" – 2" (15 – 50mm)





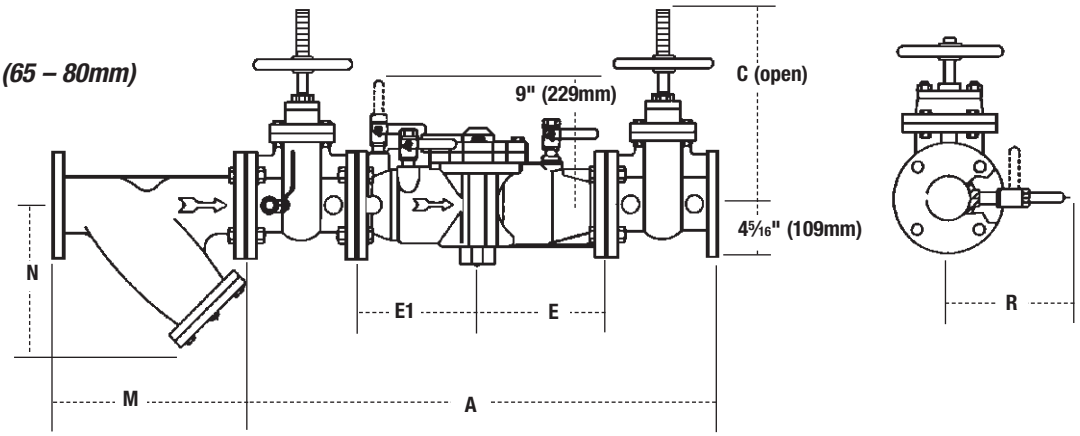
***Subscript 'S' = strainer model**

Suffix HC — Fire Hydrant Fittings dimension "A" = 23½" (594mm)

MODEL	SIZE (DN)		DIMENSIONS																WEIGHT	
			A		B		C		D		F		G		R		T			
	in.	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs.*
†▲007QT	½	15	10	254	4 5/8	117	2 7/16	62	—	—	5	127	3 3/8	85	2 5/16	59	2 1/16	52	4.5	2
†▲007M3QT	¾	20	11 1/8	282	4	102	3 1/8	79	—	—	6 3/16	157	3 7/16	87	2 1/8	54	1 5/16	33	5	2.3
†▲007M1QT	1	25	13 1/4	337	5 1/8	130	4	102	—	—	7 1/2	191	3 3/8	85	1 11/16	43	1 11/16	43	12	5.4
†▲007M2QT	1 1/4	32	16 3/8	416	5	127	3 5/16	84	—	—	9 1/2	241	5	127	3	76	2	50	15	6.8
†▲007M2QT	1 1/2	40	16 3/4	425	4 7/8	124	3 1/2	89	—	—	9 3/4	248	5 13/16	148	3 1/8	79	2 11/16	68	15.9	7.2
†▲007M1QT	2	50	19 1/2	495	6 1/4	159	4	102	—	—	13 3/8	340	6 1/8	156	3 7/16	87	2 11/16	68	25.7	11.7
• 007QT-S	½	15	13	330	6	152	2 7/16	62	3	76	5	127	3 3/8	85	2 5/16	59	2 1/16	52	5.5	2.5
• 007M3QT-S	¾	20	14 1/2	368	6 1/8	156	3 1/8	79	3	76	6 3/16	157	3 7/16	87	2 1/8	54	1 5/16	33	6.7	3.1
• 007M1QT-S	1	25	17 15/16	157	7 3/4	197	4	102	3 1/4	83	7 1/2	191	3 3/8	85	1 11/16	43	1 11/16	43	14	6.4
• 007M2QT-S	1 1/4	32	21 1/2	546	7 1/16	179	3 5/16	84	3 1/2	83	9 1/2	241	5	127	3	76	2	50	19	8.6
• 007M2QT-S	1 1/2	40	25 1/16	637	7 1/16	179	3 1/2	89	3 3/4	95	9 3/4	248	5 13/16	148	3 1/8	79	2 11/16	68	19.6	8.9
• 007M1QT-S	2	50	27 1/4	692	8 3/4	222	4	102	4	102	13 3/8	340	6 1/8	156	3 7/16	87	2 11/16	68	33.5	15.2

Dimensions – Weights

Sizes: 2½" – 3" (65 – 80mm)



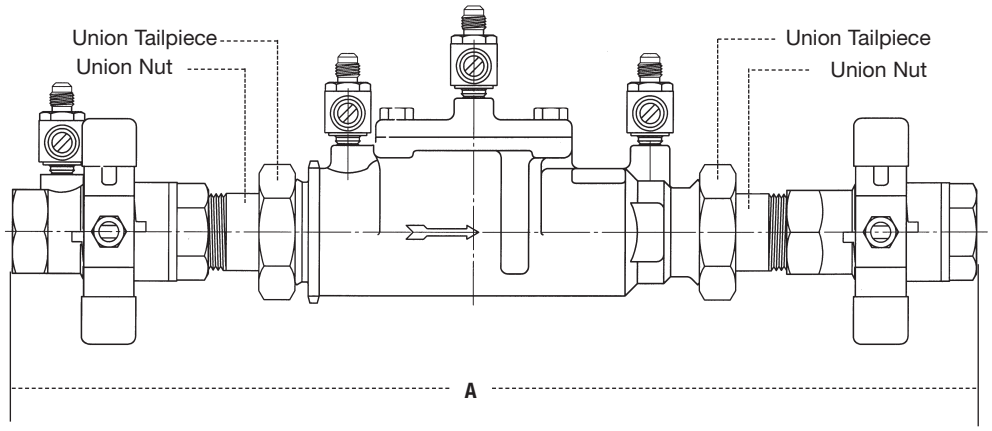
MODEL		SIZE (DN)		DIMENSIONS								WEIGHT	
				A		C		E, E1		R			
		in.	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs.*
	007QT-FDA	2½	65	33⅛	841	6⅜	162	9¹⁄₁₆	230	8¾	222	155	70
▲	007-NRS	2½	65	33⅛	841	9⅜	238	9¹⁄₁₆	230	8¾	222	155	70
▲◆	007-OSY	2½	65	33⅛	841	16⅜	416	9¹⁄₁₆	230	8¾	222	158	72
	007-QT-FDA	3	80	34⅛	867	6⅜	162	9¹⁄₁₆	230	8¾	222	155	70
▲◆	007-NRS	3	80	34⅛	867	10¼	260	9¹⁄₁₆	230	8¾	222	185	84
▲	007-OSY	3	80	34⅛	867	18⅞	479	9¹⁄₁₆	230	8¾	222	185	84

Strainer Dimensions

SIZE						WEIGHT	
		M		N			
in.	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs.*
2½	65	10	254	6½	165	28	13
3*	80	10⅛	267	7	178	34	15

*S Models only

1" U007M1QT



Sizes: ½" – 2" (15 – 50mm)

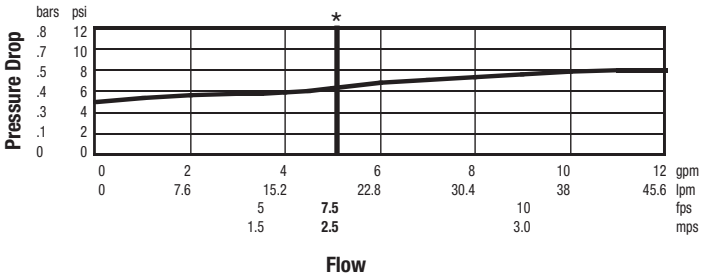
MODEL	SIZE (DN)		DIMENSIONS	
			A	
	in.	*mm*	*in.*	*mm*
U007QT	½	15	12¹³⁄₁₆	326
U007M2QT	¾	20	13¹³⁄₁₆	350
U007M2QT	1	25	16⅝	422
U007M2QT	1¼	32	20¾	527
U007M2QT	1½	40	21½	546
U007M1QT	2	50	24½	622

Capacity

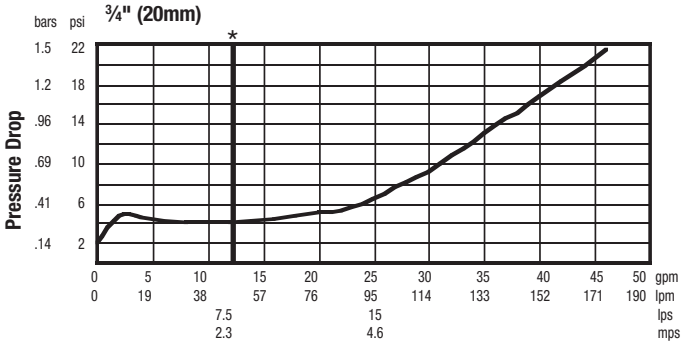
As complied from documented Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California lab tests.

* Typical maximum system flow rate (7.5 feet/sec., 2.3 meters/sec.)
** UL rated flow

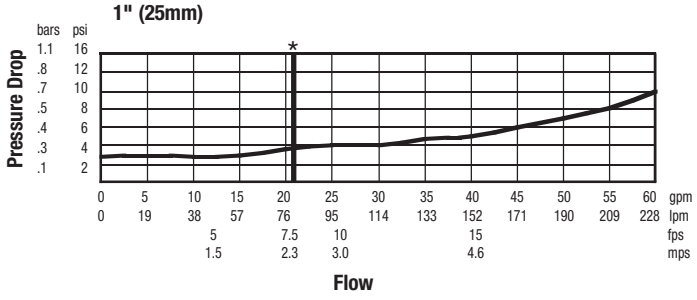
½" (15mm)



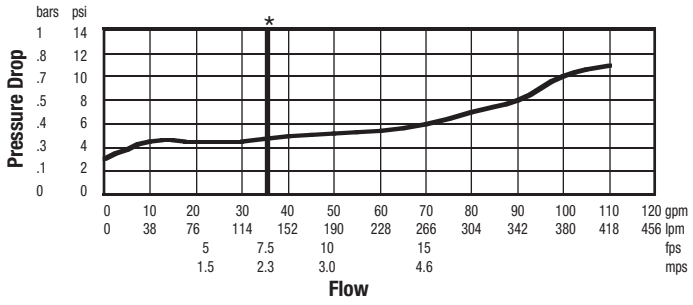
¾" (20mm)



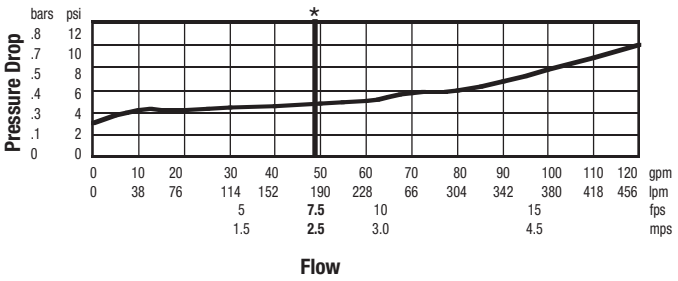
1" (25mm)



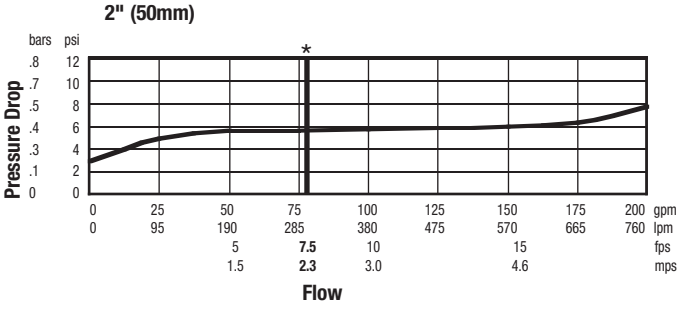
1¼" (32mm)



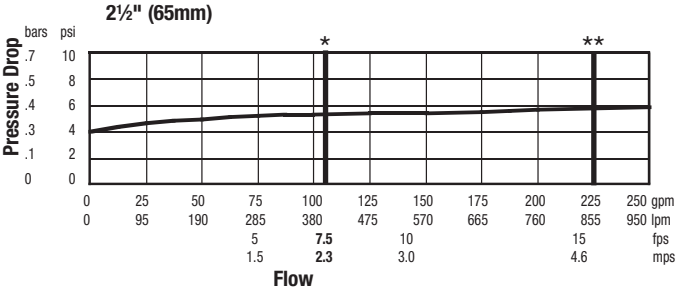
1½" (40mm)



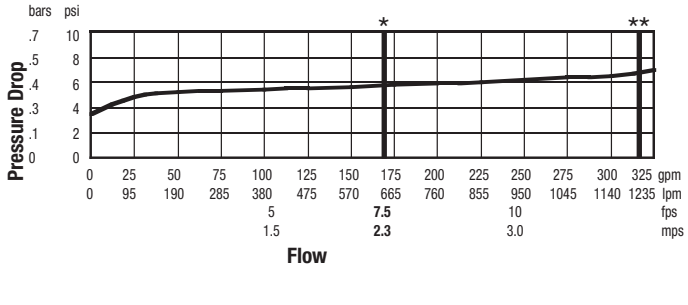
2" (50mm)



2½" (65mm)



3" (80mm)



WATTS®

A Watts Water Technologies Company

USA: 815 Chestnut St., No. Andover, MA 01845-6098; www.watts.com
Canada: 5435 North Service Rd., Burlington, ONT. L7L 5H7; www.wattscanada.ca

ES-007 0830

F-25 MEDIUM DUTY DRAINAGE GATE

- **CAST IRON CONSTRUCTION**
- **AUTOMATIC OPERATION**
- **FULLY ADJUSTABLE HINGE LINKS**
- **25 FOOT SEATING HEAD MAXIMUM**

The Waterman Model F-25 Drainage Gate features a high strength, fully adjustable linkage, providing for sensitive adjustment of the flap cover after installation. The design of this gate prevents jamming and assures proper seating through the use of built-in safety stops and a 2½° to 5° seating angle.

Flatback and Spigotback models are available.

A choice of seat facings is available and includes machined or ground iron, bronze or neoprene cover gasket which is available with either iron or bronze mating frame seats.

The use of the Waterman neoprene cover seal provides a long life tight seal, which can be easily renewed. The heavy seal also provides a moderate cushioning of shock loads where some slamming may occur.

This model is **not** recommended for pump discharges where violent slamming can occur.

- Cast Iron Frame and Cover
- High Strength Ductile Iron or Steel Links
- Stainless Steel Studs, Bolts and Pins, Standard. Brass or Monel, Optional.
- Bronze Bushings, Standard. Permanently Lubricated Bronze or Teflon, Optional.
- Minimum 2½° Seating Angle. 24" Diameter and over.
- Minimum 5° Seating Angle. 21" Diameter and smaller.
- Optional 25 lb. and 125 lb. ANSI Flange Drilling.

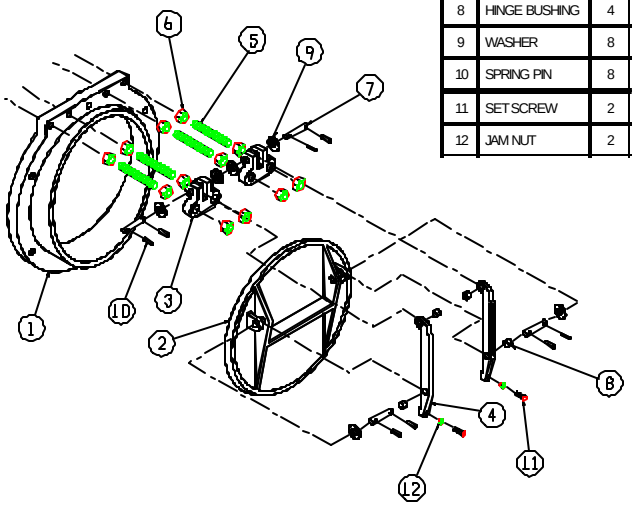
CAST IRON SEAT - Standard. Used for moderate conditions where costs must be minimized.

BRASS SEAT - Optional. Used for corrosive conditions where long service is important.

NEOPRENE SEAT (with iron or bronze) - Optional. Replaceable in flap cover. Cushions "slam" on closing and provides tighter seal.

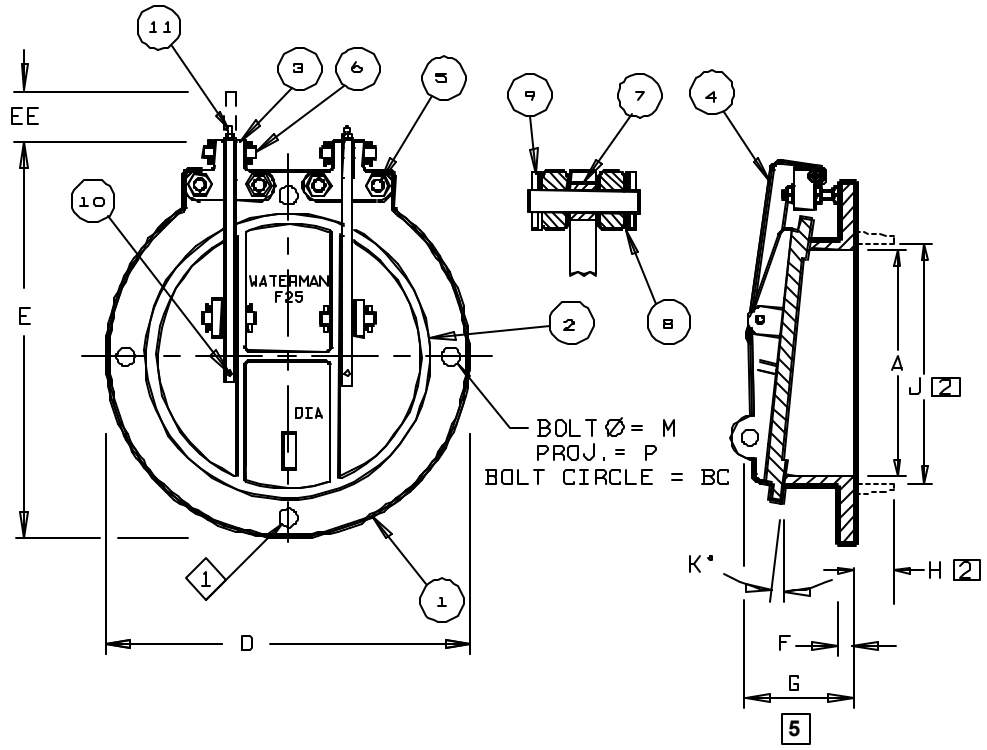
Model F-25f - Flatback
Model F-25sb - Spigotback

PARTS LIST		
No.	Name	Qty.
1	FRAME	1
2	COVER	1
3	PIVOT LUG	2
4	HINGE LINK	2
5	HINGE STUD	4
6	HINGE NUT	12
7	HINGE PIN	4
8	HINGE BUSHING	4
9	WASHER	8
10	SPRING PIN	8
11	SET SCREW	2
12	JAM NUT	2



F-25 DRAINAGE GATE

PARTS LIST	
No.	Name
1	FRAME
2	COVER
3	PIVOT LUG
4	HINGE LINK
5	HINGE STUDS & NUTS
6	HINGE PIN
7	HINGE BUSHING
8	WASHERS
9	SPRING PIN
10	SET SCREW [4]
11	LUBE FITTING (optional) [6]



[1.] 12 Bolt pattern per ◊ available on 42" & 48" only on request.

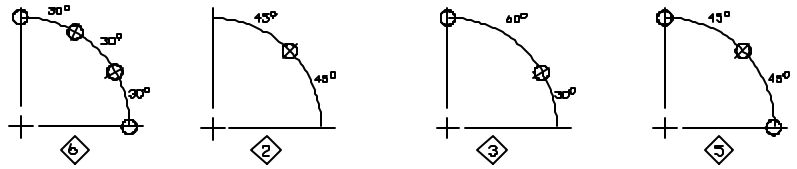
[2.] Applies to spigotback gate only. Optional spigot shown in phantom.

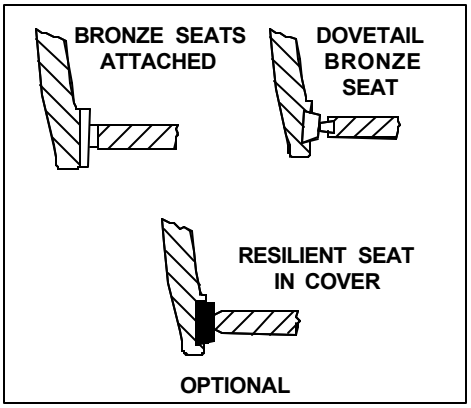
3. 25 Lb. & 125 Lb. Standard drilling available on request for all gates except 15" & 21".

[4.] Except 4" & 6" gates

[5.] If grout pad mounting is used add grout thickness to dimension.

6. Not available on 4" and 6" gates - use permalube bushings.





GATE DIMENSIONS IN INCHES

GATE SIZE A	4	6	8	10	12	14	15	16	18	20	21	24	30	36	42	48	54	60
BC	7½	9½	11¾	14¼	17	18¾	20	21¼	22¾	25	25	29½	36	42¾	49½	56	62¾	69¼
D	9	11	13½	16	19	22½	22½	23½	25	27½	27½	32	38¾	46	53	59¾	66½	73
E	9¾	12	14½	16	19	22	25	24	28½	28	30	35	40½	46½	54¾	66	72	75
EE	1⅞	2	2⅛	2⅝	3	3⅛	3⅛	3	3⅛	3⅜	2⅞	3	3½	3½	4⅛	4⅞	6	6⅛
F	½	⅝	⅝	¾	⅝	1	1	⅞	⅞	⅞	⅞	⅞	1⅛	1⅛	1½	1½	1½	1½
G	3⁹⁄₁₆	5	5	6	5½	6	6½	6½	7	7	7½	8	8	9	8½	10	10	10 1⁄₁₆
H [2]	2	2	2⅛	2¼	2⅛	2⅛	2⅛	2¼	2⅛	2⅛	2⅛	2⅛	2⅜	2⅛	2⅜	2½	3	3¼
J [2]	5	7	9	11	13	15	16	17	19	21	22	25	31	37	43 ⁹⁄₁₆	49⅛	55⅛	61⅛
K*	5	5	5	5	5	5	5	5	5	5	5	2½	2½	2½	2½	2½	2½	2½
M	½	½	½	½	⅝	⅝	⅝	⅝	⅝	¾	¾	¾	¾	¾	⅞	⅞	1	1⅛
P	1½	1½	1½	1½	1½	1½	1½	1½	1½	1¾	1¾	1¾	2¼	2¼	2¼	2⅜	2¾	3
No. of Bolts	4	4	4	6	6	6	6	6	6	8	8	6	8	8	6 [1]	6 [1]	12	12
◊	2	1	1	3	3	3	3	3	3	5	5	3	5	5	3	3	6	6

* Degrees

NOTE: FOR PRELIMINARY DESIGN PURPOSES ONLY
DO NOT USE FOR INSTALLATION
UNLESS PART OF CERTIFIED & APPROVED SUBMITTAL

TYPICAL SPECIFICATIONS
F-25 MEDIUM DUTY AUTOMATIC DRAINAGE (FLAP) (TIDE) GATES

General
The drainage gate shall be designed to allow free outflow and prevent backflow for maximum seating heads up to 25 feet. Gates shall be Waterman Model F-25 or equal.

Construction
The frame shall be cast iron of flatback or spigotback design, with machined seating surface inclined from vertical at minimum of 2½°, to assure positive closure. For flatback gates mounted to thimbles or flanges, the gate flange shall be machined and drilled to match.

The cover shall be cast iron, cast in one piece, with reinforcing ribs, designed to withstand the seating head specified. An integral cast on lifting eye shall be provided for manual operation.

Seating surfaces for frame and cover shall be:
(bronze on seat and cover) (machined iron on frame, neoprene on cover) (bronze on frame, neoprene on cover)

All machined seats shall have a minimum 63 microinch finish.

The gate shall be provided with adjustable, double pivoted hinge links so designed to permit complete seating, full opening, and with stops or other arrangement to prevent cover from rotating sufficiently to become wedged in the open position. Pivot lugs mounted to frame shall be adjustable to allow adjustment of hinge links without having to remove cover from gate. The hinge links shall be bronze-bushed, structural steel (or high strength ductile iron, cast manganese bronze, or wrought stainless steel). All assembly hardware shall be type 18-8 stainless steel.

Finish
All cast iron shall be painted with manufacturer's standard shopcoat paint (or special paint). Structural steel hinge links shall be galvanized. All bronze and stainless steel parts do not require further finish.

Materials
Frame and Cover - Cast Iron per ASTM A-126, Class B.
Pivot Lug - Ductile Iron per ASTM A-536, Gr. 65-45-12.
Hinge Link - Structural Steel per ASTM A-36, galvanized per ASTM A-123.
Bronze Bushings and Washers - Commercial Bronze.
Assembly Hardware and Pins - 18-8 Stainless Steel (Type 304).

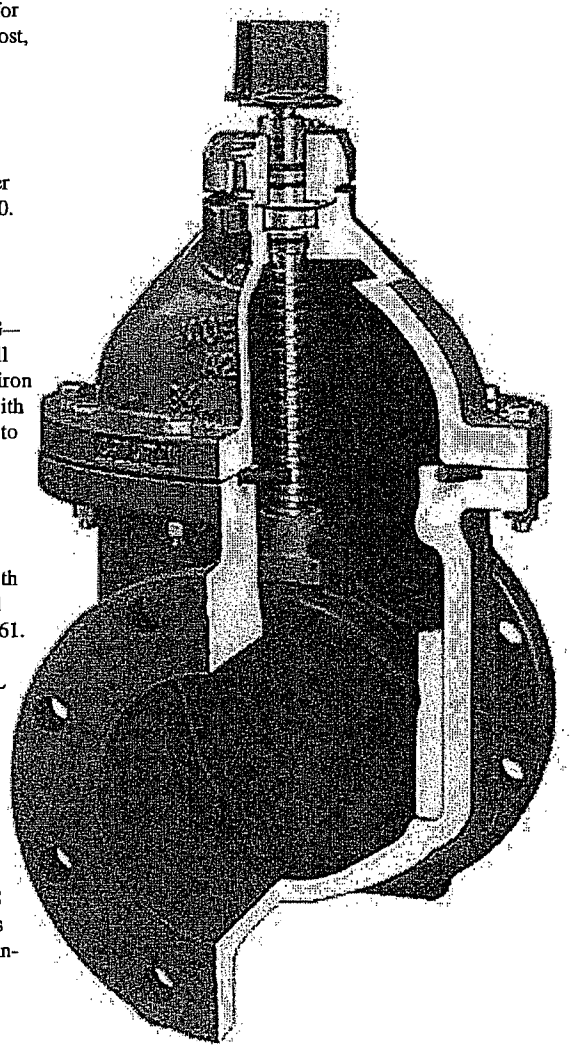
MUELLER® 2360 SERIES™ RESILIENT WEDGE GATE VALVE

Mueller Co. **10.3**

Rev. 8-04

MUELLER® 2-1/2"-12" Resilient Wedge Gate Valve

- ❑ TWO ANTI - FRICTION WASHERS — polymer washers (one above and one below the thrust collar) further reduce operating torque in both the opening and closing directions.
- ❑ STEM — machined from forged manganese bronze bar stock for strength where it is needed most, at the thrust collar.
- ❑ WEDGE — cast iron, fully encapsulated in molded rubber complying with ASTM D2000.
- ❑ MUELLER® PRO-GARD™ FUSION EPOXY COATING— of nominal 10 mils protects all interior and exterior exposed iron surfaces and complies fully with AWWA C550 and is certified to NSF 61.
- ❑ MANUFACTURED AND TESTED — in compliance with ANSI/AWWA C509 Standard and is certified to ANSI/NSF 61. Manufactured at facility with ISO 9001 certification and UL 262, FM 1120/1130.
- ❑ BI-DIRECTIONAL FLOW
- ❑ FLAT BOTTOM SURFACES — allow all 2360 series valves to stand upright for ease of handling and storage.
- ❑ TRIPLE O-RING SEALS — two above the thrust collar; one below. Uppermost serves as dirt seal. Retain lubrication on thrust collar and isolate it from waterway and outside contamination. Top two can be replaced with valve fully open and under pressure.



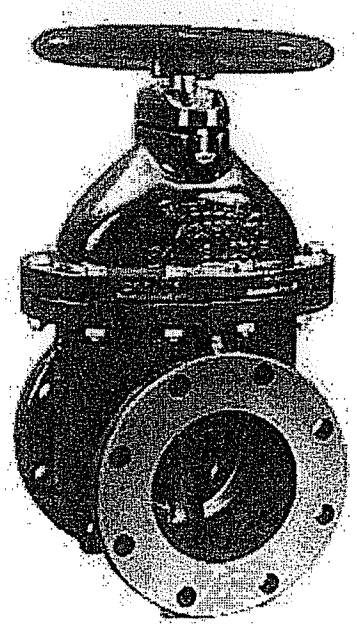
- ❑ 250 PSIG MAXIMUM WORKING PRESSURE— hydrostatically tested at 500 psig. Surpasses ANSI/AWWA C509 standards by 25% (UL/FM 200 psig working pressure, 400 psig hydrostatic pressure).
- ❑ EXTENDED WEDGE GUIDES— molded as part of the wedge, fit into guide channels in the valve body and maintain optimum wedge alignment with the stem throughout the wedge's travel, preventing the disc from tilting downstream during operation.
- ❑ GUIDE CAP BEARINGS — protective guide cap bearings made of a polymer bearing material snap over each rubber encapsulated guide on the wedge, providing a bearing interface between the wedge guides and the body's interior guide channels, protecting both from wear, even after thousands of cycles under severe pressure and flow conditions.
- ❑ SMOOTH, OVERSIZED FLOW WAY — all Mueller 2360 series RW Valves have a full, round, unobstructed flow way which accommodates full-sized shell cutters without interference and which provides superior flow characteristics.
- ❑ TEN YEAR LIMITED WARRANTY — (see separate Mueller Warranty document for terms).

2"-12" MUELLER® A-2360 RESILIENT WEDGE GATE VALVE - FL. x FL.

Rev. 8-04 Shaded area indicates change.

- ❑ Catalog number – **A-2360-6** flanged ends
- ❑ Sizes – 2", 2-1/2", 3", 4", 6", 8", 10", 12"
- ❑ Meets or exceeds all applicable requirements of ANSI/AWWA C509 Standard and is certified to ANSI/NSF 61*
- ❑ Flanged end dimensions and drilling comply with ANSI B16.1, class 125
- ❑ Iron body with nominal 10 mils MUELLER® Pro-Gard™ Fusion
- ❑ Epoxy Coated interior and exterior surfaces
- ❑ Epoxy coating meets or exceeds all applicable requirements of ANSI/AWWA C550 Standard and is certified to ANSI/NSF 61
- ❑ Iron wedge, symmetrical & fully encapsulated with molded rubber; no exposed iron
- ❑ Non-rising stem (NRS)
- ❑ Triple O-ring seal stuffing box (2 upper & 1 lower O-rings)
- ❑ Handwheel (~~2" square wrench nut optional~~)—open left ~~or open right~~
- ❑ 2"-12" sizes—250 psig (1723 kPa) maximum working pressure, 500 psig (3447 kPa) static test pressure
- ❑ UL Listed, FM Approved: 200 psig (1379 kPa) – 2-1/2"-12" sizes

* Approved for backflow prevention devices by USC (for 2-1/2" - 10" sizes)



A-2360-6

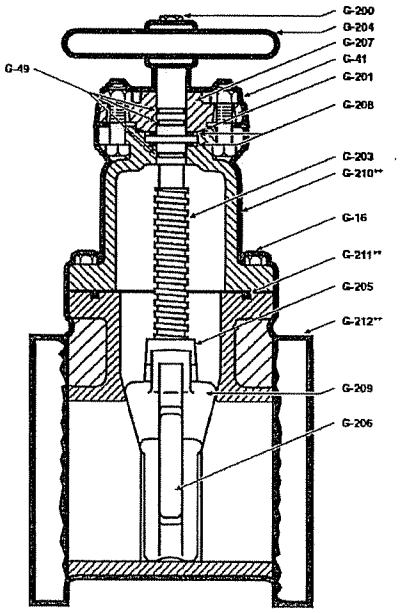
Options

See pages 10.34 and 10.35 for more information on Resilient Wedge Gate Valve options

- ❑ ~~Position indicators~~
- ❑ Stainless steel fasteners: Type 304.
- ❑ ~~PN 10/16 Drilling~~
- ❑ ~~ASTM B98 C66100/H02 stem~~
- ❑ ~~2" square wrench nut~~

Resilient wedge gate valve parts

Catalog Part No.	Description	Material	Material standard
G-16	Bonnet Bolts & Nuts	Carbon Steel	ASTM A307 Grade B, Zinc Plated
G-41	Stuffing Box Bolts & Nuts	Carbon Steel	ASTM A307 Grade B, Zinc Plated
G-49	Stem O -rings (3)	Rubber	ASTM D2000
G-200	Wrench Nut Cap Screw	Carbon Steel	ASTM A307 Grade B, Zinc Plated
G-201	Stuffing Box Seal	Rubber	ASTM D2000
G-202	Wrench Nut	Cast Iron	ASTM A126 CL.B
G-203	Stem	Bronze	ASTM B138
G-204	Hand Wheel (not shown)	Cast Iron	ASTM A126 CL.B
G-205	Stem Nut	Bronze	ASTM B62
G-206	Guide Cap Bearings	Celcon	
G-207	Stuffing Box	Cast iron	ASTM A126 CL.B
G-208	Anti-friction Washers (2)	Celcon	
G-209	Wedge, Rubber Encapsulated	Cast Iron*	ASTM A126 CL.B
G-210**	Bonnet	Cast Iron	ASTM A126 CL.B
G-211**	Bonnet O-ring	Nitrite	ASTM D2000
G-212**	Body	Cast Iron	ASTM A126 CL.B



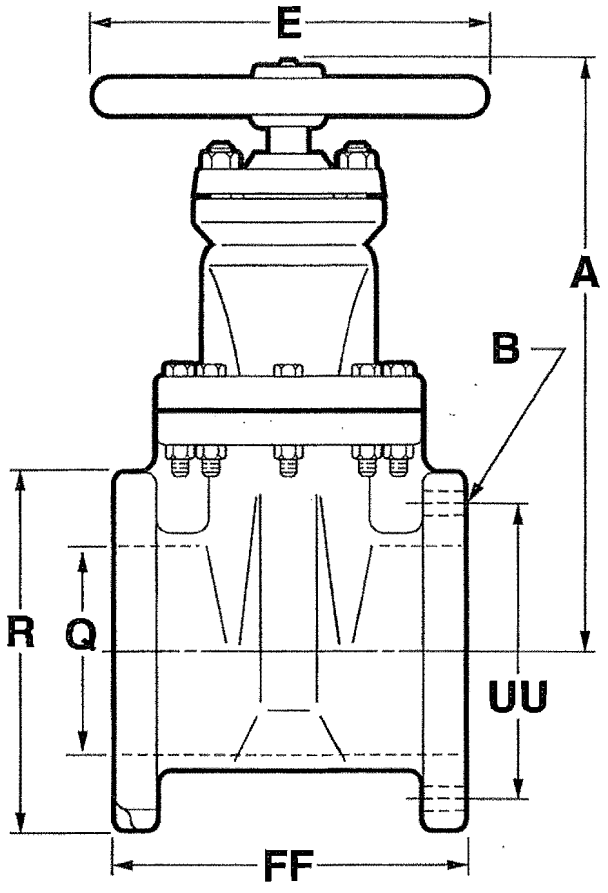
* Fully encapsulated in molded rubber with no iron exposed

** Previous to 1999 these parts on 4"-12" valves were designed with a gasket instead of an O-ring and with additional bolts (2"-3" sizes retain gasket design affecting these parts). Confirm the type of seal when ordering a replacement gasket or O-ring.

SEE PAGE 10.39 FOR ORDERING INSTRUCTIONS

2"-12" MUELLER® A-2360 RESILIENT WEDGE GATE VALVE - FL. x FL.

Rev. 8-04

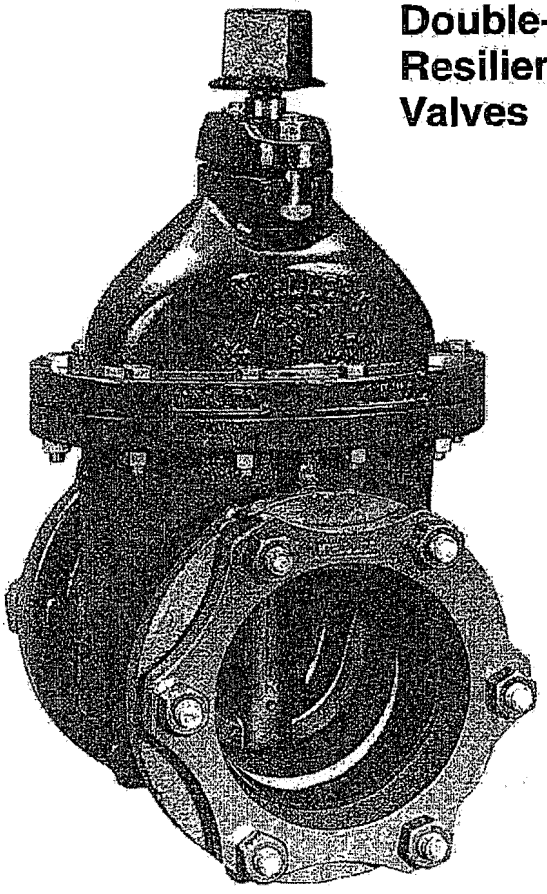


Dimensions

Dimension*	Nominal size							
	2"	2-1/2"	3	4"	6"	8"	10"	12"
A	9.88	12.38	12.38	14.19	18.00	21.50	25.50	28.62
E	6.00	6.00	8.00	11.00	13.00	14.00	16.00	16.00
R	6.00	7.00	7.50	9.00	11.00	13.50	16.00	19.00
FF	7.00	7.50	8.00	9.00	10.50	11.50	13.00	14.00
Q (bore)	2.30	2.80	3.30	4.30	6.30	8.30	10.30	12.30
UU (bolt circle diameter)	4.75	5.50	6.00	7.50	9.50	11.75	14.25	17.00
B (number and size of holes)	4–3/4"	4–3/4"	4–3/4"	8–3/4"	8–7/8"	8–7/8"	12–1"	12–1"
Turns to open	8	11	11	14	20.5	26.5	33	38.5
Weight*	37	71	73	96	154	250	400	500

*All dimensions are in inches. All weights are in pounds and are approximate.

GATE VALVE USER INSTALLATION MANUAL FOR MUELLER GATE VALVES



Double-Disc and Resilient Wedge Valves

MUELLER CO. • CHATTANOOGA, TN

LIMITED WARRANTY

Mueller Co. warrants its products to be free of defects in workmanship and material under normal use and service and when used for the purposes and under the conditions for which they are intended.

Obligation under this Warranty is limited, at Company's option; to adjustment, repair or replacement of the defective product. Purchaser must immediately notify Mueller Co. in writing of the claimed defect. Company shall have the right to inspect said product and Purchaser shall, if requested, return the defective product to Mueller Co., with transportation prepaid. Purchaser shall assume all responsibility and expense for removal, reinstallation, and freight charges in connection with the fore-going remedy.

Mueller Co. shall not be liable for indirect, special, incidental or consequential damage or penalties and does not assume any liability of Purchaser to others, or to others, for injury to persons or property.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS AND IMPLIED.

GATE VALVE USER INSTALLATION MANUAL

This booklet is designed to assist you, the installer of gate valves, by assuring that you have received a working valve, that the valve is stored and handled properly, and that after installation it will work satisfactorily. The AWWA C500 Water Works Gate Valve Standard requires working pressure and test pressure ratings be established for valves up to 12" at 200 psig water working pressure — 400 psig test pressure; for 14" valves and larger at 150 psig water working pressure — 300 psig test pressure. (Mueller® Resilient Wedge Valves through 20" are rated at 250 psig working pressure, 500 psig test pressure, 24" at 200 psig/400 psig respectively.) Every valve must be hydrostatically tested at the manufacturer's plant before shipment.

Following these simple instructions will make your job easier:

(A) INSPECTION ON DELIVERY

- When you first get the valve, check it for possible damage in shipment, conformance to specifications, opening direction, shortages, etc.
- Carefully unload all valves – do not drop valve – or lift valve using gearing, by-pass or other appendage as a hook.
- Valve should be opened and then closed to make sure it works properly. Also check opening direction against the order instruction.
- Any problems should be reported immediately to the Trucker and noted on bill of lading, and signed by the driver on your copy.

(B) STORAGE

- Valves should be stored in a fully open position.
- When possible, keep valves out of the weather.
- In cold climates the inside of the valve must be kept drained of any water to prevent freezing.
- When stored outside, valve stem should be in a vertical position.
- Whenever possible, valves should be covered with a water-proof covering.
- Protect all parts of the valve at all times.
- Protect rubber seat of resilient wedge valves from ozone and hydrocarbons (solvents, paints, and oils, etc.)

(C) INSPECTION BEFORE INSTALLATION

- Check to see the valve end-joints are clean.
- The valve is not damaged.
- Open and close valve – make sure it works properly.
- Keep valve closed when placing in trench.
- Inspect casting for damage
  (Mueller Repair Finish Kit 280087 is available for use on both resilient wedge and double-disc gate valves.)

(D) INSTALLATION

- Handle valve carefully.
- Prepare pipe ends in accordance with pipe manufacturers' instructions.
- Install valve as/per appropriate instructions for the specified joint (flanged, mechanical joint, PCV, etc.)
- Water main should be properly supported to avoid line stress on valve.
- In buried applications, make sure that the valve box does not transmit traffic loads or other stress to the valve.
- Do not use valves to force a pipeline into position.
- Do not deflect any valve/pipe joint.

(E) TESTING

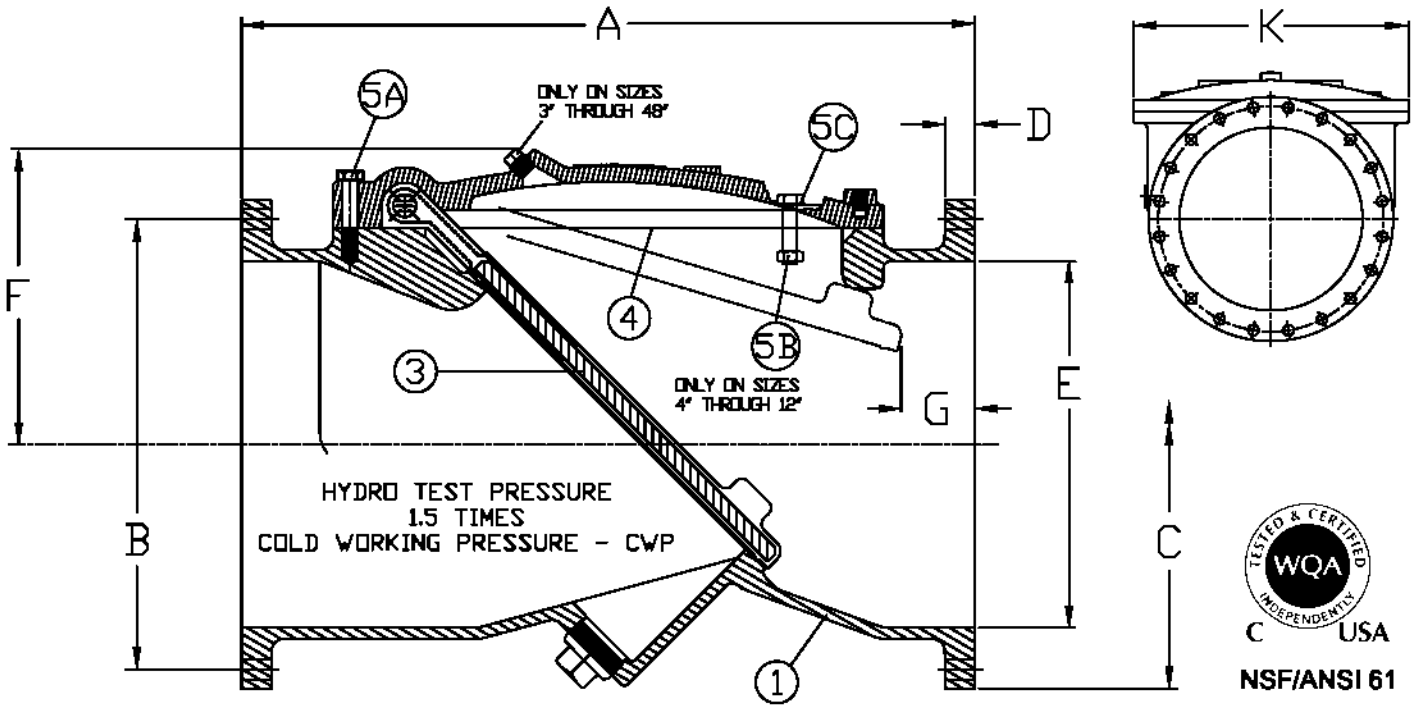
- Do not backfill valves before hydrostatic system test. Leave the valves exposed while the pipeline is being pressurized. Check to see that all valve joints and pressure containing bolting, including bonnet bolts, are tight.
- AWWA C-500 states that double-disc gate valves have an allowable leakage rate. This allowable leakage must be taken into consideration when hydrostatically testing the system. (This does not apply to resilient wedge valves.)
- Valves can be tested – **(but not operated)** at two times the rated pressure of the valve.
- After testing, steps should be taken to relieve any trapped pressure in body of valves.

GENERAL NOTES

These reference materials are available and should be helpful in the installation and testing of Gate Valve products.

- AWWA C-500 (Gate Valves – 3" thru 48")
- AWWA C-509 (Resilient Seated Gate Valves 3" thru 12" Nominal Pipe Size)
- AWWA C-600 Installation of Ductile Iron Water Mains and Main Appurtenances.
- All installation, operation and maintenance instructions issued by the manufacturer of the pipe and the valves.
- Valve user guide as published by MSS.
- AWWA Recommendation for Installation, Operation and Maintenance of Gate Valves.
- NFPA-24 – Outside Pipeline Protection Equipment U/L.
- AWWA C-515 Reduced Wall Gate valves.

These industry practices have been listed to help you make a safe and acceptable installation of a gate valve.



SEE DRAWING NO. VM-502A-M FOR STANDARD MATERIALS OF CONSTRUCTION.

DRAWING DEPICTS 24" SIZE TO SCALE

ANSI CLASS 125

VALVE SIZE	MODEL NO.	CWP (PSI)	A	B	C	D	E	F	G	K	BOLT SIZE	NO. OF BOLTS
2	502A	250	8.00	4.75	6.00	0.63	2.00	3.38	1.63	5.18	5/8	4
2 1/2	525A	250	8.50	5.50	7.00	0.68	2.50	3.38	1.63	5.18	5/8	4
3	503A	250	9.50	6.00	7.50	0.75	3.00	5.12	1.63	7.50	5/8	4
4	504A	250	11.50	7.50	9.00	0.75	4.00	5.75	2.12	8.25	5/8	8
6	506A	250	15.00	9.50	11.00	0.75	6.00	6.88	2.12	11.12	3/4	8
8	508A	250	19.50	11.75	13.50	0.88	8.00	8.38	2.88	16.00	3/4	8
10	510A	250	24.50	14.25	16.00	1.18	10.00	10.75	3.12	21.00	7/8	12
12	512A	250	27.50	17.00	19.00	1.25	12.00	12.50	3.43	24.00	7/8	12
14	514A	250	31.00	18.75	21.00	1.38	14.00	13.00	3.63	23.25	1	12
16	516A	250	32.00	21.25	23.50	1.43	16.00	14.25	3.25	25.25	1	16
18	518A	250	36.00	22.75	25.00	1.56	18.00	15.25	3.12	28.25	1 1/8	16
20	520A	250	40.00	25.00	27.50	1.68	20.00	16.88	3.50	30.63	1 1/8	20
24	524A	250	48.00	29.50	32.00	1.88	24.00	19.25	5.00	36.00	1 1/4	20
30	530	150	56.00	36.00	38.75	2.12	30.00	23.00	5.75	45.88	1 1/4	28
30	530A	250	56.00	36.00	38.75	2.12	30.00	23.00	5.75	45.88	1 1/4	28
36	536	150	63.00	42.75	46.00	2.38	36.00	27.38	3.88	55.00	1 1/2	32
36	536A	250	63.00	42.75	46.00	2.38	36.00	27.38	3.88	55.00	1 1/2	32
42	542	150	70.00	49.50	53.00	2.63	42.00	36.88	0.12	60.18	1 1/2	36
42	542A	250	70.00	49.50	53.00	2.63	42.00	36.88	0.12	60.18	1 1/2	36
48	548	150	76.00	56.00	59.50	2.75	48.00	40.66	0.12	68.00	1 1/2	44
48	548A	250	76.00	56.00	59.50	2.75	48.00	40.66	0.12	68.00	1 1/2	44

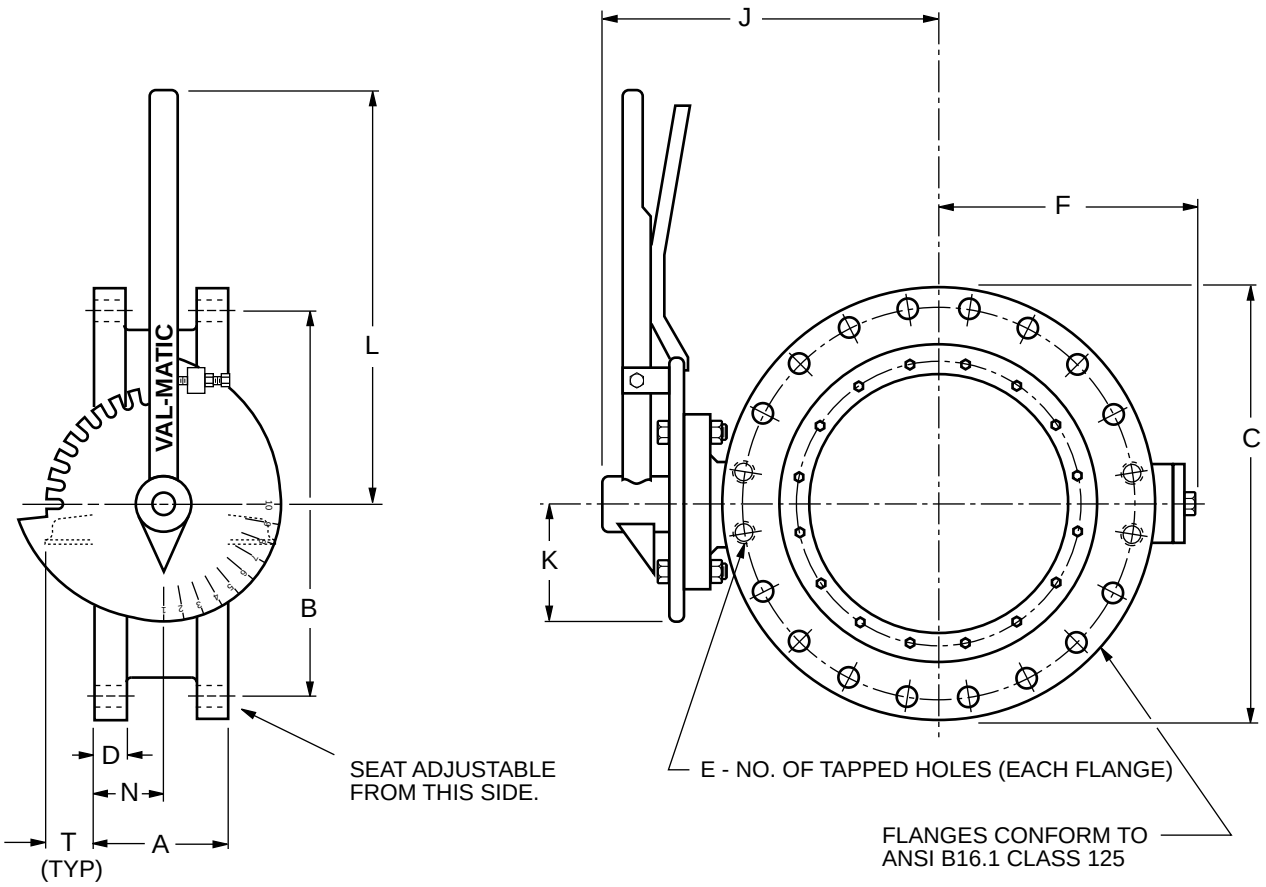
Revised 3-31-11

SWING-FLEX CHECK VALVE

DATE 10-17-08

DRWG. NO. VMC-502A

VAL-MATIC VALVE AND MANUFACTURING CORP.



FLANGE DIMENSIONS, INCHES

VALVE SIZE	AWWA C504 CLASS	ACTU-ATOR SIZE	ACTUATOR PRESSURE RATING (PSI)	A	B	C	D	E Qty	E Tap	E Deep	F	J	K	L	N	T	TURNS TO OPEN	NO. OF BOLTS	BOLT SIZE	SHPG. WT.
3	150B	4BL	150	5.00	6.00	7.50	0.94	4	5/8-11	1.06	6.00	7.88	4.31	12.00	2.50	—	1/4	4	5/8	66
4	150B	4BL	150	5.00	7.50	9.00	0.94	0	—	—	6.00	7.88	4.31	12.00	2.50	—	1/4	8	5/8	71
6	150B	6BL	150	5.00	9.50	11.00	1.00	4	3/4-10	1.00	7.00	8.62	4.31	12.00	2.50	0.69	1/4	8	3/4	90
8	150B	6BL	75	6.00	11.75	13.50	1.12	0	—	—	8.00	9.56	4.31	12.00	3.00	1.18	1/4	8	3/4	125
10	150B	10BL	25	8.00	14.25	16.00	1.18	0	—	—	10.00	12.81	4.31	18.00	4.00	1.13	1/4	12	7/8	200
12	150B	10BL	25	8.00	17.00	19.00	1.25	0	—	—	11.06	13.88	4.31	18.00	4.00	2.13	1/4	12	7/8	250

Revised 2-6-06

150B FLANGED BUTTERFLY VALVE WITH HANDLEVER

DATE 10-6-99

VAL-MATIC® VALVE AND MANUFACTURING CORP.

DRWG. NO. VM-2004/L

CLA-VAL™

MODEL 136-03 (Full Internal Port) 636-03 (Reduced Internal Port)

Solenoid Control Valve

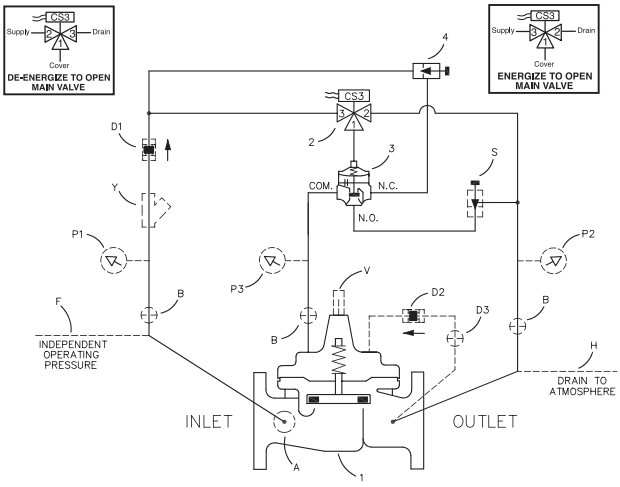
- **Fast Acting Solenoid Control**
- **Drip Tight Shut-Off**
- **Simple Design, Proven Reliable**
- **Optional Check Feature**
- **Easy Installation & Maintenance**

The Cla-Val Model 136-03/636-03 Solenoid Control Valve is an on-off control valve which either opens fully or closes drip-tight upon receiving an electrical signal to the solenoid pilot control. This valve consists of a Hytrol main valve, a three way solenoid and a high capacity three-way pilot valve. The solenoid control operates the three-way valve which alternately applies pressure to or relieves pressure from the diaphragm chamber of the main valve. It is furnished either normally open (de-energize solenoid to open) or normally closed (energize solenoid to open).

If the check feature option is added and a pressure reversal occurs, the downstream pressure is admitted into the main valve cover chamber and the valve closes to prevent return flow.

Schematic Diagram

Item	Description
1	Hytrol (Main Valve)
2	CS3 Solenoid Control
3	102C-3H Three-Way Valve
4	CNA Needle Valve (Closing)

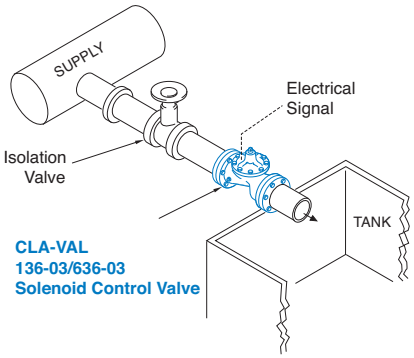


Valves 6" and larger with a "D" check feature must be installed with the main valve stem in a vertical position

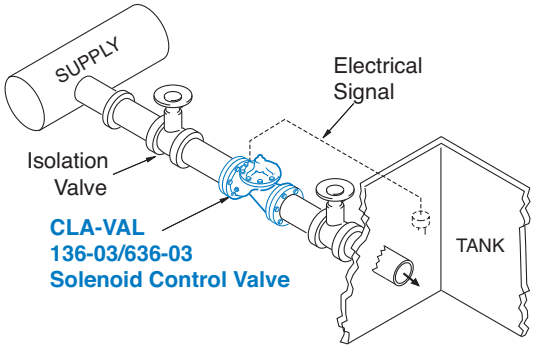
Optional Features

Item	Description
A	X46 Flow Clean Strainer
B	CK2 (Isolation Valve)
D	Check Valves With Isolation Valve
F	Independent Operating Pressure
H	Atmospheric Drain
P	X141 Pressure Gauge
S	CNA Needle Valve (Opening)
V	X101 Valve Position Indicator
Y	X43 "Y" Strainer

Typical Applications



Industrial uses for the solenoid control valve are many and include accurate control of process water for batching, mixing, washing, blending or other on-off type uses.



Liquid level control can be provided by using a float switch or electrode probe which sends an electrical signal to open or close the valve as needed.

CLA-VAL™

Model 136-03 (Uses Basic Valve Model 100-01)

Pressure Ratings (Recommended Maximum Pressure - psi)

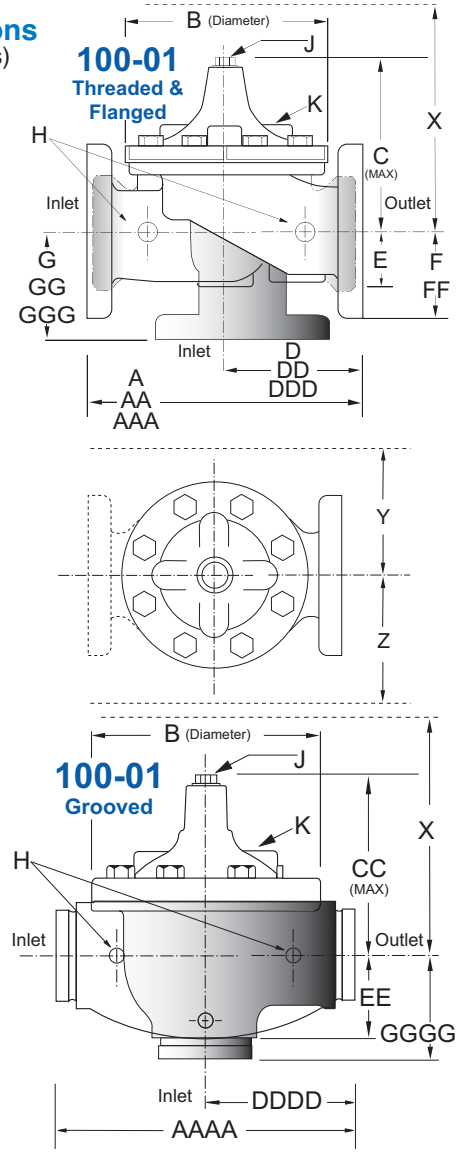
Valve Body & Cover		Pressure Class				
		Flanged			Grooved	Threaded
Grade	Material	ANSI Standards*	150 Class	300 Class	300 Class	End‡ Details
ASTM A536	Ductile Iron	B16.42	250	400	400	400
ASTM A216-WCB	Cast Steel	B16.5	285	400	400	400
ASTM B62	Bronze	B16.24	225	400	400	400

Note: * ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.
‡ End Details machined to ANSI B2.1 specifications.
Valves for higher pressure are available; consult factory for details

Materials

Component	Standard Material Combinations		
Body & Cover	Ductile Iron	Cast Steel	Bronze
Available Sizes	4" - 36"	4" - 16"	4" - 16"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze
Trim: Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is Optional		
Disc	Buna-N® Rubber		
Diaphragm	Nylon Reinforced Buna-N® Rubber		
Stem, Nut & Spring	Stainless Steel		
For material options not listed, consult factory. Cla-Val manufactures valves in more than 50 different alloys.			

Dimensions
(In inches)



Model 136-03 Dimensions (In Inches)

Valve Size (Inches)	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**24**	**30**	**36**
A Threaded	—	—	—	—	—	—	—	—	—	—	—	—
AA 150 ANSI	15.00	20.00	25.38	29.75	34.00	39.00	41.38	46.00	52.00	61.50	63.00	76.00
AAA 300 ANSI	15.62	21.00	26.38	31.12	35.50	40.50	43.50	47.64	53.62	63.24	64.50	76.00
AAAA Grooved End	15.00	20.00	25.38	—	—	—	—	—	—	—	—	—
B Dia.	11.50	15.75	20.00	23.62	28.00	32.75	35.50	41.50	45.00	53.16	56.00	66.00
C Max.	10.62	13.38	16.00	17.12	20.88	24.19	25.00	39.06	41.90	43.93	54.60	61.50
CC Max. Grooved End	9.31	12.12	14.62	—	—	—	—	—	—	—	—	—
D Threaded	—	—	—	—	—	—	—	—	—	—	—	—
DD 150 ANSI	7.50	10.00	12.69	14.88	17.00	19.50	20.81	—	—	30.75	—	—
DDD 300 ANSI	7.88	10.50	13.25	15.56	17.75	20.25	21.62	—	—	31.62	—	—
DDDD Grooved End	7.50	—	—	—	—	—	—	—	—	—	—	—
E	3.19	4.31	5.31	9.25	10.75	12.62	15.50	12.95	15.00	17.75	21.31	24.56
EE Grooved End	4.25	6.00	7.56	—	—	—	—	—	—	—	—	—
F 150 ANSI	4.50	5.50	6.75	8.00	9.50	10.50	11.75	15.00	16.50	19.25	22.50	25.60
FF 300 ANSI	5.00	6.25	7.50	8.75	10.25	11.50	12.75	15.00	16.50	19.25	24.00	25.60
G Threaded	—	—	—	—	—	—	—	—	—	—	—	—
GG 150 ANSI	5.00	6.00	8.00	8.62	13.75	14.88	15.69	—	—	22.06	—	—
GGG 300 ANSI	5.31	6.50	8.50	9.31	14.50	15.62	16.50	—	—	22.90	—	—
GGGG Grooved End	5.00	—	—	—	—	—	—	—	—	—	—	—
H NPT Body Tapping	.75	.75	1	1	1	1	1	1	1	1	2	2
J NPT Cover Center Plug	.75	.75	1	1	1.25	1.5	2	1.5	1.5	1.5	2	2
K NPT Cover Tapping	.75	.75	1	1	1	1	1	1	1	1	2	2
Stem Travel	1.1	1.7	2.3	2.8	3.4	4.0	4.5	5.1	5.63	6.75	7.5	8.5
Approx. Ship Wt. Lbs.	140	285	500	780	1165	1600	2265	2982	3900	6200	7703	11720
X Pilot System	17	29	31	33	36	40	40	43	47	68	79	85
Y Pilot System	12	20	22	24	26	29	30	32	34	39	40	45
Z Pilot System	12	20	22	24	26	29	30	32	34	39	42	47

Note: The top two flange holes on valve size 36 are threaded to 1 1/2"-6 UNC.

Model 636-03 (Uses Basic Valve Model 100-20)

Pressure Ratings (Recommended Maximum Pressure - psi)

Valve Body & Cover		Pressure Class		
		Flanged		
Grade	Material	ANSI Standards*	150 Class	300 Class
ASTM A536	Ductile Iron	B16.42	250	400
ASTM A216-WCB	Cast Steel	B16.5	285	400
ASTM B62	Bronze	B16.24	225	400

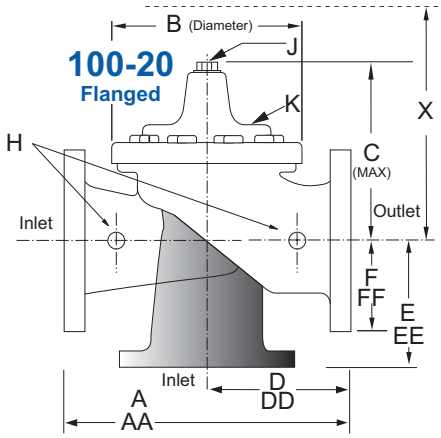
Note: * ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.
Valves for higher pressure are available; consult factory for details

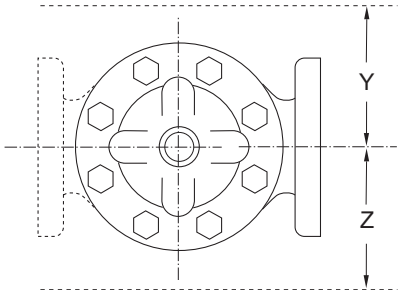
Materials

Component	Standard Material Combinations		
Body & Cover	Ductile Iron	Cast Steel	Bronze
Available Sizes	6" - 48"	6" - 16"	6" - 16"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze
Trim: Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is Optional		
Disc	Buna-N® Rubber		
Diaphragm	Nylon Reinforced Buna-N® Rubber		
Stem, Nut & Spring	Stainless Steel		

For material options not listed, consult factory.
Cla-Val manufactures valves in more than 50 different alloys.

Dimensions
(In inches)





Model 636-03 Dimensions (In Inches)

Valve Size (Inches)	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**24**	**30**	**36**	**42**	**48**
A 150 ANSI	17.75	21.38	26.00	30.00	34.25	35.00	42.12	48.00	48.00	63.25	65.00	76.00	94.50
AA 300 ANSI	18.62	22.38	27.38	31.50	35.75	36.62	43.63	49.62	49.75	63.75	67.00	76.00	94.50
B Dia.	11.50	15.75	20.00	23.62	27.47	28.00	35.44	35.44	35.44	53.19	56.00	66.00	66.00
C Max.	11.62	15.00	17.88	21.00	20.88	25.75	25.00	31.00	31.00	43.94	54.60	61.50	61.50
D 150 ANSI	8.88	10.69	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
DD 300 ANSI	9.38	11.19	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
E 150 ANSI	6.75	7.25	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
EE 300 ANSI	7.25	7.75	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
F 150 ANSI	5.50	6.75	8.00	9.50	11.00	11.75	15.88	14.56	17.00	19.88	25.50	28.00	31.50
FF 300 ANSI	6.25	7.50	8.75	10.25	11.50	12.75	15.88	16.06	19.00	22.00	27.50	28.00	31.50
H NPT Body Tapping	.75	.75	1	1	1	1	1	1	1	1	2	2	2
J NPT Cover Center Plug	.75	.75	1	1	1.25	1.25	2	2	2	2	2	2	2
K NPT Cover Tapping	.75	.75	1	1	1	1	1	1	1	1	2	2	2
Stem Travel	1.1	1.7	2.3	2.8	3.4	3.4	3.4	4.5	4.5	6.5	7.5	8.5	8.5
Approx. Ship Wt. Lbs.	195	330	625	900	1250	1380	1500	2551	2733	6500	8545	12450	13100
X Pilot System	27	30	33	36	36	41	40	46	55	68	79	85	86
Y Pilot System	18	20	22	24	26	26	30	30	30	39	40	45	47
Z Pilot System	18	20	22	24	26	26	30	30	30	39	42	47	49

*Consult Factory

Note: The top two flange holes on valve sizes 36 thru 48 are threaded to 1 1/2"-6 UNC.

136-03 Valve Selection	100-01 Pattern: Globe (G), Angle (A), End Connections: Threaded (T), Grooved (GR), Flanged (F) Indicate Available Sizes												
	Inches	4	6	8	10	12	14	16	18	20	24	30	36
	mm	100	150	200	250	300	350	400	450	500	600	750	900
Basic Valve 100-01	Pattern	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G	G	G, A	G	G
	End Detail	F, Gr	F, Gr*	F, Gr*	F	F	F	F	F	F	F	F	F
Suggested Flow (gpm)	Max. Continuous	800	1800	3100	4900	7000	8400	11000	14000	17000	25000	42000	50000
	Max. Intermittent	990	2250	3900	6150	8720	10540	13700	17500	21700	31300	48000	62500
Suggested Flow (Liters/Sec)	Max. Continuous	50	113	195	309	442	530	694	883	1073	1577	2650	3150
	Max. Intermittent	62	142	246	387	549	664	863	1104	1369	1972	3028	3940

*Globe Grooved Only

100-01 Series is the full internal port Hytrol

For 100-01 basic valves • Suggested flow calculations are based on flow through Schedule 40 Pipe. • Max continuous flow is approx. 20 ft/sec (6.1 meters/sec). • Max intermittent is approx. 25 ft/sec (7.6 meters/sec).

636-03 Valve Selection	100-20 Pattern: Globe (G), Angle (A), End Connections: Flanged (F) Indicate Available Sizes												
	Inches	6	8	10	12	14	16	18	20	24	30	36	42	48
	mm	150	200	250	300	350	400	450	500	600	750	900	1000	1200
Basic Valve 100-20	Pattern	G, A	G, A	G	G	G	G	G	G	G	G	G	G	G
	End Detail	F	F	F	F	F	F	F	F	F	F	F	F	F
Suggested Flow (gpm)	Max. Continuous	1025	2300	4100	6400	9230	9230	16500	16500	16500	28000	33500	33500	33500
Suggested Flow (Liters/Sec)	Max. Continuous	65	145	258	403	581	581	1040	1040	1040	1764	2115	2115	2115

100-20 Series is the reduced internal port size version of the 100-01 Series.

For 100-20 basic valves • Suggested flow calculations are based on flow through the valve seat. • Max continuous flow is approx. 26 ft/sec (7.9 meters/sec).
• Max continuous flow through the valve seat for the 30" 100-20 is approx. 20 ft/sec (6.1 meters/sec).
• Max continuous flow through the valve seat for the 36", 42", 48" 100-20 is approx. 15.8 ft/sec. (4.8 meters/sec).

Pilot System Specifications

Temperature Range

Water: to 180°F

Fluids

Air, water, light oils

Rubber Parts:

Buna-N® Synthetic Rubber

Solenoid Control

Body:

Brass ASTM B283

Enclosure:

NEMA Type 1,2,3,3S,4,4X general purpose watertight*

NEMA Type 6,6P,7,9 watertight Explosion Proof available at extra cost

Voltages:

110, 220 - 50Hz AC

24, 120, 240, 480 - 60Hz AC

6, 12, 24, 120, 240 - DC

Others available at additional cost

Max. operating pressure differential:

200 psi*

Coil:

Insulation molded Class	F
Watts AC	6
AC Volt Amps Inrush	30
AC Volt Amps Holding	16
Watts DC	10.6

Manual operator available at additional cost.

*Supplied unless otherwise specified

Note: Flowing Pressure Differential: 5 psi minimum

When Ordering, Please Specify

1. Catalog No. 136-03 or No. 636-03
2. Valve Size
3. Pattern - Globe or Angle
4. Pressure Class
5. Threaded or Flanged
6. Materials Desired
7. Energized or de-energized to open Main Valve
8. Solenoid Enclosure, Voltage & Hertz, Coil Insulation, and Max. Operating Pressure Differential
9. Desired Options
10. When Vertically Installed

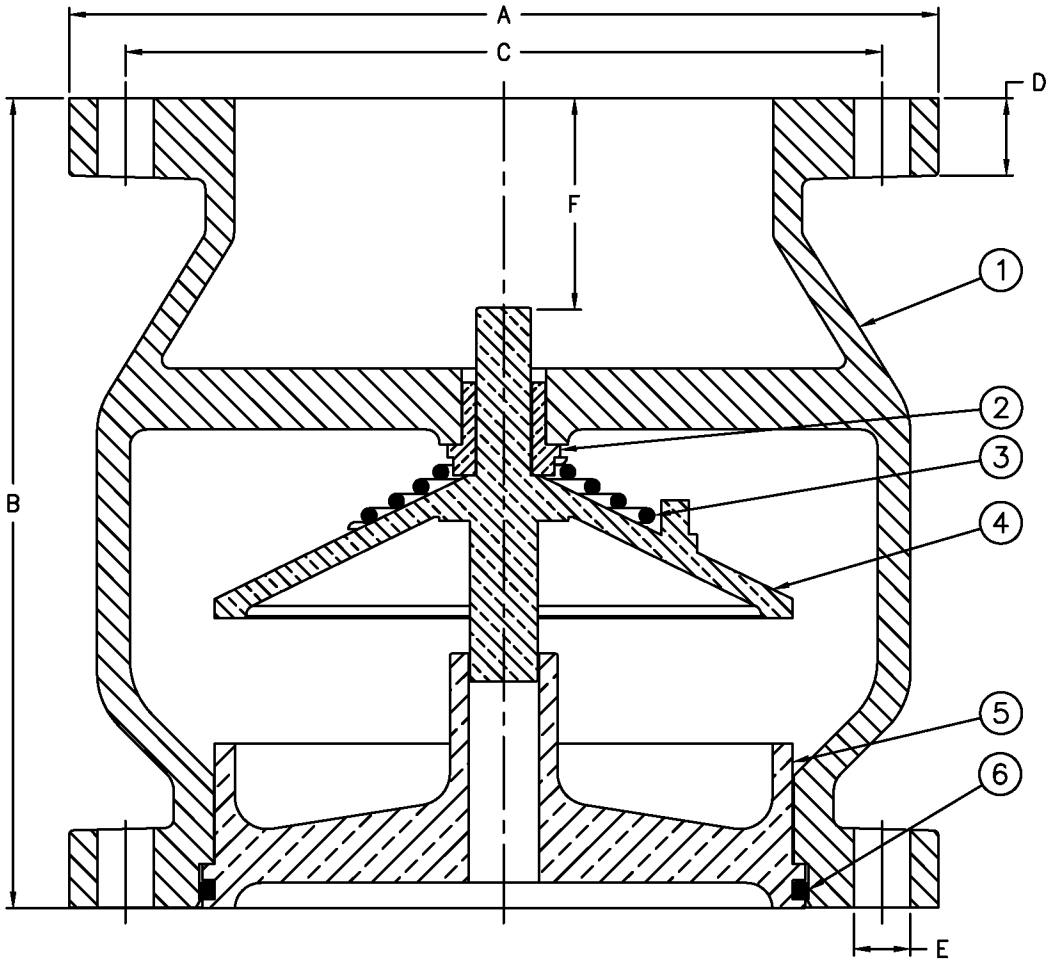
CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

Globe Style Silent Check Model 402BT

Danfoss Flomatic

Sizes 8" Thru 10" / 200 mm Thru 250 mm
125# Flange

Materials



Item #	Qty	Description	Material	ASTM
1	1	Body (Epoxy Coated)	Cast Iron	Cast Iron A126
2	1	Bushing	Bronze	C89833
3	1	Spring	Stainless Steel	302
4	1	Poppet	Bronze	C89833
5	1	*Seat Ring	Bronze	C89833
6	1	O-Ring	Buna-n	------

*OPTIONAL RESILIENT SEAT AVAILABLE, ADD "R" TO THE PART NUMBER
Max Temp 180°F (82°C)
Max Inlet Pressure 200psi (14bar)

Dimensions

Size		Part #	ØA		B		ØC		D		ØE		F		Weight		Bolt Size	# of Bolts
Inch	mm		Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	lbs	kg		
8	200	2245BT	13-1/2	343	12-9/16	319	11-3/4	299	1-1/8	29	7/8	22	3-1/4	83	116	53	3/4	8
10	250	2247BT	18	457	15-1/2	394	14-1/4	362	1-3/16	30	1	25	4-1/4	108	194	88	7/8	12

DANFOSS FLOMATIC CORP.
GLENS FALLS, N.Y. 12801
PHONE (518) 761-9797
FAX (518) 761-9798

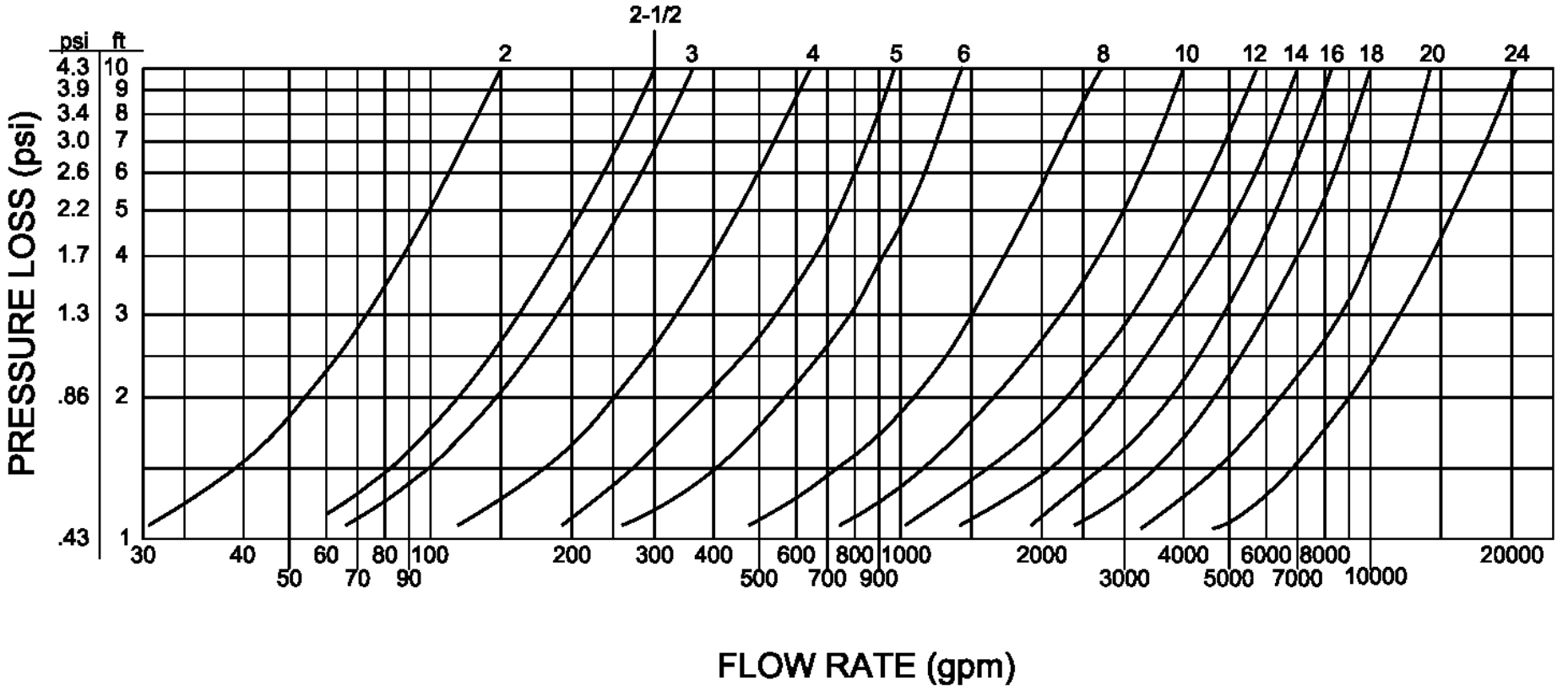
April 5, 1995
Dwg No: S402BT-2 Rev: G (6/09)

FLOMATIC®

Silent Check Valve Headloss Chart Model 402BT/402BTR

FLOMATIC®
Flomatic Corporation

Sizes 2" thru 24"/ 50 mm thru 600 mm
Globe Style



PATENT # 6,024,121

FLOMATIC® VALVES

May 12, 1994
Dwg No: S402BTHL Rev: G (5/11)

FLOMATIC CORPORATION
GLENS FALLS, N.Y. 12801
PHONE (518) 761-9797
FAX (518) 761-9796

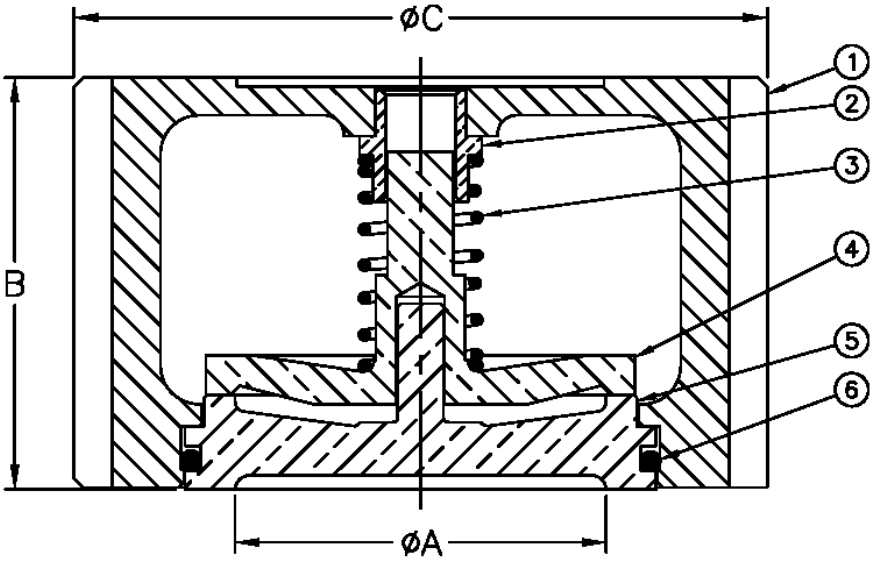
Wafer Check Valve Silent Check Model 888

Sizes 2" Thru 6" / 50 mm & 150 mm

FLOMATIC®
Flomatic Corporation

Materials

#1 Pb Lead-Free



Item #	Qty	Description	Material	ASTM
1	1	Body (Epoxy Coated)	Cast Iron	A126, Class B
2	1	Bushing	Bronze	C89833
3	1	Spring	Stainless Steel	302
4	1	Poppet	Bronze	C89833
5	1	Seat Ring*	Bronze	C89833
6	1	O'Ring	Buna-n	——

*OPTIONAL RESILIENT SEAT AVAILABLE, ADD "R" TO THE PART NUMBER
Max Temp 180°F (82°C)
Max Inlet Pressure (125#) 200 psi (14bar)
Max Inlet Pressure (250#) 400 psi (27bar)
PATENT # 6,024,121

Dimensions

Size		Part #	A		B		C		Weight		# of Bolts		Bolt Size by Flange	
Inch	mm		Inch	mm	Inch	mm	Inch	mm	lbs	kg	125#	250#	125#	250#
2	50	2434	2-13/32	61	2-43/64	68	4-1/2	114	5	2.5	4	8	5/8 x 5-1/4	5/8 x 5-1/2
2-1/2	65	2432	2-9/16	65	2-7/8	73	5	127	7	3	4	8	5/8 x 5-1/4	3/4 x 6-1/2
3	80	2435	3-1/4	83	3-13/64	81	5-3/4	146	11	5	4	8	5/8 x 6-1/4	3/4 x 7
4	100	2436	4-3/8	111	4-1/16	103	7-3/16	183	18	8	8	8	5/8 x 7	3/4 x 8
5	125	2433	5-1/4	133	4-3/4	121	8-3/8	213	25	11.5	8	8	3/4 x 7-3/4	3/4 x 9
6	150	2437	5-29/32	150	5-5/8	143	9-3/4	248	36	16.5	8	12	3/4 x 8-3/4	3/4 x 10

FLOMATIC® VALVES

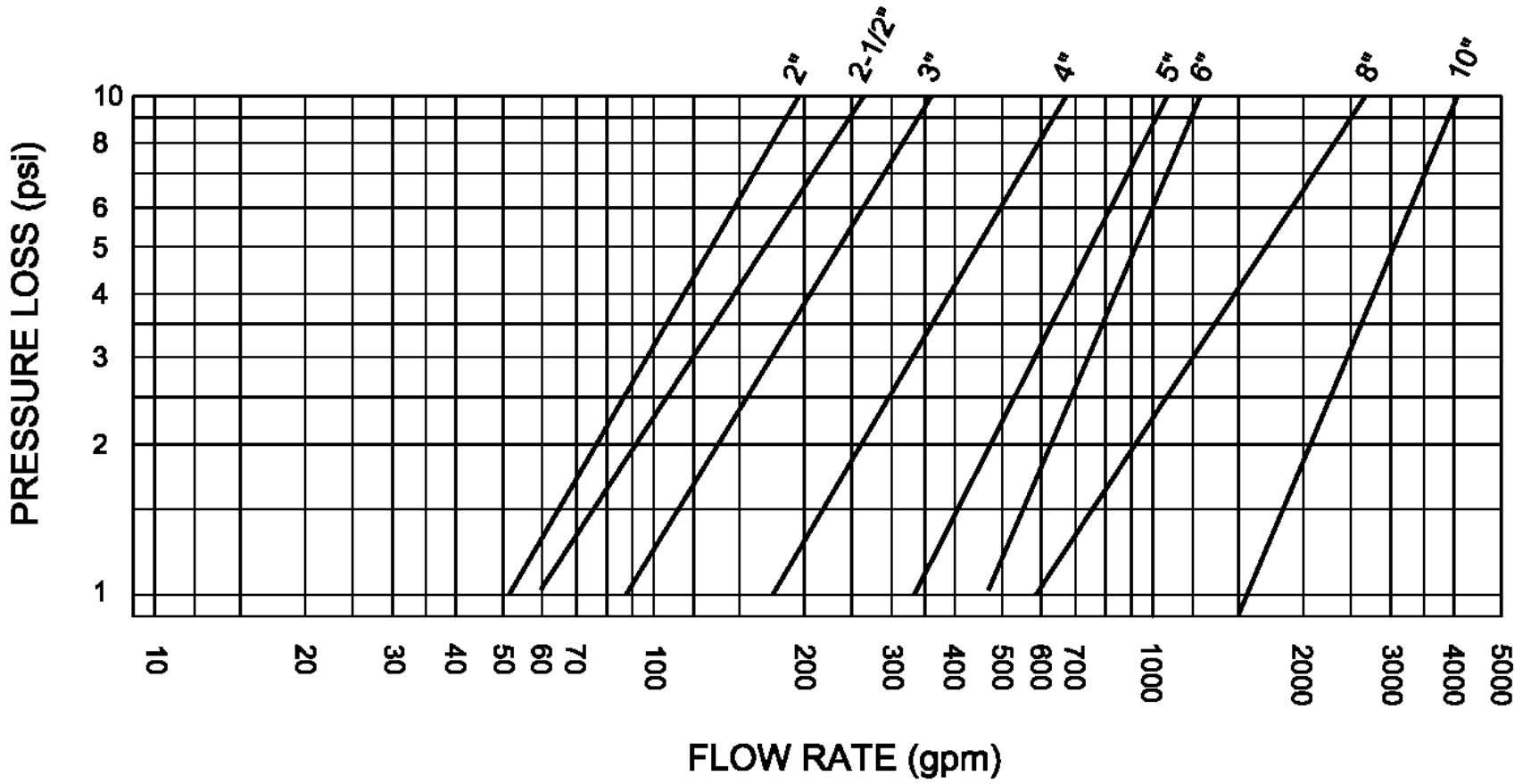
April 4, 1995
Dwg No: S888-1 Rev M (6/11)

FLOMATIC CORPORATION
GLENS FALLS, N.Y. 12801
PHONE (518) 761-9797
FAX (518) 761-9798

Wafer Check Valve — Headloss Chart — Model 888/888R

Sizes 2" thru 10"/ 50 mm thru 250 mm

FLOMATIC®
Flomatic Corporation



PATENT # 6,024,121

FLOMATIC® VALVES

December 28, 1994
Dwg No: 8868HL Rev: D (6/11)

FLOMATIC CORPORATION
GLENS FALLS, N.Y. 12801
PHONE (518) 761-9797
FAX (518) 761-9798

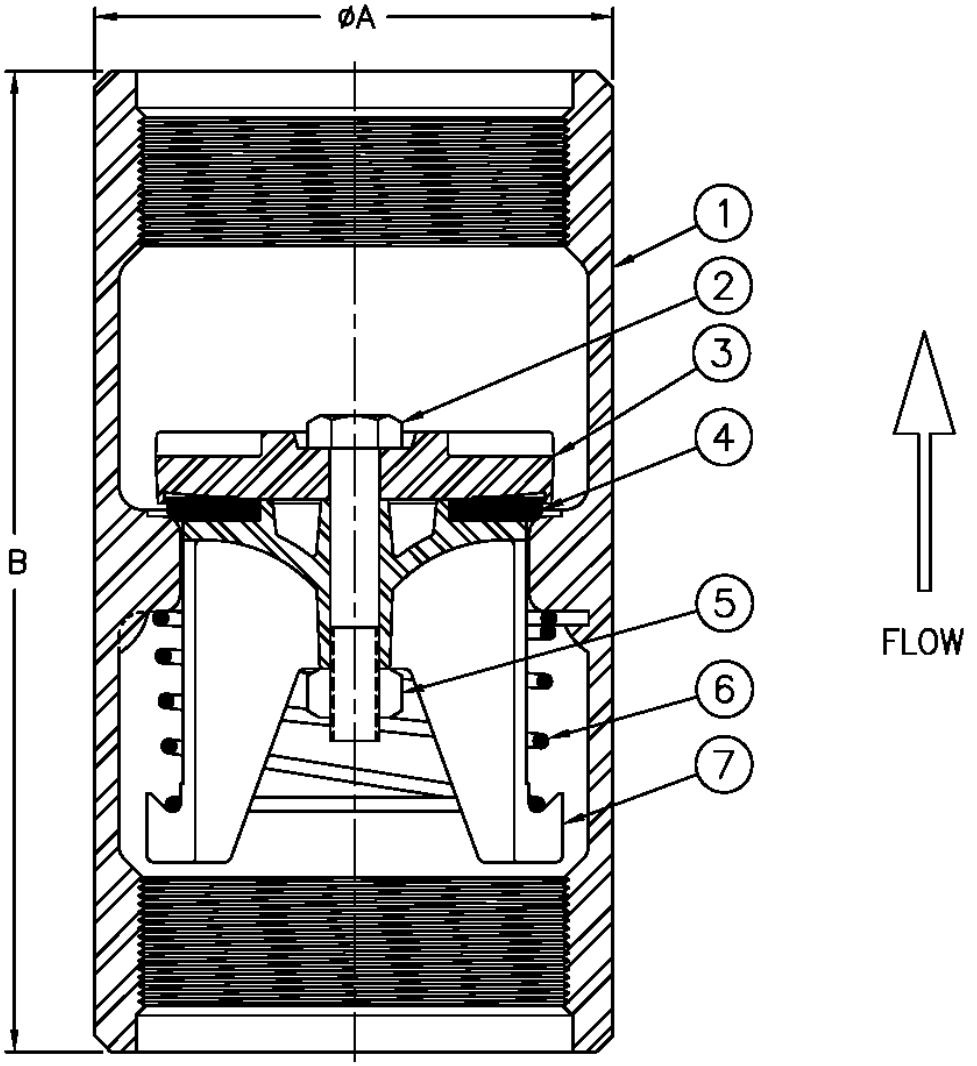
Stainless Steel Check Valve

Model 80S6

Sizes 6" / 150mm

FLOMATIC®
Flomatic Corporation

Materials



Max Temp 400°F (200°C)
Max Pressure 400psi (28bar)

Item #	Qty	Description	Material	ASTM	Item #	Qty	Description	Material	ASTM
1	1	Body	Stainless Steel	316	5	1	Nut	Stainless Steel	316
2	1	Bolt	Stainless Steel	316	6	1	Spring	Stainless Steel	316
3	1	Dome	Stainless Steel	316	7	1	Guide	Stainless Steel	316
4	1	Disc	Viton	------					

Dimensions

Size		Part #	A		B		Weight	
Inch	mm		Inch	mm	Inch	mm	lbs	kg
6	150	4089S6	8	203	15-1/8	384	65	29

FLOMATIC® VALVES

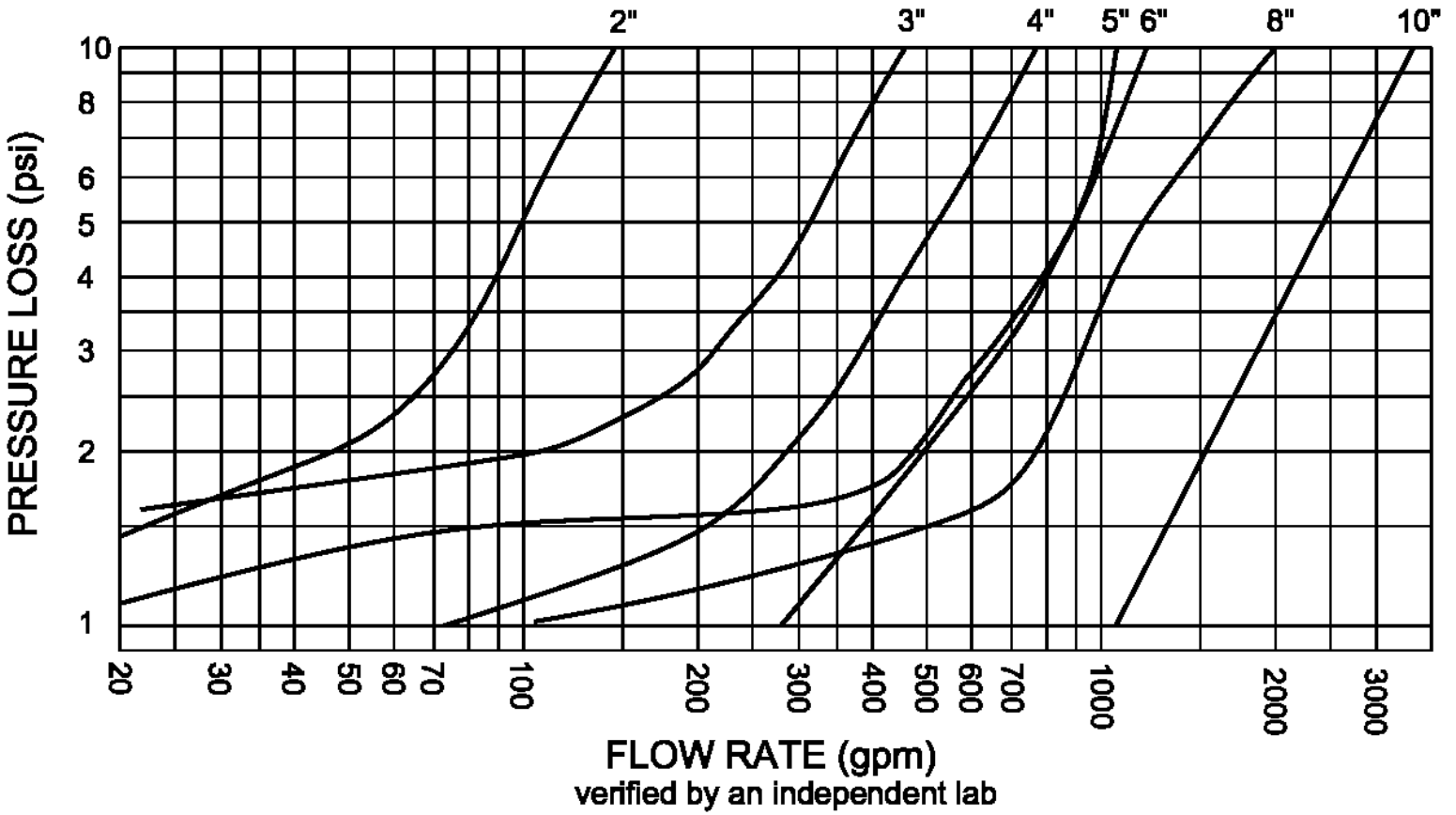
May 21, 1998
Dwg No: S4089S6 Rev: B (6/11)

FLOMATIC CORPORATION
GLENS FALLS, N.Y. 12801
PHONE (518) 761-9797
FAX (518) 761-9798

Stainless Steel Check Valves Headloss Chart Model 80S6 & 80S6CL

Sizes 2" Thru 10" / 50mm Thru 250mm

FLOMATIC®
Flomatic Corporation



FLOMATIC® VALVES

July 3, 2003
Dwg No: S80S6HL2 Rev: F (6/11)

FLOMATIC CORPORATION
GLENS FALLS, N.Y. 12801
PHONE (518) 761-9797
FAX (518) 761-9798

FRANKLIN ELECTRIC

2011 AIM MANUAL

SUBMERSIBLE MOTORS

Application • Installation • Maintenance

60 Hz, Single-Phase and Three-Phase Motors

System Solutions

Franklin Electric

ATTENTION!
IMPORTANT INFORMATION FOR INSTALLERS OF THIS EQUIPMENT!

THIS EQUIPMENT IS INTENDED FOR INSTALLATION BY TECHNICALLY QUALIFIED PERSONNEL. FAILURE TO INSTALL IT IN COMPLIANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES, AND WITHIN FRANKLIN ELECTRIC RECOMMENDATIONS, MAY RESULT IN ELECTRICAL SHOCK OR FIRE HAZARD, UNSATISFACTORY PERFORMANCE, AND EQUIPMENT FAILURE. FRANKLIN INSTALLATION INFORMATION IS AVAILABLE FROM PUMP MANUFACTURERS AND DISTRIBUTORS, AND DIRECTLY FROM FRANKLIN ELECTRIC. CALL FRANKLIN TOLL FREE 800-348-2420 FOR INFORMATION.

WARNING

SERIOUS OR FATAL ELECTRICAL SHOCK MAY RESULT FROM FAILURE TO CONNECT THE MOTOR, CONTROL ENCLOSURES, METAL PLUMBING, AND ALL OTHER METAL NEAR THE MOTOR OR CABLE, TO THE POWER SUPPLY GROUND TERMINAL USING WIRE NO SMALLER THAN MOTOR CABLE WIRES. TO REDUCE RISK OF ELECTRICAL SHOCK, DISCONNECT POWER BEFORE WORKING ON OR AROUND THE WATER SYSTEM. DO NOT USE MOTOR IN SWIMMING AREAS.

ATTENTION!
INFORMATIONS IMPORTANTES POUR L'INSTALLATEUR DE CET EQUIPEMENT.

CET EQUIPEMENT DOIT ETRE INTALLE PAR UN TECHNICIEN QUALIFIE. SI L'INSTALLATION N'EST PAS CONFORME AUX LOIS NATIONALES OU LOCALES AINSI QU'AUX RECOMMANDATIONS DE FRANKLIN ELECTRIC, UN CHOC ELECTRIQUE, LE FEU, UNE PERFORMANCE NON ACCEPTABLE, VOIRE MEME LE NON-FONCTIONNEMENT PEUVENT SURVENIR. UN GUIDE D'INSTALLATION DE FRANKLIN ELECTRIC EST DISPONIBLE CHEZ LES MANUFACTURIERS DE POMPES, LES DISTRIBUTEURS, OU DIRECTEMENT CHEZ FRANKLIN. POUR DE PLUS AMPLES RENSEIGNEMENTS, APPELEZ SANS FRAIS LE 800-348-2420.

AVERTISSEMENT

UN CHOC ELECTRIQUE SERIEUX OU MEME MORTEL EST POSSIBLE, SI L'ON NEGLIGE DE CONNECTER LE MOTEUR, LA PLOMBERIE METALLIQUE, BOITES DE CONTROLE ET TOUT METAL PROCHE DU MOTEUR A UN CABLE ALLANT VERS UNE ALIMENTATION D'ENERGIE AVEC BORNE DE MISE A LA TERRE UTILISANT AU MOINS LE MEME CALIBRE QUE LES FILS DU MOTEUR. POUR REDUIRE LE RISQUE DE CHOC ELECTRIQUE. COUPER LE COURANT AVANT DE TRAVAILLER PRES OU SUR LE SYSTEM D'EAU. NE PAS UTILISER CE MOTEUR DANS UNE ZONE DE BAIGNADE.

ATENCION!
INFORMACION PARA EL INSTALADOR DE ESTE EQUIPO.

PARA LA INSTALACION DE ESTE EQUIPO, SE REQUIERE DE PERSONAL TECNICO CALIFICADO. EL NO CUMPLIR CON LAS NORMAS ELECTRICAS NACIONALES Y LOCALES, ASI COMO CON LAS RECOMENDACIONES DE FRANKLIN ELECTRIC DURANTE SU INSTALACION, PUEDE OCASIONAR, UN CHOQUE ELECTRICO, PELIGRO DE UN INCENDIO, OPERACION DEFECTUOSA E INCLUSO LA DESCOMPOSTURA DEL EQUIPO. LOS MANUALES DE INSTALACION Y PUESTA EN MARCHA DE LOS EQUIPOS, ESTAN DISPONIBLES CON LOS DISTRIBUIDORES, FABRICANTES DE BOMBAS O DIRECTAMENTE CON FRANKLIN ELECTRIC. PUEDE LLAMAR GRATUITAMENTE PARA MAYOR INFORMACION AL TELEFONO 800-348-2420.

ADVERTENCIA

PUEDE OCURRIR UN CHOQUE ELECTRICO, SERIO O FATAL DEBIDO A UNA ERRONEA CONECCION DEL MOTOR, DE LOS TABLEROS ELECTRICOS, DE LA TUBERIA, DE CUALQUIER OTRA PARTE METALICA QUE ESTA CERCA DEL MOTOR O POR NO UTILIZAR UN CABLE PARA TIERRA DE CALIBRE IGUAL O MAYOR AL DE LA ALIMENTACION. PARA REDUCIR EL RIESGO DE CHOQUE ELECTRIC, DESCONECTAR LA ALIMENTACION ELECTRICA ANTES DE INICIAR A TRABAJAR EN EL SISTEMA HIDRAULICO. NO UTILIZAR ESTE MOTOR EN ALBERCAS O AREAS EN DONDE SE PRACTIQUE NATACION.

Commitment to Quality

Franklin Electric is committed to provide customers with defect free products through our program of continuous improvement. Quality shall, in every case, take precedence over quantity.

Franklin Electric

SUBMERSIBLE MOTORS

60 Hz, Single-Phase and Three-Phase

Application • Installation • Maintenance Manual

The submersible motor is a reliable, efficient and trouble-free means of powering a pump. Its needs for a long operational life are simple. They are:

1. A suitable operating environment
2. An adequate supply of electricity
3. An adequate flow of cooling water over the motor
4. An appropriate pump load

All considerations of application, installation, and maintenance of submersible motors relating to these four areas are presented in this manual. Franklin Electric's web page, www.franklin-electric.com, should be checked for the latest updates.

Contents

Application

Installation

Maintenance

Storage

Franklin Electric submersible motors are a water-lubricated design. The fill solution consists of a mixture of deionized water and Propylene Glycol (a non-toxic antifreeze). The solution will prevent damage from freezing in temperatures to -40 °F (-40 °C); motors should be stored in areas that do not go below this temperature. The solution will partially freeze below 27 °F (-3 °C), but no damage occurs. Repeated freezing and thawing should be avoided to prevent possible loss of fill solution.

There may be an interchange of fill solution with well water during operation. Care must be taken with motors removed from wells during freezing conditions to prevent damage.

When the storage temperature does not exceed 100 °F (37 °C), storage time should be limited to two years. Where temperatures reach 100° to 130 °F, storage time should be limited to one year.

Loss of a few drops of liquid will not damage the motor as an excess amount is provided, and the filter check valve will allow lost liquid to be replaced by filtered well water upon installation. If there is reason to believe there has been a considerable amount of leakage, consult the factory for checking procedures.

Frequency of Starts

The average number of starts per day over a period of months or years influences the life of a submersible pumping system. Excessive cycling affects the life of control components such as pressure switches, starters, relays and capacitors. Rapid cycling can also cause motor spline damage, bearing damage, and motor overheating. All these conditions can lead to reduced motor life.

The pump size, tank size and other controls should be selected to keep the starts per day as low as practical for longest life. The maximum number of starts per 24-hour period is shown in table 3.

Motors should run a minimum of one minute to dissipate heat build up from starting current. Six inch and larger motors should have a minimum of 15 minutes between starts or starting attempts.

Table 3 Number of Starts

MOTOR RATING		MAXIMUM STARTS PER 24 HR PERIOD	
HP	KW	SINGLE-PHASE	THREE-PHASE
Up to 0.75	Up to 0.55	300	300
1 thru 5.5	0.75 thru 4	100	300
7.5 thru 30	5.5 thru 22	50	100*
40 and over	30 and over	-	100

* Keeping starts per day within the recommended numbers provides the best system life. However, when used with a properly configured Reduced Voltage Starter (RVS) or Variable Frequency Drive (VFD), 7.5 thru 30 hp three-phase motors can be started up to 200 times per 24 hour period.

Mounting Position

Franklin submersible motors are designed primarily for operation in the vertical, shaft-up position.

During acceleration, the pump thrust increases as its output head increases. In cases where the pump head stays below its normal operating range during startup and full speed condition, the pump may create upward thrust. This creates upward thrust on the motor upthrust bearing. This is an acceptable operation for short periods at each start, but running continuously with upthrust will cause excessive wear on the upthrust bearing.

With certain additional restrictions as listed in this section and the Inline Booster Pump Systems sections of this manual, motors are also suitable for operation in positions from shaft-up to shaft-horizontal. As the mounting position becomes further from vertical and closer to horizontal, the probability of shortened thrust bearing life increases. For normal motor life expectancy with motor positions other than shaft-up, follow these recommendations:

1. Minimize the frequency of starts, preferably to fewer than **10** per 24-hour period. Six and eight inch motors should have a minimum of 20 minutes between starts or starting attempts
2. Do not use in systems which can run even for short periods at full speed without thrust toward the motor.

Transformer Capacity - Single-Phase or Three-Phase

Distribution transformers must be adequately sized to satisfy the kVA requirements of the submersible motor. When transformers are too small to supply the load, there is a reduction in voltage to the motor.

Table 4 references the motor horsepower rating, single-phase and three-phase, total effective kVA required, and the smallest transformer required for open or closed three-phase systems. Open systems require larger transformers since only two transformers are used.

Other loads would add directly to the kVA sizing requirements of the transformer bank.

Table 4 Transformer Capacity

MOTOR RATING		TOTAL EFFECTIVE KVA REQUIRED	SMALLEST KVA RATING-EACH TRANSFORMER	
HP	KW		OPEN WYE OR DELTA 2- TRANSFORMERS	CLOSED WYE OR DELTA 3- TRANSFORMERS
1.5	1.1	3	2	1
2	1.5	4	2	1.5
3	2.2	5	3	2
5	3.7	7.5	5	3
7.5	5.5	10	7.5	5
10	7.5	15	10	5
15	11	20	15	7.5
20	15	25	15	10
25	18.5	30	20	10
30	22	40	25	15
40	30	50	30	20
50	37	60	35	20
60	45	75	40	25
75	55	90	50	30
100	75	120	65	40
125	93	150	85	50
150	110	175	100	60
175	130	200	115	70
200	150	230	130	75

NOTE: Standard kVA ratings are shown. If power company experience and practice allows transformer loading higher than standard, higher loading values may be used to meet total effective kVA required, provided correct voltage and balance is maintained.

Effects of Torque

During starting of a submersible pump, the torque developed by the motor must be supported through the pump, delivery pipe or other supports. Most pumps rotate in the direction which causes unscrewing torque on right-handed threaded pipe or pump stages. All threaded joints, pumps and other parts of the pump support system must be capable of withstanding the maximum torque repeatedly without loosening or breaking. Unscrewing joints will break electrical cable and may cause loss of the pump-motor unit.

To safely withstand maximum unscrewing torques with a minimum safety factor of 1.5, tightening all threaded joints to at least 10 lb-ft per motor horsepower is recommended (table 4A). It may be necessary to tack or strap weld pipe joints on high horsepower pumps, especially at shallower settings.

Table 4A Torque Required (Examples)

MOTOR RATING		MINIMUM SAFE TORQUE-LOAD
HP	KW	
1 hp & Less	0.75 kW & Less	10 lb-ft
20 hp	15 kW	200 lb-ft
75 hp	55 kW	750 lb-ft
200 hp	150 kW	2000 lb-ft

Use of Engine Driven Generators - Single-Phase or Three-Phase

Table 5 lists minimum generator sizes based on typical 80 °C rise continuous duty generators, with 35% maximum voltage dip during starting, for Franklin's three-wire motors, single- or three-phase.

This is a general chart. The generator manufacturer should be consulted whenever possible, especially on larger sizes.

There are two types of generators available: externally and internally regulated. Most are externally regulated. They use an external voltage regulator that senses the output voltage. As the voltage dips at motor start-up, the regulator increases the output voltage of the generator.

Internally regulated (self-excited) generators have an extra winding in the generator stator. The extra winding senses the output current to automatically adjust the output voltage.

Generators must be sized to deliver at least 65% of the rated voltage during starting to ensure adequate starting torque. Besides sizing, generator frequency is important as the motor speed varies with the frequency (Hz). Due to pump affinity laws, a pump running at 1 to 2 Hz below motor nameplate frequency design will not meet its performance curve. Conversely, a pump running at 1 to 2 Hz above may trip overloads.

Generator Operation

Always start the generator before the motor is started and always stop the motor before the generator is shut down. The motor thrust bearing may be damaged if the generator is allowed to coast down with the motor running. This same condition occurs when the generator is allowed to run out of fuel.

Follow generator manufacturer's recommendations for de-rating at higher elevations or using natural gas.

Table 5 Engine Driven Generators

NOTE: This chart applies to 3-wire or 3-phase motors. For best starting of 2-wire motors, the minimum generator rating is 50% higher than shown.

MOTOR RATING		MINIMUM RATING OF GENERATOR			
		EXTERNALLY REGULATED		INTERNALLY REGULATED	
HP	KW	KW	KVA	KW	KVA
1/3	0.25	1.5	1.9	1.2	1.5
1/2	0.37	2	2.5	1.5	1.9
3/4	0.55	3	3.8	2	2.5
1	0.75	4	5.0	2.5	3.13
1.5	1.1	5	6.25	3	3.8
2	1.5	7.5	9.4	4	5
3	2.2	10	12.5	5	6.25
5	3.7	15	18.75	7.5	9.4
7.5	5.5	20	25.0	10	12.5
10	7.5	30	37.5	15	18.75
15	11	40	50	20	25
20	15	60	75	25	31
25	18.5	75	94	30	37.50
30	22	100	125	40	50
40	30	100	125	50	62.5
50	37	150	188	60	75
60	45	175	220	75	94
75	55	250	313	100	125
100	75	300	375	150	188
125	93	375	469	175	219
150	110	450	563	200	250
175	130	525	656	250	313
200	150	600	750	275	344

WARNING: To prevent accidental electrocution, automatic or manual transfer switches must be used any time a generator is used as standby or back up on power lines. Contact power company for use and approval.

Use of Check Valves

It is recommended that one or more check valves always be used in submersible pump installations. If the pump does not have a built-in check valve, a line check valve should be installed in the discharge line within 25 feet of the pump and below the draw down level of the water supply. For deeper settings, check valves should be installed per the manufacturer's recommendations. More than one check valve may be required, but more than the recommended number of check valves should not be used.

Swing type check valves are **not** acceptable and should never be used with submersible motors/pumps. Swing type check valves have a slower reaction time which can cause water hammer (see next page). Internal pump check valves or spring loaded check valves close quickly and help eliminate water hammer.

Check valves are used to hold pressure in the system when the pump stops. They also prevent backspin, water hammer and upthrust. Any of these can lead to early pump or motor failure.

NOTE: Only positive sealing check valves should be used in submersible installations. Although drilling the check valves or using drain-back check valves may prevent back spinning, they create upthrust and water hammer problems.

A. Backspin - With no check valve or a failed check valve, the water in the drop pipe and the water in the system can flow down the discharge pipe when the motor stops. This can cause the pump to rotate in a reverse direction. If the motor is started while it is backspinning, an excessive force is placed across the pump-motor assembly that can cause impeller damage, motor or pump shaft breakage, excessive bearing wear, etc.

B. Upthrust - With no check valve, a leaking check valve, or drilled check valve, the unit starts under

a zero head condition. This causes an uplifting or upthrust on the impeller-shaft assembly in the pump. This upward movement carries across the pump-motor coupling and creates an upthrust condition in the motor. Repeated upthrust can cause premature failure of both the pump and the motor.

C. **Water Hammer -** If the lowest check valve is more than 30 feet above the standing (lowest static) water level, or a lower check valve leaks and the check valve above holds, a vacuum is created in the discharge piping. On the next pump start, water moving at very high velocity fills the void and strikes the closed check valve and the stationary water in the pipe above it, causing a hydraulic shock. This shock can split pipes, break joints and damage the pump and/or motor. Water hammer can often be heard or felt. When discovered, the system should be shut down and the pump installer contacted to correct the problem.

Wells – Large Diameter, Uncased, Top Feeding and Screened Sections

Franklin Electric submersible motors are designed to operate with a cooling flow of water over and around the full length of the motor.

If the pump installation does not provide the minimum flow shown in table 6, a flow inducer sleeve (flow sleeve) must be used. The conditions requiring a flow sleeve are:

- Well diameter is too large to meet table 6 flow requirements.
- Pump is in an open body of water.
- Pump is in a rock well or below the well casing.
- The well is “top-feeding” (a.k.a. cascading)
- Pump is set in or below screens or perforations.

Water Temperature and Flow

Franklin Electric’s standard submersible motors, except Hi-Temp designs (see note below), are designed to operate up to maximum service factor horsepower in water up to 86 °F (30 °C). A flow of 0.25 ft/s for 4" motors rated 3 hp and higher, and 0.5 ft/s for 6" and 8" motors is required for proper cooling. Table 6 shows minimum flow rates, in gpm, for various well diameters and motor sizes.

If a standard motor is operated in water over 86 °F (30 °C), water flow past the motor must be increased to maintain safe motor operating temperatures. See HOT WATER APPLICATIONS on page 7.

NOTE: Franklin Electric offers a line of Hi-Temp motors designed to operate in water at higher temperatures or lower flow conditions. Consult factory for details.

Table 6 Required Cooling Flow

MINIMUM GPM REQUIRED FOR MOTOR COOLING IN WATER UP TO 86 °F (30 °C).			
CASING OR SLEEVE ID INCHES (MM)	4" MOTOR (3-10 HP) 0.25 FT/S GPM (L/M)	6" MOTOR 0.50 FT/S GPM (L/M)	8" MOTOR 0.50 FT/S GPM (L/M)
4 (102)	1.2 (4.5)	-	-
5 (127)	7 (26.5)	-	-
6 (152)	13 (49)	9 (34)	-
7 (178)	20 (76)	25 (95)	-
8 (203)	30 (114)	45 (170)	10 (40)
10 (254)	50 (189)	90 (340)	55 (210)
12 (305)	80 (303)	140 (530)	110 (420)
14 (356)	110 (416)	200 (760)	170 (645)
16 (406)	150 (568)	280 (1060)	245 (930)

0.25 ft/s = 7.62 cm/sec 0.50 ft/s = 15.24 cm/sec
1 inch = 2.54 cm

Flow Inducer Sleeve

If the flow rate is less than specified, then a flow inducer sleeve must be used. A flow sleeve is always required in an open body of water. FIG. 1 shows a typical flow inducer sleeve construction.

EXAMPLE: A 6" motor and pump that delivers 60 gpm will be installed in a 10" well.

From table 6, 90 gpm would be required to maintain proper cooling. In this case adding an 8" or smaller flow sleeve provides the required cooling.

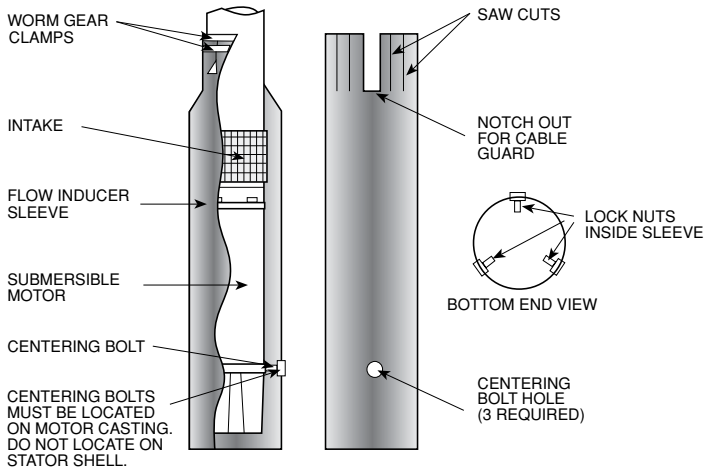


FIG. 1

Head Loss From Flow Past Motor

Table 7 lists the approximate head loss due to flow between an average length motor and smooth casing or flow inducer sleeve.

Table 7 Head Loss in Feet (Meters) at Various Flow Rates

MOTOR DIAMETER		4"	4"	4"	6"	6"	6"	8"	8"
CASING ID IN INCHES (MM)		4 (102)	5 (127)	6 (152)	6 (152)	7 (178)	8 (203)	8.1 (206)	10 (254)
Flow Rate in gpm (l/m)	25 (95)	0.3 (.09)							
	50 (189)	1.2 (.37)							
	100 (378)	4.7 (1.4)	0.3 (.09)		1.7 (.52)				
	150 (568)	10.2 (3.1)	0.6 (.18)	0.2 (.06)	3.7 (1.1)				
	200 (757)		1.1 (.34)	0.4 (.12)	6.3 (1.9)	0.5 (.15)		6.8 (2.1)	
	250 (946)		1.8 (.55)	0.7 (.21)	9.6 (2.9)	0.8 (.24)		10.4 (3.2)	
	300 (1136)		2.5 (.75)	1.0 (.30)	13.6 (4.1)	1.2 (.37)	0.2 (.06)	14.6 (4.5)	
	400 (1514)				23.7 (7.2)	2.0 (.61)	0.4 (.12)	24.6 (7.5)	
	500 (1893)					3.1 (.94)	0.7 (.21)	37.3 (11.4)	0.6 (0.2)
	600 (2271)					4.4 (1.3)	1.0 (.30)	52.2 (15.9)	0.8 (0.3)
	800 (3028)								1.5 (0.5)
	1000 (3785)								2.4 (0.7)

Hot Water Applications (Standard Motors)

Franklin Electric offers a line of Hi-Temp motors which are designed to operate in water with various temperatures up to 194 °F (90 °C) without increased flow. When a standard pump-motor operates in water hotter than 86 °F (30 °C), a flow rate of at least 3 ft/s is required. When selecting the motor to drive a pump in over 86 °F (30 °C) water, the motor horsepower must be de-rated per the following procedure.

1. Using table 7A, determine pump gpm required for different well or sleeve diameters. If necessary, add a flow sleeve to obtain at least 3 ft/s flow rate.

Table 7A Minimum gpm (l/m) Required for 3 ft/s (.91 m/sec) Flow Rate

CASING OR SLEEVE ID		4" HIGH THRUST MOTOR		6" MOTOR		8" MOTOR	
INCHES	(MM)	GPM	(L/M)	GPM	(L/M)	GPM	(L/M)
4	(102)	15	(57)				
5	(127)	80	(303)				
6	(152)	160	(606)	52	(197)		
7	(178)			150	(568)		
8	(203)			260	(984)	60	(227)
10	(254)			520	(1970)	330	(1250)
12	(305)					650	(2460)
14	(356)					1020	(3860)
16	(406)					1460	(5530)

Continued on next page

2. Determine pump horsepower required from the pump manufacturer's curve.

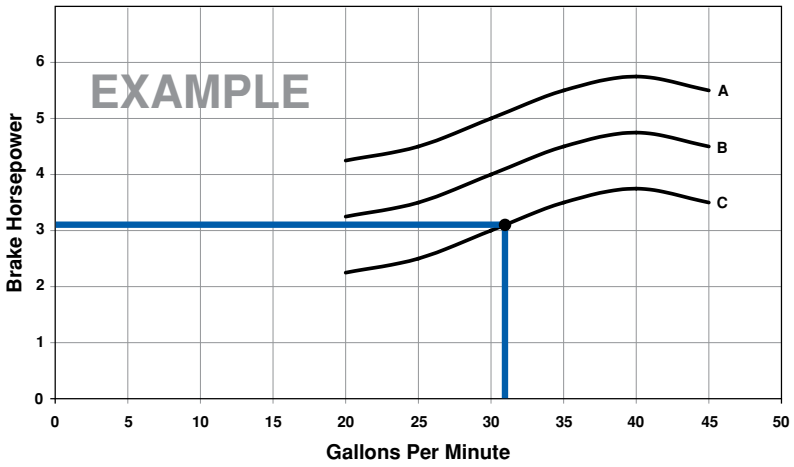


FIG. 2 MANUFACTURER'S PUMP CURVE

3. Multiply the pump horsepower required by the heat factor multiplier from table 8.

Table 8 Heat Factor Multiplier at 3 ft/s (.91 m/sec) Flow Rate

MAXIMUM WATER TEMPERATURE	1/3 - 5 HP .25 - 3.7 KW	7 1/2 - 30 HP 5.5 - 22 KW	OVER 30 HP OVER 22 KW
140 °F (60 °C)	1.25	1.62	2.00
131 °F (55 °C)	1.11	1.32	1.62
122 °F (50 °C)	1.00	1.14	1.32
113 °F (45 °C)	1.00	1.00	1.14
104 °F (40 °C)	1.00	1.00	1.00
95 °F (35 °C)	1.00	1.00	1.00

4. Select a rated hp motor on table 8A whose Service Factor Horsepower is at least the value calculated in Item 3.

Table 8A Service Factor Horsepower

HP	KW	SFHP	HP	KW	SFHP	HP	KW	SFHP	HP	KW	SFHP
1/3	0.25	0.58	3	2.2	3.45	25	18.5	28.75	100	75	115.00
1/2	0.37	0.80	5	3.7	5.75	30	22.0	34.50	125	93	143.75
3/4	0.55	1.12	7.5	5.5	8.62	40	30.0	46.00	150	110	172.50
1	0.75	1.40	10	7.5	11.50	50	37.0	57.50	175	130	201.25
1.5	1.10	1.95	15	11.0	17.25	60	45.0	69.00	200	150	230.00
2	1.50	2.50	20	15.0	23.00	75	55.0	86.25			

Hot Water Applications - Example

EXAMPLE: A 6" pump end requiring 39 hp input will pump 124 °F water in an 8" well at a delivery rate of 140 gpm. From table 7A, a 6" flow sleeve will be required to increase the flow rate to at least 3 ft/s.

Using table 8, the 1.62 heat factor multiplier is selected because the hp required is over 30 hp and water temperature is above 122 °F. Multiply 39 hp x 1.62 (multiplier), which equals 63.2 hp. This is the minimum rated service factor horsepower usable at 39 hp in 124 °F. Using table 8A, select a motor with a rated service factor horsepower above 63.2 hp. A 60 hp motor has a service factor horsepower of 69, so a 60 hp motor may be used.

Drawdown Seals

Allowable motor temperature is based on atmospheric pressure or higher surrounding the motor. “Drawdown seals,” which seal the well to the pump above its intake to maximize delivery, are not recommended, since the suction created can be lower than atmospheric pressure.

Grounding Control Boxes and Panels

The National Electrical Code requires that the control box or panel-grounding terminal always be connected to supply ground. If the circuit has no grounding conductor and no metal conduit from the box to supply panel, use a wire at least as large as line conductors and connect as required by the National Electrical Code, from the grounding terminal to the electrical supply ground.

WARNING: Failure to ground the control frame can result in a serious or fatal electrical shock hazard.

Grounding Surge Arrestors

An above ground surge arrestor must be grounded, metal to metal, all the way to the lowest draw down water strata for the surge arrestor to be effective. GROUNDING THE ARRESTOR TO THE SUPPLY GROUND OR TO A DRIVEN GROUND ROD PROVIDES LITTLE OR NO SURGE PROTECTION FOR THE MOTOR.

Control Box, Pumptec Products and Panel Environment

Franklin Electric control boxes, Pumptec products and three-phase panels meet UL requirements for NEMA Type 3R enclosures. They are suitable for indoor and outdoor applications within temperatures of +14 °F (-10 °C) to 122 °F (50 °C). Operating control boxes below +14 °F can cause reduced starting torque and loss of overload protection when overloads are located in control boxes.

Control boxes, Pumptec products and three-phase panels should never be mounted in direct sunlight or high temperature locations. This will cause shortened capacitor life (where applicable) and unnecessary tripping of overload protectors. A ventilated enclosure painted white to reflect heat is recommended for an outdoor, high temperature location.

A damp well pit, or other humid location, accelerates component failure from corrosion.

Control boxes with voltage relays are designed for vertical upright mounting only. Mounting in other positions will affect the operation of the relay.

Equipment Grounding

WARNING: Serious or fatal electrical shock may result from failure to connect the motor, control enclosures, metal plumbing and all other metal near the motor or cable to the power supply ground terminal using wire no smaller than motor cable wires.

The primary purpose of grounding the metal drop pipe and/or metal well casing in an installation is safety. It is done to limit the voltage between nonelectrical (exposed metal) parts of the system and ground, thus minimizing dangerous shock hazards. Using wire at least the size of the motor cable wires provides adequate current-carrying capability for any ground fault that might occur. It also provides a low resistance path to ground, ensuring that the current to ground will be large enough to trip any overcurrent device designed to detect faults (such as a ground fault circuit interrupter, or GFCI).

Normally, the ground wire to the motor would provide the primary path back to the power supply ground for any ground fault. There are conditions, however, where the ground wire connection could become compromised. One such example would be the case where the water in the well is abnormally corrosive or aggressive. In this example, a grounded metal drop pipe or casing would then become the primary path to ground. However, the many installations that now use plastic drop pipes and/or casings require further steps to be taken for safety purposes, so that the water column itself does not become the conductive path to ground.

When an installation has abnormally corrosive water AND the drop pipe or casing is plastic, Franklin Electric recommends the use of a GFCI with a 10 mA set-point. In this case, the motor ground wire should be routed through the current-sensing device along with the motor power leads. Wired this way, the GFCI will trip only when a ground fault has occurred AND the motor ground wire is no longer functional.

3-Wire Control Boxes

Single-phase three-wire submersible motors require the use of control boxes. Operation of motors without control boxes or with incorrect boxes can result in motor failure and voids warranty.

Control boxes contain starting capacitors, a starting relay, and, in some sizes, overload protectors, running capacitors and contactors.

Ratings through 1 hp may use either a Franklin Electric solid state QD or a potential (voltage) type starting relay, while larger ratings use potential relays.

Potential (Voltage) Relays

Potential relays have normally closed contacts. When power is applied, both start and main motor windings are energized, and the motor starts. At this instant, the voltage across the start winding is relatively low and not enough to open the contacts of the relay.

As the motor accelerates, the increasing voltage across the start winding (and the relay coil) opens the relay contacts. This opens the starting circuit and the motor continues to run on the main winding alone, or the main plus run capacitor circuit. After the motor is started the relay contacts remain open.

CAUTION: The control box and motor are two pieces of one assembly. Be certain that the control box and motor hp and voltage match. Since a motor is designed to operate with a control box from the same manufacturer, we can promise warranty coverage only when a Franklin control box is used with a Franklin motor.

2-Wire Motor Solid State Controls

BIAC Switch Operation

When power is applied the bi-metal switch contacts are closed, so the triac is conducting and energizes the start winding. As rpm increases, the voltage in the sensor coil generates heat in the bi-metal strip, causing the bi-metal strip to bend and open the switch circuit. This removes the starting winding and the motor continues to run on the main winding alone.

Approximately 5 seconds after power is removed from the motor, the bi-metal strip cools sufficiently to return to its closed position and the motor is ready for the next start cycle.

Rapid Cycling

The BIAC starting switch will reset within approximately 5 seconds after the motor is stopped. If an attempt is made to restart the motor before the starting switch has reset, the motor may not start; however, there will be current in the main winding until the overload protector interrupts the circuit. The time for the protector to reset is longer than the reset of the starting switch. Therefore, the start switch will have closed and the motor will operate.

CAUTION: Restarting the motor within 5 seconds after power is removed may cause the motor overload to trip.

A waterlogged tank will cause fast cycling. When a waterlogged condition does occur, the user will be alerted to the problem during the off time (overload reset time) since the pressure will drop drastically. When the waterlogged tank condition is detected, the condition should be corrected to prevent nuisance tripping of the overload protector.

Bound Pump (Sandlocked)

When the motor is not free to turn, as with a sandlocked pump, the BIAC switch creates a “reverse impact torque” in the motor in either direction. When the sand is dislodged, the motor will start and operate in the correct direction.

QD Relays (Solid State)

There are two elements in the relay: a reed switch and a triac. The reed switch consists of two tiny rectangular blade-type contacts, which bend under magnetic flux. It is hermetically sealed in glass and is located within a coil, which conducts line current. When power is supplied to the control box, the main winding current passing through the coil immediately closes the reed switch contacts. This turns on the triac, which supplies voltage to the start winding, thus starting the motor.

Once the motor is started, the operation of the QD relay is an interaction between the triac, the reed switch and the motor windings. The solid state switch senses motor speed through the changing phase relationship between start winding current and line current. As the motor approaches running speed, the phase angle between the start current and the line current becomes nearly in phase. At this point, the reed switch contacts open, turning off the triac. This removes voltage from the start winding and the motor continues to run on the main winding only. With the reed switch contacts open and the triac turned off, the QD relay is ready for the next starting cycle.

2- or 3-Wire Cable, 60 Hz (Service Entrance to Motor - Maximum Length In Feet)

Table 11

60 °C

MOTOR RATING			60 °C INSULATION - AWG COPPER WIRE SIZE												
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000
115	1/2	.37	100	160	250	390	620	960	1190	1460	1780	2160	2630	3140	3770
230	1/2	.37	400	650	1020	1610	2510	3880	4810	5880	7170	8720			
	3/4	.55	300	480	760	1200	1870	2890	3580	4370	5330	6470	7870		
	1	.75	250	400	630	990	1540	2380	2960	3610	4410	5360	6520		
	1.5	1.1	190	310	480	770	1200	1870	2320	2850	3500	4280	5240		
	2	1.5	150	250	390	620	970	1530	1910	2360	2930	3620	4480		
	3	2.2	**120**	190	300	470	750	1190	1490	1850	2320	2890	3610		
	5	3.7	0	0	**180**	280	450	710	890	1110	1390	1740	2170	2680	
	7.5	5.5	0	0	0	**200**	310	490	610	750	930	1140	1410	1720	
	10	7.5	0	0	0	0	**250**	390	490	600	750	930	1160	1430	1760
	15	11	0	0	0	0	**170**	**270**	340	430	530	660	820	1020	1260

Table 11A

75 °C

MOTOR RATING			75 °C INSULATION - AWG COPPER WIRE SIZE												
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000
115	1/2	.37	100	160	250	390	620	960	1190	1460	1780	2160	2630	3140	3770
230	1/2	.37	400	650	1020	1610	2510	3880	4810	5880	7170	8720			
	3/4	.55	300	480	760	1200	1870	2890	3580	4370	5330	6470	7870	9380	
	1	.75	250	400	630	990	1540	2380	2960	3610	4410	5360	6520	7780	9350
	1.5	1.1	190	310	480	770	1200	1870	2320	2850	3500	4280	5240	6300	7620
	2	1.5	150	250	390	620	970	1530	1910	2360	2930	3620	4480	5470	6700
	3	2.2	**120**	190	300	470	750	1190	1490	1850	2320	2890	3610	4470	5550
	5	3.7	0	**110**	180	280	450	710	890	1110	1390	1740	2170	2680	3330
	7.5	5.5	0	0	**120**	200	310	490	610	750	930	1140	1410	1720	2100
	10	7.5	0	0	0	**160**	250	390	490	600	750	930	1160	1430	1760
	15	11	0	0	0	0	**170**	270	340	430	530	660	820	1020	1260

1 Foot = .3048 Meter

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors 60 °C or 75 °C in free air or water, not in magnetic enclosures, conduit or direct buried.

Lengths NOT in bold meet the NEC ampacity requirements for either individual conductors or jacketed 60 °C or 75 °C cable and can be in conduit or direct buried. Flat molded and web/ribbon cable are considered jacketed cable.

If any other cable is used, the NEC and local codes should be observed.

Cable lengths in tables 11 & 11A allow for a 5% voltage drop running at maximum nameplate amperes. If 3% voltage drop is desired, multiply table 11 and 11A lengths by 0.6 to get maximum cable length.

The portion of the total cable length, which is between the supply and single-phase control box with a line contactor, should not exceed 25% of total maximum allowable to ensure reliable contactor operation. Single-phase control boxes without line contactors may be connected at any point in the total cable length.

Tables 11 & 11A are based on copper wire. If aluminum wire is used, it must be two sizes larger than copper wire and oxidation inhibitors must be used on connections.

EXAMPLE: If tables 11 & 11A call for #12 copper wire, #10 aluminum wire would be required.

Contact Franklin Electric for 90 °C cable lengths. See pages 15, 49, and 50 for applications using 230 V motors on 208 V power systems.

Two or More Different Cable Sizes Can Be Used

Depending on the installation, any number of combinations of cable may be used.

For example, in a replacement/upgrade installation, the well already has 160 feet of buried #10 cable between the service entrance and the wellhead. A new 3 hp, 230-volt, single-phase motor is being installed to replace a smaller motor. The question is: Since there is already 160 feet of #10 AWG installed, what size cable is required in the well with a 3 hp, 230-volt, single-phase motor setting at 310 feet?

From tables 11 & 11A, a 3 hp motor can use up to 300 feet of #10 AWG cable.

The application has 160 feet of #10 AWG copper wire installed.

Using the formula below, 160 feet (actual) ÷ 300 feet (max allowable) is equal to 0.533. This means 53.3% (0.533 x 100) of the allowable voltage drop or loss, which is allowed between the service entrance and the motor, occurs in this wire. This leaves us 46.7% (1.00 - 0.533 = 0.467) of some other wire size to use in the remaining 310 feet “down hole” wire run.

The table shows #8 AWG copper wire is good for 470 feet. Using the formula again, 310 feet (used) ÷ 470 feet (allowed) = 0.660; adding this to the 0.533 determined earlier; 0.533 + 0.660 = 1.193. This combination is greater than 1.00, so the voltage drop will not meet US National Electrical Code recommendations.

Tables 11 & 11A show #6 AWG copper wire is good for 750 feet. Using the formula, 310 ÷ 750 = 0.413, and using these numbers, 0.533 + 0.413 = 0.946, we find this is less than 1.00 and will meet the NEC recommended voltage drop.

This works for two, three or more combinations of wire and it does not matter which size wire comes first in the installation.

$$\text{Formula: } \frac{\text{Actual Length}}{\text{Max Allowed}} + \frac{\text{Actual Length}}{\text{Max Allowed}} = 1.00$$

EXAMPLE: 3 hp, 230-Volt, Single-Phase Motor

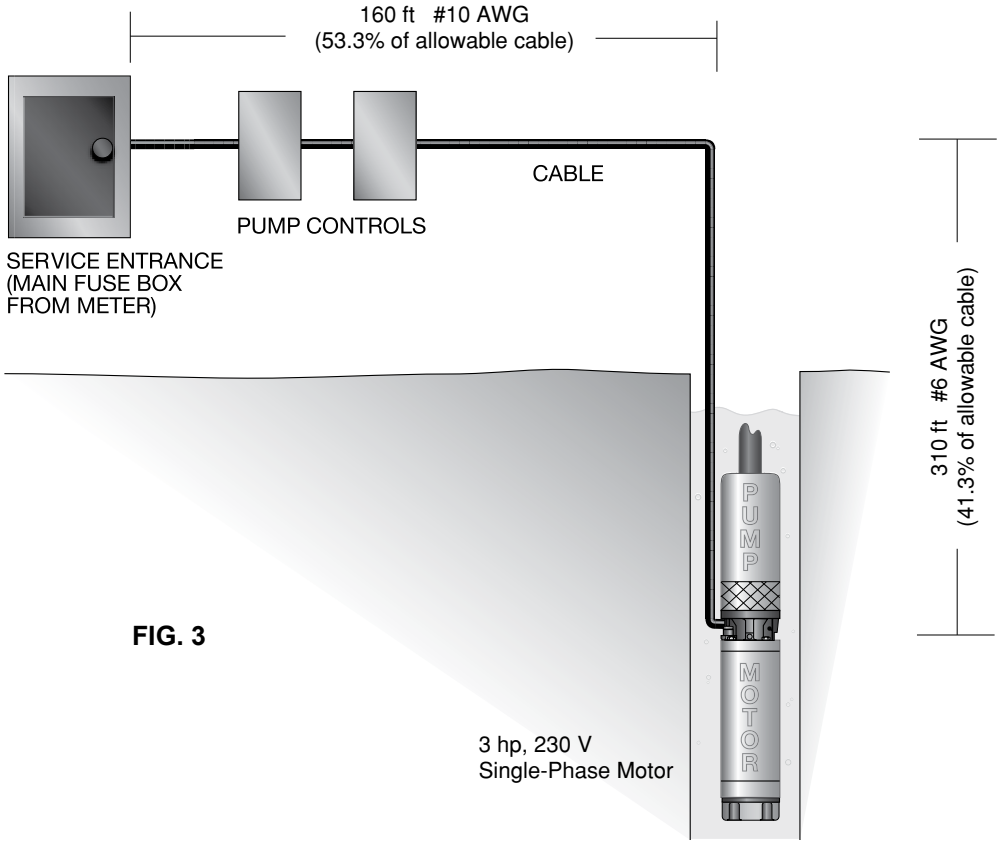


FIG. 3

Table 13 Single-Phase Motor Specifications (60 Hz) 3450 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		WINDING (1) RES. IN OHMS	EFFICIENCY %		POWER FACTOR %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	(2) AMPS	WATTS	(2) AMPS	WATTS	M=MAIN RES. S=START RES.	S.F.	F.L.	S.F.	F.L.		
4" 2-WIRE	244504	1/2	0.37	115	60	1.6	10.0	670	12.0	960	1.0-1.3	62	56	73	58	64.4	R
	244505	1/2	0.37	230	60	1.6	5.0	670	6.0	960	4.2-5.2	62	56	73	58	32.2	R
	244507	3/4	0.55	230	60	1.5	6.8	940	8.0	1310	3.0-3.6	64	59	74	62	40.7	N
	244508	1	0.75	230	60	1.4	8.2	1210	10.4	1600	2.2-2.7	65	62	74	63	48.7	N
	244309	1.5	1.1	230	60	1.3	10.6	1770	13.1	2280	1.5-2.1	64	63	83	76	66.2	M
4" 3-WIRE	214504	1/2	0.37	115	60	1.6	Y10.0 B10.0 R0	670	Y12.0 B12.0 R0	960	M1.0-1.3 S4.1-5.1	62	56	73	58	50.5	M
	214505	1/2	0.37	230	60	1.6	Y5.0 B5.0 R0	670	Y6.0 B6.0 R0	960	M4.2-5.2 S16.7-20.5	62	56	73	58	23	M
	214507	3/4	0.55	230	60	1.5	Y6.8 B6.8 R0	940	Y8.0 B8.0 R0	1310	M3.0-3.6 S10.7-13.1	64	59	74	62	34.2	M
	214508	1	0.75	230	60	1.4	Y8.2 B8.2 R0	1210	10.4 10.4 R0	1600	M2.2-2.7 S9.9-12.1	65	62	74	63	41.8	L
4" 3-WIRE W/CRC CB	214505	1/2	0.37	230	60	1.6	Y3.6 B3.7 R2.0	655	Y4.3 B4.0 R2.0	890	M4.2-5.2 S16.7-20.5	67	57	90	81	23	M
	214507	3/4	0.55	230	60	1.5	Y4.9 B5.0 R3.2	925	Y5.7 B5.2 R3.1	1220	M3.0-3.6 S10.7-13.1	69	60	92	84	34.2	M
	214508	1	0.75	230	60	1.4	Y6.0 B5.7 R3.4	1160	Y7.1 B6.2 R3.3	1490	M2.2-2.7 S9.9-12.1	70	64	92	86	41.8	L
4" 3-WIRE	214508 W/1-1.5 CB	1	0.75	230	60	1.4	Y6.6 B6.6 R1.3	1130	Y8.0 B7.9 R1.3	1500	M2.2-2.7 S9.9-12.1	70	66	82	72	43	L
	224300	1.5	1.1	230	60	1.3	Y10.0 B9.9 R1.3	1620	Y11.5 B11.0 R1.3	2080	M1.7-2.1 S7.5-9.2	70	69	85	79	51.4	J
	224301	2	1.5	230	60	1.25	Y10.0 B9.3 R2.6	2025	Y13.2 B11.9 R2.6	2555	M1.8-2.3 S5.5-7.2	73	74	95	94	53.1	G
	224302 (3)	3	2.2	230	60	1.15	Y14.0 B11.2 R6.1	3000	Y17.0 B12.6 R6.0	3400	M1.1-1.4 S4.0-4.8	75	75	99	99	83.4	H
	224303 (4)	5	3.7	230	60	1.15	Y23.0 B15.9 R11.0	4830	Y27.5 B19.1 R10.8	5500	M.71-.82 S1.8-2.2	78	77	100	100	129	G
6"	226110 (5)	5	3.7	230	60	1.15	Y23.0 B14.3 R10.8	4910	Y27.5 B17.4 R10.5	5570	M.55-.68 S1.3-1.7	77	76	100	99	99	E
	226111	7.5	5.5	230	60	1.15	Y36.5 B34.4 R5.5	7300	Y42.1 B40.5 R5.4	8800	M.36-.50 S.88-1.1	73	74	91	90	165	F
	226112	10	7.5	230	60	1.15	Y44.0 B39.5 R9.3	9800	Y51.0 B47.5 R8.9	11300	M.27-.33 S.80-.99	76	77	96	96	204	E
	226113	15	11	230	60	1.15	Y62.0 B52.0 R17.5	13900	Y75.0 B62.5 R16.9	16200	M.17-.22 S.68-.93	79	80	97	98	303	E

(1) Main winding - yellow to black
Start winding - yellow to red

(2) Y = Yellow lead - line amps
B = Black lead - main winding amps
R = Red lead - start or auxiliary winding amps

(3) Control Boxes date coded 02C and older have **35 MFD** run capacitors. Current values should be Y14.0 @ FL and Y17.0 @ Max Load.
B12.2 B14.5
R4.7 R4.5

(4) Control Boxes date coded 01M and older have **60 MFD** run capacitors and the current values on a 4" motor will be Y23.0 @ FL - Y27.5 @ Max Load.
B19.1 B23.2
R8.0 R7.8

(5) Control Boxes date coded 01M and older have **60 MFD** run capacitors and the current values on a 6" motor will be Y23.0 @ FL -Y27.5 @ Max Load.
B18.2 B23.2
R8.0 R7.8

Performance is typical, not guaranteed, at specified voltages and specified capacitor values. Performance at voltage ratings not shown is similar, except amps vary inversely with voltage.

Table 14 Single-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX	RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
		HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
4" 2-WIRE	244504	1/2	0.37	115	35	20	30	30	15	30
	244505	1/2	0.37	230	20	10	15	15	8	15
	244507	3/4	0.55	230	25	15	20	20	10	20
	244508	1	0.75	230	30	20	25	25	11	25
	244309	1.5	1.1	230	35	20	30	35	15	30
4" 3-WIRE	214504	1/2	0.37	115	35	20	30	30	15	30
	214505	1/2	0.37	230	20	10	15	15	8	15
	214507	3/4	0.55	230	25	15	20	20	10	20
	214508	1	0.75	230	30	20	25	25	11	25
4" 3-WIRE W/CRC CB	214505	1/2	0.37	230	20	10	15	15	8	15
	214507	3/4	0.55	230	25	15	20	20	10	20
	214508	1	0.75	230	30	20	25	25	11	25
4" 3-WIRE	214508 W/ 1-1.5 CB	1	0.75	230	30	20	25	25	11	25
	224300	1.5	1.1	230	35	20	30	30	15	30
	224301	2	1.5	230	30	20	25	30	15	25
	224302	3	2.2	230	45	30	40	45	20	40
	224303	5	3.7	230	80	45	60	70	30	60
6"	226110	5	3.7	230	80	45	60	70	30	60
	226111	7.5	5.5	230	125	70	100	110	50	100
	226112	10	7.5	230	150	80	125	150	60	125
	226113	15	11	230	200	125	175	200	90	175

Auxiliary Running Capacitors

Added capacitors must be connected across “Red” and “Black” control box terminals, in parallel with any existing running capacitors. The additional capacitor(s) should be mounted in an auxiliary box. The values of additional running capacitors most likely to reduce noise are given below. The tabulation gives the **max.** S.F. amps normally in each lead with the added capacitor.

Although motor amps decrease when auxiliary run capacitance is added, the load on the motor does not. If a motor is overloaded with normal capacitance, it still will be overloaded with auxiliary run capacitance, even though motor amps may be within nameplate values.

Table 15 Auxiliary Capacitor Sizing

MOTOR RATING		NORMAL RUNNING CAPACITOR(S)	AUXILIARY RUNNING CAPACITORS FOR NOISE REDUCTION			MAXIMUM AMPS WITH RUN CAP		
HP	VOLTS	MFD	MFD	MIN. VOLTS	FRANKLIN PART	YELLOW	BLACK	RED
1/2	115	0	60(1)	370	TWO 155327101	8.4	7.0	4.0
1/2	230	0	15(1)	370	ONE 155328101	4.2	3.5	2.0
3/4		0	20(1)	370	ONE 155328103	5.8	5.0	2.5
1		0	25(1)	370	ONE EA. 155328101 155328102	7.1	5.6	3.4
1.5		10	20	370	ONE 155328103	9.3	7.5	4.4
2		20	10	370	ONE 155328102	11.2	9.2	3.8
3		45	NONE	370		17.0	12.6	6.0
5		80	NONE	370		27.5	19.1	10.8
7.5		45	45	370	ONE EA. 155327101 155328101	37.0	32.0	11.3
10		70	30	370	ONE 155327101	49.0	42.0	13.0
15		135	NONE			75.0	62.5	16.9

(1) Do not add running capacitors to 1/3 through 1 hp control boxes, which use solid state switches or QD relays. Adding capacitors will cause switch failure. If the control box is converted to use a voltage relay, the specified running capacitance can be added.

Buck-Boost Transformers

When the available power supply voltage is not within the proper range, a buck-boost transformer is often used to adjust voltage to match the motor. The most common usage on submersible motors is boosting a 208 volt supply to use a standard 230 volt single-phase submersible motor and control. While tables to give a wide range of voltage boost or buck are published by transformer manufacturers, the following table shows Franklin’s recommendations. The table, based on boosting the voltage 10%, shows the minimum rated transformer kVA needed and the common standard transformer kVA.

Table 15A Buck-Boost Transformer Sizing

MOTOR HP	1/3	1/2	3/4	1	1.5	2	3	5	7.5	10	15
LOAD KVA	1.02	1.36	1.84	2.21	2.65	3.04	3.91	6.33	9.66	11.70	16.60
MINIMUM XFMR KVA	0.11	0.14	0.19	0.22	0.27	0.31	0.40	0.64	0.97	1.20	1.70
STANDARD XFMR KVA	0.25	0.25	0.25	0.25	0.50	0.50	0.50	0.75	1.00	1.50	2.00

Buck-Boost transformers are power transformers, not control transformers. They may also be used to lower voltage when the available power supply voltage is too high.

Table 16 Three-Phase 60 °C Cable, 60 Hz (Service Entrance to Motor) Maximum Length in Feet

60 °C

MOTOR RATING			60 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
200 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	710	1140	1800	2840	4420													
	3/4	0.55	510	810	1280	2030	3160													
	1	0.75	430	690	1080	1710	2670	4140	5140											
	1.5	1.1	310	500	790	1260	1960	3050	3780											
	2	1.5	240	390	610	970	1520	2360	2940	3610	4430	5420								
	3	2.2	180	290	470	740	1160	1810	2250	2760	3390	4130								
	5	3.7	**110**	170	280	440	690	1080	1350	1660	2040	2490	3050	3670	4440	5030				
	7.5	5.5	0	0	200	310	490	770	960	1180	1450	1770	2170	2600	3150	3560				
	10	7.5	0	0	0	**230**	370	570	720	880	1090	1330	1640	1970	2390	2720	3100	3480	3800	4420
	15	11	0	0	0	**160**	**250**	390	490	600	740	910	1110	1340	1630	1850	2100	2350	2570	2980
	20	15	0	0	0	0	**190**	**300**	380	460	570	700	860	1050	1270	1440	1650	1850	2020	2360
	25	18.5	0	0	0	0	0	**240**	**300**	**370**	460	570	700	840	1030	1170	1330	1500	1640	1900
	30	22	0	0	0	0	0	0	**250**	**310**	**380**	470	580	700	850	970	1110	1250	1360	1590
230 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	930	1490	2350	3700	5760	8910												
	3/4	0.55	670	1080	1700	2580	4190	6490	8060	9860										
	1	0.75	560	910	1430	2260	3520	5460	6780	8290										
	1.5	1.1	420	670	1060	1670	2610	4050	5030	6160	7530	9170								
	2	1.5	320	510	810	1280	2010	3130	3890	4770	5860	7170	8780							
	3	2.2	240	390	620	990	1540	2400	2980	3660	4480	5470	6690	8020	9680					
	5	3.7	**140**	230	370	590	920	1430	1790	2190	2690	3290	4030	4850	5870	6650	7560	8460	9220	
	7.5	5.5	0	**160**	260	420	650	1020	1270	1560	1920	2340	2870	3440	4160	4710	5340	5970	6500	7510
	10	7.5	0	0	**190**	310	490	760	950	1170	1440	1760	2160	2610	3160	3590	4100	4600	5020	5840
	15	11	0	0	0	**210**	330	520	650	800	980	1200	1470	1780	2150	2440	2780	3110	3400	3940
	20	15	0	0	0	0	**250**	400	500	610	760	930	1140	1380	1680	1910	2180	2450	2680	3120
	25	18.5	0	0	0	0	0	**320**	400	500	610	750	920	1120	1360	1540	1760	1980	2160	2520
	30	22	0	0	0	0	0	**260**	**330**	**410**	510	620	760	930	1130	1280	1470	1650	1800	2110
380 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	2690	4290	6730															
	3/4	0.55	2000	3190	5010	7860														
	1	0.75	1620	2580	4060	6390	9980													
	1.5	1.1	1230	1970	3100	4890	7630													
	2	1.5	870	1390	2180	3450	5400	8380												
	3	2.2	680	1090	1710	2690	4200	6500	8020	9830										
	5	3.7	400	640	1010	1590	2490	3870	4780	5870	7230	8830								
	7.5	5.5	270	440	690	1090	1710	2640	3260	4000	4930	6010	7290	8780						
	10	7.5	**200**	**320**	510	800	1250	1930	2380	2910	3570	4330	5230	6260	7390	8280	9340			
	15	11	0	0	**370**	590	920	1430	1770	2170	2690	3290	4000	4840	5770	6520	7430	8250	8990	
	20	15	0	0	0	**440**	700	1090	1350	1670	2060	2530	3090	3760	4500	5110	5840	6510	7120	8190
	25	18.5	0	0	0	**360**	570	880	1100	1350	1670	2050	2510	3040	3640	4130	4720	5250	5740	6590
	30	22	0	0	0	0	**470**	730	910	1120	1380	1700	2080	2520	3020	3430	3920	4360	4770	5490
	40	30	0	0	0	0	0	**530**	660	820	1010	1240	1520	1840	2200	2500	2850	3170	3470	3990
	50	37	0	0	0	0	0	0	**540**	**660**	820	1000	1220	1480	1770	2010	2290	2550	2780	3190
	60	45	0	0	0	0	0	0	0	**560**	**690**	850	1030	1250	1500	1700	1940	2150	2350	2700
	75	55	0	0	0	0	0	0	0	0	**570**	**700**	**860**	1050	1270	1440	1660	1850	2030	2350
	100	75	0	0	0	0	0	0	0	0	0	**510**	**630**	**760**	910	1030	1180	1310	1430	1650
	125	93	0	0	0	0	0	0	0	0	0	0	0	**620**	**740**	**840**	**950**	1060	1160	1330
	150	110	0	0	0	0	0	0	0	0	0	0	0	0	**620**	**700**	**790**	**880**	**960**	1090
	175	130	0	0	0	0	0	0	0	0	0	0	0	0	0	**650**	**750**	**840**	**920**	1070
	200	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**630**	**700**	**760**	**880**

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

Continued on next page

Table 17 Three-Phase 60 °C Cable (Continued)

60 °C

MOTOR RATING			60 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
460 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	3770	6020	9460															
	3/4	0.55	2730	4350	6850															
	1	0.75	2300	3670	5770	9070														
	1.5	1.1	1700	2710	4270	6730														
	2	1.5	1300	2070	3270	5150	8050													
	3	2.2	1000	1600	2520	3970	6200													
	5	3.7	590	950	1500	2360	3700	5750												
	7.5	5.5	420	680	1070	1690	2640	4100	5100	6260	7680									
	10	7.5	310	500	790	1250	1960	3050	3800	4680	5750	7050								
	15	11	0	**340**	540	850	1340	2090	2600	3200	3930	4810	5900	7110						
	20	15	0	0	**410**	650	1030	1610	2000	2470	3040	3730	4580	5530						
	25	18.5	0	0	0	**530**	830	1300	1620	1990	2450	3010	3700	4470	5430					
	30	22	0	0	0	**430**	680	1070	1330	1640	2030	2490	3060	3700	4500	5130	5860			
	40	30	0	0	0	0	**500**	790	980	1210	1490	1830	2250	2710	3290	3730	4250			
	50	37	0	0	0	0	0	**640**	800	980	1210	1480	1810	2190	2650	3010	3420	3830	4180	4850
	60	45	0	0	0	0	0	**540**	**670**	**830**	1020	1250	1540	1850	2240	2540	2890	3240	3540	4100
	75	55	0	0	0	0	0	0	0	**680**	**840**	1030	1260	1520	1850	2100	2400	2700	2950	3440
	100	75	0	0	0	0	0	0	0	0	**620**	**760**	**940**	1130	1380	1560	1790	2010	2190	2550
	125	93	0	0	0	0	0	0	0	0	0	0	**740**	**890**	**1000**	1220	1390	1560	1700	1960
	150	110	0	0	0	0	0	0	0	0	0	0	0	**760**	**920**	**1050**	**1190**	1340	1460	1690
	175	130	0	0	0	0	0	0	0	0	0	0	0	0	**810**	**930**	**1060**	**1190**	1300	1510
	200	150	0	0	0	0	0	0	0	0	0	0	0	0	0	**810**	**920**	**1030**	**1130**	1310
575 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	5900	9410																
	3/4	0.55	4270	6810																
	1	0.75	3630	5800	9120															
	1.5	1.1	2620	4180	6580															
	2	1.5	2030	3250	5110	8060														
	3	2.2	1580	2530	3980	6270														
	5	3.7	920	1480	2330	3680	5750													
	7.5	5.5	660	1060	1680	2650	4150													
	10	7.5	490	780	1240	1950	3060	4770	5940											
	15	11	**330**	530	850	1340	2090	3260	4060											
	20	15	0	**410**	650	1030	1610	2520	3140	3860	4760	5830								
	25	18.5	0	0	**520**	830	1300	2030	2530	3110	3840	4710								
	30	22	0	0	**430**	680	1070	1670	2080	2560	3160	3880	4770	5780	7030	8000				
	40	30	0	0	0	**500**	790	1240	1540	1900	2330	2860	3510	4230	5140	5830				
	50	37	0	0	0	0	**640**	1000	1250	1540	1890	2310	2840	3420	4140	4700	5340	5990	6530	7580
	60	45	0	0	0	0	0	**850**	1060	1300	1600	1960	2400	2890	3500	3970	4520	5070	5530	6410
	75	55	0	0	0	0	0	**690**	**860**	**1060**	1310	1600	1970	2380	2890	3290	3750	5220	4610	5370
	100	75	0	0	0	0	0	0	0	**790**	**970**	**1190**	1460	1770	2150	2440	2790	3140	3430	3990
	125	93	0	0	0	0	0	0	0	0	**770**	**950**	**1160**	1400	1690	1920	2180	2440	2650	3070
	150	110	0	0	0	0	0	0	0	0	0	**800**	**990**	**1190**	1440	1630	1860	2080	2270	2640
	175	130	0	0	0	0	0	0	0	0	0	0	**870**	**1050**	**1270**	**1450**	1650	1860	2030	2360
	200	150	0	0	0	0	0	0	0	0	0	0	0	**920**	**1110**	**1260**	**1440**	1620	1760	2050

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See 11 for additional details.

Continued on next page

Table 18 Three-Phase 60 °C Cable (Continued)

60 °C

MOTOR RATING			60 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
200 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	160	250	420	660	1030	1620	2020	2490	3060	3730	4570	5500	6660	7540				
	7.5	5.5	110	180	300	460	730	1150	1440	1770	2170	2650	3250	3900	4720	5340				
	10	7.5	**80**	130	210	340	550	850	1080	1320	1630	1990	2460	2950	3580	4080	4650	5220	5700	6630
	15	11	0	0	**140**	240	370	580	730	900	1110	1360	1660	2010	2440	2770	3150	3520	3850	4470
	20	15	0	0	0	**170**	280	450	570	690	850	1050	1290	1570	1900	2160	2470	2770	3030	3540
	25	18.5	0	0	0	**140**	**220**	360	450	550	690	850	1050	1260	1540	1750	1990	2250	2460	2850
	30	22	0	0	0	0	**180**	294	370	460	570	700	870	1050	1270	1450	1660	1870	2040	2380
230 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	210	340	550	880	1380	2140	2680	3280	4030	4930	6040	7270	8800	9970				
	7.5	5.5	150	240	390	630	970	1530	1900	2340	2880	3510	4300	5160	6240	7060	8010	8950	9750	
	10	7.5	**110**	180	280	460	730	1140	1420	1750	2160	2640	3240	3910	4740	5380	6150	6900	7530	8760
	15	11	0	0	**190**	310	490	780	970	1200	1470	1800	2200	2670	3220	3660	4170	4660	5100	5910
	20	15	0	0	**140**	230	370	600	750	910	1140	1390	1710	2070	2520	2860	3270	3670	4020	4680
	25	18.5	0	0	0	**190**	300	480	600	750	910	1120	1380	1680	2040	2310	2640	2970	3240	3780
	30	22	0	0	0	**150**	**240**	390	490	610	760	930	1140	1390	1690	1920	2200	2470	2700	3160
380 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	600	960	1510	2380	3730	5800	7170	8800										
	7.5	5.5	400	660	1030	1630	2560	3960	4890	6000	7390	9010								
	10	7.5	300	480	760	1200	1870	2890	3570	4360	5350	6490	7840	9390						
	15	11	210	340	550	880	1380	2140	2650	3250	4030	4930	6000	7260	8650	9780				
	20	15	**160**	260	410	660	1050	1630	2020	2500	3090	3790	4630	5640	6750	7660	4260	9760		
	25	18.5	0	**210**	330	540	850	1320	1650	2020	2500	3070	3760	4560	5460	6190	7080	7870	8610	9880
	30	22	0	0	**270**	430	700	1090	1360	1680	2070	2550	3120	3780	4530	5140	5880	6540	7150	8230
	40	30	0	0	0	**320**	510	790	990	1230	1510	1860	2280	2760	3300	3750	4270	4750	5200	5980
	50	37	0	0	0	**250**	**400**	630	810	990	1230	1500	1830	2220	2650	3010	3430	3820	4170	4780
	60	45	0	0	0	0	**340**	540	660	840	1030	1270	1540	1870	2250	2550	2910	3220	3520	4050
	75	55	0	0	0	0	0	**450**	550	690	855	1050	1290	1570	1900	2160	2490	2770	3040	3520
	100	75	0	0	0	0	0	0	**420**	**520**	640	760	940	1140	1360	1540	1770	1960	2140	2470
	125	93	0	0	0	0	0	0	0	**400**	**490**	**600**	730	930	1110	1260	1420	1590	1740	1990
	150	110	0	0	0	0	0	0	0	0	**420**	**510**	**620**	750	930	1050	1180	1320	1440	1630
	175	130	0	0	0	0	0	0	0	0	**360**	**440**	**540**	660	780	970	1120	1260	1380	1600
	200	150	0	0	0	0	0	0	0	0	0	0	**480**	**580**	**690**	790	940	1050	1140	1320
460 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	880	1420	2250	3540	5550	8620												
	7.5	5.5	630	1020	1600	2530	3960	6150	7650	9390										
	10	7.5	460	750	1180	1870	2940	4570	5700	7020	8620									
	15	11	310	510	810	1270	2010	3130	3900	4800	5890	7210	8850							
	20	15	**230**	380	610	970	1540	2410	3000	3700	4560	5590	6870	8290						
	25	18.5	**190**	310	490	790	1240	1950	2430	2980	3670	4510	5550	6700	8140					
	30	22	0	**250**	410	640	1020	1600	1990	2460	3040	3730	4590	5550	6750	7690	8790			
	40	30	0	0	**300**	480	750	1180	1470	1810	2230	2740	3370	4060	4930	5590	6370			
	50	37	0	0	0	**370**	590	960	1200	1470	1810	2220	2710	3280	3970	4510	5130	5740	6270	7270
	60	45	0	0	0	**320**	**500**	810	1000	1240	1530	1870	2310	2770	3360	3810	4330	4860	5310	6150
	75	55	0	0	0	0	**420**	660	810	1020	1260	1540	1890	2280	2770	3150	3600	4050	4420	5160
	100	75	0	0	0	0	0	**500**	**610**	760	930	1140	1410	1690	2070	2340	2680	3010	3280	3820
	125	93	0	0	0	0	0	0	**470**	**590**	**730**	880	1110	1330	1500	1830	2080	2340	2550	2940
	150	110	0	0	0	0	0	0	0	**510**	**630**	**770**	950	1140	1380	1570	1790	2000	2180	2530
	175	130	0	0	0	0	0	0	0	0	**550**	**680**	**830**	1000	1220	1390	1580	1780	1950	2270
	200	150	0	0	0	0	0	0	0	0	0	**590**	**730**	**880**	1070	1210	1380	1550	1690	1970
575 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	1380	2220	3490	5520	8620													
	7.5	5.5	990	1590	2520	3970	6220													
	10	7.5	730	1170	1860	2920	4590	7150	8910											
	15	11	490	790	1270	2010	3130	4890	6090											
	20	15	370	610	970	1540	2410	3780	4710	5790	7140	8740								
	25	18.5	**300**	490	780	1240	1950	3040	3790	4660	5760	7060								
	30	22	**240**	400	645	1020	1600	2500	3120	3840	4740	5820	7150	8670						
	40	30	0	**300**	480	750	1180	1860	2310	2850	3490	4290	5260	6340	7710	8740				
	50	37	0	0	**380**	590	960	1500	1870	2310	2830	3460	4260	5130	6210	7050	8010	8980	9790	
	60	45	0	0	0	**500**	**790**	1270	1590	1950	2400	2940	3600	4330	5250	5950	6780	7600	8290	9610
	75	55	0	0	0	**420**	**660**	1030	1290	1590	1960	2400	2950	3570	4330	4930	5620	6330	6910	8050
	100	75	0	0	0	0	**400**	**780**	960	1180	1450	1780	2190	2650	3220	3660	4180	4710	5140	5980
	125	93	0	0	0	0	0	**600**	**740**	920	1150	1420	1740	2100	2530	2880	3270	3660	3970	4600
	150	110	0	0	0	0	0	0	**650**	**800**	**990**	1210	1480	1780	2160	2450	2790	3120	3410	3950
	175	130	0	0	0	0	0	0	0	**700**	**860**	1060	1300	1570	1910	2170	2480	2780	3040	3540
	200	150	0	0	0	0	0	0	0	0	**760**	**930**	1140	1370	1670	1890	2160	2420	2640	3070

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

Table 19 Three-Phase 75 °C Cable, 60 Hz (Service Entrance to Motor) Maximum Length in Feet

75 °C

MOTOR RATING			75 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
200 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	710	1140	1800	2840	4420													
	3/4	0.55	510	810	1280	2030	3160													
	1	0.75	430	690	1080	1710	2670	4140	5140											
	1.5	1.1	310	500	790	1260	1960	3050	3780											
	2	1.5	240	390	610	970	1520	2360	2940	3610	4430	5420								
	3	2.2	180	290	470	740	1160	1810	2250	2760	3390	4130								
	5	3.7	**110**	170	280	440	690	1080	1350	1660	2040	2490	3050	3670	4440	5030				
	7.5	5.5	0	0	200	310	490	770	960	1180	1450	1770	2170	2600	3150	3560				
	10	7.5	0	0	**150**	230	370	570	720	880	1090	1330	1640	1970	2390	2720	3100	3480	3800	4420
	15	11	0	0	0	**160**	250	390	490	600	740	910	1110	1340	1630	1850	2100	2350	2570	2980
	20	15	0	0	0	0	**190**	300	380	460	570	700	860	1050	1270	1440	1650	1850	2020	2360
	25	18.5	0	0	0	0	0	**240**	300	370	460	570	700	840	1030	1170	1330	1500	1640	1900
	30	22	0	0	0	0	0	**200**	**250**	310	380	470	580	700	850	970	1110	1250	1360	1590
230 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	930	1490	2350	3700	5760	8910												
	3/4	0.55	670	1080	1700	2580	4190	6490	8060	9860										
	1	0.75	560	910	1430	2260	3520	5460	6780	8290										
	1.5	1.1	420	670	1060	1670	2610	4050	5030	6160	7530	9170								
	2	1.5	320	510	810	1280	2010	3130	3890	4770	5860	7170	8780							
	3	2.2	240	390	620	990	1540	2400	2980	3660	4480	5470	6690	8020	9680					
	5	3.7	**140**	230	370	590	920	1430	1790	2190	2690	3290	4030	4850	5870	6650	7560	8460	9220	
	7.5	5.5	0	**160**	260	420	650	1020	1270	1560	1920	2340	2870	3440	4160	4710	5340	5970	6500	7510
	10	7.5	0	0	**190**	310	490	760	950	1170	1440	1760	2160	2610	3160	3590	4100	4600	5020	5840
	15	11	0	0	0	**210**	330	520	650	800	980	1200	1470	1780	2150	2440	2780	3110	3400	3940
	20	15	0	0	0	**160**	**250**	400	500	610	760	930	1140	1380	1680	1910	2180	2450	2680	3120
	25	18.5	0	0	0	0	**200**	320	400	500	610	750	920	1120	1360	1540	1760	1980	2160	2520
	30	22	0	0	0	0	0	**260**	330	410	510	620	760	930	1130	1280	1470	1650	1800	2110
380 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	2690	4290	6730															
	3/4	0.55	2000	3190	5010	7860														
	1	0.75	1620	2580	4060	6390	9980													
	1.5	1.1	1230	1970	3100	4890	7630													
	2	1.5	870	1390	2180	3450	5400	8380												
	3	2.2	680	1090	1710	2690	4200	6500	8020	9830										
	5	3.7	400	640	1010	1590	2490	3870	4780	5870	7230	8830								
	7.5	5.5	270	440	690	1090	1710	2640	3260	4000	4930	6010	7290	8780						
	10	7.5	**200**	320	510	800	1250	1930	2380	2910	3570	4330	5230	6260	7390	8280	9340			
	15	11	0	0	370	590	920	1430	1770	2170	2690	3290	4000	4840	5770	6520	7430	8250	8990	
	20	15	0	0	**280**	440	700	1090	1350	1670	2060	2530	3090	3760	4500	5110	2840	6510	7120	8190
	25	18.5	0	0	0	**360**	570	880	1100	1350	1670	2050	2510	3040	3640	4130	4720	5250	5740	6590
	30	22	0	0	0	**290**	470	730	910	1120	1380	1700	2080	2520	3020	3430	3920	4360	4770	5490
	40	30	0	0	0	0	0	**530**	660	820	1010	1240	1520	1840	2200	2500	2850	3170	3470	3990
	50	37	0	0	0	0	0	**440**	**540**	660	820	1000	1220	1480	1770	2010	2290	2550	2780	3190
	60	45	0	0	0	0	0	**370**	**460**	**560**	690	850	1030	1250	1500	1700	1940	2150	2350	2700
	75	55	0	0	0	0	0	0	0	**460**	**570**	700	860	1050	1270	1440	1660	1850	2030	2350
	100	75	0	0	0	0	0	0	0	0	**420**	**510**	**630**	760	910	1030	1180	1310	1430	1650
	125	93	0	0	0	0	0	0	0	0	0	0	**510**	**620**	**740**	840	950	1060	1160	1330
	150	110	0	0	0	0	0	0	0	0	0	0	0	**520**	**620**	**700**	**790**	880	960	1090
	175	130	0	0	0	0	0	0	0	0	0	0	0	0	**560**	**650**	**750**	**840**	920	1070
	200	150	0	0	0	0	0	0	0	0	0	0	0	0	0	**550**	**630**	**700**	**760**	880

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

Continued on next page

Table 20 Three-Phase 75 °C Cable (Continued)

75 °C

MOTOR RATING			75 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
460 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	3770	6020	9460															
	3/4	0.55	2730	4350	6850															
	1	0.75	2300	3670	5770	9070														
	1.5	1.1	1700	2710	4270	6730														
	2	1.5	1300	2070	3270	5150	8050													
	3	2.2	1000	1600	2520	3970	6200													
	5	3.7	590	950	1500	2360	3700	5750												
	7.5	5.5	420	680	1070	1690	2640	4100	5100	6260	7680									
	10	7.5	310	500	790	1250	1960	3050	3800	4680	5750	7050								
	15	11	0	**340**	540	850	1340	2090	2600	3200	3930	4810	5900	7110						
	20	15	0	0	410	650	1030	1610	2000	2470	3040	3730	4580	5530						
	25	18.5	0	0	**330**	530	830	1300	1620	1990	2450	3010	3700	4470	5430					
	30	22	0	0	**270**	430	680	1070	1330	1640	2030	2490	3060	3700	4500	5130	5860			
	40	30	0	0	0	**320**	**500**	790	980	1210	1490	1830	2250	2710	3290	3730	4250			
	50	37	0	0	0	0	**410**	640	800	980	1210	1480	1810	2190	2650	3010	3420	3830	4180	4850
	60	45	0	0	0	0	0	**540**	**670**	830	1020	1250	1540	1850	2240	2540	2890	3240	3540	4100
	75	55	0	0	0	0	0	**440**	**550**	**680**	840	1030	1260	1520	1850	2100	2400	2700	2950	3440
	100	75	0	0	0	0	0	0	0	**500**	**620**	**760**	940	1130	1380	1560	1790	2010	2190	2550
	125	93	0	0	0	0	0	0	0	0	0	**600**	**740**	**890**	1000	1220	1390	1560	1700	1960
	150	110	0	0	0	0	0	0	0	0	0	0	**630**	**760**	**920**	1050	1190	1340	1460	1690
	175	130	0	0	0	0	0	0	0	0	0	0	0	**670**	**810**	**930**	1060	1190	1300	1510
	200	150	0	0	0	0	0	0	0	0	0	0	0	**590**	**710**	**810**	**920**	1030	1130	1310
575 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	5900	9410																
	3/4	0.55	4270	6810																
	1	0.75	3630	5800	9120															
	1.5	1.1	2620	4180	6580															
	2	1.5	2030	3250	5110	8060														
	3	2.2	1580	2530	3980	6270														
	5	3.7	920	1480	2330	3680	5750													
	7.5	5.5	660	1060	1680	2650	4150													
	10	7.5	490	780	1240	1950	3060	4770	5940											
	15	11	**330**	530	850	1340	2090	3260	4060											
	20	15	0	**410**	650	1030	1610	2520	3140	3860	4760	5830								
	25	18.5	0	0	520	830	1300	2030	2530	3110	3840	4710								
	30	22	0	0	**430**	680	1070	1670	2080	2560	3160	3880	4770	5780	7030	8000				
	40	30	0	0	0	**500**	790	1240	1540	1900	2330	2860	3510	4230	5140	5830				
	50	37	0	0	0	**410**	**640**	1000	1250	1540	1890	2310	2840	3420	4140	4700	5340	5990	6530	7580
	60	45	0	0	0	0	**540**	850	1060	1300	1600	1960	2400	2890	3500	3970	4520	5070	5530	6410
	75	55	0	0	0	0	0	**690**	860	1060	1310	1600	1970	2380	2890	3290	3750	5220	4610	5370
	100	75	0	0	0	0	0	0	**640**	**790**	970	1190	1460	1770	2150	2440	2790	3140	3430	3990
	125	93	0	0	0	0	0	0	0	**630**	**770**	**950**	1160	1400	1690	1920	2180	2440	2650	3070
	150	110	0	0	0	0	0	0	0	0	**660**	**800**	**990**	1190	1440	1630	1860	2080	2270	2640
	175	130	0	0	0	0	0	0	0	0	0	**700**	**870**	**1050**	1270	1450	1650	1860	2030	2360
	200	150	0	0	0	0	0	0	0	0	0	0	**760**	**920**	**1110**	1260	1440	1620	1760	2050

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

Continued on next page

APPLICATION
Three-Phase Motors

Table 21 Three-Phase 75 °C Cable (Continued)

75 °C

MOTOR RATING			75 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
200 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	160	250	420	660	1030	1620	2020	2490	3060	3730	4570	5500	6660	7540				
	7.5	5.5	110	180	300	460	730	1150	1440	1770	2170	2650	3250	3900	4720	5340				
	10	7.5	**80**	130	210	340	550	850	1080	1320	1630	1990	2460	2950	3580	4080	4650	5220	5700	6630
	15	11	0	0	140	240	370	580	730	900	1110	1360	1660	2010	2440	2770	3150	3520	3850	4470
	20	15	0	0	**120**	170	280	450	570	690	850	1050	1290	1570	1900	2160	2470	2770	3030	3540
	25	18.5	0	0	0	**140**	220	360	450	550	690	850	1050	1260	1540	1750	1990	2250	2460	2850
	30	22	0	0	0	**120**	**180**	294	370	460	570	700	870	1050	1270	1450	1660	1870	2040	2380
230 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	210	340	550	880	1380	2140	2680	3280	4030	4930	6040	7270	8800	9970				
	7.5	5.5	150	240	390	630	970	1530	1900	2340	2880	3510	4300	5160	6240	7060	8010	8950	9750	
	10	7.5	**110**	180	280	460	730	1140	1420	1750	2160	2640	3240	3910	4740	5380	6150	6900	7530	8760
	15	11	0	**130**	190	310	490	780	970	1200	1470	1800	2200	2670	3220	3660	4170	4660	5100	5910
	20	15	0	0	**140**	230	370	600	750	910	1140	1390	1710	2070	2520	2860	3270	3670	4020	4680
	25	18.5	0	0	**120**	190	300	480	600	750	910	1120	1380	1680	2040	2310	2640	2970	3240	3780
	30	22	0	0	0	**150**	240	390	490	610	760	930	1140	1390	1690	1920	2200	2470	2700	3160
380 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	600	960	1510	2380	3730	5800	7170	8800										
	7.5	5.5	400	660	1030	1630	2560	3960	4890	6000	7390	9010								
	10	7.5	300	480	760	1200	1870	2890	3570	4360	5350	6490	7840	9390						
	15	11	210	340	550	880	1380	2140	2650	3250	4030	4930	6000	7260	8650	9780				
	20	15	**160**	260	410	660	1050	1630	2020	2500	3090	3790	4630	5640	6750	7660	4260	9760		
	25	18.5	0	**210**	330	540	850	1320	1650	2020	2500	3070	3760	4560	5460	6190	7080	7870	8610	9880
	30	22	0	0	**270**	430	700	1090	1360	1680	2070	2550	3120	3780	4530	5140	5880	6540	7150	8230
	40	30	0	0	**210**	320	510	790	990	1230	1510	1860	2280	2760	3300	3750	4270	4750	5200	5980
	50	37	0	0	0	**250**	400	630	810	990	1230	1500	1830	2220	2650	3010	3430	3820	4170	4780
	60	45	0	0	0	0	**340**	540	660	840	1030	1270	1540	1870	2250	2550	2910	3220	3520	4050
	75	55	0	0	0	0	**290**	450	550	690	855	1050	1290	1570	1900	2160	2490	2770	3040	3520
	100	75	0	0	0	0	0	**340**	**420**	520	640	760	940	1140	1360	1540	1770	1960	2140	2470
	125	93	0	0	0	0	0	0	**340**	**400**	**490**	600	730	930	1110	1260	1420	1590	1740	1990
	150	110	0	0	0	0	0	0	0	**350**	**420**	**510**	620	750	930	1050	1180	1320	1440	1630
	175	130	0	0	0	0	0	0	0	0	**360**	**440**	**540**	660	780	970	1120	1260	1380	1600
	200	150	0	0	0	0	0	0	0	0	0	**410**	**480**	**580**	690	790	940	1050	1140	1320
460 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	880	1420	2250	3540	5550	8620												
	7.5	5.5	630	1020	1600	2530	3960	6150	7650	9390										
	10	7.5	460	750	1180	1870	2940	4570	5700	7020	8620									
	15	11	310	510	810	1270	2010	3130	3900	4800	5890	7210	8850							
	20	15	230	380	610	970	1540	2410	3000	3700	4560	5590	6870	8290						
	25	18.5	**190**	310	490	790	1240	1950	2430	2980	3670	4510	5550	6700	8140					
	30	22	0	**250**	410	640	1020	1600	1990	2460	3040	3730	4590	5550	6750	7690	8790			
	40	30	0	0	**300**	480	750	1180	1470	1810	2230	2740	3370	4060	4930	5590	6370			
	50	37	0	0	**250**	370	590	960	1200	1470	1810	2220	2710	3280	3970	4510	5130	5740	6270	7270
	60	45	0	0	0	**320**	500	810	1000	1240	1530	1870	2310	2770	3360	3810	4330	4860	5310	6150
	75	55	0	0	0	0	**420**	660	810	1020	1260	1540	1890	2280	2770	3150	3600	4050	4420	5160
	100	75	0	0	0	0	**310**	**500**	610	760	930	1140	1410	1690	2070	2340	2680	3010	3280	3820
	125	93	0	0	0	0	0	**390**	**470**	**590**	730	880	1110	1330	1500	1830	2080	2340	2550	2940
	150	110	0	0	0	0	0	0	**420**	**510**	**630**	770	950	1140	1380	1570	1790	2000	2180	2530
	175	130	0	0	0	0	0	0	0	**450**	**550**	**680**	830	1000	1220	1390	1580	1780	1950	2270
	200	150	0	0	0	0	0	0	0	0	**480**	**590**	**730**	880	1070	1210	1380	1550	1690	1970
575 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	1380	2220	3490	5520	8620													
	7.5	5.5	990	1590	2520	3970	6220													
	10	7.5	730	1170	1860	2920	4590	7150	8910											
	15	11	490	790	1270	2010	3130	4890	6090											
	20	15	370	610	970	1540	2410	3780	4710	5790	7140	8740								
	25	18.5	**300**	490	780	1240	1950	3040	3790	4660	5760	7060								
	30	22	**240**	400	645	1020	1600	2500	3120	3840	4740	5820	7150	8670						
	40	30	0	**300**	480	750	1180	1860	2310	2850	3490	4290	5260	6340	7710	8740				
	50	37	0	0	**380**	590	960	1500	1870	2310	2830	3460	4260	5130	6210	7050	8010	8980	9790	
	60	45	0	0	**330**	500	790	1270	1590	1950	2400	2940	3600	4330	5250	5950	6780	7600	8290	9610
	75	55	0	0	0	**420**	660	1030	1290	1590	1960	2400	2950	3570	4330	4930	5620	6330	6910	8050
	100	75	0	0	0	0	**400**	780	960	1180	1450	1780	2190	2650	3220	3660	4180	4710	5140	5980
	125	93	0	0	0	0	0	**600**	740	920	1150	1420	1740	2100	2530	2880	3270	3660	3970	4600
	150	110	0	0	0	0	0	**520**	**650**	800	990	1210	1480	1780	2160	2450	2790	3120	3410	3950
	175	130	0	0	0	0	0	0	**570**	**700**	860	1060	1300	1570	1910	2170	2480	2780	3040	3540
	200	150	0	0	0	0	0	0	**500**	**610**	**760**	930	1140	1370	1670	1890	2160	2420	2640	3070

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

Table 22 Three-Phase Motor Specifications (60 Hz) 3450 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	WATTS	AMPS	WATTS		S.F.	F.L.		
4"	234501	1/2	0.37	200	60	1.6	2.8	585	3.4	860	6.6-8.4	70	64	17.5	N
	234511			230	60	1.6	2.4	585	2.9	860	9.5-10.9	70	64	15.2	N
	234541			380	60	1.6	1.4	585	2.1	860	23.2-28.6	70	64	9.2	N
	234521			460	60	1.6	1.2	585	1.5	860	38.4-44.1	70	64	7.6	N
	234531			575	60	1.6	1.0	585	1.2	860	58.0-71.0	70	64	6.1	N
	234502	3/4	0.55	200	60	1.5	3.6	810	4.4	1150	4.6-5.9	73	69	24.6	N
	234512			230	60	1.5	3.1	810	3.8	1150	6.8-7.8	73	69	21.4	N
	234542			380	60	1.5	1.9	810	2.5	1150	16.6-20.3	73	69	13	N
	234522			460	60	1.5	1.6	810	1.9	1150	27.2-30.9	73	69	10.7	N
	234532			575	60	1.5	1.3	810	1.6	1150	41.5-50.7	73	69	8.6	N
	234503	1	0.75	200	60	1.4	4.5	1070	5.4	1440	3.8-4.5	72	70	30.9	M
	234513			230	60	1.4	3.9	1070	4.7	1440	4.9-5.6	72	70	26.9	M
	234543			380	60	1.4	2.3	1070	2.8	1440	12.2-14.9	72	70	16.3	M
	234523			460	60	1.4	2	1070	2.4	1440	19.9-23.0	72	70	13.5	M
	234533			575	60	1.4	1.6	1070	1.9	1440	30.1-36.7	72	70	10.8	M
	234504	1.5	1.1	200	60	1.3	5.8	1460	6.8	1890	2.5-3.0	76	76	38.2	K
	234514			230	60	1.3	5	1460	5.9	1890	3.2-4.0	76	76	33.2	K
	234544			380	60	1.3	3	1460	3.6	1890	8.5-10.4	76	76	20.1	K
	234524			460	60	1.3	2.5	1460	3.1	1890	13.0-16.0	76	76	16.6	K
	234534			575	60	1.3	2	1460	2.4	1890	20.3-25.0	76	76	13.3	K
	234305	2	1.5	200	60	1.25	7.7	1960	9.3	2430	1.8-2.4	76	76	50.3	K
	234315			230	60	1.25	6.7	1960	8.1	2430	2.3-3.0	76	76	45.0	K
	234345			380	60	1.25	4.1	1960	4.9	2430	6.6-8.2	76	76	26.6	K
	234325			460	60	1.25	3.4	1960	4.1	2430	9.2-12.0	76	76	22.5	K
	234335			575	60	1.25	2.7	1960	3.2	2430	14.6-18.7	76	76	17.8	K
	234306	3	2.2	200	60	1.15	10.9	2920	12.5	3360	1.3-1.7	77	77	69.5	K
	234316			230	60	1.15	9.5	2920	10.9	3360	1.8-2.2	77	77	60.3	K
	234346			380	60	1.15	5.8	2920	6.6	3360	4.7-6.0	77	77	37.5	K
	234326			460	60	1.15	4.8	2920	5.5	3360	7.2-8.8	77	77	31.0	K
	234336			575	60	1.15	3.8	2920	4.4	3360	11.4-13.9	77	77	25.1	K
	234307	5	3.7	200	60	1.15	18.3	4800	20.5	5500	.68-.83	78	78	116	K
	234317			230	60	1.15	15.9	4800	17.8	5500	.91-1.1	78	78	102	K
	234347			380	60	1.15	9.6	4800	10.8	5500	2.6-3.2	78	78	60.2	K
	234327			460	60	1.15	8.0	4800	8.9	5500	3.6-4.4	78	78	53.7	K
	234337			575	60	1.15	6.4	4800	7.1	5500	5.6-6.9	78	78	41.8	K
	234308	7.5	5.5	200	60	1.15	26.5	7150	30.5	8200	.43-.53	78	78	177	K
	234318			230	60	1.15	23.0	7150	26.4	8200	.60-.73	78	78	152	K
	234348			380	60	1.15	13.9	7150	16.0	8200	1.6-2.0	78	78	92.7	K
	234328			460	60	1.15	11.5	7150	13.2	8200	2.3-2.8	78	78	83.8	K
	234338			575	60	1.15	9.2	7150	10.6	8200	3.6-4.5	78	78	64.6	K
	234549	10	7.5	380	60	1.15	19.3	10000	21.0	11400	1.2-1.6	75	75	140	L
	234595			460	60	1.15	15.9	10000	17.3	11400	1.8-2.3	75	75	116.0	L
	234598			575	60	1.15	12.5	10000	13.6	11400	2.8-3.5	75	75	92.8	L

Table 23 Three-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX	RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
		HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
4"	234501	1/2	0.37	200	10	5	8	10	4	15
	234511			230	8	4.5	6	8	4	15
	234541			380	5	2.5	4	5	2	15
	234521			460	4	2.25	3	4	2	15
	234531			575	3	1.8	3	3	1.4	15
	234502	3/4	0.55	200	15	7	10	12	5	15
	234512			230	10	5.6	8	10	5	15
	234542			380	6	3.5	5	6	3	15
	234522			460	5	2.8	4	5	3	15
	234532			575	4	2.5	4	4	1.8	15
	234503	1	0.75	200	15	8	15	15	6	15
	234513			230	15	7	10	12	6	15
	234543			380	8	4.5	8	8	4	15
	234523			460	6	3.5	5	6	3	15
	234533			575	5	2.8	4	5	2.5	15
	234504	1.5	1.1	200	20	12	15	20	8	15
	234514			230	15	9	15	15	8	15
	234544			380	10	5.6	8	10	4	15
	234524			460	8	4.5	8	8	4	15
	234534			575	6	3.5	5	6	3	15
	234305	2	1.5	200	25	15	20	25	11	20
	234315			230	25	12	20	25	10	20
	234345			380	15	8	15	15	6	15
	234325			460	15	6	10	11	5	15
	234335			575	10	5	8	10	4	15
	234306	3	2.2	200	35	20	30	35	15	30
	234316			230	30	17.5	25	30	12	25
	234346			380	20	12	15	20	8	15
	234326			460	15	9	15	15	6	15
	234336			575	15	7	10	11	5	15
	234307	5	3.7	200	60	35	50	60	25	50
	234317			230	50	30	40	45	20	40
	234347			380	30	17.5	25	30	12	25
	234327			460	25	15	20	25	10	20
	234337			575	20	12	20	20	8	20
	234308	7.5	5.5	200	90	50	70	80	35	70
	234318			230	80	45	60	70	30	60
	234348			380	45	25	40	40	20	40
	234328			460	40	25	30	35	15	30
	234338			575	30	17.5	25	30	12	25
	234349	10	7.5	380	70	40	60	60	25	60
	234329			460	60	30	45	50	25	45
	234339			575	45	25	35	40	20	35
	234549			380	70	35	60	60	25	60
	234595			460	60	30	45	50	25	45
	234598			575	45	25	35	40	20	35

Table 24 Three-Phase Motor Specifications (60 Hz) 3450 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	WATTS	AMPS	WATTS		S.F.	F.L.		
6" STD.	236650	5	3.7	200	60	1.15	17.5	4700	20.0	5400	.77-.93	79	79	99	H
	236600			230	60	1.15	15	4700	17.6	5400	1.0-1.2	79	79	86	H
	236660			380	60	1.15	9.1	4700	10.7	5400	2.6-3.2	79	79	52	H
	236610			460	60	1.15	7.5	4700	8.8	5400	3.9-4.8	79	79	43	H
	236620			575	60	1.15	6	4700	7.1	5400	6.3-7.7	79	79	34	H
	236651	7.5	5.5	200	60	1.15	25.1	7000	28.3	8000	.43-.53	80	80	150	H
	236601			230	60	1.15	21.8	7000	24.6	8000	.64-.78	80	80	130	H
	236661			380	60	1.15	13.4	7000	15	8000	1.6-2.1	80	80	79	H
	236611			460	60	1.15	10.9	7000	12.3	8000	2.4-2.9	80	80	65	H
	236621			575	60	1.15	8.7	7000	9.8	8000	3.7-4.6	80	80	52	H
	236652	10	7.5	200	60	1.15	32.7	9400	37	10800	.37-.45	79	79	198	H
	236602			230	60	1.15	28.4	9400	32.2	10800	.47-.57	79	79	172	H
	236662			380	60	1.15	17.6	9400	19.6	10800	1.2-1.5	79	79	104	H
	236612			460	60	1.15	14.2	9400	16.1	10800	1.9-2.4	79	79	86	H
	236622			575	60	1.15	11.4	9400	12.9	10800	3.0-3.7	79	79	69	H
	236653	15	11	200	60	1.15	47.8	13700	54.4	15800	.24-.29	81	81	306	H
	236603			230	60	1.15	41.6	13700	47.4	15800	.28-.35	81	81	266	H
	236663			380	60	1.15	25.8	13700	28.9	15800	.77-.95	81	81	161	H
	236613			460	60	1.15	20.8	13700	23.7	15800	1.1-1.4	81	81	133	H
	236623			575	60	1.15	16.6	13700	19	15800	1.8-2.3	81	81	106	H
	236654	20	15	200	60	1.15	61.9	18100	69.7	20900	.16-.20	82	82	416	J
	236604			230	60	1.15	53.8	18100	60.6	20900	.22-.26	82	82	362	J
	236664			380	60	1.15	33	18100	37.3	20900	.55-.68	82	82	219	J
	236614			460	60	1.15	26.9	18100	30.3	20900	.8-1.0	82	82	181	J
	236624			575	60	1.15	21.5	18100	24.2	20900	1.3-1.6	82	82	145	J
	236655	25	18.5	200	60	1.15	77.1	22500	86.3	25700	.12-.15	83	83	552	J
	236605			230	60	1.15	67	22500	75	25700	.15-.19	83	83	480	J
	236665			380	60	1.15	41	22500	46	25700	.46-.56	83	83	291	J
	236615			460	60	1.15	33.5	22500	37.5	25700	.63-.77	83	83	240	J
	236625			575	60	1.15	26.8	22500	30	25700	1.0-1.3	83	83	192	J
	236656	30	22	200	60	1.15	90.9	26900	104	31100	.09-.11	83	83	653	J
	236606			230	60	1.15	79	26900	90.4	31100	.14-.17	83	83	568	J
	236666			380	60	1.15	48.8	26900	55.4	31100	.35-.43	83	83	317	J
	236616			460	60	1.15	39.5	26900	45.2	31100	.52-.64	83	83	284	J
	236626			575	60	1.15	31.6	26900	36.2	31100	.78-.95	83	83	227	J
	236667	40	30	380	60	1.15	66.5	35600	74.6	42400	.26-.33	83	83	481	J
	236617			460	60	1.15	54.9	35600	61.6	42400	.34-.42	83	83	397	J
	236627			575	60	1.15	42.8	35600	49.6	42400	.52-.64	83	83	318	H
	236668	50	37	380	60	1.15	83.5	45100	95	52200	.21-.25	82	83	501	H
	236618			460	60	1.15	67.7	45100	77	52200	.25-.32	82	83	414	H
	236628			575	60	1.15	54.2	45100	61.6	52200	.40-.49	82	83	331	H
	276668			380	60	1.15	82.4	45100	94.5	52200	.21 - .25	82	83	501	H
	276618			460	60	1.15	68.1	45100	78.1	52200	.25 - .32	82	83	414	H
	276628			575	60	1.15	54.5	45100	62.5	52200	.40 - .49	82	83	331	H
	236669	60	45	380	60	1.15	98.7	53500	111	61700	.15-.18	84	84	627	H
	236619			460	60	1.15	80.5	53500	91	61700	.22-.27	84	84	518	H
	236629			575	60	1.15	64.4	53500	72.8	61700	.35-.39	84	84	414	H
	276669			380	60	1.15	98.1	53500	111.8	61700	.15 - .18	84	84	627	H
	276619			460	60	1.15	81.0	53500	92.3	61700	.22 - .27	84	84	518	H
	276629			575	60	1.15	64.8	53500	73.9	61700	.35 - .39	84	84	414	H

Model numbers above are for three-lead motors. Six-lead motors with different model numbers have the same running performance, but when Wye connected for starting have locked rotor amps 33% of the values shown. Six-lead individual phase resistance = table X 1.5.

Table 25 6" Three-Phase Motor Specifications (60 Hz) 3450 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	WATTS	AMPS	WATTS		S.F.	F.L.		
6" HI-TEMP 90 °C	276650	5	3.7	200	60	1.15	17.2	5200	19.8	5800	.53 - .65	73	72	124	K
	276600			230	60	1.15	15.0	5200	17.2	5800	.68 - .84	73	72	108	K
	276660			380	60	1.15	9.1	5200	10.4	5800	2.0 - 2.4	73	72	66.0	K
	276610			460	60	1.15	7.5	5200	8.6	5800	2.8 - 3.4	73	72	54.0	K
	276620			575	60	1.15	6.0	5200	6.9	5800	4.7 - 5.7	73	72	43.0	K
	276651	7.5	5.5	200	60	1.15	24.8	7400	28.3	8400	.30 - .37	77	76	193	K
	276601			230	60	1.15	21.6	7400	24.6	8400	.41 - .50	77	76	168	K
	276661			380	60	1.15	13.1	7400	14.9	8400	1.1 - 1.4	77	76	102	K
	276611			460	60	1.15	10.8	7400	12.3	8400	1.7 - 2.0	77	76	84.0	K
	276621			575	60	1.15	8.6	7400	9.9	8400	2.6 - 3.2	77	76	67.0	K
	276652	10	7.5	200	60	1.15	32.0	9400	36.3	10700	.21 - .26	80	79	274	L
	276602			230	60	1.15	27.8	9400	31.6	10700	.28 - .35	80	79	238	L
	276662			380	60	1.15	16.8	9400	19.2	10700	.80 - .98	80	79	144	L
	276612			460	60	1.15	13.9	9400	15.8	10700	1.2 - 1.4	80	79	119	L
	276622			575	60	1.15	11.1	9400	12.7	10700	1.8 - 2.2	80	79	95.0	L
	276653	15	11	200	60	1.15	48.5	14000	54.5	15900	.15 - .19	81	80	407	L
	276603			230	60	1.15	42.2	14000	47.4	15900	.19 - .24	81	80	354	L
	276663			380	60	1.15	25.5	14000	28.7	15900	.52 - .65	81	80	214	L
	276613			460	60	1.15	21.1	14000	23.7	15900	.78 - .96	81	80	177	L
	276623			575	60	1.15	16.9	14000	19.0	15900	1.2 - 1.4	81	80	142	L
	276654	20	15	200	60	1.15	64.9	18600	73.6	21300	.10 - .12	80	80	481	K
	276604			230	60	1.15	56.4	18600	64.0	21300	.14 - .18	80	80	418	K
	276664			380	60	1.15	34.1	18600	38.8	21300	.41 - .51	80	80	253	K
	276614			460	60	1.15	28.2	18600	32.0	21300	.58 - .72	80	80	209	K
	276624			575	60	1.15	22.6	18600	25.6	21300	.93 - 1.15	80	80	167	K
	276655	25	18.5	200	60	1.15	80.0	22600	90.6	25800	.09 - .11	83	82	665	L
	276605			230	60	1.15	69.6	22600	78.8	25800	.11 - .14	83	82	578	L
	276665			380	60	1.15	42.1	22600	47.7	25800	.27 - .34	83	82	350	L
	276615			460	60	1.15	34.8	22600	39.4	25800	.41 - .51	83	82	289	L
	276625			575	60	1.15	27.8	22600	31.6	25800	.70 - .86	83	82	231	L
	276656	30	22	200	60	1.15	95.0	28000	108.6	31900	.07 - .09	81	80	736	K
	276606			230	60	1.15	82.6	28000	94.4	31900	.09 - .12	81	80	640	K
	276666			380	60	1.15	50.0	28000	57.2	31900	.23 - .29	81	80	387	K
	276616			460	60	1.15	41.3	28000	47.2	31900	.34 - .42	81	80	320	K
	276626			575	60	1.15	33.0	28000	37.8	31900	.52 - .65	81	80	256	K
	276667	40	30	380	60	1.15	67.2	35900	76.0	42400	.18 - .23	84	83	545	L
	276617			460	60	1.15	55.4	35900	62.8	42400	.23 - .29	84	83	450	L
	276627			575	60	1.15	45.2	35900	50.2	42400	.34 - .43	84	83	360	L

Model numbers above are for three-lead motors. Six-lead motors with different model numbers have the same running performance, but when Wye connected for starting have locked rotor amps 33% of the values shown. Six-lead individual phase resistance = table X 1.5.

Table 26 Three-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX		RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
			HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
6" STD. & HI-TEMP	236650	276650	5	3.7	200	60	35	45	50	25	45
	236600	276600			230	45	30	40	45	20	40
	236660	276660			380	30	17.5	25	30	12	25
	236610	276610			460	25	15	20	25	10	20
	236620	276620			575	20	12	15	20	8	15
	236651	276651	7.5	5.5	200	80	45	70	80	35	70
	236601	276601			230	70	40	60	70	30	60
	236661	276661			380	45	25	35	40	20	35
	236611	276611			460	35	20	30	35	15	30
	236621	276621			575	30	17.5	25	25	11	25
	236652	276652	10	7.5	200	100	60	90	100	45	90
	236602	276602			230	90	50	80	90	40	80
	236662	276662			380	60	35	45	50	25	45
	236612	276612			460	45	25	40	45	20	40
	236622	276622			575	35	20	30	35	15	30
	236653	276653	15	11	200	150	90	125	150	60	125
	236603	276603			230	150	80	110	125	60	110
	236663	276663			380	80	50	70	80	35	70
	236613	276613			460	70	40	60	60	30	60
	236623	276623			575	60	30	45	50	25	45
	236654	276654	20	15	200	200	110	175	175	80	175
	236604	276604			230	175	100	150	175	70	150
	236664	276664			380	100	60	90	100	45	90
	236614	276614			460	90	50	70	80	35	70
	236624	276624			575	70	40	60	70	30	60
	236655	276655	25	18.5	200	250	150	200	225	100	200
	236605	276605			230	225	125	175	200	90	175
	236665	276665			380	125	80	110	125	50	110
	236615	276615			460	110	60	90	100	45	90
	236625	276625			575	90	50	70	80	35	70
	236656	276656	30	22	200	300	175	250	300	125	250
	236606	276606			230	250	150	225	250	100	200
	236666	276666			380	150	90	125	150	60	125
	236616	276616			460	125	70	110	125	50	100
	236626	276626			575	100	60	90	100	40	80
	236667	276667	40	30	380	200	125	175	200	90	175
	236617	276617			460	175	100	150	175	70	150
	236627	276627			575	150	80	110	125	60	110
	236668	276668	50	37	380	250	150	225	250	110	225
	236618	276618			460	225	125	175	200	90	175
	236628	276628			575	175	100	150	175	70	150
	236669	276669	60	45	380	300	175	250	300	125	250
	236619	276619			460	250	150	225	250	100	225
	236629	276629			575	200	125	175	200	80	175

Table 27 Three-Phase Motor Specifications (60 Hz) 3525 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	KILOWATTS	AMPS	KILOWATTS		S.F.	F.L.		
8" STD.	239660	40	30	380	60	1.15	64	35	72	40	.16-.20	86	86	479	J
	239600			460	60	1.15	53	35	60	40	.24-.30	86	86	396	J
	239610			575	60	1.15	42	35	48	40	.39-.49	86	86	317	J
	239661	50	37	380	60	1.15	79	43	88	49	.12-.16	87	87	656	K
	239601			460	60	1.15	64	43	73	49	.18-.22	87	87	542	K
	239611			575	60	1.15	51	43	59	49	.28-.34	87	87	434	K
	239662	60	45	380	60	1.15	92	52	104	60	.09-.11	88	87	797	K
	239602			460	60	1.15	76	52	86	60	.14-.17	88	87	658	K
	239612			575	60	1.15	61	52	69	60	.22-.28	88	87	526	K
	239663	75	55	380	60	1.15	114	64	130	73.5	.06-.09	88	88	1046	L
	239603			460	60	1.15	94	64	107	73.5	.10-.13	88	88	864	L
	239613			575	60	1.15	76	64	86	73.5	.16-.21	88	88	691	L
	239664	100	75	380	60	1.15	153	85	172	97.5	.05-.06	89	89	1466	L
	239604			460	60	1.15	126	85	142	97.5	.07-.09	89	89	1211	L
	239614			575	60	1.15	101	85	114	97.5	.11-.13	89	89	969	L
	239165	125	93	380	60	1.15	202	109	228	125	.03-.04	87	86	1596	K
	239105			460	60	1.15	167	109	188	125	.05-.07	87	86	1318	K
	239115			575	60	1.15	134	109	151	125	.08-.11	87	86	1054	K
	239166	150	110	380	60	1.15	235	128	266	146	.02-.03	88	87	1961	K
	239106			460	60	1.15	194	128	219	146	.04-.05	88	87	1620	K
	239116			575	60	1.15	155	128	176	146	.06-.08	88	87	1296	K
	239167	175	130	380	60	1.15	265	150	302	173	.02-.04	88	88	1991	J
	239107			460	60	1.15	219	150	249	173	.04-.05	88	88	1645	J
	239117			575	60	1.15	175	150	200	173	.06-.08	88	88	1316	J
	239168	200	150	380	60	1.15	298	169	342	194	.02-.03	88	88	2270	J
	239108			460	60	1.15	246	169	282	194	.03-.05	88	88	1875	J
	239118			575	60	1.15	197	169	226	194	.05-.07	88	88	1500	J

Table 27A 8" Three-Phase Motor Specifications (60 Hz) 3525 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	KILOWATTS	AMPS	KILOWATTS		S.F.	F.L.		
8" HI-TEMP	279160	40	30	380	60	1.15	69.6	38	78.7	43	.11 - .14	79	78	616	M
	279100			460	60	1.15	57.5	38	65.0	43	.16 - .19	79	78	509	M
	279110			575	60	1.15	46.0	38	52.0	43	.25 - .31	79	78	407	M
	279161	50	37	380	60	1.15	84.3	47	95.4	53	.07 - .09	81	80	832	M
	279101			460	60	1.15	69.6	47	78.8	53	.11 - .14	81	80	687	M
	279111			575	60	1.15	55.7	47	63.0	53	.18 - .22	81	80	550	M
	279162	60	45	380	60	1.15	98.4	55	112	62	.06 - .07	83	82	1081	N
	279102			460	60	1.15	81.3	55	92.1	62	.09 - .11	83	82	893	N
	279112			575	60	1.15	65.0	55	73.7	62	.13 - .16	83	82	715	N
	279163	75	56	380	60	1.15	125	68	141	77	.05 - .06	83	82	1175	L
	279103			460	60	1.15	100	68	114	77	.07 - .09	83	82	922	L
	279113			575	60	1.15	80	68	92	77	.11 - .14	83	82	738	L
	279164	100	75	380	60	1.15	159	88	181	100	.04 - .05	86	85	1508	M
	279104			460	60	1.15	131	88	149	100	.05 - .07	86	85	1246	M
	279114			575	60	1.15	105	88	119	100	.08 - .10	86	85	997	M
	279165	125	93	380	60	1.15	195	109	223	125	.03 - .04	86	85	1793	L
	279105			460	60	1.15	161	109	184	125	.04 - .06	86	85	1481	L
	279115			575	60	1.15	129	109	148	125	.07 - .09	86	85	1185	L
	279166	150	110	380	60	1.15	235	133	269	151	.02 - .03	85	84	2012	K
	279106			460	60	1.15	194	133	222	151	.03 - .05	85	84	1662	K
	279116			575	60	1.15	155	133	178	151	.05 - .07	85	84	1330	K

Model numbers above are for three-lead motors. Six-lead motors with different model numbers have the same running performance, but when Wye connected for starting have locked rotor amps 33% of the values shown. Six-lead individual phase resistance = table X 1.5.

Table 28 Three-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX	RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
		HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
8" STD.	239660	40	30	380	200	125	175	200	80	175
	239600			460	175	100	150	175	70	150
	239610			575	150	80	110	125	60	110
	239661	50	37	380	250	150	200	225	100	200
	239601			460	200	125	175	200	80	175
	239611			575	175	90	150	150	70	150
	239662	60	45	380	300	175	250	300	125	250
	239602			460	250	150	200	225	100	200
	239612			575	200	110	175	175	80	175
	239663	75	55	380	350	200	300	350	150	300
	239603			460	300	175	250	300	125	250
	239613			575	250	150	200	225	100	200
	239664	100	75	380	500	275	400	450	200	400
	239604			460	400	225	350	400	175	350
	239614			575	350	200	300	300	125	300
	239165	125	93	380	700	400	600	600	250	600
	239105			460	500	300	450	500	225	450
	239115			575	450	250	350	400	175	350
	239166	150	110	380	800	450	600	700	300	600
	239106			460	600	350	500	600	250	500
	239116			575	500	300	400	450	200	400
	239167	175	130	380	800	500	700	800	350	700
	239107			460	700	400	600	700	300	600
	239117			575	600	350	450	600	225	450
	239168	200	150	380	1000	600	800	1000	400	800
	239108			460	800	450	700	800	350	700
	239118			575	600	350	500	600	250	500

Table 28A 8" Three-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX	RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
		HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
8" HI-TEMP	279160	40	30	380	225	125	175	200	90	175
	279100			460	175	110	150	175	70	150
	279110			575	150	90	125	125	60	125
	279161	50	37	380	250	150	225	225	110	225
	279101			460	200	125	175	200	90	175
	279111			575	175	100	150	150	70	150
	279162	60	45	380	300	175	250	300	125	250
	279102			460	275	150	225	250	100	225
	279112			575	200	125	175	175	80	175
	279163	75	56	380	400	200	350	350	150	350
	279103			460	300	175	275	300	125	275
	279113			575	275	150	225	225	100	225
	279164	100	75	380	500	300	450	450	200	450
	279104			460	400	250	350	400	175	350
	279114			575	350	200	300	300	125	300
	279165	125	93	380	700	400	600	600	250	600
	279105			460	500	300	450	500	225	450
	279115			575	450	250	350	400	175	350
	279166	150	110	380	800	450	600	700	300	600
	279106			460	600	350	500	600	250	500
	279116			575	500	300	400	450	200	400

Overload Protection of Three-Phase Submersible Motors Class 10 Protection Required

The characteristics of submersible motors are different than standard motors and special overload protection is required.

If the motor is locked, the overload protection must trip within 10 seconds to protect the motor windings. Subtrol/SubMonitor, a Franklin-approved adjustable overload relay, or a Franklin-approved fixed heater must be used.

Fixed heater overloads must be the ambient-compensated quick-trip type to maintain protection at high and low air temperatures.

All heaters and amp settings shown are based on total line amps. When determining amperage settings or making heater selections for a six-lead motor with a Wye-Delta starter, divide motor amps by 1.732.

Pages 29, 30 and 31 list the correct selection and settings for some manufacturers. Approval for other manufacturers' types not listed may be requested by calling Franklin's Submersible Service Hotline at 800-348-2420.

Refer to notes on page 30.

Table 29 - 60 Hz 4" Motors

HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS		ADJUSTABLE RELAYS (NOTE 3)	
				FURNAS (NOTE 1)	G.E. (NOTE 2)	SET	MAX.
1/2	0.37	200	00	K31	L380A	3.2	3.4
		230	00	K28	L343A	2.7	2.9
		380	00	K22	L211A	1.7	1.8
		460	00	-	L174A	1.4	1.5
		575	00	-	-	1.2	1.3
3/4	0.55	200	00	K34	L510A	4.1	4.4
		230	00	K32	L420A	3.5	3.8
		380	00	K27	L282A	2.3	2.5
		460	00	K23	L211A	1.8	1.9
		575	00	K21	L193A	1.5	1.6
1	0.75	200	00	K37	L618A	5.0	5.4
		230	00	K36	L561A	4.4	4.7
		380	00	K28	L310A	2.6	2.8
		460	00	K26	L282A	2.2	2.4
		575	00	K23	L211A	1.8	1.9
1.5	1.1	200	00	K42	L750A	6.3	6.8
		230	00	K39	L680A	5.5	5.9
		380	00	K32	L420A	3.3	3.6
		460	00	K29	L343A	2.8	3.0
		575	00	K26	L282A	2.2	2.4
2	1.5	200	0	K50	L111B	8.6	9.3
		230	0	K49	L910A	7.5	8.1
		380	0	K36	L561A	4.6	4.9
		460	00	K33	L463A	3.8	4.1
		575	00	K29	L380A	3.0	3.2
3	2.2	200	0	K55	L147B	11.6	12.5
		230	0	K52	L122B	10.1	10.9
		380	0	K41	L750A	6.1	6.6
		460	0	K37	L618A	5.1	5.5
		575	0	K34	L510A	4.1	4.4
5	3.7	200	1	K62	L241B	19.1	20.5
		230	1	K61	L199B	16.6	17.8
		380	0	K52	L122B	10.0	10.8
		460	0	K49	L100B	8.3	8.9
		575	0	K42	L825A	6.6	7.1
7.5	5.5	200	1	K68	L332B	28.4	30.5
		230	1	K67	L293B	24.6	26.4
		380	1	K58	L181B	14.9	16.0
		460	1	K55	L147B	12.3	13.2
		575	1	K52	L122B	9.9	10.6
10	7.5	380	1	K62	L241B	19.5	21.0
		460	1	K60	L199B	16.1	17.3
		575	1	K56	L165B	12.9	13.6

Table 30 - 60 Hz 6" Standard & Hi-Temp Motors

HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS		ADJUSTABLE RELAYS (NOTE 3)	
				FURNAS (NOTE 1)	G.E. (NOTE 2)	SET	MAX.
5	3.7	200	1	K61	L220B	17.6	19.1
		230	1	K61	L199B	15.4	16.6
		380	0	K52	L122B	9.4	10.1
		460	0	K49	L100B	7.7	8.3
		575	0	K42	L825A	6.1	6.6
7.5	5.5	200	1	K67	L322B	26.3	28.3
		230	1	K64	L293B	22.9	24.6
		380	1	K57	L165B	13.9	14.9
		460	1	K54	L147B	11.4	12.3
		575	1	K52	L111B	9.1	9.8
10	7.5	200	2(1)	K72	L426B	34.4	37.0
		230	2(1)	K70	L390B	29.9	32.2
		380	1	K61	L220B	18.1	19.5
		460	1	K58	L181B	15.0	16.1
		575	1	K55	L147B	12.0	12.9
15	11	200	3(1)	K76	L650B	50.7	54.5
		230	2	K75	L520B	44.1	47.4
		380	2(1)	K68	L322B	26.7	28.7
		460	2(1)	K64	L265B	22.0	23.7
		575	2(1)	K61	L220B	17.7	19.0
20	15	200	3	K78	L787B	64.8	69.7
		230	3(1)	K77	L710B	56.4	60.6
		380	2	K72	L426B	34.1	36.7
		460	2	K69	L352B	28.2	30.3
		575	2	K64	L393B	22.7	24.4
25	18.5	200	3	K86	L107C	80.3	86.3
		230	3	K83	L866B	69.8	75.0
		380	2	K74	L520B	42.2	45.4
		460	2	K72	L426B	34.9	37.5
		575	2	K69	L352B	27.9	30.0
30	22	200	4(1)	K88	L126C	96.7	104.0
		230	3	K87	L107C	84.1	90.4
		380	3(1)	K76	L650B	50.9	54.7
		460	3(1)	K74	L520B	42.0	45.2
		575	3(1)	K72	L390B	33.7	36.2
40	30	380	3	K83	L866B	69.8	75.0
		460	3	K77	L710B	57.7	62.0
		575	3	K74	L593B	46.1	49.6
50	37	380	3	K87	L107C	86.7	93.2
		460	3	K83	L950B	71.6	77.0
		575	3	K77	L710B	57.3	61.6
60	45	380	4(1)	K89	L126C	102.5	110.2
		460	4(1)	K87	L107C	84.6	91.0
		575	4(1)	K78	L866B	67.7	72.8

Footnotes for Tables 29, 30, and 31

NOTE 1: Furnas intermediate sizes between NEMA starter sizes apply where (1) is shown in tables, size 1.75 replacing 2, 2.5 replacing 3, 3.5 replacing 4, and 4.5 replacing 5. Heaters were selected from Catalog 294, table 332 and table 632 (starter size 00, size B). Size 4 starters are heater type 4 (JG). Starters using these heater tables include classes 14, 17 and 18 (inNOVA), classes 36 and 37 (reduced voltage), and classes 87, 88 and 89 (pump and motor control centers). Overload relay adjustments should be set no higher than 100% unless necessary to stop nuisance tripping with measured amps in all lines below nameplate maximum. Heater selections for class 16 starters (Magnetic Definite Purpose) will be furnished upon request.

NOTE 2: General Electric heaters are type CR123 usable only on type CR124 overload relays and were selected from Catalog GEP-126OJ, page 184. Adjustment should be set no higher than 100%, unless necessary to stop nuisance tripping with measured amps in all lines below nameplate maximum.

NOTE 3: Adjustable overload relay amp settings apply to approved types listed. Relay adjustment should be set at the specified SET amps. Only if tripping occurs with amps in all lines measured to be within nameplate maximum amps should the setting be increased, not to exceed the MAX value shown.

NOTE 4: Heaters shown for ratings requiring NEMA size 5 or 6 starters are all used with current transformers per manufacturer standards. Adjustable relays may or may not use current transformers depending on design.

Table 31 - 60 Hz 8" Motors

MOTOR MODEL PREFIX	HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS		ADJUSTABLE RELAYS (NOTE 3)	
					FURNAS (NOTE 1)	G.E. (NOTE 2)	SET	MAX.
239660	40	30	380	3	K78	L866B	68	73
239600			460	3	K77	L710B	56	60
239610			575	3	K73	L520B	45	48
239661	50	37	380	3	K86	L107C	81	87
239601			460	3	K78	L866B	68	73
239611			575	3	K77	L710B	56	60
239662	60	45	380	4(1)	K89	L126C	101	108
239602			460	4(1)	K86	L107C	83	89
239612			575	4(1)	K78	L787B	64	69
239663	75	55	380	4	K92	L142C	121	130
239603			460	4(1)	K89	L126C	100	107
239613			575	4(1)	K85	L950C	79	85
239664	100	75	380	5(1)	K28	L100B	168	181
239604			460	4	K92	L155C	134	144
239614			575	4	K90	L142C	108	116
239165	125	93	380	5	K32	L135B	207	223
239105			460	5(1)	K29	L111B	176	189
239115			575	5(1)	K26	L825A	140	150
239166	150	110	380	5	-	L147B	248	267
239106			460	5(1)	K32	L122B	206	221
239116			575	5(1)	K28	L100B	165	177
239167	175	130	380	6	K26	-	270	290
239107			460	5	K33	L147B	233	250
239117			575	5	K31	L111B	186	200
239168	200	150	380	6	K27	-	316	340
239108			460	5	K33	L165B	266	286
239118			575	5	K32	L135B	213	229

Table 31A - 60 Hz 8" Hi-Temp 75°C Motors

MOTOR MODEL PREFIX	HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS		ADJUSTABLE RELAYS (NOTE 3)	
					FURNAS (NOTE 1)	G.E. (NOTE 2)	SET	MAX.
279160	40	30	380	3	K83	L866B	73	79
279100			460	3	K77	L710B	60	65
279110			575	3	K74	L593B	48	52
279161	50	37	380	3	K87	L107C	89	95
279101			460	3	K83	L866B	73	79
279111			575	3	K77	L710B	59	63
279162	60	45	380	4(1)	K89	L126C	104	112
279102			460	4(1)	K87	L107C	86	92
279112			575	4(1)	K78	L866B	69	74
279163	75	56	380	4	K92	L155C	131	141
279103			460	4(1)	K89	L126C	106	114
279113			575	4(1)	K87	L950C	86	92
279164	100	75	380	5(1)	K28	L100B	168	181
279104			460	5(1)	K26	L825A	139	149
279114			575	4	K90	L142C	111	119
279165	125	93	380	5	K32	L135B	207	223
279105			460	5(1)	K29	L111B	171	184
279115			575	5(1)	K26	L825A	138	148
279166	150	110	380	5	-	L147B	250	269
279106			460	5(1)	K32	L122B	206	222
279116			575	5(1)	K28	L100B	166	178

Note: Other relay types from these and other manufacturers may or may not provide acceptable protection, and they should not be used without approval of Franklin Electric.

Some approved types may only be available for part of the listed motor ratings. When relays are used with current transformers, relay setting is the specified amps divided by the transformer ratio.

Recommended Adjustable Overload Relays

Advance Controls: MDR3 Overload

AEG Series: B17S, B27S, B27-2

ABB Type: RVH 40, RVH65, RVP160, T25DU, T25CT, TA25DU

AGUT: MT03, R1K1, R1L0, R1L3, TE set Class 5

Allen Bradley: Bulletin 193, SMP-Class 10 only

Automatic Switch Types: DQ, LR1-D, LR1-F, LR2 Class 10

Benshaw: RSD6 (Class 10) Soft Start

Bharita C-H: MC 305 ANA 3

Clipsal: 6CTR, 6MTR

Cutler-Hammer: C316F, C316P, C316S, C310-set at 6 sec max, Advantage Class10

Fanal Types: K7 or K7D through K400

Franklin Electric: Subtrol-Plus, SubMonitor

Fuji Types: TR-OQ, TR-OQH, TR-2NQ, TR- 3NQ, TR-4NQ, TR-6NQ, RCa 3737-ICQ & ICQH

Furnas Types: US15 48AG & 48BG, 958L, ESP100-Class 10 only, 3RB10-Class 10

General Electric: CR4G, CR7G, RT*1, RT*2, RTF3, RT*4, CR324X-Class 10 only

Kasuga: RU Set Operating Time Code = 10 & time setting 6 sec max

Klockner-Moeller Types: ZOO, Z1, Z4, PKZM1, PKZM3 & PKZ2

Lovato: RC9, RC22, RC80, RF9, RF25 & RF95

Matsushita: FKT-15N, 15GN, 15E, 15GE, FT-15N, FHT-15N

Mitsubishi: ET, TH-K12ABKP, TH-K20KF, TH-K20KP, TH-K20TAKF, TH-K60KF, TH-K60TAKF

Omron: K2CM Set Operating Timing Code = 10 & time setting 6 sec max, SE-KP24E time setting 6 sec max

Riken: PM1, PM3

Samwha: EOCRS Set for Class 5, EOCR-ST, EOCR-SE, EOCR-AT time setting 6 sec max

Siemens Types: 3UA50, -52, -54, -55, -58, -59, -60, -61, -62, -66, -68, -70, 3VUI3, 3VE, 3UB (Class 5)

Sprecher and Schuh Types: CT, CT1, CTA 1, CT3K, CT3-12 thru CT3-42, KTA3, CEF1 & CET3 set at 6 sec max, CEP 7 Class 10, CT4, 6, & 7, CT3, KT7

Square D/Telemecanique: Class 9065 Types: TD, TE, TF, TG, TJ, TK, TR, TJE &TJF (Class 10), LR1-D, LR1-F, LR2 Class 10, Types 18A, 32A, SS-Class 10, SR-Class 10 and 63-A-LB Series. Integral 18,32,63, GV2-L, GV2-M, GV2-P, GV3-M (1.6-10 amp only) LR9D, SF Class 10, ST Class 10, LT6 (Class 5 or 10), LRD (Class 10), Motor Logic (Class10)

Toshiba Type: 2E RC820, set at 8 sec max.

WEG: RW2

Westinghouse Types: FT13, FT23, FT33, FT43, K7D, K27D, K67D, Advantage (Class 10), MOR, IQ500 (Class 5)

Westmaster: OLWROO and OLWTOO suffix D thru P

SUBMERSIBLE PUMP
Installation Check List

1. Motor Inspection

- ☐ A. Verify that the model, hp or kW, voltage, phase and hertz on the motor nameplate match the installation requirements.
- ☐ B. Check that the motor lead assembly is not damaged.
- ☐ C. Measure insulation resistance using a 500 or 1000 volt DC megohmmeter from each lead wire to the motor frame. Resistance should be at least 200 megohms without drop cable.
- ☐ D. Keep a record of motor model number, hp or kW, voltage, and serial number (S/N). (S/N is stamped in shell above the nameplate. A typical example, S/N 07A18 01-0123)

2. Pump Inspection

- ☐ A. Check that the pump rating matches the motor.
- ☐ B. Check for pump damage and verify that the pump shaft turns freely.

3. Pump/Motor Assembly

- ☐ A. If not yet assembled, check that pump and motor mounting faces are free from dirt, debris and uneven paint thickness.
- ☐ B. Pumps and motors over 5 hp should be assembled in the vertical position to prevent stress on pump brackets and shafts. Assemble the pump and motor together so their mounting faces are in contact and then tighten assembly bolts or nuts evenly to manufacturer specifications.
- ☐ C. If accessible, check that the pump shaft turns freely.
- ☐ D. Assemble the pump lead guard over the motor leads. Do not cut or pinch lead wires during assembly or installation.

4. Power Supply and Controls

- ☐ A. Verify that the power supply voltage, Hertz, and kVA capacity match motor requirements.
- ☐ B. Verify control box hp and voltage matches motor (3-wire only).
- ☐ C. Check that the electrical installation and controls meet all safety regulations and match the motor requirements, including fuse or circuit breaker size and motor overload protection. Connect all metal plumbing and electrical enclosures to the power supply ground to prevent shock hazard. Comply with national and local codes.

5. Lightning and Surge Protection

- ☐ A. Use properly rated surge (lightning) arrestors on all submersible pump installations. Motors 5 hp and smaller, which are marked “Equipped with Lightning Arrestors”, contain internal arrestors.
- ☐ B. Ground all above ground arrestors with copper wire directly to the motor frame, or to metal drop pipe or casing which reaches below the well pumping level. Connecting to a ground rod does not provide good surge protection.

6. Electrical Drop Cable

- ☐ A. Use submersible cable sized in accordance with local regulations and the cable charts. See pages 11 and 16-21. Ground motor per national and local codes.
- ☐ B. Include a ground wire to the motor and surge protection, connected to the power supply ground if required by codes. Always ground any pump operated outside a drilled well.

7. Motor Cooling

- ☐ A. Ensure at all times that the installation provides adequate motor cooling; see page 6 for details.

SUBMERSIBLE PUMP
Installation Check List

8. Pump/Motor Installation

- ☐ A. Splice motor leads to supply cable using electrical grade solder or compression connectors, and carefully insulate each splice with watertight tape or adhesive-lined shrink tubing, as shown in motor or pump installation data.
- ☐ B. Support the cable to the delivery pipe every 10 feet (3 meters) with straps or tape strong enough to prevent sagging. Use padding between cable and any metal straps.
- ☐ C. A check valve in the delivery pipe is recommended. More than one check valve may be required, depending on valve rating and pump setting; see page 5 for details.
- ☐ D. Assemble all pipe joints as tightly as practical, to prevent unscrewing from motor torque. Torque should be at least 10 pound feet per hp (2 meter-KG per kW).
- ☐ E. Set the pump far enough below the lowest pumping level to assure the pump inlet will always have at least the Net Positive Suction Head (NPSH) specified by the pump manufacturer. Pump should be at least 10 feet (3 meters) from the bottom of the well to allow for sediment build up.
- ☐ F. Check insulation resistance as pump/motor assembly is lowered into the well. Resistance may drop gradually as more cable enters the water, but any sudden drop indicates possible cable, splice or motor lead damage; see page 45.

9. After Installation

- ☐ A. Check all electrical and water line connections and parts before starting the pump.
- ☐ B. Start the pump and check motor amps and pump delivery. If normal, continue to run the pump until delivery is clear. If three-phase pump delivery is low, it may be running backward. Rotation may be reversed (with power off) by interchanging any two motor lead connections to the power supply.
- ☐ C. Check three-phase motors for current balance within 5% of average, using motor manufacturer instructions Imbalance over 5% will cause higher motor temperatures and may cause overload trip, vibration, and reduced life.
- ☐ D. Verify that starting, running and stopping cause no significant vibration or hydraulic shocks.
- ☐ E. After at least 15 minutes running time, verify that pump output, electrical input, pumping level, and other characteristics are stable and as specified.

Date _____ Filled In By _____

Notes _____

_____

_____

_____

_____

_____

Franklin Electric

SUBMERSIBLE MOTOR INSTALLATION RECORD
Form 2207 - Page 1

RMA Number

KEY DEALER #

DISTRIBUTOR	INSTALLER	END USER
Name:	Name:	Name:
City:	City:	City:
State: Zip:	State: Zip:	State: Zip:

Well ID or GPS: _____ _____ _____ Water Temperature: _____ ☐ °F ☐ °C

Application/Water Use (e.g. potable water, irrigation, municipal, fountain, etc.): _____

Date Installed (mm/yy): _____ Date Failed (mm/yy): _____ Motor Position Shaft-Up: ☐ Yes ☐ No

Operating Cycle: ON Time Per Start _____ ☐ Hrs. ☐ Mins. Time OFF Between Stop & Restart _____ ☐ Hrs. ☐ Mins.

MOTOR

Model: _____ Serial Number: _____ Date Code (if updated): _____

MOTOR OVERLOAD

System Typical Operating Current: _____ Amps @ _____ Volts

Overload: ☐ FE SubMonitor Input Amps _____ D3 Attached ☐ Yes ☐ No Fault Settings Attached ☐ Yes ☐ No

☐ Other Manufacturer Model: _____ Dial Set at: _____ or Heater# _____

NEMA Class: ☐ 10 ☐ 20 ☐ 30 Ambient Compensated: ☐ Yes ☐ No

Power to Motor by: ☐ Full Volt Starter ☐ VFD ☐ Soft Starter VFD or Soft Starter Mfr. & Model: _____

PUMP

Manufacturer: _____

Model: _____

Stages: _____

Design Rating: _____ gpm @ _____ ft TDH

Horsepower Required by Pump End: _____

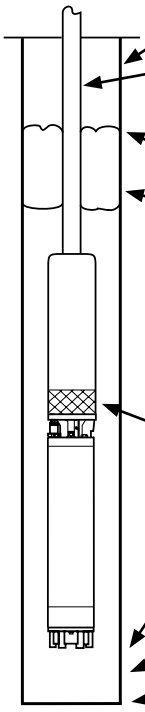
Actual Pump Delivery: _____ gpm @ _____ psi

What Controls When System Runs & Stops:

_____

(e.g. pressure, level, flow, manual on/off, timer, time clock etc.)

WELL DATA (All measurements from well head down.)



Casing Diameter _____ in

Drop Pipe Diameter _____ in

Number of Sticks of Drop Pipe _____

Static Water Level _____ ft

Drawdown (pumping) Water Level _____ ft

Spring Assist Check Valves:
(Measured from Well Head Down)

#1 _____ #2 _____ #3 _____ #4 _____ ft

☐ Solid ☐ Drilled Poppet ☐ Break-Off Plug

Pump Inlet Setting _____ ft

Flow Sleeve ☐ No ☐ Yes, Dia. _____ in

Case Ends _____ ft

☐ Well Screen ☐ Perforated Casing

#1 from ____ to ____ ft & #2 from ____ to ____ ft

Well Depth _____ ft

YOUR NAME / DATE

_____ / _____

Franklin Electric

SUBMERSIBLE MOTOR INSTALLATION RECORD
Form 2207 - Page 2

RMA Number

TRANSFORMERS

Number of Transformers: ☐ Two ☐ Three Transformers Supply Motor Only: ☐ Yes ☐ No ☐ Unsure

Transformer #1: _____ kVA Transformer #2: _____ kVA Transformer #3: _____ kVA

POWER CABLES & GROUND WIRE

1 **Service Entrance to Pump Control Panel:**

Length: _____ ft. & Gauge: _____ AWG/MCM

Material: ☐ Copper ☐ Aluminum Construction: ☐ Jacketed ☐ Individual Conductors ☐ Web ☐ Twisted

Temperature Rating of Cable: ☐ 60C ☐ 75C ☐ 90C ☐ 125C or Insulation Type: _____ (e.g. THHN)

2 **Pump Control Panel to Motor:**

Length: _____ ft. & Gauge: _____ AWG/MCM

Material: ☐ Copper ☐ Aluminum Construction: ☐ Jacketed ☐ Individual Conductors ☐ Web ☐ Twisted

Temperature Rating of Cable: ☐ 60C ☐ 75C ☐ 90C ☐ 125C or Insulation Type: _____ (e.g. THHN)

3 **Ground Wire Size:** From Control Panel to Motor: _____ AWG/MCM

Control Grounded to (mark all that apply):

☐ Well Head ☐ Metal Casing ☐ Motor ☐ Driven Rod ☐ Power Supply

INCOMING VOLTAGE

No Load L1-L2 _____ L2-L3 _____ L1-L3 _____

Full Load L1-L2 _____ L2-L3 _____ L1-L3 _____

RUNNING AMPS & CURRENT BALANCE

Full Load L1 _____ L2 _____ L3 _____

% Unbalance: _____

CONTROL PANEL

1 **Pump Panel Manufacturer/Fabricator:** _____

2 **Short Circuit Protection - Fuses or Circuit Breaker**

Option #1 - Fuse

Manufacturer: _____ Model: _____ Rating: _____ Amps

Type: ☐ Time-Delay ☐ Standard

Option #2 - Circuit Breaker

Manufacturer: _____ Model: _____ Rating: _____ Amps Setting: _____

3 **Starter - Full Voltage, Reduced Voltage, Soft-Starter or VFD (Variable Frequency Drive)**

Option #1 - Full Voltage

Manufacturer: _____ Model: _____ Size: _____ Contacts: ☐ NEMA ☐ IEC

Option #2 - Reduced Voltage

Manufacturer: _____ Model: _____ Ramp Time to Full Voltage: _____ sec.

Option #3 - Soft-Starter or VFD

Manufacturer: _____ Model: _____ Max. Continuous Amp Output Rating: _____

Min. Setting: _____ Hz & GPM: _____ Max. Setting: _____ Hz & GPM: _____

Start Ramp Time to 30 Hz: _____ sec. Stop Mode: ☐ Power Off Coast ☐ 30-0 Hz Ramp _____ sec.

Special Output Filter Purchased: ☐ Yes ☐ No

Output Filter Manufacturer: _____ Model: _____ % Reactance: _____

4 **Surge Arrestor:** ☐ No ☐ Yes, Manufacturer: _____ Model: _____

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SUBMERSIBLE MOTOR
Booster Installation Record

RMA Number

Date _____ /_____/_____ Filled In By _____

INSTALLATION

Owner/User _____ Telephone (_____) _____
Address _____City _____ State _____ Zip _____
Installation Site, If Different _____
Contact _____ Telephone (_____) _____
System Application_____
_____
_____
System Manufactured By_____Model _____ Serial No. _____
System Supplied By_____ City _____ State _____ Zip _____
Is this a "HERO" system (10.0 - 10.5 PH)? ☐ Yes ☐ No

MOTOR

Model No. _____ Serial No. _____ Date Code _____
Horsepower _____ Voltage _____ ☐ Single-Phase ☐ Three-Phase Diameter _____ in.
Slinger Removed? ☐ Yes ☐ No Check Valve Plug Removed? ☐ Yes ☐ No
Motor Fill Solution ☐ Standard ☐ DI Water Model No. _____ Serial No. _____ Date Code _____

PUMP

Manufacturer _____ Model _____ Serial No. _____
Stages _____ Diameter _____ Flow Rate Of _____ gpm At _____TDH
Booster Case Internal Diameter _____ Material _____

CONTROLS AND PROTECTIVE DEVICES

SubMonitor? ☐ Yes ☐ No If Yes, Warranty Registration No._____
If Yes, Overload Set? ☐ Yes ☐ No _____ Set At _____
Underload Sets? ☐ Yes ☐ No _____ Set At _____
VFD or Reduced Voltage Starter? ☐ Yes ☐ No If Yes, Type _____
Mfr. _____Setting _____% Full Voltage In _____sec
Pump Panel? ☐ Yes ☐ No If Yes, Mfr. _____Size _____
Magnetic Starter/Contactor Mfr. _____ Model _____Size_____
Heaters Mfr. _____ No. _____ If Adjustable Set At _____
Fuses Mfr. _____ Size _____ Type _____
Lightning/Surge Arrestor Mfr. _____ Model _____
Controls Are Grounded to _____ with No. _____Wire
Inlet Pressure Control ☐ Yes ☐ No If Yes, Mfr._____ Model _____ Setting _____ psi Delay ____ sec
Inlet Flow Control ☐ Yes ☐ No If Yes, Mfr._____ Model _____ Setting _____ gpm Delay ____ sec
Outlet Pressure Control ☐ Yes ☐ No If Yes, Mfr._____ Model _____ Setting _____ psi Delay ____ sec
Outlet Flow Control ☐ Yes ☐ No If Yes, Mfr._____ Model _____ Setting _____ gpm Delay ____ sec
Water Temperature Control ☐ Yes ☐ No If Yes, Mfr._____ Model _____ Delay ____ sec
Set At _____ °F or _____ °C Located _____

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SUBMERSIBLE MOTOR
Booster Installation Record

INSULATION CHECK

Initial Megs: Motor & Lead Only Black (T1/U1)_____ Yellow (T2/V1)_____ Red (T3/W1)_____

Installed Megs: Motor, Lead, & Cable Black (T1/U1)_____ Yellow (T2/V1)_____ Red (T3/W1)_____

VOLTAGE TO MOTOR

Non-Operating: B-Y (T1/U1 - T2/V1)_____ Y-R (T2/V1 - T3/W1)_____ R-B (T3/W1 - T1/U1)_____

At Rated Flow of _____gpm B-Y (T1/U1 - T2/V1)_____ Y-R (T2/V1 - T3/W1)_____ R-B (T3/W1 - T1/U1)_____

At Open Flow _____gpm B-Y (T1/U1 - T2/V1)_____ Y-R (T2/V1 - T3/W1)_____ R-B (T3/W1 - T1/U1)_____

AMPS TO MOTOR

At Rated Flow of _____gpm Black (T1/U1)_____ Yellow (T2/V1)_____ Red (T3/W1)_____

At Open Flow _____gpm Black (T1/U1)_____ Yellow (T2/V1)_____ Red (T3/W1)_____

At Shut Off* Black (T1/U1)_____ Yellow (T2/V1)_____ Red (T3/W1)_____

*Do **NOT** run at Shut Off more than two (2) minutes.

Inlet Pressure _____psi Outlet Pressure _____psi Water Temperature _____ °F or _____ °C

If you have any questions or problems, call the Franklin Electric Toll-Free Hot Line: 1-800-348-2420

Comments: _____

_____

_____

_____

PLEASE SKETCH THE SYSTEM

Franklin Electric

SubMonitor Three-Phase Protection

Applications

SubMonitor is designed to protect 3-phase pumps/motors with service factor amp ratings (SFA) from 5 to 350 A (approx. 3 to 200 hp). Current, voltage, and motor temperature are monitored using all three legs and allows the user to set up the SubMonitor quickly and easily.

Protects Against

- Under/Overload
- Under/Overvoltage
- Current Unbalance
- Overheated Motor
  (if equipped with Subtrol Heat Sensor)
- False Start (Chattering)
- Phase Reversal

Power Factor Correction

In some installations, power supply limitations make it necessary or desirable to increase the power factor of a submersible motor. The table lists the capacitive kVAR required to increase the power factor of large Franklin three-phase submersible motors to the approximate values shown at maximum input loading.

Capacitors must be connected on the line side of the overload relay, or overload protection will be lost.

Table 32 kVAR Required 60 Hz

MOTOR		KVAR REQUIRED FOR PF OF:		
HP	KW	0.90	0.95	1.00
5	3.7	1.2	2.1	4.0
7.5	5.5	1.7	3.1	6.0
10	7.5	1.5	3.3	7.0
15	11	2.2	4.7	10.0
20	15	1.7	5.0	12.0
25	18.5	2.1	6.2	15.0
30	22	2.5	7.4	18.0
40	30	4.5	11.0	24.0
50	37	7.1	15.0	32.0
60	45	8.4	18.0	38.0
75	55	6.3	18.0	43.0
100	75	11.0	27.0	60.0
125	93	17.0	36.0	77.0
150	110	20.0	42.0	90.0
175	130	9.6	36.0	93.0
200	150	16.0	46.0	110.0

Values listed are total required (not per phase).

Three-Phase Starter Diagrams

Three-phase combination magnetic starters have two distinct circuits: a power circuit and a control circuit.

The power circuit consists of a circuit breaker or fused line switch, contacts, and overload heaters connecting incoming power lines L1, L2, L3 and the three-phase motor.

The control circuit consists of the magnetic coil, overload contacts and a control device such as a pressure switch. When the control device contacts are closed, current flows through the magnetic contactor coil, the contacts close, and power is applied to the motor. Hand-Off-Auto switches, start timers, level controls and other control devices may also be in series in the control circuit.

Line Voltage Control

This is the most common type of control encountered. Since the coil is connected directly across the power lines L1 and L2, the coil must match the line voltage.

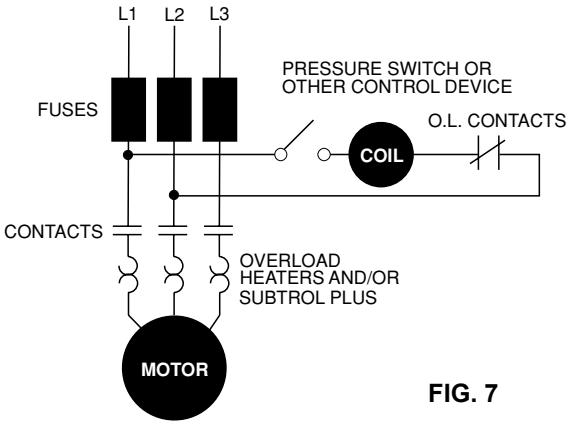


FIG. 7

Low Voltage Transformer Control

This control is used when it is desirable to operate push buttons or other control devices at some voltage lower than the motor voltage. The transformer primary must match the line voltage and the coil voltage must match the secondary voltage of the transformer.

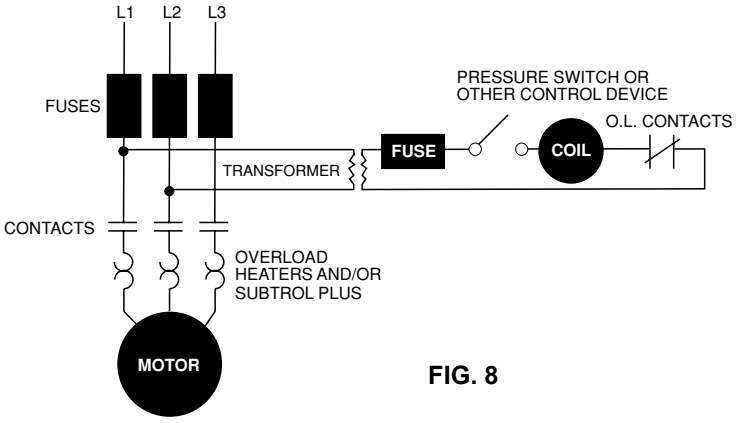


FIG. 8

External Voltage Controls

Control of a power circuit by a lower circuit voltage can also be obtained by connecting to a separate control voltage source. The coil rating must match the control voltage source, such as 115 or 24 volts.

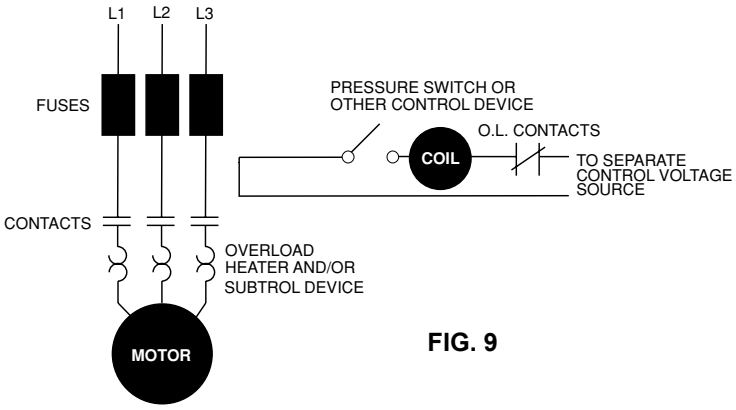


FIG. 9

Three-Phase Power Unbalance

A full three-phase supply is recommended for all three-phase motors, consisting of three individual transformers or one three-phase transformer. So-called “open” delta or Wye connections using only two transformers can be used, but are more likely to cause problems, such as poor performance, overload tripping or early motor failure due to current unbalance.

Transformer rating should be no smaller than listed in table 4 for supply power to the motor alone.

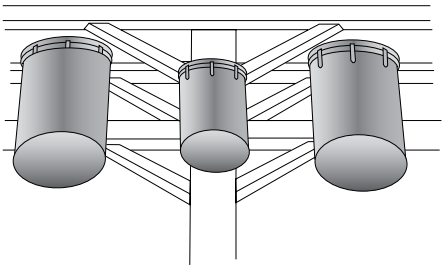


FIG. 10
FULL THREE-PHASE

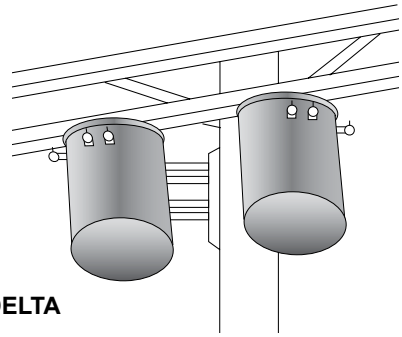


FIG. 11
OPEN DELTA

Checking and Correcting Rotation and Current Unbalance

1. Establish correct motor rotation by running the motor in both directions. Normal rotation is CCW viewing the shaft end. Rotation can be changed by interchanging any two of the three motor leads. The rotation that gives the most water flow is typically the correct rotation.
2. After correct rotation has been established, check the current in each of the three motor leads and calculate the current unbalance as explained in 3 below.

   If the current unbalance is 2% or less, leave the leads as connected.

   If the current unbalance is more than 2%, current readings should be checked on each leg using each of three possible hook-ups. Roll the motor leads across the starter in the same direction to prevent motor reversal.
3. To calculate percent of current unbalance:
   A. Add the three line amps values together.
   B. Divide the sum by three, yielding average current.
   C. Pick the amp value which is furthest from the average current (either high or low).
   D. Determine the difference between this amp value (furthest from average) and the average.
   E. Divide the difference by the average. Multiply the result by 100 to determine percent of unbalance.
4. Current unbalance should not exceed 5% at max amp load or 10% at rated input load. If the unbalance cannot be corrected by rolling leads, the source of the unbalance must be located and corrected. If, on the three possible hookups, the leg farthest from the average stays on the same power lead, most of the unbalance is coming from the “power side” of the system. If the reading farthest from average moves with the same motor lead, the primary source of unbalance is on the “motor side” of the starter. In this instance, consider a damaged cable, leaking splice, poor connection, or faulty motor winding.

Phase designation of leads for CCW rotation viewing shaft end.

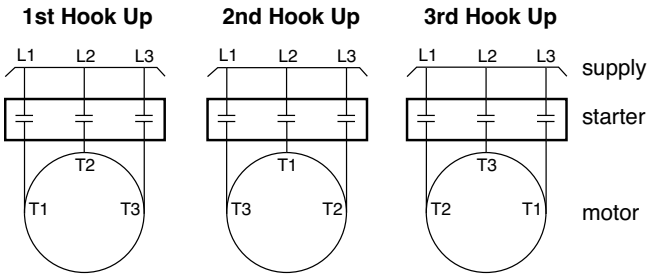
To reverse rotation, interchange any two leads.

Phase 1 or “A” - Black, T1, or U1

Phase 2 or “B” - Yellow, T2, or V1

Phase 3 or “C” - Red, T3, or W1

NOTICE: Phase 1, 2 and 3 may not be L1, L2 and L3.



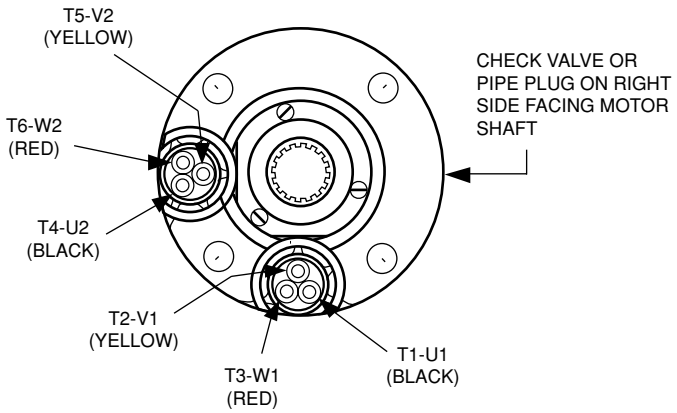
EXAMPLE:

T1 = 51 amps	T3 = 50 amps	T2 = 50 amps
T2 = 46 amps	T1 = 49 amps	T3 = 48 amps
+ T3 = 53 amps	+ T2 = 51 amps	+ T1 = 52 amps
Total = 150 amps	Total = 150 amps	Total = 150 amps
$\frac{150}{3}$ = 50 amps	$\frac{150}{3}$ = 50 amps	$\frac{150}{3}$ = 50 amps
50 - 46 = 4 amps	50 - 49 = 1 amp	50 - 48 = 2 amps
$\frac{4}{50}$ = 0.08 or 8%	$\frac{1}{50}$ = 0.02 or 2%	$\frac{2}{50}$ = 0.04 or 4%

Three-Phase Motor Lead Identification

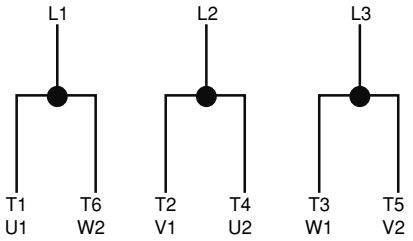
WARNING: When installing 6-lead motors extra care must be used to ensure lead identification at the surface. Leads must be marked and connected per diagram. Motor leads are not connected red to red, yellow to yellow, etc.

Line Connections — Six-Lead Motors

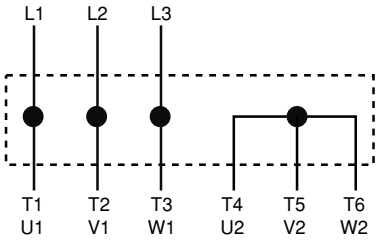


90° Lead Spacing

Connections for across-the-line starting, running, and any reduced voltage starting except WYE-DELTA type starters.



WYE-DELTA starters connect the motor as shown below during starting, then change to the running connection shown at the left.



Each motor lead is numbered with two markers, one near each end. To reverse rotation, interchange any two line connections.

Phase Converters

There are a number of different types of phase converters available. Each generates three-phase power from a single-phase power line.

In all phase converters, the voltage balance is critical to current balance. Although some phase converters may be well balanced at one point on the system-operating curve, submersible pumping systems often operate at differing points on the curve as water levels and operating pressures fluctuate. Other converters may be well balanced at varying loads, but their output may vary widely with fluctuations in the input voltage.

The following guidelines have been established for submersible installations to be warrantable when used with a phase converter.

1. Limit pump loading to rated horsepower. Do not load into motor service factor.
2. Maintain at least 3 ft/s flow past the motor. Use a flow sleeve when necessary.
3. Use time delay fuses or circuit breakers in pump panel. Standard fuses or circuit breakers do not provide secondary motor protection.
4. SubMonitor may be used with electro mechanical type phase converters, however special connections are required. Consult SubMonitor Manual for connections of receiver and lightning arrestor.
5. SubMonitor will not work with electronic solid state phase converters.
6. Current unbalance must not exceed 10%.

Reduced Voltage Starters

All Franklin three-phase submersible motors are suitable for full-voltage starting. Under this condition the motor speed goes from zero to full speed within a half second or less. The motor current goes from zero to locked rotor amps, then drops to running amps at full speed. This may dim lights, cause momentary voltage dips to other electrical equipment, and shock power distribution transformers.

In some cases the power companies may require reduced-voltage starters to limit this voltage dip. There are also times when reduced-voltage starters may be desirable to reduce motor starting torque thus reducing the stress on shafts, couplings, and discharge piping. Reduced-voltage starters also slow the rapid acceleration of the water on start-up to help control upthrust and water hammer.

Reduced-voltage starters may not be required if the maximum recommended cable length is used. With maximum recommended cable length there is a 5% voltage drop in the cable at running amps, resulting in about 20% reduction in starting current and about 36% reduction in starting torque compared to having rated voltage at the motor. This may be enough reduction in starting current so that reduced-voltage starters are not required.

Three-Lead Motors: Autotransformer or solid-state reduced-voltage starters may be used for soft-starting standard three-phase motors.

When autotransformer starters are used, the motor should be supplied with at least 55% of rated voltage to ensure adequate starting torque. Most autotransformer starters have 65% and 80% taps. Setting the taps on these starters depends on the percentage of the maximum allowable cable length used in the system. If the cable length is less than 50% of the maximum allowable, either the 65% or the 80% taps may be used. When the cable length is more than 50% of allowable, the 80% tap should be used.

Six-Lead Motors: Wye-Delta starters are used with six-lead Wye-Delta motors. All Franklin 6" and 8" three-phase motors are available in six-lead Wye-Delta construction. Consult the factory for details and availability. Part winding starters are not compatible with Franklin Electric submersible motors and should not be used.

Wye-Delta starters of the open-transition type, which momentarily interrupt power during the starting cycle, are not recommended. Closed-transition starters have no interruption of power during the start cycle and can be used with satisfactory results.

Reduced-voltage starters have adjustable settings for acceleration ramp time, typically preset at 30 seconds. They must be adjusted so the motor is at full voltage within THREE SECONDS MAXIMUM to prevent excessive radial and thrust bearing wear.

If Subtrol-Plus or SubMonitor is used the acceleration time must be set to TWO SECONDS MAXIMUM due to the 3 second reaction time of the Subtrol-Plus or SubMonitor.

Solid-state starters AKA soft starts may not be compatible with Subtrol-Plus/SubMonitor. However, in some cases a bypass contactor has been used. Consult the factory for details.

During shutdown, Franklin Electric's recommendation is for the power to be removed, allowing the pump/motor to coast down. Stopping the motor by ramping down the voltage is possible, but should be limited to three (3) seconds maximum.

Inline Booster Pump Systems

Franklin Electric offers three different types of motors for non-vertical applications.

1. The **Booster** motors are specifically designed for booster applications. They are the **"Best Choice" for sealed Reverse Osmosis applications.** These motors are the result of two years of focused development and bring additional value and durability to booster module systems. These motors are only available to OEMs or Distributors who have demonstrated capability in Booster Module systems design and operation and adhere to Franklin's Application Manual requirements.

2. The **Hi-Temp** motors have many of the internal design features of the Booster motor. It's additional length allows for higher temperature handling and the Sand Fighter sealing system provides greater abrasion resistance. One or both of these conditions are often experienced in open atmosphere applications such as lakes, ponds, etc.

3. The **Standard Vertical Water Well** (40-125 hp) motors can be adapted to non-vertical applications when applied per the below guidelines. However, they will be more sensitive to application variances than the other two designs.

All of the above motors must be applied per the guidelines listed below. In addition, for all applications where the motor is applied in a sealed system, a Submersible Motor Booster Installation Record (Form 3655) or its equivalent must be completed at startup and received by Franklin Electric within 60 days. A sealed system is one where the motor and pump intake are mounted in a sleeve and the water feeding the pump intake is not open to the atmosphere.

Continued on next page

Inline Booster Pump Systems (continued)

Design And Operational Requirements

1. **Non-Vertical Operation:** Vertical Shaft-up (0°) to Horizontal (90°) operation is acceptable as long as the pump transmits "down-thrust" to the motor within 3 seconds after start-up and continuously during operation. However, it is best practice to provide a positive slope whenever it is possible, even if it is only a few degrees.

2. **Motor, Sleeve, and Pump Support System:** The booster sleeve ID must be sized according to the motor cooling and pump NPSHR requirements. The support system must support the motor's weight, prevent motor rotation and keep the motor and pump aligned. The support system must also allow for thermal axial expansion of the motor without creating binding forces.

3. **Motor Support Points:** A minimum of two support points are required on the motor. One in the motor/pump flange connection area and one in the bottom end of the motor area. The motor castings, not the shell area, are recommended as support points. If the support is a full length support and/or has bands in the shell area, they must not restrict heat transfer or deform the shell.

4. **Motor Support Material and Design:** The support system shall not create any areas of cavitation or other areas of reduced flow less than the minimum rate required by this manual. They should also be designed to minimize turbulence and vibration and provide stable alignment. The support materials and locations must not inhibit the heat transfer away from the motor.

5. **Motor and Pump Alignment:** The maximum allowable misalignment between the motor, pump, and pump discharge is 0.025 inch per 12 inches of length (2 mm per 1000 mm of length). This must be measured in both directions along the assembly using the motor/pump flange connection as the starting point. The booster sleeve and support system must be rigid enough to maintain this alignment during assembly, shipping, operation and maintenance.

6. The best motor lubrication and heat resistance is obtained with the factory based propylene glycol fill solution. Only when an application MUST HAVE deionized (DI) water should the factory fill solution be replaced. When a deionized water fill is required, the motor must be derated as indicated on the below chart. The exchange of the motor fill solution to DI water must be done by an approved Franklin service shop or representative using a vacuum fill system per Franklin's Motor Service Manual instruction. The motor shell then must be permanently stamped with a D closely behind the Serial Number.

   The maximum pressure that can be applied to the motor internal components during the removal of the factory fill solution is 7 psi (0.5 bar.)

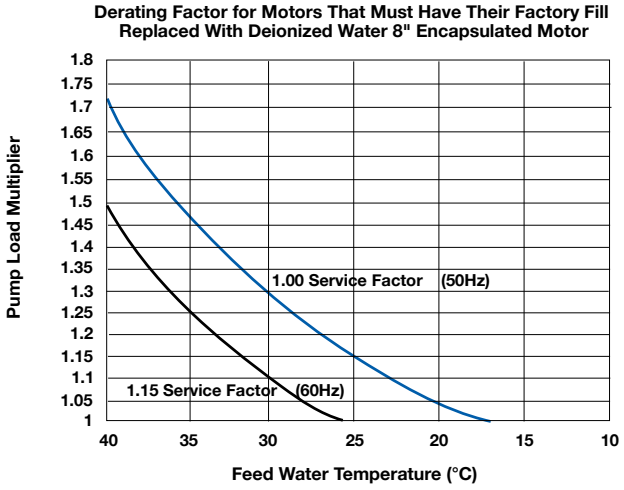


FIG. 12

First: Determine maximum Feed Water Temperature that will be experienced in this application. If the feed water exceeds the maximum ambient of the motor, both the DI water derating and a hot water application derating must be applied.

Second: Determine the Pump Load Multiplier from the appropriate Service Factor curve. (Typical 1.15 Service Factor is for 60 Hz ratings &1.00 Service Factor for 50 Hz ratings).

Third: Multiply the Pump Load Requirement times the pump load multiplier number indicated on the vertical axis to determine the Minimum Motor Nameplate Rating.

Fourth: Select a motor with a nameplate equal or higher than the above calculated value.

7. **Motor Alterations - Sand Slinger & Check Valve Plug:** On 6" and 8" motors, the rubber sand slinger located on the shaft must be removed. If a pipe plug is covering the check valve, it must be removed. The special Booster motor already has these modifications.

8. **Frequency of Starts:** Fewer than 10 starts per 24-hour period are recommended. Allow at least 20 minutes between shutdown and start-up of the motor.

Continued on next page

Inline Booster Pump Systems (continued)

9. **Controls-Soft Starters and VFDs:** Reduced voltage starters and variable speed drives (inverter drives) may be used with Franklin three-phase submersible motors to reduce starting current, upthrust, and mechanical stress during start-up. The guidelines for their use with submersible motors are different than with normal air cooled motor applications. Refer to the Franklin Electric Application, Installation and Maintenance (AIM) Manual Reduced Voltage Starters section or Variable Speed Submersible Pump Operation, Inverter Drives sections for specific details including required filtering.

10. **Motor Overload Protection:** Submersible motors require properly sized ambient compensated Class 10 quick-trip overloads per Franklin's AIM Manual guidelines to protect the motor. Class 20 or higher overloads are NOT acceptable. Franklin's SubMonitor is strongly recommended for all large submersibles since it is capable of sensing motor heat without any additional wiring to the motor. Applications using Soft Starters with a SubMonitor require a start-up bypass - consult the factory for details. SubMonitor can not be used in applications using a VFD control.

11. **Motor Surge Protection:** Properly sized, grounded and dedicated motor surge arrestors must be installed in the supply line of the booster module as close to the motor as possible. This is required on all systems including those using soft-starters and variable speed drives (inverter drives).

12. **Wiring:** Franklin's lead assemblies are only sized for submerged operation in water to the motor nameplate maximum ambient temperature and may overheat and cause failure or serious injury if operated in air. Any wiring not submerged must meet applicable national and local wiring codes and Franklin Cable Chart tables 16-21. (Notice: wire size, wire rating and insulation temperature rating must be known when determining its suitability to operate in air or conduit. Typically, for a given size and rating, as the insulation temperature rating increases its ability to operate in air or conduit also increases.)

13. **Check Valves:** Spring-loaded check valves must be used on start-up to minimize motor upthrusting, water hammer, or in multiple booster (parallel) applications to prevent reverse flow.

14. **Pressure Relief Valves:** A pressure relief valve is required and must be selected to ensure that, as the pump approaches shut-off, it never reaches the point that the motor will not have adequate cooling flow past it.

15. **System Purge (Can Flooding):** An air bleeder valve must be installed on the booster sleeve so that flooding may be accomplished prior to booster start-up. Once flooding is complete, the booster should be started and brought up to operating pressure as quickly as possible to minimize the duration of an upthrust condition. At no time should air be allowed to gather in the booster sleeve because this will prevent proper cooling of the motor and permanently damage it.

16. **System Flush – Must Not Spin Pump:** Applications may utilize a low flow flushing operation. Flow through the booster sleeve must not spin the pump impellers and the motor shaft. If spinning takes place, the bearing system will be permanently damaged and the motor life shortened. Consult the booster pump manufacturer for maximum flow rate through the pump when the motor is not energized.

Table 38 Franklin Cable chart (See 12. Wiring)

CABLE TEMP. RATING (°C)	MOTOR NAMEPLATE RATED AMPS FULL LOAD	#10 AWG		#8 AWG		#6 AWG		#4 AWG		#2 AWG	
		IN AIR	IN CONDUIT	IN AIR	IN CONDUIT	IN AIR	IN CONDUIT	IN AIR	IN CONDUIT	IN AIR	IN CONDUIT
75	3-LEAD (DOL)	40A	28A	56A	40A	76A	52A	100A	68A	136A	92A
	6-LEAD (Y-Δ)	69A	48A	97A	69A	132A	90A	173A	118A	236A	159A
90	3-LEAD (DOL)	44A	32A	64A	44A	84A	60A	112A	76A	152A	104A
	6-LEAD (Y-Δ)	76A	55A	111A	76A	145A	104A	194A	132A	263A	180A
125	3-LEAD (DOL)	66A	46A	77A	53A	109A	75A	153A	105A	195A	134A
	6-LEAD (Y-Δ)	114A	80A	133A	91A	188A	130A	265A	181A	337A	232A

Based on 30 °C maximum ambient with cable length of 100 feet or less.

Continued on next page

Inline Booster Pump Systems (continued)

17. **Open Atmosphere Booster Pump Systems:** When an open booster is placed in a lake, tank, etc. that is open to atmospheric pressure, the water level must provide sufficient head pressure to allow the pump to operate above its NPSHR requirement at all times and all seasons. Adequate inlet pressure must be provided prior to booster start-up.

Four Continuous Monitoring System Requirements for Sealed Booster Systems.

1. **Water Temperature:** Feed water on each booster must be continuously monitored and not allowed to exceed the motor nameplate maximum ambient temperature at any time. IF THE INLET TEMPERATURE EXCEEDS THE MOTOR NAMEPLATE MAXIMUM AMBIENT TEMPERATURE, THE SYSTEM MUST SHUTDOWN IMMEDIATELY TO PREVENT PERMANENT MOTOR DAMAGE. If feed water temperatures are expected to be above the allowable temperature, the motor must be derated. See Franklin's AIM Manual Hot Water Applications section for derating guidelines. (The high temperature feed water derating is in addition to the exchange to DI water derating if the motor factory fill solution was exchanged to DI water.)

2. **Inlet Pressure:** The inlet pressure on each booster module must be continuously monitored. It must always be positive and higher than the NPSHR (Net Positive Suction Head Requirement) of the pump. A minimum of 20 PSIG (1.38 Bar) is required at all times, except for 10 seconds or less when the motor is starting and the system is coming up to pressure. Even during these 10 seconds the pressure must remain positive and be higher than the NPSHR (Net Positive Suction Head Requirement) of the pump.

   PSIG is the actual value displayed on a pressure gauge in the system piping. PSIG is the pressure above the atmospheric conditions. If at any time these pressure requirements are not being met, the motor must be de-energized immediately to prevent permanent damage to the motor. Once the motor is damaged, it is usually not immediately noticeable, but progresses and results in a premature motor failure weeks or months after the damage occurred.

   Motors that will be exposed to pressure in excess of 500 psi (34.47 Bar) must undergo special high pressure testing. Consult factory for details and availability.

3. **Discharge Flow:** The flow rate for each pump must not be allowed to drop below the motor minimum cooling flow requirement. IF THE MOTOR MINIMUM COOLING FLOW REQUIREMENT IS NOT BEING MET FOR MORE THAN 10 SECONDS, THE SYSTEM MUST BE SHUT DOWN IMMEDIATELY TO PREVENT PERMANENT MOTOR DAMAGE.

4. **Discharge Pressure:** The discharge pressure must be monitored to ensure that a downthrust load toward the motor is present within 3 seconds after start-up and continuously during operation. IF THE MOTOR DISCHARGE PRESSURE IS NOT ADEQUATE TO MEET THIS REQUIREMENT, THE SYSTEM MUST BE SHUT DOWN IMMEDIATELY TO PREVENT PERMANENT MOTOR DAMAGE.

Variable Frequency Drive Submersible Motor Requirements

Franklin Electric's three-phase, encapsulated submersible motors can be used with variable frequency drives (VFD) when applied within the guidelines below.

All three-phase, encapsulated submersible motors must have the VFD sized based on the motor's nameplate maximum amps, not horsepower. The continuous rated amps of the VFD must be equal to or greater than the motor's nameplate maximum amps or warranty will be void.

Franklin Electric's single-phase, 2- and 3-wire, encapsulated submersible motors can only be used with the appropriate Franklin constant pressure controller.

Franklin Electric's submersible motor Application Installation Maintenance (AIM) manual should be checked for the latest guidelines and can be found online at www.franklin-electric.com.

WARNING: There is a potential shock hazard from contact with and/or touching the insulated cables connected to the variable frequency drive output anytime the motor has energy applied.

Output Filter Requirement Test:

NOTICE: An incoming power supply or line-side filter for the drive does not replace the need for additional output filters.

An output filter is required if the answer is yes to one or both of the items below:
#1 - Is the VFD's pulse width modulation (PWM) voltage rise-time (dV/dt) more than 500 Volts per micro-second (500 V/µ-second)?

#2 - Is the motor nameplate voltage more than 379 Volts and is the cable from drive-to-motor more than 50 ft (15.2 m)?

NOTICE:
More than 99% of the drives applied on water well submersible motors will require the purchase of additional output filtering based on question #1.

Output filters can be expensive. However, when needed, it is required for the motor to be considered for warranty. Make sure this item is not overlooked when quoting a job.

PWM dV/dt value can be defined as: the rate at which voltage is changing with time or how fast the voltage is accelerating. This information can be supplied by the drive manufacturer or the manufacturer's drive specification sheet. The dV/dt value cannot be measured with typical field equipment, even when using a true-RMS voltage/amperage multi-meter.

Franklin Electric has a line of VFDs that are specifically designed for Franklin application systems. These VFDs are used in the MonoDrive and SubDrive constant pressure systems. Franklin drive systems have the required additional output filtering installed; however, the SubDrive HPX does not.

Types of Output Filters:

A resistor-inductor-capacitor (RLC) filter has both a high pass filter & a low pass filter section and are considered the best practice, but a high pass reactor filter is also acceptable.

Filters should be recommended by the drive manufacturer; for the correct recommendations provide them with answers to all five of the items below.

REQUIRED ITEMS FOR PROPER VFD FILTER SIZING:
(1) VFD model (2) Carrier frequency setting (3) Motor nameplate voltage (4) Motor nameplate max amps (5) Cable length from the drive output terminals to the motor

Input Current & Motor Overload Protection:

- Motor input current should be set at the system's typical operating current when running at nameplate rated voltage and frequency (Hz).
- Motor overload protection should be set to trip at 115% of the system's typical operating current.
- Motor overload protection must trip equal to or faster than NEMA Class 10 motor overload curve requirements.

Motor Maximum Load Limits:

- The system must never operate in excess of the motor nameplate maximum amps.
- On 50 Hz motors, nameplate amps are maximum amps as these motors have a 1.0 service factor.

Variable Frequency Drive Submersible Motor Requirements

Motor Operating Hertz, Cooling Requirements & Underload Settings:

- Standard practice for large VFD installations is to limit the operation to 60 Hz max. Operating at greater than 60 Hz requires special system design considerations.
- The motor must never operate below 30 Hz. This is the minimum speed required to provide correct bearing lubrication.
- The motor's operating speed must always operate so the minimum water flow requirements of 0.5 ft/sec for 6-inch & 8-inch motors and 0.25 ft/sec for 4-inch motors is supplied.
- The motor underload protection is normally set to trip at 80% of the system's typical operating current. However, the underload trip point must be selected so that minimum flow requirements are always met.

Starting & Stopping Ramp Settings:

- The motor must reach or pass the 30 Hz operating speed within 1 second of the motor being energized. If this does not occur, the motor bearings will be damaged and the motor life reduced.
- The best stopping method is to turn power off followed by a natural coast to stop.
- A controlled stop from 30 Hz to 0 Hz is allowed if the time does not exceed 1 second.

Drive Carrier Frequency:

- The carrier frequency is set in the field. The drive typically has a selectable range between 2k and 12k Hz. The higher the carrier wave frequency setting, the greater the voltage spikes; the lower the carrier wave frequency setting, the rougher/poorer the shape of the power curve.
- The carrier frequency should be set within the range of 4k to 5k Hz for encapsulated submersible motors.

Application Function Setting:

- If the VFD has a setting of centrifugal pump or propeller fan it should be used.
- Centrifugal pumps and fans have similar load characteristics.

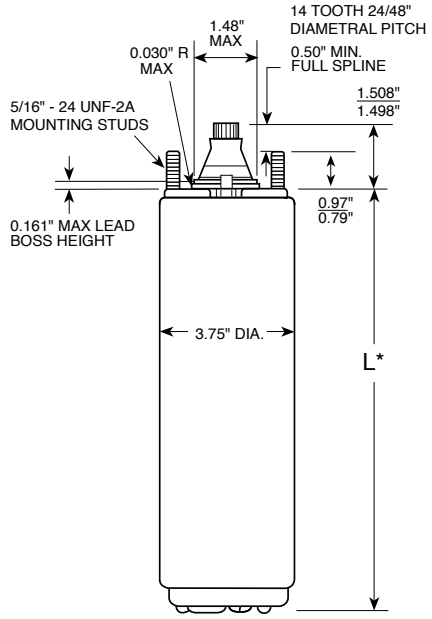
VFD Frequency of Starts:

- Keeping the starts per day within the recommended numbers shown in the frequency of starts section of the AIM manual provides the best system life. However, since in-rush current is typically reduced when used with a properly configured VFD, large 3-phase submersible motors can be started more frequently. In all cases a minimum of 7 minutes must be allowed between a power off and the next restart attempt or consecutive restart attempts.

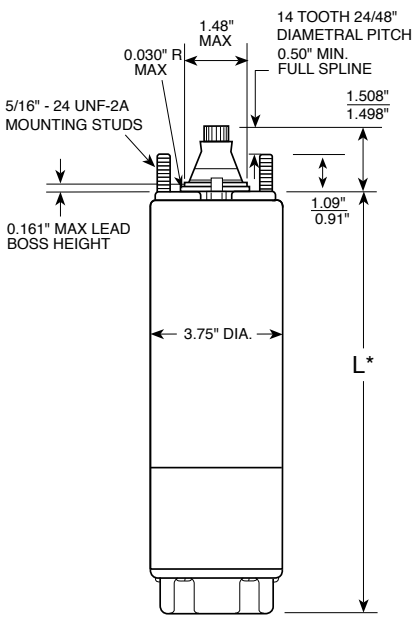
NEMA MG1 Above Ground Motor Standard Comments:

- Franklin Electric encapsulated submersible motors are not declared inverter duty motors by NEMA MG1 standards. The reason is NEMA MG1 standard part 31 does not include a section covering encapsulated winding designs.
- Franklin submersible motors can be used with VFDs without problems or warranty concerns providing Franklin's Application Installation Maintenance (AIM) manual guidelines are followed. See Franklin's on-line AIM manual for the latest guidelines.

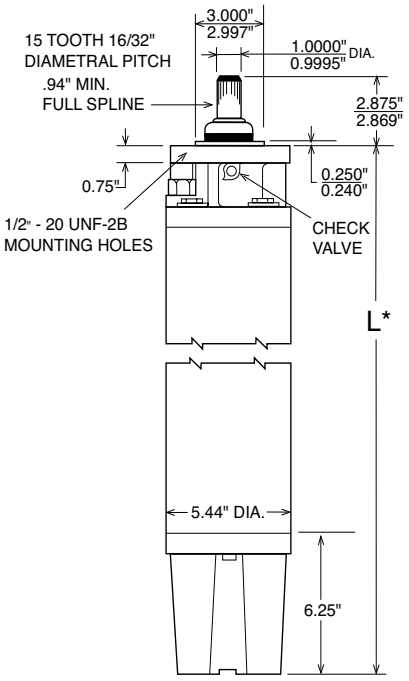
4" Super Stainless — Dimensions
(Standard Water Well)



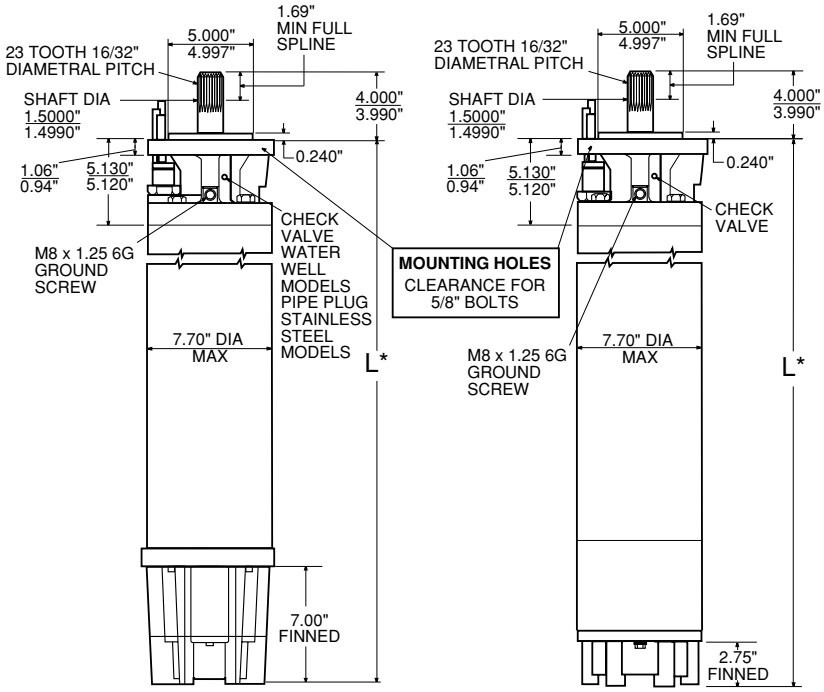
4" High Thrust — Dimensions
(Standard Water Well)



6" — Dimensions
(Standard Water Well)



8" — Dimensions
(Standard Water Well)



*** Motor lengths and shipping weights are available on Franklin Electric's web site (www.franklin-electric.com) or by calling Franklin's submersible hotline (800-348-2420).**

Tightening Motor Lead Connector Jam Nut

4" Motors with Jam Nut:
15 to 20 ft-lb (20 to 27 Nm)

4" Motors with 2 Screw Clamp Plate:
35 to 45 in-lb (4.0 to 5.1 Nm)

6" Motors:
40 to 50 ft-lb (54 to 68 Nm)

8" Motors with 1-3/16" to 1-5/8" Jam Nut:
50 to 60 ft-lb (68 to 81 Nm)

8" Motors with 4 Screw Clamp Plate:
Apply increasing torque to the screws equally in a criss-cross pattern until 80 to 90 in-lb (9.0 to 10.2 Nm) is reached.

Jam nut tightening torques recommended for field assembly are shown. Rubber compression set within the first few hours after assembly may reduce the jam nut torque. This is a normal condition which does not indicate reduced seal effectiveness. Retightening is not required, but is permissible and recommended if original torque was questionable.

A motor lead assembly should not be reused. A new lead assembly should be used whenever one is removed from the motor, because rubber set and possible damage from removal may prevent proper resealing of the old lead.

All motors returned for warranty consideration must have the lead returned with the motor.

Pump to Motor Coupling

Assemble coupling with non-toxic FDA approved waterproof grease such as Mobile FM102, Texaco CYGNUS2661, or approved equivalent. This prevents abrasives from entering the spline area and prolongs spline life.

Pump to Motor Assembly

After assembling the motor to the pump, torque mounting fasteners to the following:

4" Pump and Motor: 10 lb-ft (14 Nm)

6" Pump and Motor: 50 lb-ft (68 Nm)

8" Pump and Motor: 120 lb-ft (163 Nm)

Shaft Height and Free End Play

Table 42

MOTOR	NORMAL SHAFT HEIGHT		DIMENSION SHAFT HEIGHT		FREE END PLAY	
					MIN.	MAX.
4"	1 1/2"	38.1 mm	1.508" / 1.498"	38.30 / 38.05 mm	0.010" 0.25 mm	0.045" 1.14 mm
6"	2 7/8"	73.0 mm	2.875" / 2.869"	73.02 / 72.88 mm	0.030" 0.76 mm	0.050" 1.27 mm
8" TYPE 1	4"	101.6 mm	4.000" / 3.990"	101.60 / 101.35 mm	0.008" 0.20 mm	0.032" 0.81 mm
8" TYPE 2.1	4"	101.6 mm	4.000" / 3.990"	101.60 / 101.35 mm	0.030" 0.76 mm	0.080" 2.03 mm

If the height, measured from the pump-mounting surface of the motor, is low and/or end play exceeds the limit, the motor thrust bearing is possibly damaged, and should be replaced.

Submersible Leads and Cables

A common question is why motor leads are smaller than specified in Franklin's cable charts.

The leads are considered a part of the motor and actually are a connection between the large supply wire and the motor winding. The motor leads are short and there is virtually no voltage drop across the lead.

In addition, the lead assemblies **operate under water**, while at least part of the supply cable must **operate in air.** Lead assemblies running under water operate cooler.

CAUTION: Lead assemblies on submersible motors are suitable only for use in water and may overheat and cause failure if operated in air.

System Troubleshooting

Motor Does Not Start

POSSIBLE CAUSE	CHECKING PROCEDURES	CORRECTIVE ACTION
A. No power or incorrect voltage.	Check voltage at line terminals. The voltage must be ± 10% of rated voltage.	Contact power company if voltage is incorrect.
B. Fuses blown or circuit breakers tripped.	Check fuses for recommended size and check for loose, dirty or corroded connections in fuse receptacle. Check for tripped circuit breakers.	Replace with proper fuse or reset circuit breakers.
C. Defective pressure switch.	Check voltage at contact points. Improper contact of switch points can cause voltage less than line voltage.	Replace pressure switch or clean points.
D. Control box malfunction.	For detailed procedure, see pages 48-56.	Repair or replace.
E. Defective wiring.	Check for loose or corroded connections or defective wiring	Correct faulty wiring or connections.
F. Bound pump.	Check for misalignment between pump and motor or a sand bound pump. Amp readings will be 3 to 6 times higher than normal until the overload trips	Pull pump and correct problem. Run new installation until the water clears
G. Defective cable or motor.	For detailed procedure, see pages 46 & 47.	Repair or replace.

Motor Starts Too Often

A. Pressure switch.	Check setting on pressure switch and examine for defects.	Reset limit or replace switch.
B. Check valve - stuck open.	Damaged or defective check valve will not hold pressure.	Replace if defective.
C. Waterlogged tank.	Check air charge	Clean or replace.
D. Leak in system.	Check system for leaks.	Replace damaged pipes or repair leaks.

System Troubleshooting

Motor Runs Continuously

POSSIBLE CAUSE	CHECKING PROCEDURES	CORRECTIVE ACTION
A. Pressure switch.	Check switch for welded contacts. Check switch adjustments.	Clean contacts, replace switch, or adjust setting.
B. Low water level in well.	Pump may exceed well capacity. Shut off pump, wait for well to recover. Check static and drawdown level from well head.	Throttle pump output or reset pump to lower level. Do not lower if sand may clog pump.
C. Leak in system.	Check system for leaks.	Replace damaged pipes or repair leaks.
D. Worn pump.	Symptoms of worn pump are similar to those of drop pipe leak or low water level in well. Reduce pressure switch setting, if pump shuts off worn parts may be the fault.	Pull pump and replace worn parts.
E. Loose coupling or broken motor shaft.	Check for loose coupling or damaged shaft.	Replace worn or damaged parts.
F. Pump screen blocked.	Check for clogged intake screen.	Clean screen and reset pump depth.
G. Check valve stuck closed.	Check operation of check valve.	Replace if defective.
H. Control box malfunction.	See pages 47-55 for single-phase.	Repair or replace.

Motor Runs But Overload Protector Trips

A. Incorrect voltage.	Using voltmeter, check the line terminals. Voltage must be within ± 10% of rated voltage.	Contact power company if voltage is incorrect.
B. Overheated protectors.	Direct sunlight or other heat source can raise control box temperature causing protectors to trip. The box must not be hot to touch.	Shade box, provide ventilation or move box away from source.
C. Defective control box.	For detailed procedures, see pages 47-55.	Repair or replace.
D. Defective motor or cable.	For detailed procedures, see pages 45 & 46.	Repair or replace.
E. Worn pump or motor.	Check running current, see tables 13, 22, 24 & 27.	Replace pump and/or motor.

Table 45 Preliminary Tests - All Sizes Single- and Three-Phase

TEST	PROCEDURE	WHAT IT MEANS
Insulation Resistance	1. Open master breaker and disconnect all leads from control box or pressure switch (QD type control, remove lid) to avoid electric shock hazard and damage to the meter. 2. Use a megohmmeter or set the scale lever to R X 100K on an ohmmeter. Zero the meter. 3. Connect one meter lead to any one of the motor leads and the other lead to the metal drop pipe. If the drop pipe is plastic, connect the meter lead to ground.	1. If the ohms value is normal (table 46), the motor is not grounded and the cable insulation is not damaged. 2. If the ohms value is below normal, either the windings are grounded or the cable insulation is damaged. Check the cable at the well seal as the insulation is sometimes damaged by being pinched.
Winding Resistance	1. Open master breaker and disconnect all leads from control box or pressure switch (QD type control, remove lid) to avoid electric shock hazard and damage to the meter. 2. Set the scale lever to R X 1 for values under 10 ohms. For values over 10 ohms, set the scale lever to R X 10. "zero" the ohmmeter. 3. On 3-wire motors measure the resistance of yellow to black (main winding) and yellow to red (start winding). On 2-wire motors: measure the resistance from line-to-line. Three-phase motors: measure the resistance line-to-line for all three combinations.	1. If all ohms values are normal (tables 13, 22, 24 & 27), the motor windings are neither shorted nor open, and the cable colors are correct 2. If any one value is less than normal, the motor is shorted. 3. If any one ohm value is greater than normal, the winding or the cable is open, or there is a poor cable joint or connection. 4. If some ohms values are greater than normal and some less on single-phase motors, the leads are mixed. See page 46 to verify cable colors.

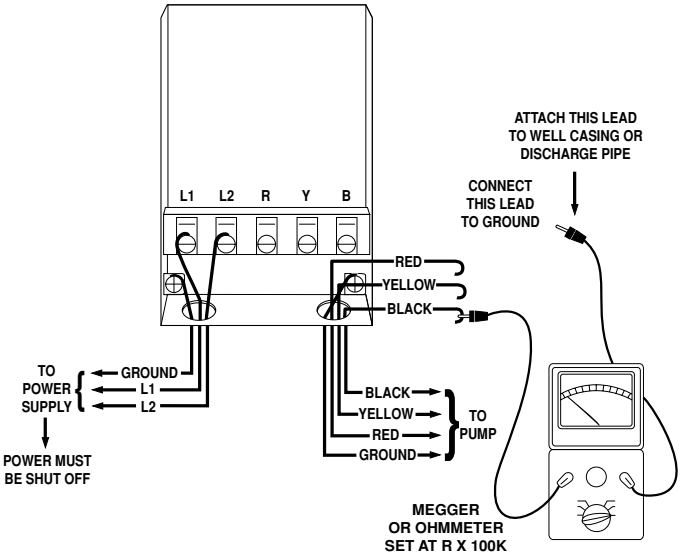


FIG. 13

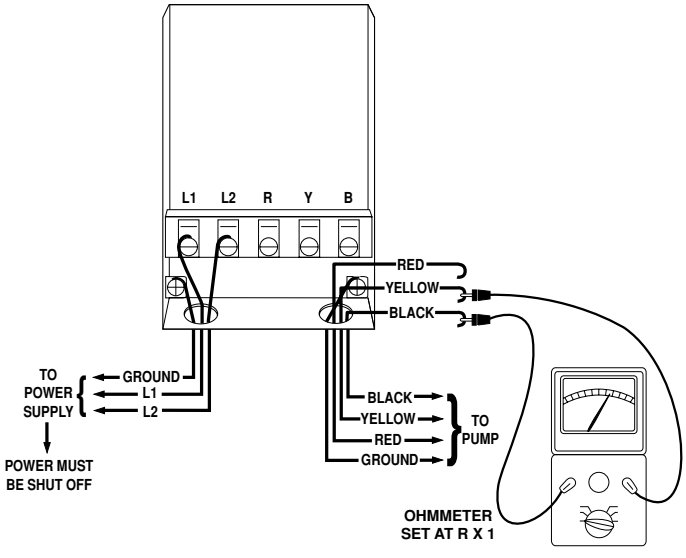


FIG. 14

Insulation Resistance Readings

Table 46 Normal ohm and Megohm Values Between All Leads and Ground

CONDITION OF MOTOR AND LEADS	OHMS VALUE	MEGOHM VALUE
A new motor (without drop cable).	200,000,000 (or more)	200.0 (or more)
A used motor which can be reinstalled in well.	10,000,000 (or more)	10.0 (or more)
MOTOR IN WELL. READINGS ARE FOR DROP CABLE PLUS MOTOR.		
New motor.	2,000,000 (or more)	2.0 (or more)
Motor in good condition.	500,000 - 2,000,000	0.50 - 2.0
Insulation damage, locate and repair.	Less than 500,000	Less than .50

Insulation resistance varies very little with rating. Motors of all hp, voltage, and phase rating have similar values of insulation resistance.

The table above is based on readings taken with a megohm meter with a 500 VDC output. Readings may vary using a lower voltage ohmmeter, consult Franklin Electric if readings are in question.

Resistance of Drop Cable (ohms)

The values below are for copper conductors. If aluminum conductor drop cable is used, the resistance will be higher. To determine the actual resistance of the aluminum drop cable, divide the ohm readings from this chart by 0.61. This chart shows total resistance of cable from control to motor and back.

Winding Resistance Measuring

The winding resistance measured at the motor should fall within the values in tables 13, 22, 24 & 27. When measured through the drop cable, the resistance of the drop cable must be subtracted from the ohmmeter readings to get the winding resistance of the motor. See table below.

Table 46A DC Resistance in ohms per 100 ft of Wire (Two conductors) @ 50 °F

AWG OR MCM WIRE SIZE (COPPER)	14	12	10	8	6	4	3	2
OHMS	0.544	0.338	0.214	0.135	0.082	0.052	0.041	0.032

1	1/0	2/0	3/0	4/0	250	300	350	400	500	600	700
0.026	0.021	0.017	0.013	0.010	0.0088	0.0073	0.0063	0.0056	0.0044	0.0037	0.0032

Identification Of Cables When Color Code Is Unknown (Single-Phase 3-Wire Units)

If the colors on the individual drop cables cannot be found with an ohmmeter, measure:

Cable 1 to Cable 2
Cable 2 to Cable 3
Cable 3 to Cable 1

Find the highest resistance reading.

The lead not used in the highest reading is the yellow lead.

Use the yellow lead and each of the other two leads to get two readings:

Highest is the red lead.
Lowest is the black lead.

EXAMPLE:

The ohmmeter readings were:

Cable 1 to Cable 2 - 6 ohms
Cable 2 to Cable 3 - 2 ohms
Cable 3 to Cable 1 - 4 ohms

The lead not used in the highest reading (6 ohms) was

Cable 3—Yellow

From the yellow lead, the highest reading (4 ohms) was

To Cable 1—Red

From the yellow lead, the lowest reading (2 ohms) was

To Cable 2—Black

Single-Phase Control Boxes

Checking and Repairing Procedures (Power On)

WARNING: Power must be on for these tests. Do not touch any live parts.

A. VOLTAGE MEASUREMENTS

Step 1. Motor Off

1. Measure voltage at L1 and L2 of pressure switch or line contactor.
2. Voltage Reading: Should be ± 10% of motor rating.

Step 2. Motor Running

1. Measure voltage at load side of pressure switch or line contactor with pump running.
2. Voltage Reading: Should remain the same except for slight dip on starting. Excessive voltage drop can be caused by loose connections, bad contacts, ground faults, or inadequate power supply.
3. Relay chatter is caused by low voltage or ground faults.

B. CURRENT (AMP) MEASUREMENTS

1. Measure current on all motor leads.
2. Amp Reading: Current in red lead should momentarily be high, then drop within one second to values in table 13. This verifies relay or solid state relay operation. Current in black and yellow leads should not exceed values in table 13.
3. Relay or switch failures will cause red lead current to remain high and overload tripping.
4. Open run capacitor(s) will cause amps to be higher than normal in the black and yellow motor leads and lower than normal in the red motor lead.
5. A bound pump will cause locked rotor amps and overloading tripping.
6. Low amps may be caused by pump running at shutoff, worn pump, or stripped splines.
7. Failed start capacitor or open switch/relay are indicated if the red lead current is not momentarily high at starting.

CAUTION: The tests in this manual for components such as capacitors, relays, and QD switches should be regarded as indicative and not as conclusive. For example, a capacitor may test good (not open, not shorted) but may have lost some of its capacitance and may no longer be able to perform its function.

Ohmmeter Tests

QD, Solid State Control Box (Power Off)

A. START CAPACITOR AND RUN CAPACITOR IF APPLICABLE (CRC)

1. Meter Setting: R x 1,000.
2. Connections: Capacitor terminals.
3. Correct meter reading: Pointer should swing toward zero, then back to infinity.

B. Q.D. (BLUE) RELAY

Step 1. Triac Test

1. Meter setting: R x 1,000.
2. Connections: Cap and B terminal.
3. Correct meter reading: Infinity for all models.

Step 2. Coil Test

1. Meter Setting: R x 1.
2. Connections: L1 and B.
3. Correct meter reading: Zero ohms for all models.

C. POTENTIAL (VOLTAGE) RELAY

Step 1. Coil Test

1. Meter setting: R x 1,000.
2. Connections: #2 & #5.
3. Correct meter readings:

   For 115 Volt Boxes:
   0.7-1.8 (700 to 1,800 ohms).

   For 230 Volt Boxes:
   4.5-7.0 (4,500 to 7,000 ohms).

Step 2. Contact Test

1. Meter setting: R x 1.
2. Connections: #1 & #2.
3. Correct meter reading: Zero for all models.

Ohmmeter Tests

Integral Horsepower Control Box (Power Off)

A. OVERLOADS (Push Reset Buttons to make sure contacts are closed.)

1. Meter Setting: R x 1.
2. Connections: Overload terminals.
3. Correct meter reading: Less than 0.5 ohms.

B. CAPACITOR (Disconnect leads from one side of each capacitor before checking.)

1. Meter Setting: R x 1,000.
2. Connections: Capacitor terminals.
3. Correct meter reading: Pointer should swing toward zero, then drift back to infinity, except for capacitors with resistors which will drift back to 15,000 ohms.

C. POTENTIAL (VOLTAGE) RELAY

Step 1. Coil Test

1. Meter setting: R x 1,000.
2. Connections: #2 & #5.
3. Correct meter readings: 4.5-7.0 (4,500 to 7,000 ohms) for all models.

Step 2. Contact Test

1. Meter Setting: R x 1.
2. Connections: #1 & #2.
3. Correct meter reading: Zero ohms for all models.

D. CONTACTOR

Step 1. Coil

1. Meter setting: R x 100
2. Connections: Coil terminals
3. Correct meter reading:
   1.8-14.0 (180 to 1,400 ohms)

Step 2. Contacts

1. Meter Setting: R X 1
2. Connections: L1 & T1 or L2 & T2
3. Manually close contacts
4. Correct meter reading: Zero ohms

CAUTION: The tests in this manual for components such as capacitors, relays, and QD switches should be regarded as indicative and not as conclusive. For example, a capacitor may test good (not open, not shorted) but may have lost some of its capacitance and may no longer be able to perform its function.

Table 49 QD Control Box Parts 60 Hz

HP	VOLTS	CONTROL BOX MODEL NUMBER	QD (BLUE) RELAY	START CAPACITOR	MFD	VOLTS	RUN CAPACITOR	MFD	VOLTS
1/3	115	280 102 4915	223 415 905	275 464 125	159-191	110			
	230	280 103 4915	223 415 901	275 464 126	43-53	220			
1/2	115	280 104 4915	223 415 906	275 464 201	250-300	125			
	230	280 105 4915	223 415 902	275 464 105	59-71	220			
	230	282 405 5015 (CRC)	223 415 912	275 464 126	43-53	220	156 362 101	15	370
3/4	230	280 107 4915	223 415 903	275 464 118	86-103	220			
	230	282 407 5015 (CRC)	223 415 913	275 464 105	59-71	220	156 362 102	23	370
1	230	280 108 4915	223 415 904	275 464 113	105-126	220			
	230	282 408 5015 (CRC)	223 415 914	275 464 118	86-103	220	156 362 102	23	370

Table 49A QD Capacitor Replacement Kits

CAPACITOR NUMBER	KIT
275 464 105	305 207 905
275 464 113	305 207 913
275 464 118	305 207 918
275 464 125	305 207 925
275 464 126	305 207 926
275 464 201	305 207 951
156 362 101	305 203 907
156 362 102	305 203 908

Table 49B Overload Kits 60 Hz

HP	VOLTS	KIT (1)
1/3	115	305 100 901
1/3	230	305 100 902
1/2	115	305 100 903
1/2	230	305 100 904
3/4	230	305 100 905
1	230	305 100 906

(1) For Control Boxes with model numbers that end with 4915.

Table 49C QD Relay Replacement Kits

QD RELAY NUMBER	KIT
223 415 901	305 101 901
223 415 902	305 101 902
223 415 903	305 101 903
223 415 904	305 101 904
223 415 905	305 101 905
223 415 906	305 101 906
223 415 912 (CRC)	305 105 901
223 415 913 (CRC)	305 105 902
223 415 914 (CRC)	305 105 903

FOOTNOTES:

(1) Control boxes supplied with QD Relays are designed to operate on 230-volt systems. For 208-volt systems or where line voltage is between 200 volts and 210 volts use the next larger cable size, or use a boost transformer to raise the voltage.

(2) Voltage relays kits for 115-volts (305 102 901) and 230-volts (305 102 902) will replace current, voltage or QD Relays, and solid state switches.

Table 50 Integral Horsepower Control Box Parts 60 Hz

MOTOR SIZE	MOTOR RATING HP	CONTROL BOX (1) MODEL NO.	CAPACITORS				OVERLOAD (2) PART NO.	RELAY (3) PART NO.	CONTACTOR (2) PART NO.
			PART NO. (2)	MFD.	VOLTS	QTY.			
4"	1 - 1.5 STANDARD	282 300 8110 (See Note 5)	275 464 113 S 155 328 102 R	105-126 10	220 370	1 1	275 411 107	155 031 102	
		282 300 8110 (See Note 5)	275 464 113 S 155 328 101 R	105-126 15	220 370	1 1	275 411 114 S 275 411 113 M	155 031 102	
		282 300 8610	275 464 113 S 155 328 101 R	105-126 15	220 370	1 1	None (See Note 4)	155 031 102	
4"	2 STANDARD	282 301 8110	275 464 113 S 155 328 103 R	105-126 20	220 370	1 1	275 411 117 S 275 411 113 M	155 031 102	
4"	2 DELUXE	282 301 8310	275 464 113 S 155 328 103 R	105-126 20	220 370	1 1	275 411 117 S 275 411 113 M	155 031 102	155 325 102 L
4"	3 STANDARD	282 302 8110	275 463 123 S 155 327 109 R	208-250 45	220 370	1 1	275 411 118 S 275 411 115 M	155 031 102	
4"	3 DELUXE	282 302 8310	275 463 123 S 155 327 109 R	208-250 45	220 370	1 1	275 411 118 S 275 411 115 M	155 031 102	155 325 102 L
4" & 6"	5 STANDARD	282 113 8110	275 468 119 S 155 327 114 R	270-324 40	330 370	1 2	275 411 119 S 275 406 102 M	155 031 601	
4" & 6"	5 DELUXE	282 113 9310	275 468 119 S 155 327 114 R	270-324 40	330 370	1 2	275 411 119 S 275 406 102 M	155 031 601	155 326 101 L
6"	7.5 STANDARD	282 201 9210	275 468 119 S 275 468 118 S 155 327 109 R	270-324 216-259 45	330 330 370	1 1 1	275 411 102 S 275 406 122 M	155 031 601	
6"	7.5 DELUXE	282 201 9310	275 468 119 S 275 468 118 S 155 327 109 R	270-324 216-259 45	330 330 370	1 1 1	275 411 102 S 275 406 121 M	155 031 601	155 326 102 L
6"	10 STANDARD	282 202 9210	275 468 119 S 275468 120 S 155 327 102 R	270-324 350-420 35	330 330 370	1 1 2	275 406 103 S 155 409 101 M	155 031 601	
6"	10 STANDARD	282 202 9230	275 463 120 S 275 468 118 S 275 468 119 S 155 327 102 R	130-154 216-259 270-324 35	330 330 330 370	1 1 1 2	275 406 103 S 155 409 101 M	155 031 601	
6"	10 DELUXE	282 202 9310	275 468 119 S 275468 120 S 155 327 102 R	270-324 350-420 35	330 330 370	1 1 2	275 406 103 S 155 409 101 M	155 031 601	155 326 102 L
6"	10 DELUXE	282 202 9330	275 463 120 S 275 468 118 S 275 468 119 S 155 327 102 R	130-154 216-259 270-324 35	330 330 330 370	1 1 1 2	275 406 103 S 155 409 101 M	155 031 601	155 326 102 L
6"	15 DELUXE	282 203 9310	275 468 120 S 155 327 109 R	350-420 45	330 370	2 3	275 406 103 S 155 409 102 M	155 031 601	155 429 101 L
6"	15 DELUXE	282 203 9330	275 463 122 S 275 468 119 S 155 327 109 R	161-193 270-324 45	330 330 370	1 2 3	275 406 103 S 155 409 102 M	155 031 601	155 429 101 L
6"	15 X-LARGE	282 203 9621	275 468 120 S 155 327 109 R	350-420 45	330 370	2 3	275 406 103 S 155 409 102 M	155 031 601 2 required	155 429 101 L

FOOTNOTES:

(1) Lightning arrestors 150 814 902 are suitable for all control boxes.

(2) S = Start, M = Main, L = Line, R = Run
Deluxe = Control box with line contactor.

(3) For 208-volt systems or where line voltage is between 200 volts and 210 volts, a low voltage relay is required. On 3 hp and smaller control boxes use relay part 155 031 103 in place of 155 031 102 and use the next larger cable size than specified in the 230-volt table. On 5 hp and larger use relay 155 031 602 in place of 155 031 601 and next larger wire. Boost transformers per page 15 are an alternative to special relays and cable.

(4) Control box model 282 300 8610 is designed for use with motors having internal overload protectors. If used with a 1.5 hp motor manufactured prior to date code 06H18, Overload/Capacitor Kit 305 388 901 is required.

(5) Control box model 282 300 8110 with date code 11C19 (March 2011) and newer contain 15 MFD run capacitor and both start and run overloads. This box is designed for use with any Franklin 1.5 hp motor.

Table 51 Integral hp Capacitor Replacement Kits

CAPACITOR NUMBER	KIT
275 463 120	305 206 920
275 463 122	305 206 922
275 463 123	305 206 923
275 464 113	305 207 913
275 468 118	305 208 918
275 468 119	305 208 919
275 468 120	305 208 920
155 327 101	305 203 901
155 327 102	305 203 902
155 327 109	305 203 909
155 327 114	305 203 914
155 328 101	305 204 901
155 328 102	305 204 902
155 328 103	305 204 903

Table 51A Integral hp Overload Replacement Kits

OVERLOAD NUMBER	KIT
275 406 102	305 214 902
275 406 103	305 214 903
275 406 121	305 214 921
275 406 122	305 214 922
275 411 102	305 215 902
275 411 107	305 215 907
275 411 108	305 215 908
275 411 113	305 215 913
275 411 114	305 215 914
275 411 115	305 215 915
275 411 117	305 215 917
275 411 118	305 215 918
275 411 119	305 215 919

Table 51B Integral hp Voltage Relay Replacement Kits

RELAY NUMBER	KIT
155 031 102	305 213 902
155 031 103	305 213 903
155 031 601	305 213 961
155 031 602	305 213 962

Table 51C Integral hp Contactor Replacement Kits

CONTACTOR	KIT
155 325 102	305 226 902
155 326 101	305 347 903
155 326 102	305 347 902
155 429 101	305 347 901

FOOTNOTES:

(1) The following kit number changes were made for number consistency purposes only. Parts in the kit did not change.

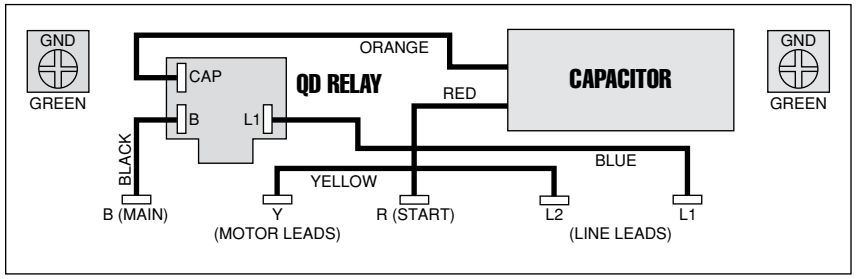
305 206 922 was 305 206 912

305 206 923 was 305 206 911

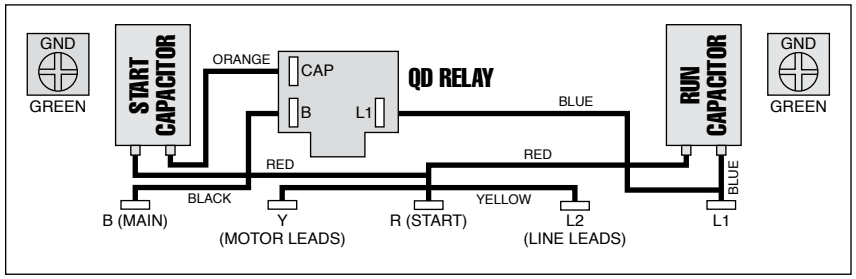
305 213 962 was 305 213 904

305 226 902 was 305 226 901

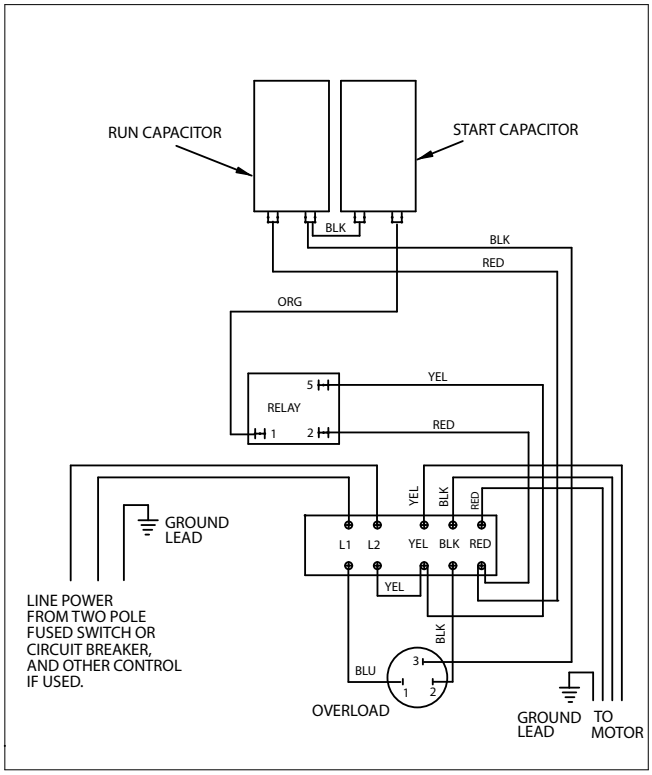
Control Box Wiring Diagrams



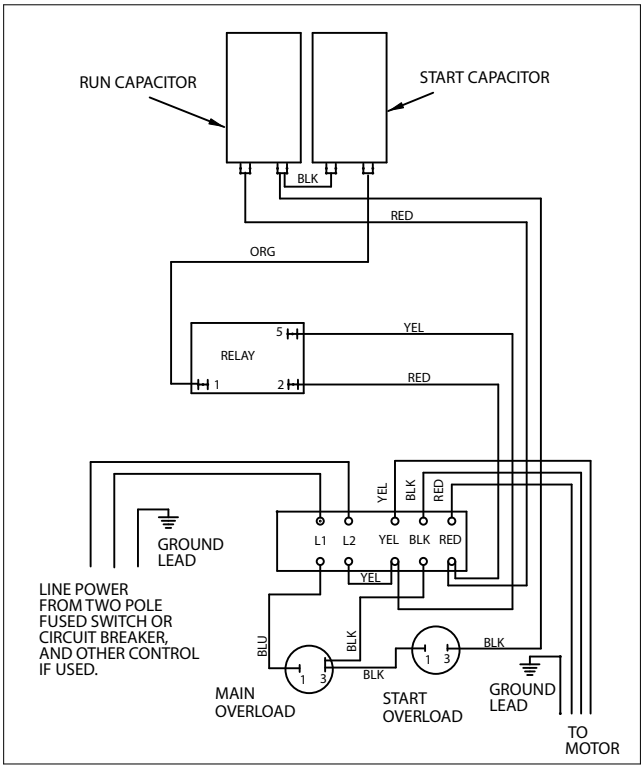
1/3 - 1 hp QD RELAY
280 10_ 4915
Sixth digit depends on hp



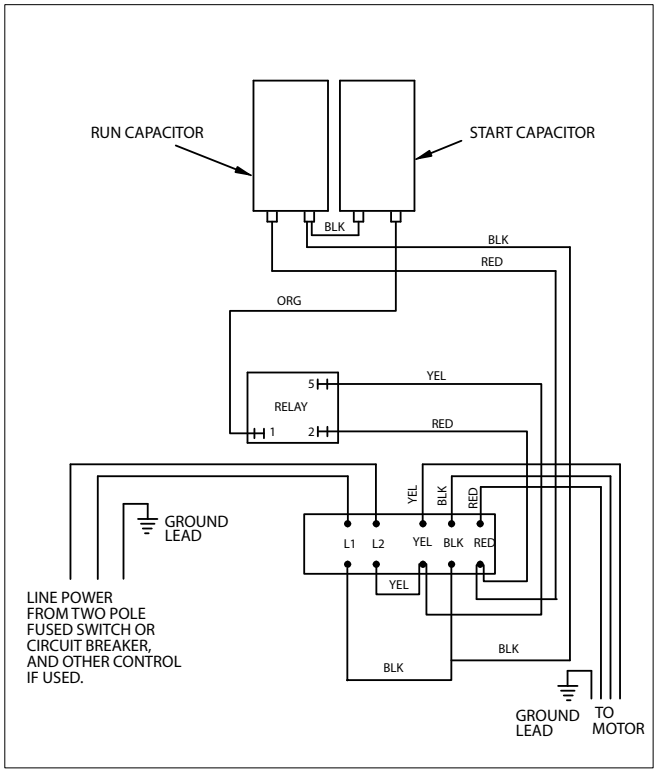
1/2 - 1 hp CRC QD RELAY
282 40_ 5015
Sixth digit depends on hp



1 - 1.5 hp
282 300 8110
(Date Codes 11C19 & Older)

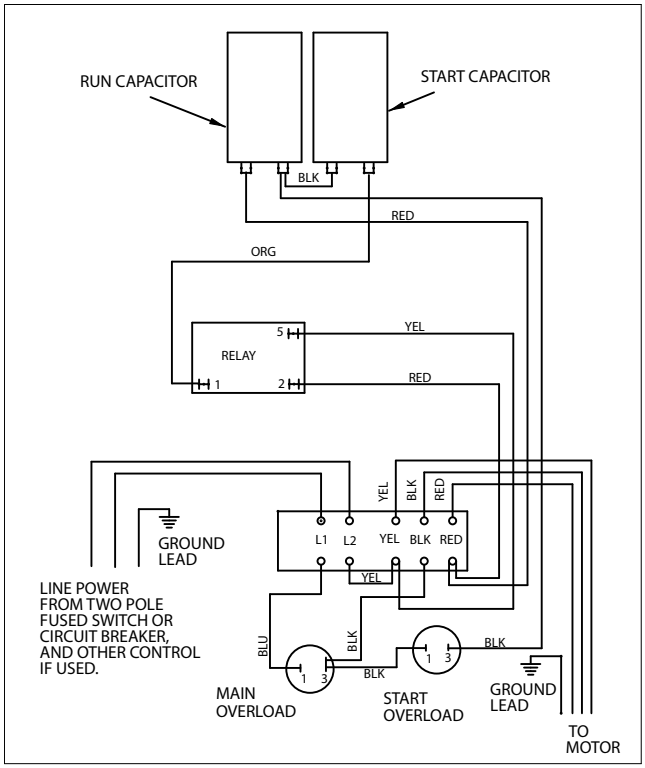


1 - 1.5 hp
282 300 8110
(Date Codes 11C19 & Newer)

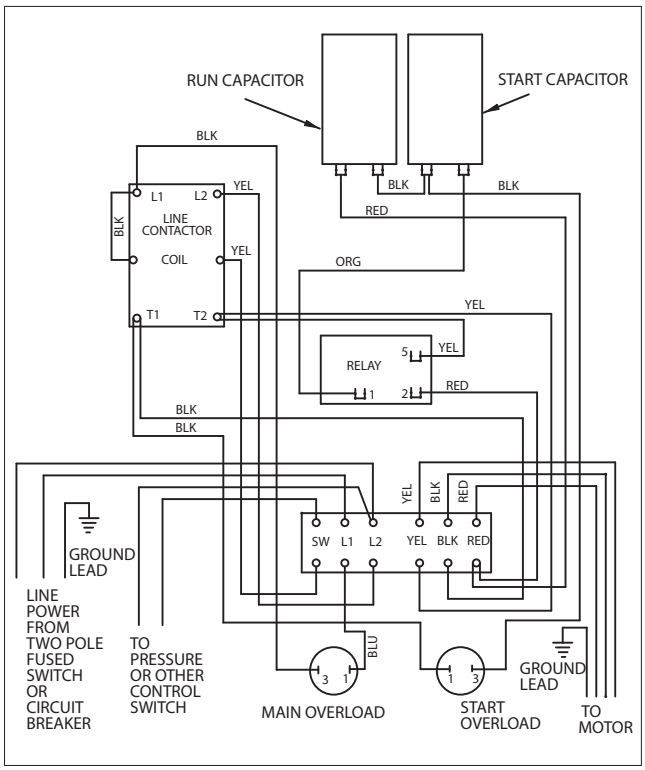


1 - 1.5 hp
282 300 8610

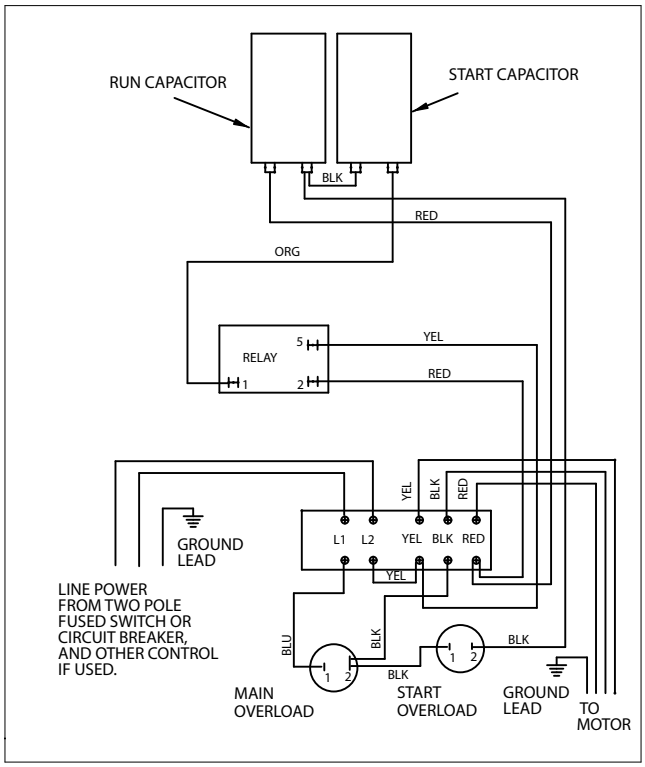
Single-Phase Motors & Controls



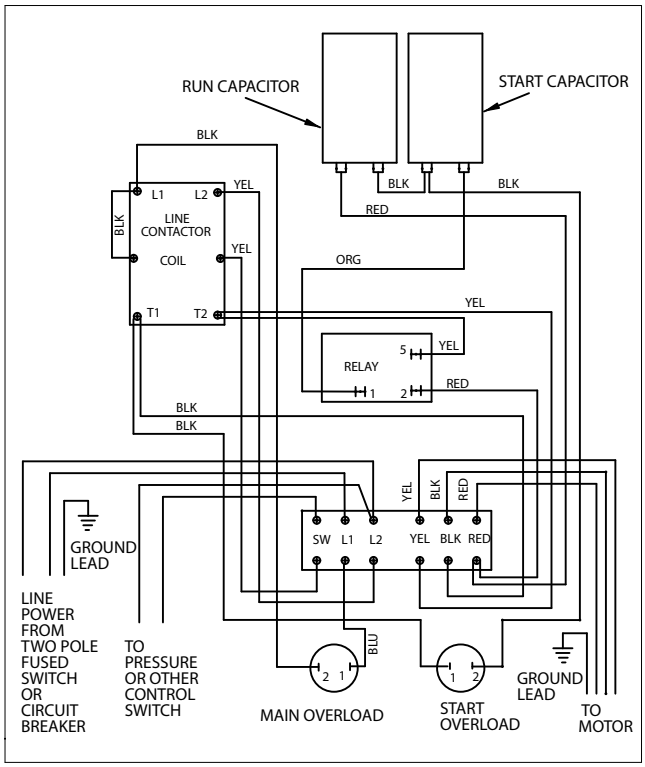
2 hp STANDARD
282 301 8110



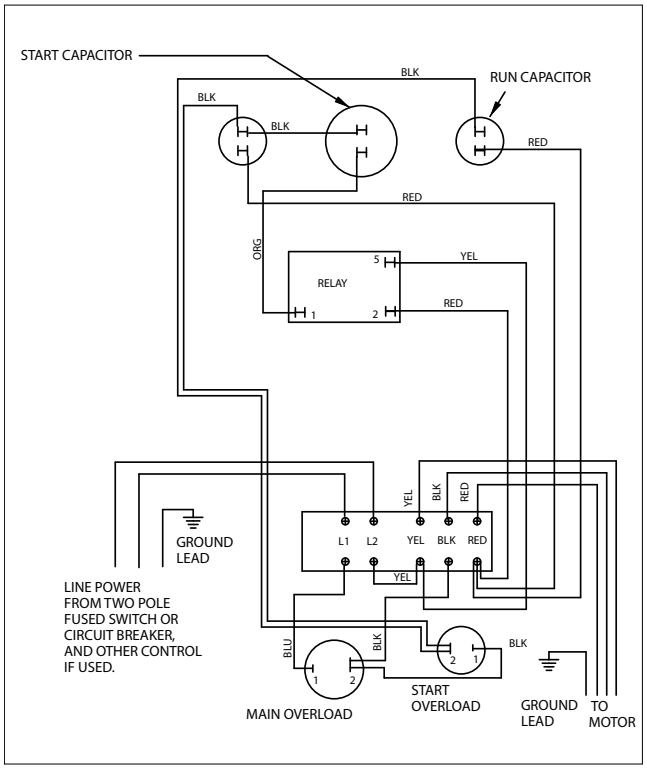
2 hp DELUXE
282 301 8310



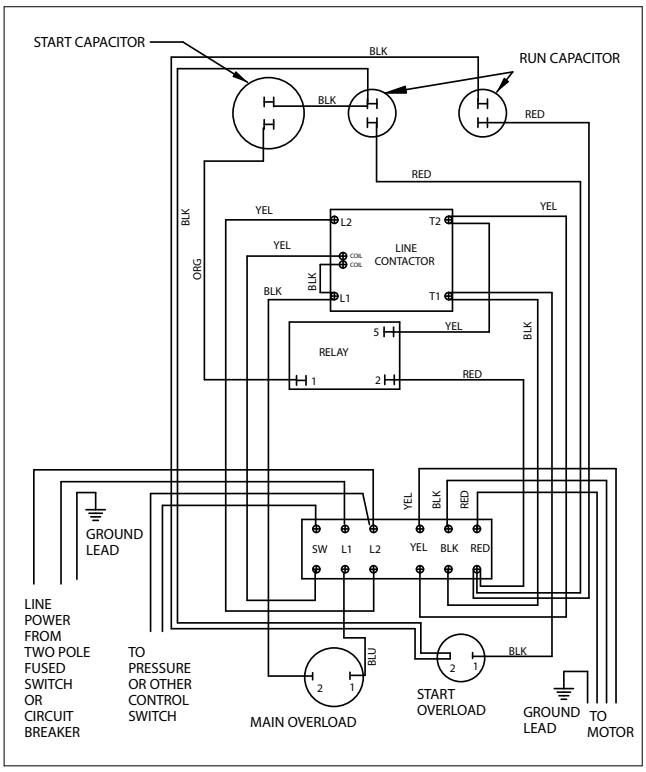
3 hp STANDARD
282 302 8110



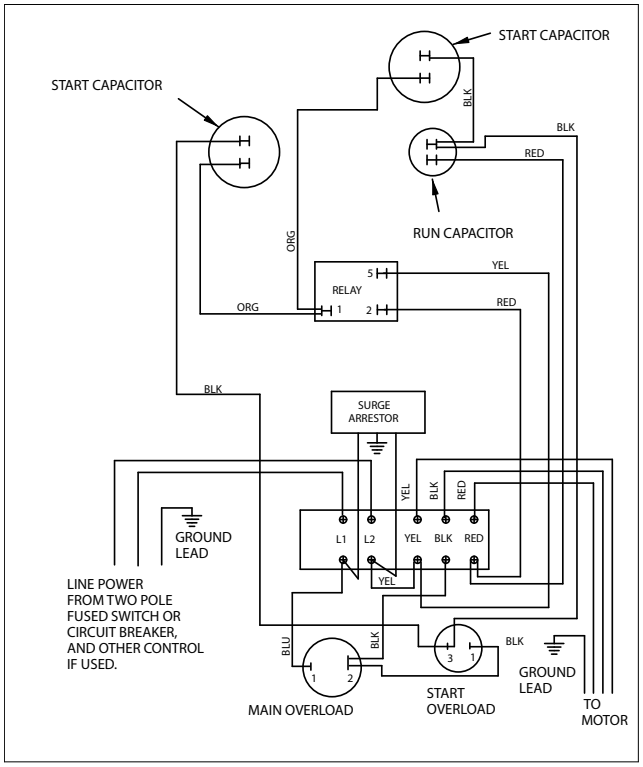
3 hp DELUXE
282 302 8310



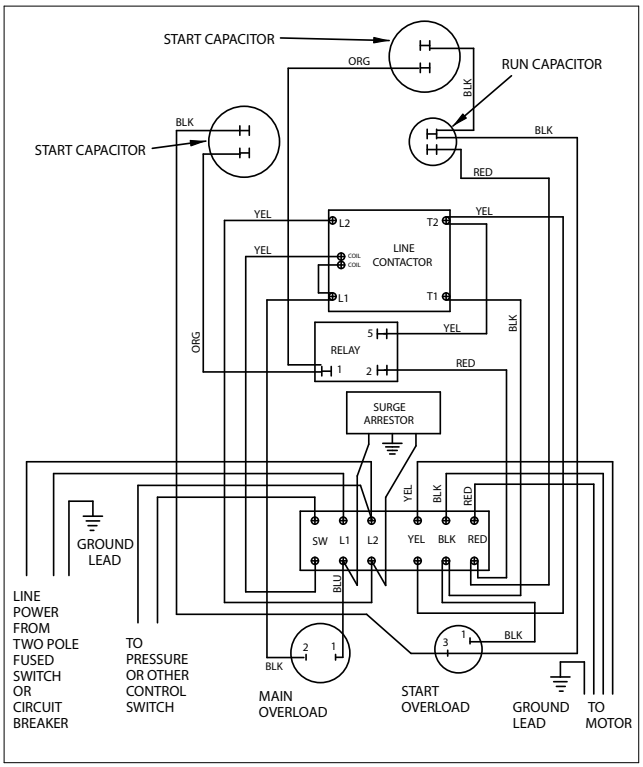
5 hp STANDARD
282 113 8110



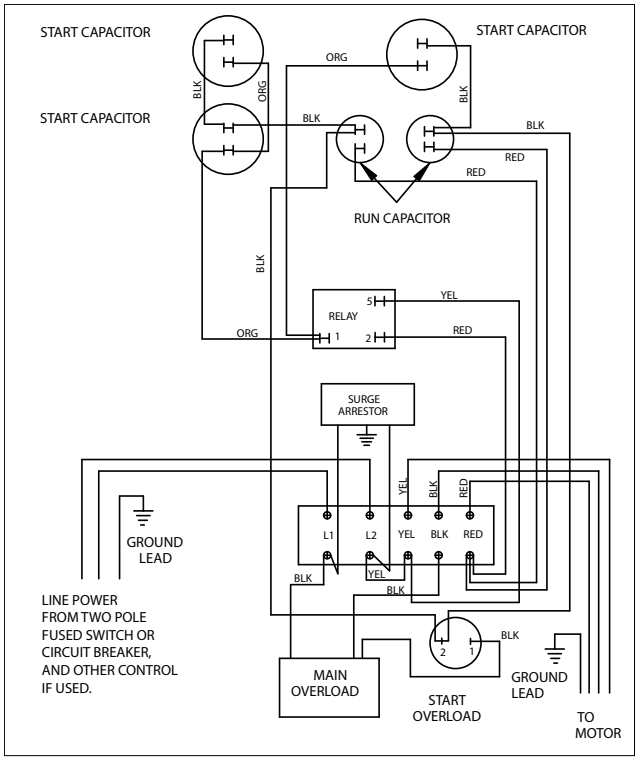
5 hp DELUXE
282 113 8310 or 282 113 9310



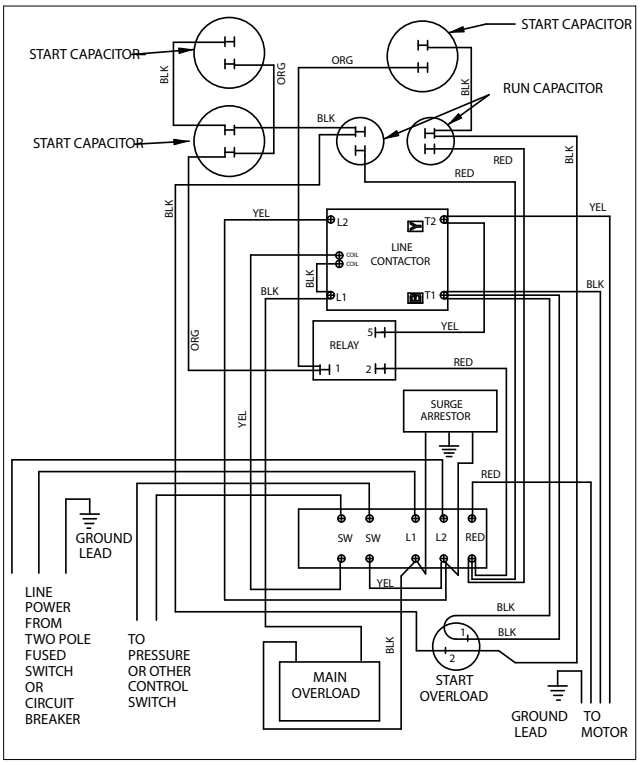
7.5 hp STANDARD
282 201 9210



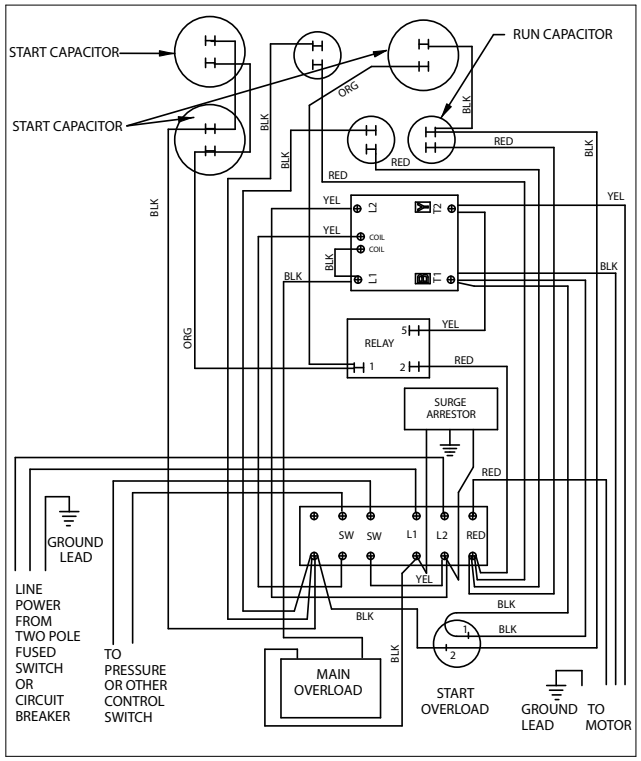
7.5 hp DELUXE
282 201 9310



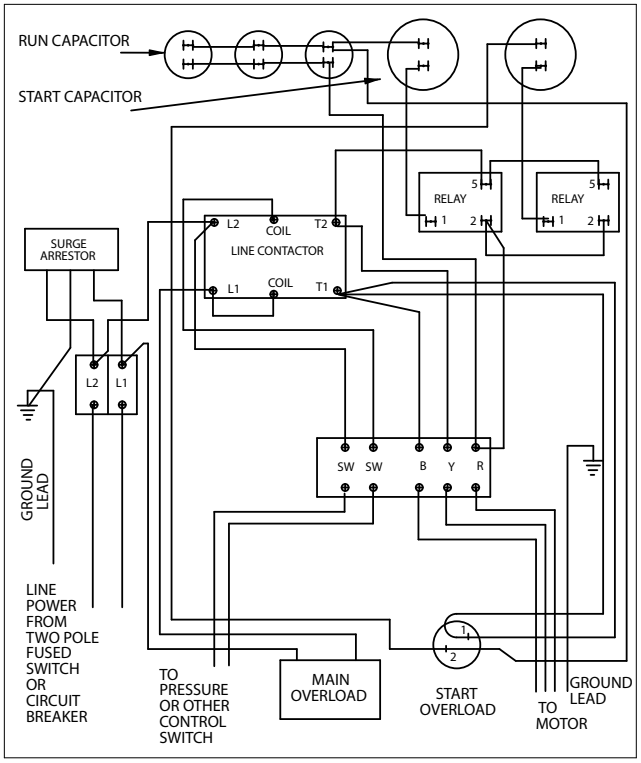
10 hp STANDARD
282 202 9210 or 282 202 9230



10 hp DELUXE
282 202 9230 or 282 202 9330



15 hp DELUXE
282 203 9310 or 282 203 9330



15 hp X-LARGE
282 203 9621

Pumptec-Plus

Pumptec-Plus is a pump/motor protection device designed to work on any 230 V single-phase induction motor (PSC, CSCR, CSIR, and split phase) ranging in size from 1/2 to 5 horsepower. Pumptec-Plus uses a micro-computer to continuously monitor motor power and line voltage to provide protection against dry well, water logged tank, high and low voltage and mud or sand clogging.

Pumptec-Plus – Troubleshooting During Installation

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Unit Appears Dead (No Lights)	No Power to Unit	Check wiring. Power supply voltage should be applied to L1 and L2 terminals of the Pumptec-Plus. In some installations the pressure switch or other control devices is wired to the input of the Pumptec-Plus. Make sure this switch is closed.
Flashing Yellow Light	Unit Needs to Be Calibrated	Pumptec-Plus is calibrated at the factory so that it will overload on most pump systems when the unit is first installed. This overload condition is a reminder that the Pumptec-Plus unit requires calibration before use. See step 7 of the installation instructions.
	Miscalibrated	Pumptec-Plus should be calibrated on a full recovery well with the maximum water flow. Flow restrictors are not recommended.
Flashing Yellow Light During Calibration	2-Wire Motor	Step C of the calibration instructions indicate that a flashing green light condition will occur 2 to 3 seconds after taking the SNAPSHOT of the motor load. On some two-wire motors the yellow light will flash instead of the green light. Press and release the reset button. The green should start flashing.
Flashing Red and Yellow Lights	Power Interruption	During the installation of Pumptec-Plus power may be switched on and off several times. If power is cycled more than four times within a minute Pumptec-Plus will trip on rapid cycle. Press and release the reset button to restart the unit.
	Float Switch	A bobbing float switch may cause the unit to detect a rapid cycle condition on any motor or an overload condition on two-wire motors. Try to reduce water splashing or use a different switch.
Flashing Red Light	High Line Voltage	The line voltage is over 253 volts. Check line voltage. Report high line voltage to the power company.
	Unloaded Generator	If you are using a generator the line voltage may become too high when the generator unloads. Pumptec-Plus will not allow the motor to turn on again until the line voltage returns to normal. Overvoltage trips will also occur if line frequency drops too far below 60 Hz.
Solid Red Light	Low Line Voltage	The line voltage is below 207 volts. Check line voltage.
	Loose Connections	Check for loose connections which may cause voltage drops.
	Loaded Generator	If you are using a generator the line voltage may become too low when the generator loads. Pumptec-Plus will trip on undervoltage if the generator voltage drops below 207 volts for more than 2.5 seconds. Undervoltage trips will also occur if the line frequency rises too far above 60 Hz.

Pumptec-Plus

Pumptec-Plus - Troubleshooting After Installation

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Solid Yellow Light	Dry Well	Wait for the automatic restart timer to time out. During the time out period the well should recover and fill with water. If the automatic reset timer is set to the manual position, then the reset button must be pressed to reactivate the unit.
	Blocked Intake	Clear or replace pump intake screen.
	Blocked Discharge	Remove blockage in plumbing.
	Check Valve Stuck	Replace check valve.
	Broken Shaft	Replace broken parts.
	Severe Rapid Cycling	Machine gun rapid cycling can cause an underload condition. See flashing red and yellow lights section below.
	Worn Pump	Replace worn pump parts and recalibrate.
Yellow Flashing Light	Stalled Motor	Repair or replace motor. Pump may be sand or mud locked.
	Float Switch	A bobbing float switch can cause two-wire motors to stall. Arrange plumbing to avoid splashing water. Replace float switch.
	Ground Fault	Check insulation resistance on motor and control box cable.
Solid Red Light	Low Line Voltage	The line voltage is below 207 volts. Pumptec-Plus will try to restart the motor every two minutes until line voltage is normal.
	Loose Connections	Check for excessive voltage drops in the system electrical connections (i.e. circuit breakers, fuse clips, pressure switch, and Pumptec-Plus L1 and L2 terminals). Repair connections.
Flashing Red Light	High Line Voltage	The line voltage is over 253 volts. Check line voltage. Report high line voltage to the power company.
Flashing Red and Yellow Lights	Rapid Cycle	The most common cause for the rapid cycle condition is a waterlogged tank. Check for a ruptured bladder in the water tank. Check the air volume control or snifter valve for proper operation. Check setting on the pressure switch and examine for defects.
	Leaky Well System	Replace damaged pipes or repair leaks.
	Stuck Check Valve	Failed valve will not hold pressure. Replace valve.
	Float Switch	Press and release the reset button to restart the unit. A bobbing float switch may cause the unit to detect a rapid cycle condition on any motor or an overload condition on 2-wire motors. Try to reduce water splashing or use a different switch.

QD Pumptec and Pumptec

QD Pumptec and Pumptec are load sensing devices that monitor the load on submersible pumps/motors. If the load drops below a preset level for a minimum of 4 seconds the QD Pumptec or the Pumptec will shut off the motor.

The QD Pumptec is designed and calibrated expressly for use on Franklin Electric 230 V 3-wire motors (1/3 to 1 hp.) The QD Pumptec must be installed in QD relay boxes.

The Pumptec is designed for use on Franklin Electric 2- and 3-wire motors (1/3 to 1.5 hp) 115 and 230 V. The Pumptec is not designed for jet pumps.

QD Pumptec & Pumptec – Troubleshooting

SYMPTOM	CHECKS OR SOLUTION
If the QD Pumptec or Pumptec trips in about 4 seconds with some water delivery.	A. Is the voltage less than 90% of nameplate rating? B. Are the pump and motor correctly matched? C. Is the **QD Pumptec** or **Pumptec** wired correctly? For the **Pumptec** check the wiring diagram and pay special attention to the positioning of the power lead (230 V or 115 V). D. For **QD Pumptec** is your system 230 V 60 Hz or 220 V 50 Hz?
If the QD Pumptec or Pumptec trips in about 4 seconds with no water delivery.	A. The pump may be airlocked. If there ia a check valve on top of the pump, put another section of pipe between the pump and the check valve. B. The pump may be out of water. C. Check the valve settings. The pump may be dead-heading. D. Pump or motor shaft may be broken. E. Motor overload may be tripped. Check the motor current (amperage).
If the QD Pumptec or Pumptec will not timeout and reset.	A. Check switch position on side of circuit board on **Pumptec**. **QD Pumptec** check timer position on top/front of unit. Make sure the switch is not between settings. B. If the reset time switch is set to manual reset (position 0), **QD Pumptec** and **Pumptec** will not reset (turn power off for 5 sec. then back on to reset).
If your pump/motor will not run at all.	A. Check voltage. B. Check wiring. C. Remove the **QD Pumptec** from the control box. Reconnect wires in box to original state. If motor does not run the problem is not **QD Pumptec**. Bypass **Pumptec** by connecting L2 and motor lead with jumper. Motor should run. If not, the problem is not **Pumptec**. D. On **Pumptec** only check that **Pumptec** is installed between the control switch and the motor.
If your QD Pumptec or Pumptec will not trip when the pump breaks suction.	A. Be sure you have a Franklin motor. B. Check wiring connections. On **Pumptec** is lead power (230 V or 115 V) connected to correct terminal? Is motor lead connected to correct terminal? C. Check for ground fault in the motor and excessive friction in the pump. D. The well may be “gulping” enough water to keep **QD Pumptec** or **Pumptec** from tripping. It may be necessary to adjust the **QD Pumptec** or the **Pumptec** for these extreme applications. Call the Franklin Electric Service Hotline at 800-348-2420 for information. E. On **Pumptec** applications does the control box have a run capacitor? If so, **Pumptec** will not trip. (Except for Franklin 1.5 hp motors).
If your QD Pumptec or Pumptec chatters when running.	A. Check for low voltage. B. Check for waterlogged tank. Rapid cycling for any reason can cause the **QD Pumptec** or the **Pumptec** relay to chatter. C. On **Pumptec** make sure the L2 and motor wires are installed correctly. If they are reversed, the unit can chatter.

SubDrive2W, 75, 100, 150, 300, MonoDrive, & MonoDrive XT

The Franklin Electric SubDrive/MonoDrive Constant Pressure controller is a variable-speed drive that delivers water at a constant pressure.

WARNING: Serious or fatal electrical shock may result from failure to connect the motor, SubDrive/MonoDrive Controller, metal plumbing and all other metal near the motor or cable to the power supply ground terminal using wire no smaller than motor cable wires. To reduce the risk of electrical shock, disconnect power before working on or around the water system. Capacitors inside the SubDrive/MonoDrive Controller can still hold a lethal voltage even after power has been removed. Allow 10 minutes for dangerous internal voltage to discharge. Do not use motor in swimming areas.

SubDrive2W, 75, 100, 150, 300, MonoDrive, & MonoDrive XT

SubDrive/MonoDrive Troubleshooting

Should an application or system problem occur, built-in diagnostics will protect the system. The “FAULT” light or digital display on the front of the SubDrive/MonoDrive Controller will flash a given number of times or display a number indicating the nature of the fault. In some cases, the system will shut itself off until corrective action is taken. Fault codes and their corrective actions are listed below. See SubDrive/MonoDrive Installation Manual for installation data.

NUMBER OF FLASHES OR DIGITAL DISPLAY	FAULT	POSSIBLE CAUSE	CORRECTIVE ACTION
1	MOTOR UNDERLOAD	- Overpumped well - Broken shaft or coupling - Blocked screen, worn pump - Air/gas locked pump - SubDrive not set properly for pump end	- Frequency near maximum with less than 65% of expected load, 42% if DIP #3 is “on” - System is drawing down to pump inlet (out of water) - High static, light loading pump - reset DIP switch #3 to “on” for less sensitivity if not out of water - Check pump rotation (SubDrive only) reconnect if necessary for proper rotation - Air/gas locked pump - if possible, set deeper in well to reduce - Verify DIP switches are set properly
2	UNDERVOLTAGE	- Low line voltage - Misconnected input leads	- Line voltage low, less than approximately 150 VAC (normal operating range = 190 to 260 VAC) - Check incoming power connections and correct or tighten if necessary - Correct incoming voltage - check circuit breaker or fuses, contact power company
3	LOCKED PUMP	- Motor and/or pump misalignment - Dragging motor and/or pump - Abrasives in pump	- Amperage above SFL at 10 Hz - Remove and repair or replace as required
4 (MonoDrive & MonoDriveXT only)	INCORRECTLY WIRED	- MonoDrive only - Wrong resistance values on main and start	- Wrong resistance on DC test at start - Check wiring, check motor size and DIP switch setting, adjust or repair as needed
5	OPEN CIRCUIT	- Loose connection - Defective motor or drop cable - Wrong motor	- Open reading on DC test at start. - Check drop cable and motor resistance, tighten output connections, repair or replace as necessary, use “dry” motor to check drive functions, if drive will not run and exhibits underload fault replace drive
6	SHORT CIRCUIT	- When fault is indicated immediately after power-up, short circuit due to loose connection, defective cable, splice or motor	- Amperage exceeded 50 amps on DC test at start or max amps during running - Incorrect output wiring, phase to phase short, phase to ground short in wiring or motor - If fault is present after resetting and removing motor leads, replace drive
	OVER CURRENT	- When fault is indicated while motor is running, over current due to loose debris trapped in pump	- Check pump
7	OVERHEATED DRIVE	- High ambient temperature - Direct sunlight - Obstruction of airflow	- Drive heat sink has exceeded max rated temperature, needs to drop below 85 °C to restart - Fan blocked or inoperable, ambient above 125 °F, direct sunlight, air flow blocked - Replace fan or relocate drive as necessary
8 (SubDrive300 only)	OVER PRESSURE	- Improper pre-charge - Valve closing too fast - Pressure setting too close to relief valve rating	- Reset the pre-charge pressure to 70% of sensor setting. Reduce pressure setting well below relief valve rating. Use next size larger pressure tank. - Verify valve operation is within manufacturer’s specifications. - Reduce system pressure setting to a value less than pressure relief rating.
RAPID	INTERNAL FAULT	- A fault was found internal to drive	- Unit may require replacement. Contact your supplier.
9 (SubDrive2W only)	OVER RANGE (Values outside normal operating range)	- Wrong hp/voltage - Internal fault	- Verify motor hp and voltage - Unit may require replacement. Contact your supplier.

SubMonitor

SubMonitor Troubleshooting

FAULT MESSAGE	PROBLEM/CONDITION	POSSIBLE CAUSE
SF Amps Set Too High	SF Amps setting above 359 Amps.	Motor SF Amps not entered.
Phase Reversal	Reversed incoming voltage phase sequence.	Incoming power problem.
Underload	Normal line current.	Wrong SF Max Amps setting.
	Low line current.	Over pumping well. Clogged pump intake. Closed valve. Loose pump impeller. Broken shaft or coupling. Phase loss.
Overload	Normal line current.	Wrong SF Max Amps setting.
	High line current.	High or low line voltage. Ground fault. Pump or motor dragging. Motor stalled or bound pump.
Overheat	Motor temperature sensor has detected excess motor temperature.	High or low line voltage. Motor is overloaded. Excessive current unbalance. Poor motor cooling. High water temperature. Excessive electrical noise (VFD in close proximity).
Unbalance	Current difference between any two legs exceeds programmed setting.	Phase loss. Unbalanced power supply. Open Delta transformer.
Overvoltage	Line voltage exceeds programmed setting.	Unstable power supply.
Undervoltage	Line voltage below programmed setting.	Poor connection in motor power circuit. Unstable or weak power supply.
False Starts	Power has been interrupted too many times in a 10 second period.	Chattering contacts. Loose connections in motor power circuit. Arcing contacts.

Continued on next page

Subtrol-Plus (Obsolete - See SubMonitor)

Subtrol-Plus - Troubleshooting After Installation

SYMPTOM	POSSIBLE CAUSE OR SOLUTION
Subtrol-Plus Dead	When the Subtrol-Plus reset button is depressed and released, all indicator lights should flash. If line voltage is correct at the Subtrol-Plus L1, L2, L3 terminals and the reset button does not cause lights to flash, Subtrol-Plus receiver is malfunctioning.
Green Off Time Light Flashes	The green light will flash and not allow operation unless both sensor coils are plugged into the receiver. If both are properly connected and it still flashes, the sensor coil or the receiver is faulty. An ohmmeter check between the two center terminals of each sensor coil connected should read less than 1 ohm, or coil is faulty. If both coils check good, receiver is faulty.
Green Off Time Light On	The green light is on and the Subtrol-Plus requires the specified off time before the pump can be restarted after having been turned off. If the green light is on except as described, the receiver is faulty. Note that a power interruption when the motor is running will initiate the delay function.
Overheat Light On	This is a normal protective function which turns off the pump when the motor reaches maximum safe temperatures. Check that amps are within the nameplate maximum on all three lines, and that the motor has proper water flow past it. If overheat trip occurs without apparent motor overheating, it may be the result of an arcing connection somewhere in the circuit or extreme noise interference on the power lines. Check with the power company or Franklin Electric. A true motor overheat trip will require at least five minutes for a motor started cold. If trips do not conform to this characteristic, suspect arcing connections, power line noise, ground fault, or SCR variable speed control equipment.
Overload Light On	This is a normal protective function, protecting against an overload or locked pump. Check the amps in all lines through a complete pumping cycle, and monitor whether low or unbalanced voltage may be causing high amps at particular times. If overload trip occurs without high amps, it may be caused by a faulty rating insert, receiver, or sensor coil. Recheck that the insert rating matches the motor. If it is correct, carefully remove it from the receiver by alternately lifting sides with a knife blade or thin screwdriver, and make sure it has no pins bent over. If the insert is correct and its pins are okay, replace receiver and/or sensor coils.
Underload Light On	This is a normal protective function. A. Make sure the rating insert is correct for the motor. B. Adjusting the underload setting as described to allow the desired range of operating conditions. Note that a DECREASE in underload setting is required to allow loading without trip. C. Check for drop in amps and delivery just before trip, indicating pump breaking suction, and for unbalanced line current. D. With the power turned off, recheck motor lead resistance to ground. A grounded lead can cause underload trip.

Subtrol-Plus (Obsolete - See SubMonitor)

Subtrol-Plus - Troubleshooting After Installation (Continued)

SYMPTOM	POSSIBLE CAUSE OR SOLUTION
Tripped Light On	Whenever the pump is off as a result of Subtrol-Plus protective function, the red tripped light is on. A steady light indicates the Subtrol-Plus will automatically allow the pump to restart as described, and a flashing light indicates repeated trips, requiring manual reset before the pump can be restarted. Any other red light operation indicates a faulty receiver. One-half voltage on 460 V will cause tripped light on.
Control Circuit Fuse Blows	With power turned off, check for a shorted contactor coil or a grounded control circuit lead. The coil resistance should be at least 10 ohms and the circuit resistance to panel frame over 1 megohm. A standard or delay-type 2 amp fuse should be used.
Contactor Will Not Close	If proper voltage is at the control coil terminals when controls are operated to turn the pump on, but the contactor does not close, turn off power and replace the coil. If there is no voltage at the coil, trace the control circuit to determine if the fault is in the Subtrol-Plus receiver, fuse, wiring, or panel operating switches. This tracing can be done by first connecting a voltmeter at the coil terminals, and then moving the meter connections step by step along each circuit to the power source, to determine at which component the voltage is lost. With the Subtrol-Plus receiver powered up, with all leads disconnected from the control terminals and with an ohmmeter set at RX10, measure the resistance between the control terminals. It should measure 100 to 400 ohms. Depress and hold in the reset button. The resistance between the control terminals should measure close to infinity.
Contactor Hums or Chatters	Check that coil voltage is within 10% of rated voltage. If voltage is correct and matches line voltage, turn off power and remove the contactor magnetic assembly and check for wear, corrosion, and dirt. If voltage is erratic or lower than line voltage, trace the control circuit for faults similar to the previous item, but looking for a major drop in voltage rather than its complete loss.
Contactor Opens When Start Switch is Released	Check that the small interlocks switch on the side of the contactor closes when the contactor closes. If the switch or circuit is open, the contactor will not stay closed when the selector switch is in HAND position.
Contactor Closes But Motor Doesn't Run	Turn off power. Check the contactor contacts for dirt, corrosion, and proper closing when the contactor is closed by hand.
Signal Circuit Terminals Do Not Energize	With the Subtrol-Plus receiver powered up and all leads disconnected from the signal terminals, with an 0hmmeter set at RX10, measure the resistance between the signal terminals. Resistance should measure close to infinite. Depress and hold in the reset button. The resistance between the signal terminals should measure 100 to 400 ohms.

Abbreviations

A	Amp or amperage
AWG	American Wire Gauge
BJT	Bipolar Junction Transistor
°C	Degree Celsius
CB	Control Box
CRC	Capacitor Run Control
DI	Deionized
Dv/dt	Rise Time of the Voltage
EFF	Efficiency
°F	Degree Fahrenheit
FDA	Federal Drug Administration
FL	Full Load
ft	Foot
ft-lb	Foot Pound
ft/s	Feet per Second
GFCI	Ground Fault Circuit Interrupter
gpm	Gallon per Minute
HERO	High Efficiency Reverse Osmosis
hp	Horsepower
Hz	Hertz
ID	Inside Diameter
IGBT	Insulated Gate Bipolar Transistor
in	Inch
kVA	Kilovolt Amp
kVAR	Kilovolt Amp Rating
kW	Kilowatt (1000 watts)
L1, L2, L3	Line One, Line Two, Line Three
lb-ft	Pound Feet
L/min	Liter per Minute
mA	Milliamp
max	Maximum
MCM	Thousand Circular Mils
mm	Millimeter
MOV	Metal Oxide Varister
NEC	National Electrical Code
NEMA	National Electrical Manufacturer Association
Nm	Newton Meter
NPSH	Net Positive Suction Head
OD	Outside Diameter
OL	Overload
PF	Power Factor
psi	Pounds per Square Inch
PWM	Pulse Width Modulation
QD	Quick Disconnect
R	Resistance
RMA	Return Material Authorization
RMS	Root Mean Squared
rpm	Revolutions per Minute
SF	Service Factor
SFhp	Service Factor Horsepower
S/N	Serial Number
TDH	Total Dynamic Head
UNF	Fine Thread
V	Voltage
VAC	Voltage Alternating Current
VDC	Voltage Direct Current
VFD	Variable Frequency Drive
W	Watts
XFMR	Transformer
Y-D	Wye-Delta
Ω	ohms

Notes

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TOLL FREE HELP FROM A FRIEND

800-348-2420 • 260-827-5102 (fax)

Phone Franklin's toll free SERVICE HOTLINE for answers to your pump and motor installation questions. When you call, a Franklin expert will offer assistance in troubleshooting and provide immediate answers to your system application questions. Technical support is also available online. Visit our website at:

www.franklin-electric.com

Franklin Electric

The Company You Trust Deep Down

M1311 07.11

Submersible Motors & Accessories Catalog

Franklin Electric

Commitment To Quality

Franklin Electric is committed to provide customers with defect free products through our program of continuous improvement. Quality shall, in every case, take precedence over quantity.

Franklin Electric

Submersible Motors Catalog Contents

4" Motors & Leads


6" Motors & Leads


8" Motors & Leads


Control Boxes & Protection

Submersible Motors Catalog Contents

Constant Pressure Controllers

Accessories & Services

4” Submersible Motors Super Stainless

Applications

These motors are built for dependable operation in 4" diameter or larger water wells.

Basic Features

- Corrosion-resistant stainless steel exterior
- Stainless steel splined shaft
- Hermetically-sealed windings
- StatorShield™ resin system
- Filter check valve
- Water lubrication
- Kingsbury-type thrust bearing
- Pressure-equalizing diaphragm
- Built-in lightning arrestors (all single-phase; 200 & 300 V three-phase)
- Removable water bloc lead
- Franklin-manufactured control boxes available for single-phase motors
- UL 778 recognized (North American voltages)
- CSA certified
- ANSI/NSF 61 certified
- Industry standard NEMA mounting dimensions

Special Features

- Flow inducer sleeve not required in water up to 86 °F (30 °C) for motors through 2 hp.
- Two-wire motors are split-phase designs with integral starting components and do not require a control box. They feature Franklin’s patented 2-wire BIAC starting switch which provides reverse impact torque to aid starting in adverse environments and prevents extreme fast cycling (e.g. water logged tank).
- Three-wire motors through 1 hp use Franklin’s exclusive three-wire QD (Quick Disconnect) Control Box with the patented QD Relay. This relay provides the ultimate in operational life.
- Single-phase motors can be used with Pumptec products to protect against dry-run and other installation conditions that can damage motors and/or pumps. See Single-phase Protection Devices for details.

Constant Pressure Options

- MonoDrive controllers utilize Franklin Electric’s single-phase 3-wire motors to provide constant water pressure.
- SubDrive controllers utilize Franklin Electric’s three-phase motors to provide constant water pressure.

Pollution Recovery Option

- Pollution recovery motors are equipped for use in monitoring and recovery wells in which hydrocarbons and other chemicals may be present.
- Special Viton® rubber parts and other chemical resistant materials are listed in Construction Materials chart.

4" Submersible Motors Super Stainless

4" Super Stainless Motor Specifications

Hz	Ph	Hp Range	kW Range	Poles	RPM	Max. Ambient Temp.	Duty Rating
60	2-Wire	0.3 - 1.5	0.25 - 1.1	2	3450	86 °F / 30 °C	Continuous
50	2-Wire	0.5 - 1.5	0.37 - 1.1	2	2875	86 °F / 30 °C	Continuous
60	3-Wire	0.3 - 3	0.25 - 2.2	2	3450	86 °F / 30 °C	Continuous*
50	3-Wire	0.3 - 3	0.25 - 2.2	2	2875	86 °F / 30 °C	Continuous*
60	Three-Phase	0.5 - 3	0.37 - 2.2	2	3450	86 °F / 30 °C	Continuous*
50	Three-Phase	0.5 - 3	0.37 - 2.2	2	2875	86 °F / 30 °C	Continuous*

4" Pollution Recovery Motor Specifications

Hz	Ph	Hp Range	kW Range	Poles	RPM	Max. Ambient Temp.	Duty Rating
60	2-Wire	0.3 - 1.5	0.25 - 1.1	2	3450	86 °F / 30 °C	Continuous
50	2-Wire	0.5 - 1.5	0.37 - 1.1	2	2875	86 °F / 30 °C	Continuous
60	3-Wire	0.3 - 2	0.25 - 1.5	2	3450	86 °F / 30 °C	Continuous*
50	3-Wire	0.3 - 2	0.25 - 1.5	2	2875	86 °F / 30 °C	Continuous*
60	Three-Phase	0.5 - 2	0.37 - 1.5	2	3450	86 °F / 30 °C	Continuous*
50	Three-Phase	0.5 - 2	0.37 - 1.5	2	2875	86 °F / 30 °C	Continuous*

* 3 hp motors require 0.25 ft/sec flow past motor.

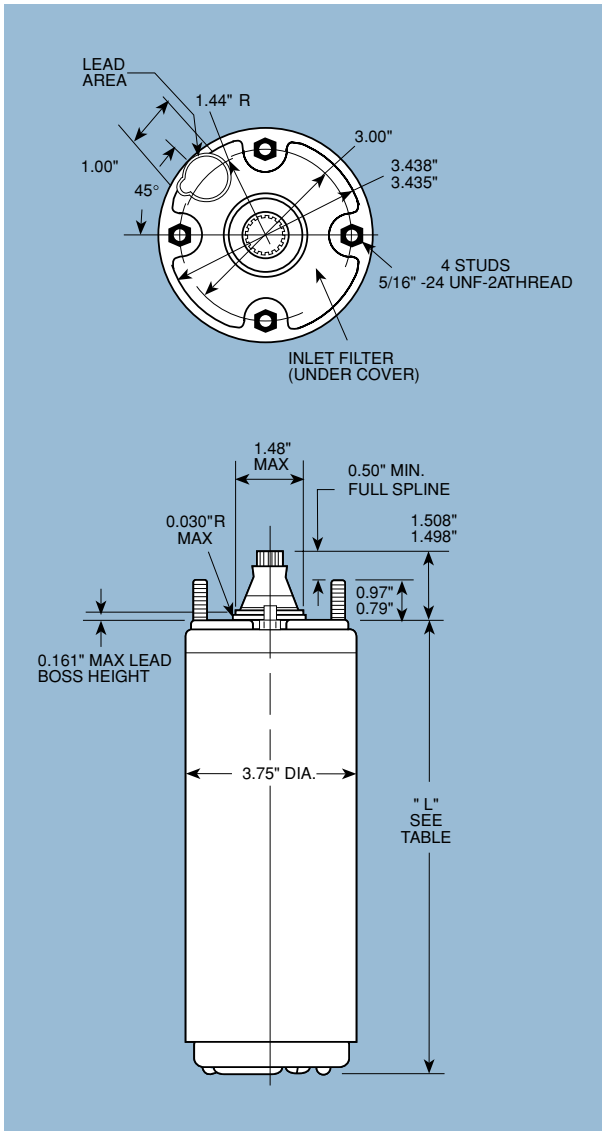
4" Construction Materials

	Construction Type	
Component	Standard Water Well	Pollution Recovery
Castings	304 SS Over Iron	304 SS over Iron
Stator Shell	301 SS	301 SS
Shaft Extension	17-4 SS or 303 SS	303 SS
Fasteners	305 SS or 302 SS	316 SS
Seal Cover	Acetal	Tefzel®
Seal	Nitrile Rubber Lip	Viton®
Diaphragm	Nitrile Rubber	Viton®
Slinger	Nitrile Rubber	Viton®
Lead Wire (or Cable)	XLPE	Lead not furnished with motor
Lead Potting	Epoxy	Lead not furnished with motor
Lead Jam Nut	303 SS	Lead not furnished with motor

Specifications subject to change without notice. Contact Franklin Electric if current material types are required for bid specifications.

Viton® is a registered trademark of DuPont Dow Elastomers.
Tefzel® is a registered trademark of E.I. du Pont Nemours and Company.

4" Dimensions and Weights



Single-Phase Motors - 2-Wire

HP	KW	"L" (inches)	Shipping Weight LBS	Shipping Weight KG	Motor Carton Size (in inches)
1/3	0.25	8.76	16	7.3	4 x 4.375 x 16
0.5	0.37	9.51	18	8.2	4 x 4.375 x 16
0.75	0.55	10.64	21	9.5	4 x 4.375 x 19
1	0.75	11.73	24	10.9	4 x 4.375 x 19
1.5	1.1	15.10	31	14.1	4 x 4.375 x 21

Single-Phase Motors - 3-Wire

HP	KW	"L" (inches)	Shipping Weight LBS	Shipping Weight KG	Motor Carton Size (in inches)
1/3	0.25	8.76	17	7.7	4 x 4.375 x 16
0.5	0.37	9.51	19	8.6	4 x 4.375 x 16
0.75	0.55	10.64	21	9.5	4 x 4.375 x 19
1	0.75	11.73	24	10.9	4 x 4.375 x 19
1.5	1.1	13.60	28	12.7	4 x 4.375 x 21
2	1.5	15.10	33	15.0	5 x 4.375 x 21
3	2.2	19.04	41	18.6	6 x 4.375 x 21

Three-Phase Motors

HP	KW	"L" (inches)	Shipping Weight LBS	Shipping Weight KG	Motor Carton Size (in inches)
0.5	0.37	9.51	18	8.2	4 x 4.375 x 16
0.75	0.55	10.64	21	9.5	4 x 4.375 x 16
1	0.75	11.73	24	10.9	4 x 4.375 x 19
1.5	1.1	11.73	24	10.9	4 x 4.375 x 19
2	1.5	13.60	28	12.7	4 x 4.375 x 21
3	2.2	16.04	35	15.9	4 x 4.375 x 21

All dimensions listed above are for models supplied with lead. Consult factory for other models.

4" Submersible Motors Super Stainless

4" 2-Wire Models

HP (kW)	Description						Model	Stock Status	Downward Thrust Rating
	W/PH	Construction	Volts	HZ	S.F.	Lead In Mtr.			
⅓ hp 0.25 kW	2-Wire	Water Well	115	60	1.75		244 502 01--S		300 LBS (1500 N)
			115	60	1.75	Yes	244 502 90--S	Yes	
			230	60	1.75		244 503 01--S		
			230	60	1.75	Yes	244 503 90--S	Yes	
		Pollution Recovery	115	60	1.75		244 502 09--S		
			230	60	1.75		244 503 09--S		
½ hp 0.37 kW	2-Wire	Water Well	115	60	1.60		244 504 01--S		300 LBS (1500 N)
			115	60	1.60	Yes	244 504 90--S	Yes	
			220	50	1.00		244 555 01--S		
			230	60	1.60		244 505 01--S		
			230	60	1.60	Yes	244 505 90--S	Yes	
		Pollution Recovery	115	60	1.60		244 504 09--S		
			230	60	1.60		244 505 09--S		
¾ hp 0.55 kW	2-Wire	Water Well	220	50	1.00		244 557 01--S		300 LBS (1500 N)
			230	60	1.50		244 507 01--S		
			230	60	1.50	Yes	244 507 90--S	Yes	
		Pollution Recovery	230	60	1.50		244 507 09--S		
1 hp 0.75 kW	2-Wire	Water Well	220	50	1.00		244 558 12--S		650 LBS (3000 N)
			230	60	1.40		244 508 12--S		
			230	60	1.40	Yes	244 508 90--S	Yes	
		Pollution Recovery	230	60	1.40		244 508 23--S		
1.5 hp 1.1 kW	2-Wire	Water Well	220	50	1.00		244 359 12--S		650 LBS (3000 N)
			230	60	1.30		244 309 12--S		
			230	60	1.30	Yes	244 309 90--S	Yes	
		Pollution Recovery	230	60	1.30		244 309 23--S		

NOTES:

1. Pack Designation: --S = Single Pack, available in any quantity. All 3 hp motors are single-packed.
2. Contact factory for lead time for non-stocked items.
3. Pallet packs available but not shown. Please contact customer service for availability.

4" Submersible Motors Super Stainless

4" 3-Wire Models

HP (KW)	Description						Motor Model	Control Box Model	Stock Status	Downward Thrust Rating
	W/PH	Construction	Volts	HZ	S.F.	Lead in Mtr.				
⅓ hp 0.25 kW	3-Wire	Water Well	115	60	1.75		214 502 44--S	280 102 49		300 LBS (1500 N)
			115	60	1.75	Yes	214 502 90--S	280 102 49	Yes	
			220	50	1.00		214 553 41--S	280 353 01		
			230	60	1.75		214 503 44--S	280 103 49		
			230	60	1.75	Yes	214 503 90--S	280 103 49	Yes	
		Pollution Recovery	115	60	1.75		214 502 49--S	280 102 49		
			230	60	1.75		214 503 49--S	280 103 49		
½ hp 0.37 kW	3-Wire	Water Well	115	60	1.60		214 504 44--S	280 104 49		300 LBS (1500 N)
			115	60	1.60	Yes	214 504 90--S	280 104 49	Yes	
			220	50	1.00		214 555 41--S	280 355 01	Yes	
			230	60	1.60		214 505 44--S	280 105 49		
			230	60	1.60	Yes	214 505 90--S	280 105 49	Yes	
		Pollution Recovery	115	60	1.60		214 504 49--S	280 104 49		
			230	60	1.60		214 505 49--S	280 105 49		
¾ hp 0.55 kW	3-Wire	Water Well	220	50	1.00		214 557 41--S	280 357 01	Yes	300 LBS (1500 N)
			230	60	1.50		214 507 44--S	280 107 49		
			230	60	1.50	Yes	214 507 90--S	280 107 49	Yes	
		Pollution Recovery	230	60	1.50		214 507 49--S	280 107 49		
		Series 600M	230	60	1.50	Yes	214 507 0600S		Yes	
1 hp 0.75 kW	3-Wire	Water Well	220	50	1.00		214 558 19--S	280 358 01	Yes	650 LBS (3000 N)
			230	60	1.40		214 508 12--S	280 108 49		
			230	60	1.40	Yes	214 508 90--S	280 108 49	Yes	
		Pollution Recovery	230	60	1.40		214 508 23--S	280 108 49		
		Series 600M	230	60	1.40	Yes	214 508 0610S		Yes	
1.5 hp 1.1 kW	3-Wire	Water Well	220	50	1.00		224 350 19--S	282 350 81	Yes	650 LBS (3000 N)
			230	60	1.30		224 300 19--S	282 300 81	Yes	
			230	60	1.30	Yes	224 300 92--S	282 300 81	Yes	
		Pollution Recovery	230	60	1.30		224 300 23--S	282 300 81		
		Series 600M	230	60	1.30	Yes	224 300 0610S		Yes	
2 hp 1.5 kW	3-Wire	Water Well	220	50	1.00		224 351 19--S	282 351 81	Yes	650 LBS (3000 N)
			230	60	1.25		224 301 19--S	282 301 81	Yes	
			230	60	1.25	Yes	224 301 92--S	282 301 81	Yes	
		Pollution Recovery	230	60	1.25		224 301 23--S	282 301 81		
		Series 600M	230	60	1.25	Yes	224 301 0610S		Yes	
3 hp 2.2 kW	3-Wire	Water Well	220	50	1.00		224 352 25	282 352 81	Yes	900 LBS (4000 N)
			230	60	1.15		224 302 25	282 302 81		
			230	60	1.15	Yes	224 302 26	282 302 81	Yes	
		Series 600M	230	60	1.15	Yes	224 302 0620		Yes	

NOTES:

1. Pack Designation: --S = Single Pack, available in any quantity. All 3 hp motors are single-packed.
2. Contact factory for lead time for non-stocked items.
3. Pallet packs available but not shown. Please contact customer service for availability.

4" Submersible Motors Super Stainless

4" Three-Phase Models

HP (KW)	Description						Model	Stock Status	Downward Thrust Rating
	W/PH	Construction	Volts	HZ	S.F.	Lead In Mtr.			
½ hp 0.37 kW	3-Phase	Water Well	200	60	1.60		234 501 41--S		300 LBS (1500 N)
			200	60	1.60	Yes	234 501 92--S		
			220	50	1.00		234 551 41--S		
			230	60	1.60		234 511 41--S		
			230	60	1.60	Yes	234 511 92--S		
			380/415	50	1.00		234 561 31--S	Yes	
			460	60	1.60		234 521 31--S		
			460	60	1.60	Yes	234 521 94--S		
		Pollution Recovery	200	60	1.60		234 501 49--S		
			230	60	1.60		234 511 49--S		
			460	60	1.60		234 521 49--S		
¾ hp 0.55 kW	3-Phase	Water Well	200	60	1.50		234 502 41--S		300 LBS (1500 N)
			200	60	1.50	Yes	234 502 92--S		
			220	50	1.00		234 552 41--S		
			230	60	1.50		234 512 41--S		
			230	60	1.50	Yes	234 512 92--S		
			380/415	50	1.00		234 562 31--S	Yes	
			460	60	1.50		234 522 31--S		
			460	60	1.50	Yes	234 522 94--S		
		Pollution Recovery	200	60	1.50		234 502 49--S		
			230	60	1.50		234 512 49--S		
			460	60	1.50		234 522 49--S		
		Series 600M	230	60	1.50	Yes	234 512 0600S	Yes	
			460	60	1.50	Yes	234 522 0600S		
1 hp 0.75 kW	3-Phase	Water Well	200	60	1.40		234 503 19--S		650 LBS (3000 N)
			200	60	1.40	Yes	234 503 92--S		
			220	50	1.00		234 553 41--S		
			230	60	1.40		234 513 19--S		
			230	60	1.40	Yes	234 513 92--S	Yes	
			380/415	50	1.00		234 563 31--S	Yes	
			460	60	1.40		234 523 16--S		
			460	60	1.40	Yes	234 523 94--S	Yes	
		Pollution Recovery	200	60	1.40		234 503 23--S		
			230	60	1.40		234 513 23--S		
			460	60	1.40		234 523 23--S		
		Series 600M	230	60	1.40	Yes	234 513 0610S	Yes	
			460	60	1.40	Yes	234 523 0610S		

4" Submersible Motors Super Stainless

4" Three-Phase Models

HP (KW)	Description						Model	Stock Status	Downward Thrust Rating
	W/PH	Construction	Volts	HZ	S.F.	Lead In Mtr.			
1.5 hp 1.1 kW	3-Phase	Water Well	200	60	1.30		234 504 19--S		650 LBS (3000 N)
			200	60	1.30	Yes	234 504 92--S	Yes	
			220	50	1.00		234 554 19--S		
			230	60	1.30		234 514 19--S		
			230	60	1.30	Yes	234 514 92--S	Yes	
			460/380	60/50	1.30/1.00		234 524 16--S		
			460/380	60/50	1.30/1.00	Yes	234 524 94--S	Yes	
			575	60	1.30		234 534 16--S		
			575	60	1.30	Yes	234 534 94--S	Yes	
		Pollution Recovery	200	60	1.30		234 504 23--S		
			230	60	1.30		234 514 23--S		
			460/380	60/50	1.30/1.00		234 524 23--S		
		Series 600M	230	60	1.30	Yes	234 514 0610	Yes	
			460/380	60	1.30/1.00	Yes	234 524 0610		
2 hp 1.5 kW	3-Phase	Water Well	200	60	1.25		234 305 16--S		650 LBS (3000 N)
			200	60	1.25	Yes	234 305 92--S	Yes	
			220	50	1.00		234 355 19--S		
			230	60	1.25		234 315 16--S	Yes	
			230	60	1.25	Yes	234 315 92--S	Yes	
			460/380	60/50	1.25/1.00		234 325 16--S	Yes	
			460/380	60/50	1.25/1.00	Yes	234 325 94--S	Yes	
			575	60	1.25		234 335 16--S		
			575	60	1.25	Yes	234 335 94--S	Yes	
		Pollution Recovery	200	60	1.25		234 305 23--S		
			230	60	1.25		234 315 23--S		
			460/380	60/50	1.25/1.00		234 325 23--S		
		Series 600M	230	60	1.25	Yes	234 315 0610	Yes	
			460/380	60	1.25/1.00	Yes	234 325 0610		
3 hp 2.2 kW	3-Phase	Water Well	200	60	1.15		234 306 25		900 LBS (4000 N)
			200	60	1.15	Yes	234 306 26	Yes	
			220	50	1.00		234 356 25		
			230	60	1.15		234 316 25		
			230	60	1.15	Yes	234 316 26	Yes	
			380	60	1.15		234 346 25		
			380	60	1.15	Yes	234 346 26	Yes	
			460/380	60/50	1.15/1.00		234 326 25		
			460/380	60/50	1.15/1.00	Yes	234 326 26	Yes	
			575	60	1.15		234 336 25		
			575	60	1.15	Yes	234 336 26	Yes	
		Series 600M	230	60	1.15	Yes	234 316 0620		
			460/380	60	1.15/1.00	Yes	234 326 0620		

NOTES:

1. Pack Designation: --S = Single Pack, available in any quantity. All 3 hp motors are single-packed.
2. Contact factory for lead time for non-stocked items.
3. Pallet packs available but not shown. Please contact customer service for availability.

4” Submersible Motors High Thrust

Application

These motors are built for dependable operation in 4" diameter or larger water wells.

Basic Features

- Corrosion-resistant construction
- Stainless steel splined shaft
- Hermetically-sealed windings
- StatorShield™ resin system
- Filter check valve
- Water lubrication
- Kingsbury-type thrust bearing
- Pressure-equalizing diaphragm
- Sand fighting slinger
- Built-in lightning arrestors (single-phase)
- New lead assembly
- Franklin-manufactured control boxes available for single-phase motors
- UL 778 recognized (North American voltages)
- CSA certified
- ANSI/NSF 61 certified
- Industry standard NEMA mounting dimensions

Special Options

- **316 SS Construction**
  Special construction option for corrosive applications, including acids, low pH and seawater.
- **Sand Fighter® Construction**
  Special construction option for sandy water wells. Motors include Sand Fighter sealing system with silicon carbide mechanical shaft seal and are warranted against sand entry failure.
- **Coalbed Methane Construction**
  Special construction option for coalbed methane wells. Includes Sand Fighter sealing system, reinforced diaphragm housing to resist damage from bottom tagging and protective filter to shield diaphragm from debris.
- **Oil Stripper Construction**
  Special construction option for secondary oil recovery wells where there is a mixture of oil and water. They are also suitable for geothermal and other water well applications where high temperatures and/or high pH conditions exist.

4" Submersible Motors High Thrust

4" High Thrust Motor Specifications

Hz	Ph	Hp Range	kW Range	Poles	RPM	Max. Ambient Temp.	Duty Rating
60	1	1.5 - 5	1.1 - 3.7	2	3450	86 °F / 30 °C	Continuous at 0.25 ft/sec flow past motor
50	1	1.5 - 5	1.1 - 3.7	2	2875	86 °F / 30 °C	Continuous at 0.25 ft/sec flow past motor
60	3	1.5 - 10	1.1 - 7.5	2	3450	86 °F / 30 °C	Continuous at 0.25 ft/sec flow past motor
50	3	1.5 - 10	1.1 - 7.5	2	2875	86 °F / 30 °C	Continuous at 0.25 ft/sec flow past motor

NOTE: Not all ratings available in all construction options.

4" High Thrust Construction Materials

	Construction Type		
Component	Standard Water Well	Coalbed Methane	Sand Fighter®
Top Castings	303 SS	303 SS	303 SS
Bottom Castings	303 SS Over Painted Cast Iron	303 SS Over Painted Cast Iron	303 SS Over Painted Cast Iron
Stator Shell	301 SS	301 SS	301 SS
Stator Ends	Low Carbon Steel	Low Carbon Steel	Low Carbon Steel
Shaft Extension	17-4 SS	17-4 SS	17-4 SS
Fasteners	300 Series SS	300 Series SS	300 Series SS
Seal Cover	Acetal	Sintered Bronze	Sintered Bronze
Seal	Nitrile Rubber Lip	Sand Fighter™ SiC/ SiC Mech. Seal	Sand Fighter SiC/ SiC Mech. Seal
Diaphragm	Nitrile Rubber	Nitrile Rubber	Nitrile Rubber
Diaphragm Cup	316 SS	316 SS	316 SS
Diaphragm Spring	316 SS	316 SS	316 SS
Diaphragm Cover	Gray Iron	Gray Iron	304 SS
Slinger	Nitrile Rubber	Nitrile Rubber	Nitrile Rubber
Lead Wire (or Cable)	XLPE*	XLPE*	XLPE*
Lead Potting	Epoxy	Epoxy	Epoxy
Lead Screws / Clamp	316 SS	316 SS	316 SS
Filter	Delrin & Polyester	Delrin & Polyester	Delrin & Polyester

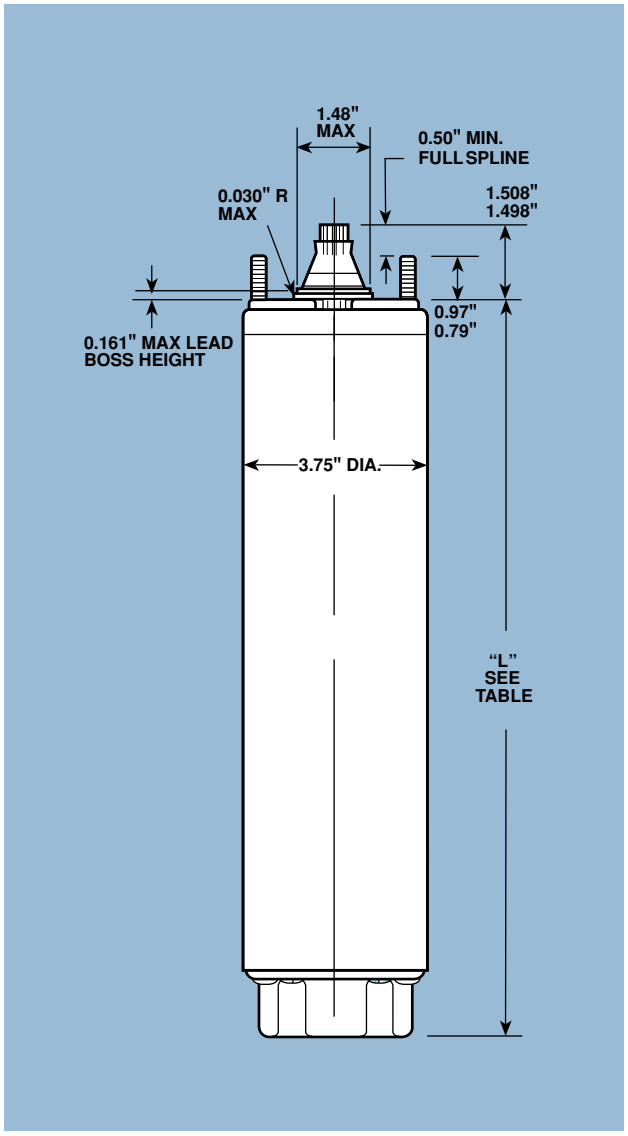
	Construction Type	
Component	Chemical (316 STNLS)	Oil Stripper
Top Casting	316 SS	316 SS
Bottom Casting	316 SS	316 SS
Stator Shell	316 SS	316 SS
Stator Ends	316 SS	316 SS
Shaft Extension	17-4 SS	17-4 SS
Fasteners	316 SS	316 SS
Seal Cover	316 SS	316 SS
Seal	Sand Fighter SiC Mech. Seal	Sand Fighter Viton®
Diaphragm	Nitrile Rubber	Viton®
Diaphragm Cup	316 SS	316 SS
Diaphragm Spring	316 SS	316 SS
Diaphragm Cover	316 SS	316 SS
Slinger	Nitrile Rubber	Viton®
Lead Wire (or Cable)	XLPE*	Nitrile Rubber
Lead Potting	Epoxy	Epoxy
Lead Screws / Clamp	316 SS	316 SS
Filter	316 SS Plug	316 SS Plug

* Removable type, factory-installed in 60 Hz and dual frequency rated water well motors. Consult catalog for additional leads.

Specifications subject to change without notice. Contact Franklin Electric if current material types are required for bid specifications.

Viton® is a registered trademark of DuPont Dow Elastomers.

4" High Thrust Dimensions and Weights



Single-Phase Motors*

HP	KW	"L" (inches)	Shipping Weight LBS	Shipping Weight KG	Motor Carton Size (in inches)
1.5	1.1	19.10	35	15.9	6 x 6 x 23
2	1.5	20.60	43	19.5	6 x 6 x 25
3	2.2	23.18	56	25.4	6 x 6 x 28
5	3.7	29.18	71	32.2	6 x 6 x 34

Single-Phase Motors - Oil Stripper

HP	KW	"L" (inches)	Shipping Weight LBS	Shipping Weight KG	Motor Carton Size (in inches)
2	1.5	22.85	46	20.9	6 x 6 x 28
3	2.2	23.18	56	25.4	6 x 6 x 34
5	3.7	29.18	71	32.2	6 x 6 x 37

Three-Phase Motors*

HP	KW	"L" (inches)	Shipping Weight LBS	Shipping Weight KG	Motor Carton Size (in inches)
1.5	1.1	17.98	37	16.8	6 x 6 x 23
2	1.5	19.10	44	20.0	6 x 6 x 23
3	2.2	20.18	44	20.0	6 x 6 x 25
4	3.0	23.18	56	25.4	6 x 6 x 28
5	3.7	23.18	56	25.4	6 x 6 x 28
5.5	4.0	25.66	63	28.6	6 x 6 x 28
7.5	5.5	29.18	71	32.2	6 x 6 x 34
10	7.5	32.18	77	34.9	6 x 6 x 34

Three-Phase Motors - Oil Stripper

HP	KW	"L" (inches)	Shipping Weight LBS	Shipping Weight KG	Motor Carton Size (in inches)
2	1.5	21.35	42	19.1	6 x 6 x 25
3	2.2	20.18	44	20.0	6 x 6 x 28
5	3.7	25.66	63	28.6	6 x 6 x 34
7.5	5.5	29.18	71	32.2	6 x 6 x 37

* Represents standard and Sand Fighter® construction models. Consult factory for Coalbed Methane and 316 SS weights and dimensions.

4" Submersible Motors High Thrust

4" High Thrust Models

HP (KW)	Description						Model	Stock Status	Downward Thrust Rating
	Construction	PH	Volts	HZ	S.F.	Lead in Mtr.			
1.5 hp 1.1 kW	Water Well	1P	230	60	1.30		224 300 8600		1500 LBS (6500 N)
		3P	200	60	1.30		234 504 8600		
		3P	230	60	1.30		234 514 8600		
		3P	460/380	60/50	1.30/1.00		234 524 8600		
		3P	575	60	1.30		234 534 8600		
	316 SS	1P	230	60	1.30	Yes	224 300 8502		
		3P	200	60	1.30	Yes	234 504 8502		
		3P	230	60	1.30	Yes	234 514 8502		
		3P	460/380	60/50	1.30/1.00	Yes	234 524 8502		
		3P	575	60	1.30	Yes	234 534 8502		
2 hp 1.5 kW	Water Well	1P	230	60	1.25	Yes	224 301 8602		1500 LBS (6500 N)
		3P	200	60	1.25		234 305 8600		
		3P	230	60	1.25		234 315 8600		
		3P	460/380	60/50	1.25/1.00		234 325 8600		
		3P	575	60	1.25		234 335 8600		
	Sand Fighter	1P	230	60	1.15	Yes	224 301 8802		
	316 SS	1P	230	60	1.25	Yes	224 301 8502		
		3P	200	60	1.25	Yes	234 305 8502		
		3P	230	60	1.25	Yes	234 315 8502		
		3P	460/380	60/50	1.25/1.00	Yes	234 325 8502		
		3P	575	60	1.25	Yes	234 335 8502		
	Oil Stripper	1P	230	60	1.25	Yes	224 301 8702		
		3P	230	60	1.25	Yes	234 315 8702		
		3P	460/380	60/50	1.25/1.00	Yes	234 325 8702		

4" Submersible Motors High Thrust

4" High Thrust Models

HP (KW)	Description						Model	Stock Status	Downward Thrust Rating
	Construction	PH	Volts	HZ	S.F.	Lead in Mtr.			
3 hp 2.2 kW	Water Well	1P	220	50	1.00		224 352 8600		1500 LBS (6500 N)
		1P	230	60	1.15		224 302 8600		
		1P	230	60	1.15	Yes	224 302 8602		
		3P	200	60	1.15		234 306 8600		
		3P	200	60	1.15	Yes	234 306 8602		
		3P	220	50	1.00		234 356 8600		
		3P	230	60	1.15		234 316 8600		
		3P	230	60	1.15	Yes	234 316 8602		
		3P	380	60	1.15		234 346 8600		
		3P	380	60	1.15	Yes	234 346 8602		
		3P	460/380	60/50	1.15/1.00		234 326 8600		
		3P	460/380	60/50	1.15/1.00	Yes	234 326 8602		
		3P	575	60	1.15		234 336 8600		
		3P	575	60	1.15	Yes	234 336 8602		
	Coalbed Methane	3P	200	60	1.15	Yes	234 306 8902		
		3P	230	60	1.15	Yes	234 316 8902		
		3P	460/380	60/50	1.15/1.00	Yes	234 326 8902	Yes	
		3P	575	60	1.15	Yes	234 336 8902		
		3P	380	60	1.15	Yes	234 346 8902		
	Sand Fighter	1P	230	60	1.15	Yes	224 302 8802	Yes	
		3P	200	60	1.15	Yes	234 306 8802		
		3P	230	60	1.15	Yes	234 316 8802	Yes	
		3P	460/380	60/50	1.15/1.00	Yes	234 326 8802	Yes	
		3P	575	60	1.15	Yes	234 336 8802		
		3P	380	60	1.15	Yes	234 346 8802		
	Series 600M	1P	230	60	1.15	Yes	224 302 0630	Yes	
		3P	230	60	1.15	Yes	234 316 0630	Yes	
		3P	460/380	60	1.15/1.00	Yes	234 326 0630		
	316 SS	1P	230	60	1.15	Yes	224 302 8502		
		3P	200	60	1.15	Yes	234 306 8502		
		3P	230	60	1.15	Yes	234 316 8502		
		3P	460/380	60/50	1.15/1.00	Yes	234 326 8502		
		3P	575	60	1.15	Yes	234 336 8502		
	Oil Stripper	1P	230	60	1.15	Yes	224 302 8702		
		3P	230	60	1.15	Yes	234 316 8702		
		3P	460/380	60/50	1.15/1.00	Yes	234 326 8702		
4 hp 3 kW	Water Well	3P	460/415-380	60/50	1.15/1.00		234 395 8600		1500 LBS (6500 N)
		3P	460/415-380	60/50	1.15/1.00	Yes	234 395 8602		

4" Submersible Motors High Thrust

4" High Thrust Models

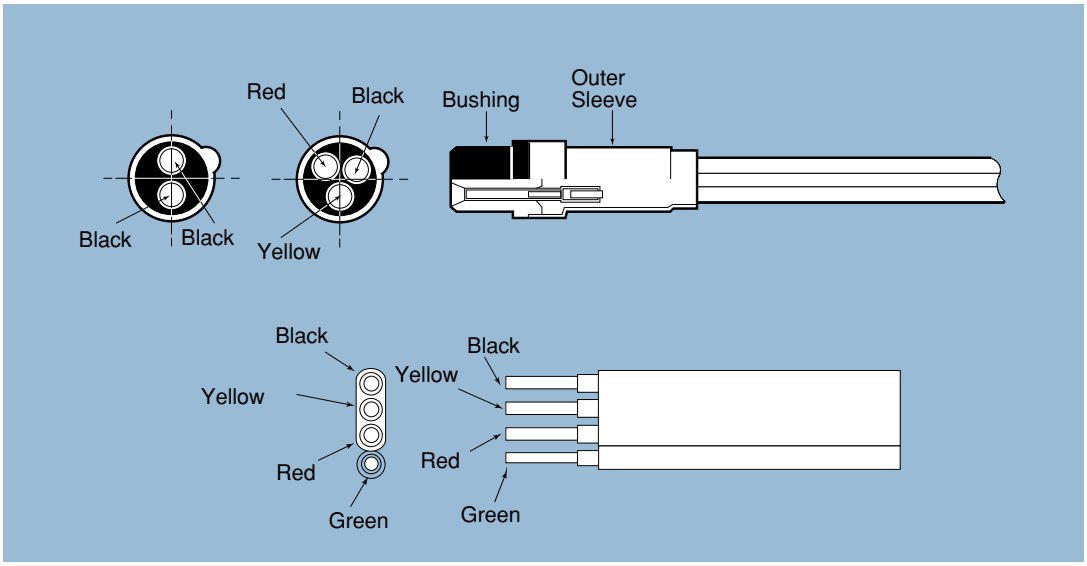
HP (KW)	Description						Model	Stock Status	Downward Thrust Rating
	Construction	PH	Volts	HZ	S.F.	Lead in Mtr.			
5 hp 3.7 kW	Water Well	1P	220	50	1.00		224 353 8600	Yes	1500 LBS (6500 N)
		1P	230	60	1.15		224 303 8600		
		1P	230	60	1.15	Yes	224 303 8602	Yes	
		3P	200	60	1.15		234 307 8600		
		3P	200	60	1.15	Yes	234 307 8602	Yes	
		3P	220	50	1.00		234 357 8600		
		3P	230	60	1.15		234 317 8600		
		3P	230	60	1.15	Yes	234 317 8602	Yes	
		3P	380	60	1.15		234 347 8600		
		3P	380	60	1.15	Yes	234 347 8602		
		3P	460/380	60/50	1.15/1.00		234 327 8600	Yes	
		3P	460/380	60/50	1.15/1.00	Yes	234 327 8602	Yes	
		3P	575	60	1.15		234 337 8600		
		3P	575	60	1.15	Yes	234 337 8602	Yes	
	Coalbed Methane	3P	200	60	1.15	Yes	234 307 8902		
		3P	230	60	1.15	Yes	234 317 89042		
		3P	460/380	60/50	1.15/1.00	Yes	234 327 8902	Yes	
		3P	575	60	1.15	Yes	234 337 8902		
		3P	380	60	1.15	Yes	234 347 8902		
	Sand Fighter	1P	230	60	1.15	Yes	224 303 8802	Yes	
		3P	200	60	1.15	Yes	234 307 8802		
		3P	230	60	1.15	Yes	234 317 8802	Yes	
		3P	460/380	60/50	1.15/1.00	Yes	234 327 8802	Yes	
		3P	575	60	1.15	Yes	234 337 8802		
		3P	380	60	1.15	Yes	234 347 8802		
	Series 600M	1P	230	60	1.15	Yes	224 303 0630	Yes	
		3P	230	60	1.15	Yes	234 317 0630	Yes	
		3P	460/380	60	1.15/1.00	Yes	234 327 0630		
	316 SS	1P	230	60	1.15	Yes	224 303 8502		
		3P	200	60	1.15	Yes	234 307 8502		
		3P	230	60	1.15	Yes	234 317 8502		
		3P	460/380	60/50	1.15/1.00	Yes	234 327 8502		
		3P	575	60	1.15	Yes	234 337 8502		
	Oil Stripper	1P	230	60	1.15	Yes	224 303 8702		
		3P	230	60	1.15	Yes	234 317 8702		
		3P	460/380	60/50	1.15/1.00	Yes	234 327 8702		
5.5 hp 4 kW	Water Well	3P	460/380	60/50	1.15/1.00		234 397 8600		1500 LBS (6500 N)
		3P	460/380	60/50	1.15/1.00	Yes	234 397 8602		

4" Submersible Motors High Thrust

4" High Thrust Models

HP (KW)	Description						Model	Stock Status	Downward Thrust Rating
	Construction	PH	Volts	HZ	S.F.	Lead in Mtr.			
7.5 hp 5.5 kW	Water Well	3P	200	60	1.15		234 308 8600		1500 LBS (6500 N)
		3P	200	60	1.15	Yes	234 308 8602	Yes	
		3P	220	50	1.00		234 358 8600		
		3P	230	60	1.15		234 318 8600		
		3P	230	60	1.15	Yes	234 318 8602	Yes	
		3P	380	60	1.15		234 348 8600		
		3P	380	60	1.15	Yes	234 348 8602		
		3P	460/380	60/50	1.15/1.00		234 328 8600	Yes	
		3P	460/380	60/50	1.15/1.00	Yes	234 328 8602	Yes	
		3P	575	60	1.15		234 338 8600		
		3P	575	60	1.15	Yes	234 338 8602	Yes	
	Coalbed Methane	3P	200	60	1.15	Yes	234 308 8904		
		3P	230	60	1.15	Yes	234 318 8904		
		3P	460/380	60/50	1.15/1.00	Yes	234 328 8904	Yes	
		3P	575	60	1.15	Yes	234 338 8904		
		3P	380	60	1.15	Yes	234 348 8904		
	Sand Fighter	3P	200	60	1.15	Yes	234 308 8802		
		3P	230	60	1.15	Yes	234 318 8802	Yes	
		3P	460/380	60/50	1.15/1.00	Yes	234 328 8802	Yes	
		3P	575	60	1.15	Yes	234 338 8802		
		3P	380	60	1.15	Yes	234 348 8802		
	316 SS	3P	200	60	1.15	Yes	234 308 8502		
		3P	230	60	1.15	Yes	234 318 8502		
		3P	460/380	60/50	1.15/1.00	Yes	234 328 8502		
		3P	575	60	1.15	Yes	234 338 8502		
	Oil Stripper	3P	230	60	1.15	Yes	234 318 8702		
		3P	460/380	60/50	1.15/1.00	Yes	234 328 8702		
10 hp 7.5 kW	Water Well	3P	380	60	1.15		234 549 8602		1500 LBS (6500 N)
		3P	460/380	60/50	1.15/1.00		234 595 8602	Yes	
		3P	575	60	1.15		234 598 8602	Yes	
	Coalbed Methane	3P	380	60	1.15	Yes	234 549 8904		
		3P	460/380	60/50	1.15/1.00	Yes	234 595 8904	Yes	
		3P	575	60	1.15	Yes	234 598 8904		
	Sand Fighter	3P	380	60	1.15	Yes	234 549 8802		
		3P	460/380	60/50	1.15/1.00	Yes	234 595 8802	Yes	
		3P	575	60	1.15	Yes	234 598 8802		
	316 SS	3P	460/380	60/50	1.15/1.00	Yes	234 595 8502		
	Oil Stripper	3P	460/380	60/50	1.15/1.00	Yes	234 595 8802		

4" Submersible Motors Leads



4" Motor Leads And Cables

Wire	Construction	Material	Lead Length		Wire Size	Grounded	Jam Nut Model	Clamp Style Model
			IN / FT	M				
2W	Individual	Nitrile*	48 in	1.2	AWG 14	No	152 328 905	N/A
	Individual	Nitrile*	100 in	2.5	AWG 14	No	152 328 906	N/A
	Individual	XLPE	48 in	1.2	AWG 14	Yes	152 552 905	N/A
	Individual	XLPE	100 in	2.5	AWG 14	Yes	152 552 906	N/A
3W	Individual	XLPE	48 in	1.2	AWG 14	Yes	152 553 905	152 735 911
	Individual	XLPE	100 in	2.5	AWG 14	Yes	152 553 906	152 735 941
	Individual	Nitrile*	48 in	1.2	AWG 14	No	152 255 901	N/A
	Individual	Nitrile*	100 in	2.5	AWG 14	No	152 255 902	152 744 902
	Individual	Nitrile*	160 in	4.0	AWG 14	No	152 255 904	152 744 904
	Individual	Nitrile*	30 ft	9.1	AWG 14	No	152 255 906	152 744 906
	Individual	Nitrile*	50 ft	15.2	AWG 14	No	152 255 907	152 744 907
	Individual	Nitrile*	100 ft	30.5	AWG 14	No	152 255 910	152 744 910
	Individual	Nitrile*	150 ft	45.7	AWG 14	No	152 255 912	152 744 912
	Indiv / Dbl Conn	XLPE	48 in	1.2	AWG 14	Yes	152 570 901	N/A
	Indiv / Dbl Conn	XLPE	100 in	2.5	AWG 14	Yes	152 570 902	N/A

* Nitrile material not for use in potable water.

NOTES:

1. Refer to Franklin Application Installation Maintenance (AIM) Manual for accurate cable sizing.
2. MOTOR WARRANTY IS VOID if Franklin-supplied leads are not used.

6” Submersible Motors Standard

Applications

These motors are built for dependable operation in 6" diameter or larger water wells.

Basic Features

- Double flanged NEMA mounting design
- Stainless steel splined shaft
- StatorShield™ - Franklin’s six feature encapsulation system
- High capacity Kingsbury-type water lubricated thrust bearing
- Factory filled with Franklin’s non-toxic water soluble fill solution
- Field replaceable lead using Franklin’s exclusive Water Bloc™ technology
- Full 3450 rpm 60 Hz design point
- External sand slinger on shaft
- Mechanical face seal at shaft exit
- Copper bar rotor
- All models suitable for use with variable frequency drives (VFD)
- Single-phase models must be used with a Franklin Electric control box

Special Options

- Sand Fighter® models are equipped with:
  - Franklin’s exclusive Sand Fighter Sealing System for sand or other abrasives well water.
  - Franklin’s exclusive on winding SubTrol® heat sensor for use with SubMonitor®.
- 316 Stainless Steel construction models come standard with:
  - Franklin’s exclusive Sand Fighter Sealing System for sand or other abrasives well water.
  - Franklin’s exclusive on winding SubTrol heat sensor for use with SubMonitor™.
- SubMonitor is a state-of-the-art electronic motor overload that is sold separately.
  - Mounts in the above ground panel requiring no additional wiring to the motor.
  - User friendly, field proven.
  - Protection monitors for balanced power, overload, underload, overheating, rapid cycling and more.
  - Can be used with or without a SubTrol heat sensor.
  - Supplies superior on winding heat protection when mtor manufactured with the SubTrol heat sensor.

Consult factory for other voltage, Hertz and horsepower ratings not listed in this catalog.
Specifications are subject to change without notice. Contact Franklin Electric if current materials are required for bid specifications.

6" Submersible Motors Standard

Standard 6" Motor Specifications

Hz	Ph	Hp Range	kW Range	Poles	RPM	Max. Ambient Temp.	Duty Rating
60	1	5 - 15	3.7 - 11	2	3450	86 °F / 30 °C	Continuous at 0.5 ft/sec flow past motor
60	3	5 - 40	3.7 - 30	2	3450	86 °F / 30 °C	Continuous at 0.5 ft/sec flow past motor
60	3	50 - 60	37 - 45	2	3450	122 °F / 50 °C	Continuous at 0.5 ft/sec flow past motor
50	1	5 - 15	3.7 - 11	2	2875	86 °F / 30 °C	Continuous at 0.5 ft/sec flow past motor
50	3	5 - 40	3.7 - 30	2	2875	86 °F / 30 °C	Continuous at 0.5 ft/sec flow past motor
50	3	50 - 60	37 - 45	2	2875	122 °F / 50 °C	Continuous at 0.5 ft/sec flow past motor

6" Construction Materials

Component	Construction Type		
	Standard Water Well	Sand Fighter™	Corrosion Resistant (316 SS)
UL Insulation Class Rating	Class F	Per Standard Water Well	Per Standard Water Well
Motor Ambient Temperature Rating	86 °F / 30 °C (5-40 hp) 122 °F / 50 °C (50-60 hp)	Per Standard Water Well	Per Standard Water Well
Stator Resin Type	FE Standard (5-40 hp) FE Hi-Temp (50-60 hp)	Per Standard Water Well	Per Standard Water Well
Motor Fill Solution (Water Soluble/Non-Toxic)	FPS91	Per Standard Water Well	Per Standard Water Well
Top End Bell & Thrust Housing	Epoxy Coated Gray Iron	Per Standard Water Well	316 SS
On Winding SubTrol™ Heat Sensor	No (5-40 hp) Yes (50-60 hp)	Yes	Yes
Stator Shell	300 SS Series	Per Standard Water Well	316 SS
Stator Ends	Carbon Steel	Per Standard Water Well	316 SS
Shaft Extension	300 SS Series (5-30 hp) 17-4 SS (40-60 hp)	Per Standard Water Well	17-4 SS
Bushing	Bronze	Per Standard Water Well	316 SS
Bushing Retainer	300 SS Series	Per Standard Water Well	316 SS
Shaft Mechanical Seal	Carbon Ceramic Seal (5-40 hp) Sand Fighter™ Seal System (50-60 hp)	Sand Fighter Seal System	Sand Fighter Seal System
Mechanical Seal Rubber Components	Nitrile (5-40 hp) Viton® (50-60 hp)	Per Standard Water Well	Per Standard Water Well
Diaphragm Material	Nitrile (5-40 hp) Viton® (50-60 hp)	Per Standard Water Well	Per Standard Water Well
Diaphragm Plate	300 SS Series	Per Standard Water Well	316 SS
Diaphragm Spring	300 SS Series	Per Standard Water Well	25-6 MO SS
Shaft Slinger	Nitrile (5-40 hp) Viton® (50-60 hp)	Per Standard Water Well	Nitrile
Lead Wire	XLPE	Per Standard Water Well	Per Standard Water Well
Lead Potting	Epoxy	Per Standard Water Well	Per Standard Water Well
Lead Jam Nut	Brass	Per Standard Water Well	316 SS
Thrust Bearing Rating (86 °F / 30 °C)	3500 lbs (5-30 hp) 6000 lbs (40-60 hp)	Per Standard Water Well	Per Standard Water Well
Method Of Connecting System Ground To Motor	Ground Wire In Power Lead Connector	Per Standard Water Well	Per Standard Water Well

Specifications subject to change without notice. Contact Franklin Electric if current material types are required for bid specifications.
Viton® is a registered trademark of DuPont Dow Elastomers.

6" Submersible Motors Standard

6" Dimensions and Weights

Standard Single-Phase Water Well

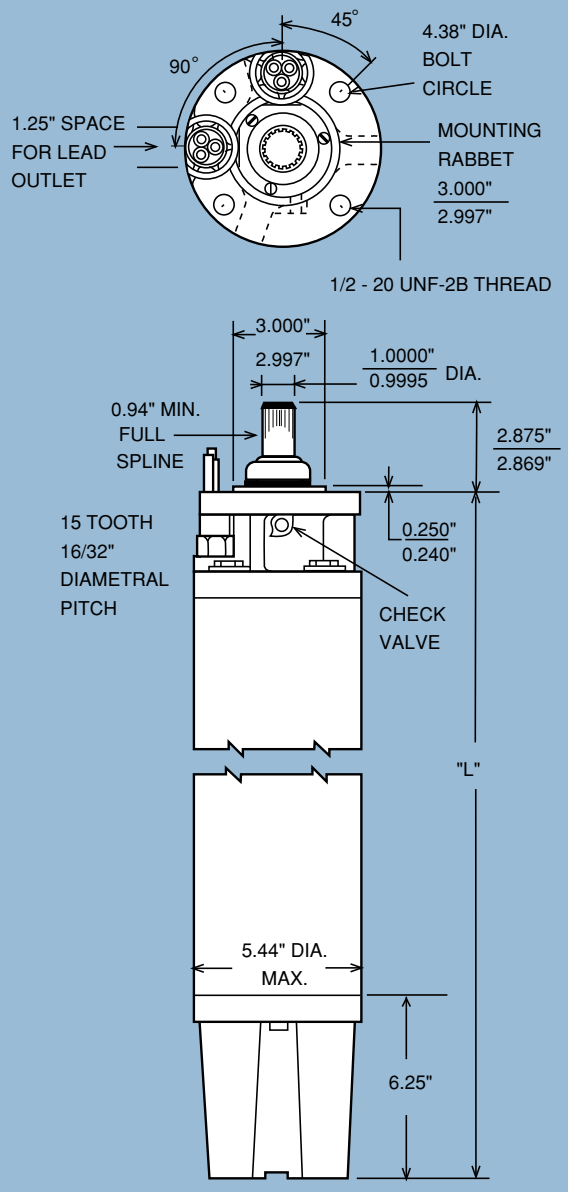
HP	KW	"L" (inches)	Shipping Weight LBS	Shipping Weight KG	Motor Carton Size (in inches)
5	3.7	25.4	110	50	7.50 x 10.75 x 34.50
7.5	5.5	28	123	56	7.50 x 10.75 x 34.50
10	7.5	30.6	141	64	7.50 x 10.75 x 37.00
15	11	33.1	154	70	7.50 x 10.75 x 42.25

Standard Three-Phase Water Well

HP	KW	"L" (inches)	Shipping Weight LBS	Shipping Weight KG	Motor Carton Size (in inches)
5	3.7	22.9	101	46	7.50 x 10.75 x 34.50
7.5	5.5	24.2	108	49	7.50 x 10.75 x 34.50
10	7.5	25.4	116	53	7.50 x 10.75 x 34.50
15	11	28.0	129	59	7.50 x 10.75 x 34.50
20	15	30.6	145	66	7.50 x 10.75 x 37.00
25	18.5	33.1	156	71	7.50 x 10.75 x 42.25
30	22	35.7	174	79	7.50 x 10.75 x 42.25
40	30	40.8	202	92	7.50 x 10.75 x 47.25
50	37	55.3	300	136	8.75 x 10.50 x 71.75
60	45	61.3	330	150	8.75 x 10.50 x 71.75

6-Lead Y-Δ models available. (Add 5 lbs to shipping weight.)

Standard Water Well



316 SS Shell Single-Phase 3-Lead

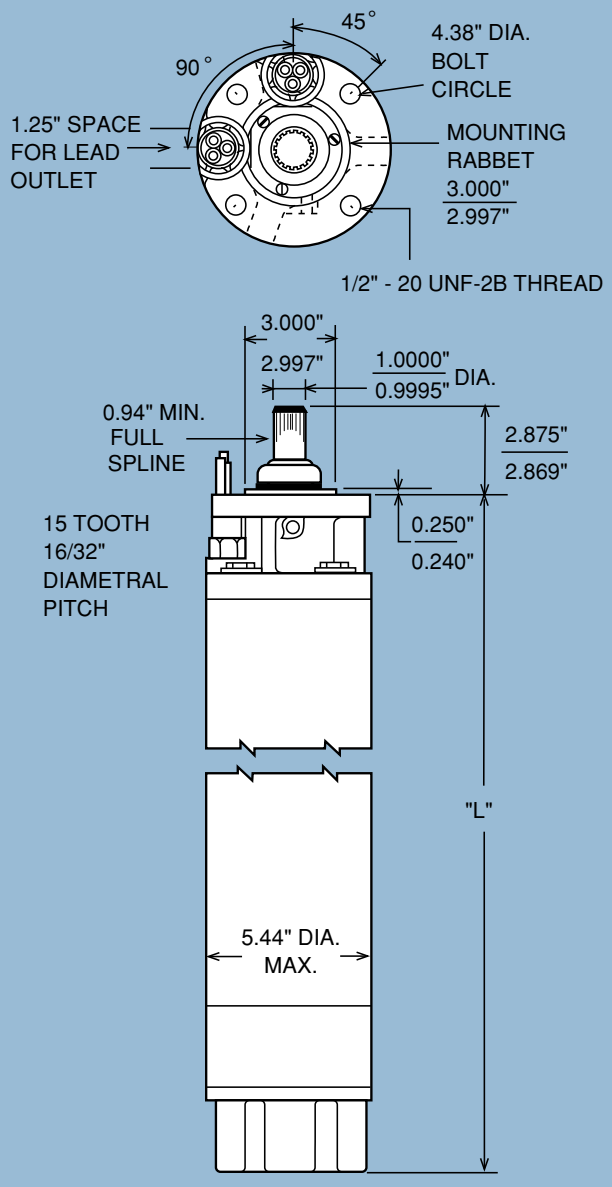
HP	KW	"L" (inches)	Shipping Weight LBS	Shipping Weight KG	Motor Carton Size (in inches)
5	3.7	25.4	110	50	7.50 x 10.75 x 34.50
7.5	5.5	28	123	56	7.50 x 10.75 x 34.50
10	7.5	30.6	141	64	7.50 x 10.75 x 37.00
15	11	33.1	154	70	7.50 x 10.75 x 42.25

316 SS Shell 3-Lead

HP	KW	"L" (inches)	Shipping Weight LBS	Shipping Weight KG	Motor Carton Size (in inches)
5	3.7	22.5	101	46	7.50 x 10.75 x 34.50
7.5	5.5	23.8	108	49	7.50 x 10.75 x 34.50
10	7.5	25.0	116	53	7.50 x 10.75 x 34.50
15	11	27.6	129	59	7.50 x 10.75 x 34.50
20	15	30.2	145	66	7.50 x 10.75 x 37.00
25	18.5	32.7	156	71	7.50 x 10.75 x 42.25
30	22	35.3	174	79	7.50 x 10.75 x 42.25
40	30	40.4	202	92	7.50 x 10.75 x 47.25
50	37	59.2	300	136	8.75 x 10.50 x 71.75
60	45	65.2	330	150	8.75 x 10.50 x 71.75

6-Lead Y-Δ models available. (Add 5 lbs to shipping weight.)

316 Stainless



6" Submersible Motors Standard

6" Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Wire Size (AWG)		
5 hp 3.7 kW	Water Well	1P	230	60	Not Available	1.15	3	#10 w/GND	226 110 90	Yes
		3P	200-208	60	Not Available	1.15	3	#10 w/GND	236 650 90	Yes
		3P	220	50	Not Available	1.00	3	#10 w/GND	236 680 90	
		3P	220	50	Not Available	1.00	6-90°	#10 w/GND	236 670 90	
		3P	230	60	Not Available	1.15	3	#10 w/GND	236 600 90	Yes
		3P	230	60	Not Available	1.15	6-90°	#10 w/GND	236 720 90	
		3P	380	60	Not Available	1.15	3	#10 w/GND	236 660 90	
		3P	380	60	Not Available	1.15	6-90°	#10 w/GND	236 780 90	
		3P	415	50	Not Available	1.00	3	#10 w/GND	236 690 90	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#10 w/GND	236 610 90	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#10 w/GND	236 710 90	
		3P	575	60	Not Available	1.15	3	#10 w/GND	236 620 90	
	Sand Fighter	1P	230	60	Not Available	1.15	3	#10 w/GND	226 110 80	Yes
		3P	200-208	60	Yes	1.15	3	#10 w/GND	236 650 81	Yes
		3P	220	50	Yes	1.00	3	#10 w/GND	236 680 81	
		3P	220	50	Yes	1.00	6-90°	#10 w/GND	236 670 81	
		3P	230	60	Yes	1.15	3	#10 w/GND	236 600 81	Yes
		3P	230	60	Yes	1.15	6-90°	#10 w/GND	236 720 81	
		3P	380	60	Yes	1.15	3	#10 w/GND	236 660 81	
		3P	380	60	Yes	1.15	6-90°	#10 w/GND	236 780 81	
		3P	415	50	Yes	1.00	3	#10 w/GND	236 690 81	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#10 w/GND	236 610 81	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#10 w/GND	236 710 81	
		3P	575	60	Yes	1.15	3	#10 w/GND	236 620 81	Yes
	316 SS	1P	230	60	Not Available	1.15	3	#10 w/GND	226 110 39	
		3P	200-208	60	Yes	1.15	3	#10 w/GND	236 650 40	
		3P	220	50	Yes	1.00	3	#10 w/GND	236 680 40	
		3P	220	50	Yes	1.00	6-90°	#10 w/GND	236 670 40	
		3P	230	60	Yes	1.15	3	#10 w/GND	236 600 40	Yes
		3P	230	60	Yes	1.15	6-90°	#10 w/GND	236 720 40	
		3P	380	60	Yes	1.15	3	#10 w/GND	236 660 40	
		3P	380	60	Yes	1.15	6-90°	#10 w/GND	236 780 40	
		3P	415	50	Yes	1.15	3	#10 w/GND	236 690 40	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#10 w/GND	236 610 40	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#10 w/GND	236 710 40	
		3P	575	60	Yes	1.15	3	#10 w/GND	236 620 40	

6" Submersible Motors Standard

6" Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Wire Size (AWG)		
7.5 hp 5.5 kW	Water Well	1P	230	60	Not Available	1.15	3	#10 w/GND	226 111 90	Yes
		3P	200-208	60	Not Available	1.15	3	#10 w/GND	236 651 90	Yes
		3P	220	50	Not Available	1.00	3	#10 w/GND	236 681 90	
		3P	220	50	Not Available	1.00	6-90°	#10 w/GND	236 671 90	
		3P	230	60	Not Available	1.15	3	#10 w/GND	236 601 90	Yes
		3P	230	60	Not Available	1.15	6-90°	#10 w/GND	236 721 90	
		3P	380	60	Not Available	1.15	3	#10 w/GND	236 661 90	Yes
		3P	380	60	Not Available	1.15	6-90°	#10 w/GND	236 781 90	
		3P	415	50	Not Available	1.00	3	#10 w/GND	236 691 90	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#10 w/GND	236 611 90	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#10 w/GND	236 711 90	Yes
		3P	575	60	Not Available	1.15	3	#10 w/GND	236 621 90	
	Sand Fighter	1P	230	60	Not Available	1.15	3	#10 w/GND	226 111 80	Yes
		3P	200-208	60	Yes	1.15	3	#10 w/GND	236 651 81	Yes
		3P	220	50	Yes	1.00	3	#10 w/GND	236 681 81	
		3P	220	50	Yes	1.00	6-90°	#10 w/GND	236 671 81	
		3P	230	60	Yes	1.15	3	#10 w/GND	236 601 81	Yes
		3P	230	60	Yes	1.15	6-90°	#10 w/GND	236 721 81	
		3P	380	60	Yes	1.15	3	#10 w/GND	236 661 81	
		3P	380	60	Yes	1.15	6-90°	#10 w/GND	236 781 81	
		3P	415	50	Yes	1.00	3	#10 w/GND	236 691 81	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#10 w/GND	236 611 81	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#10 w/GND	236 711 81	
		3P	575	60	Yes	1.15	3	#10 w/GND	236 621 81	Yes
	316 SS	1P	230	60	Not Available	1.15	3	#10 w/GND	226 111 39	
		3P	200-208	60	Yes	1.15	3	#10 w/GND	236 651 40	
		3P	220	50	Yes	1.00	3	#10 w/GND	236 681 40	
		3P	220	50	Yes	1.00	6-90°	#10 w/GND	236 671 40	
		3P	230	60	Yes	1.15	3	#10 w/GND	236 601 40	Yes
		3P	230	60	Yes	1.15	6-90°	#10 w/GND	236 721 40	
		3P	380	60	Yes	1.15	3	#10 w/GND	236 661 40	
		3P	380	60	Yes	1.15	6-90°	#10 w/GND	236 781 40	
		3P	415	50	Yes	1.00	3	#10 w/GND	236 691 40	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#10 w/GND	236 611 40	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#10 w/GND	236 711 40	
		3P	575	60	Yes	1.15	3	#10 w/GND	236 621 40	

6" Submersible Motors Standard

6" Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Wire Size (AWG)		
10 hp 7.5 kW	Water Well	1P	230	60	Not Available	1.15	3	#10 w/GND	226 112 90	Yes
		3P	200-208	60	Not Available	1.15	3	#10 w/GND	236 652 90	Yes
		3P	220	50	Not Available	1.00	3	#10 w/GND	236 682 90	
		3P	220	50	Not Available	1.00	6-90°	#10 w/GND	236 672 90	
		3P	230	60	Not Available	1.15	3	#10 w/GND	236 602 90	Yes
		3P	230	60	Not Available	1.15	6-90°	#10 w/GND	236 722 90	
		3P	380	60	Not Available	1.15	3	#10 w/GND	236 662 90	Yes
		3P	380	60	Not Available	1.15	6-90°	#10 w/GND	236 782 90	
		3P	415	50	Not Available	1.00	3	#10 w/GND	236 692 90	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#10 w/GND	236 612 90	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#10 w/GND	236 712 90	Yes
		3P	575	60	Not Available	1.15	3	#10 w/GND	236 622 90	
	Sand Fighter	1P	230	60	Not Available	1.15	3	#10 w/GND	226 112 80	Yes
		3P	200-208	60	Yes	1.15	3	#10 w/GND	236 652 81	Yes
		3P	220	50	Yes	1.00	3	#10 w/GND	236 682 81	
		3P	220	50	Yes	1.00	6-90°	#10 w/GND	236 672 81	
		3P	230	60	Yes	1.15	3	#10 w/GND	236 602 81	Yes
		3P	230	60	Yes	1.15	6-90°	#10 w/GND	236 722 81	
		3P	380	60	Yes	1.15	3	#10 w/GND	236 662 81	
		3P	380	60	Yes	1.15	6-90°	#10 w/GND	236 782 81	
		3P	415	50	Yes	1.00	3	#10 w/GND	236 692 81	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#10 w/GND	236 612 81	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#10 w/GND	236 712 81	
		3P	575	60	Yes	1.15	3	#10 w/GND	236 622 81	Yes
	316 SS	1P	230	60	Not Available	1.15	3	#10 w/GND	226 112 39	
		3P	200-208	60	Yes	1.15	3	#10 w/GND	236 652 40	
		3P	220	50	Yes	1.00	3	#10 w/GND	236 682 40	
		3P	220	50	Yes	1.00	6-90°	#10 w/GND	236 672 40	
		3P	230	60	Yes	1.15	3	#10 w/GND	236 602 40	Yes
		3P	230	60	Yes	1.15	6-90°	#10 w/GND	236 722 40	
		3P	380	60	Yes	1.15	3	#10 w/GND	236 662 40	
		3P	380	60	Yes	1.15	6-90°	#10 w/GND	236 782 40	
		3P	415	50	Yes	1.00	3	#10 w/GND	236 692 40	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#10 w/GND	236 612 40	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#10 w/GND	236 712 40	
		3P	575	60	Yes	1.15	3	#10 w/GND	236 622 40	

6" Submersible Motors Standard

6" Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Wire Size (AWG)		
15 hp 11 kW	Water Well	1P	230	60	Not Available	1.15	3	#10 w/GND	226 113 90	Yes
		3P	200-208	60	Not Available	1.15	3	#10 w/GND	236 653 90	Yes
		3P	220	50	Not Available	1.00	3	#10 w/GND	236 683 90	
		3P	220	50	Not Available	1.00	6-90°	#10 w/GND	236 673 90	
		3P	230	60	Not Available	1.15	3	#10 w/GND	236 603 90	Yes
		3P	230	60	Not Available	1.15	6-90°	#10 w/GND	236 723 90	Yes
		3P	380	60	Not Available	1.15	3	#10 w/GND	236 663 90	Yes
		3P	380	60	Not Available	1.15	6-90°	#10 w/GND	236 783 90	
		3P	415	50	Not Available	1.00	3	#10 w/GND	236 693 90	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#10 w/GND	236 613 90	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#10 w/GND	236 713 90	Yes
		3P	575	60	Not Available	1.15	3	#10 w/GND	236 623 90	
	Sand Fighter	1P	230	60	Not Available	1.15	3	#10 w/GND	226 113 80	Yes
		3P	200-208	60	Yes	1.15	3	#10 w/GND	236 653 81	Yes
		3P	220	50	Yes	1.00	3	#10 w/GND	236 683 81	
		3P	220	50	Yes	1.00	6-90°	#10 w/GND	236 673 81	
		3P	230	60	Yes	1.15	3	#10 w/GND	236 603 81	Yes
		3P	230	60	Yes	1.15	6-90°	#10 w/GND	236 723 81	
		3P	380	60	Yes	1.15	3	#10 w/GND	236 663 81	
		3P	380	60	Yes	1.15	6-90°	#10 w/GND	236 783 81	
		3P	415	50	Yes	1.00	3	#10 w/GND	236 693 81	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#10 w/GND	236 613 81	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#10 w/GND	236 713 81	
		3P	575	60	Yes	1.15	3	#10 w/GND	236 623 81	Yes
	316 SS	1P	230	60	Not Available	1.15	3	#10 w/GND	226 113 39	
		3P	200-208	60	Yes	1.15	3	#10 w/GND	236 653 40	
		3P	220	50	Yes	1.00	3	#10 w/GND	236 683 40	
		3P	220	50	Yes	1.00	6-90°	#10 w/GND	236 673 40	
		3P	230	60	Yes	1.15	3	#10 w/GND	236 603 40	Yes
		3P	230	60	Yes	1.15	6-90°	#10 w/GND	236 723 40	
		3P	380	60	Yes	1.15	3	#10 w/GND	236 663 40	
		3P	380	60	Yes	1.15	6-90°	#10 w/GND	236 783 40	
		3P	415	50	Yes	1.00	3	#10 w/GND	236 693 40	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#10 w/GND	236 613 40	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#10 w/GND	236 713 40	
		3P	575	60	Yes	1.15	3	#10 w/GND	236 623 40	

6" Submersible Motors Standard

6" Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Wire Size (AWG)		
20 hp 15 kW	Water Well	3P	200-208	60	Not Available	1.15	3	#8 w/GND	236 654 90	Yes
		3P	220	50	Not Available	1.00	3	#8 w/GND	236 684 90	
		3P	220	60	Not Available	1.15	6-90°	#10 w/GND	236 674 90	
		3P	230	60	Not Available	1.15	3	#8 w/GND	236 604 90	Yes
		3P	230	60	Not Available	1.15	6-90°	#10 w/GND	236 724 90	
		3P	380	60	Not Available	1.15	3	#10 w/GND	236 664 90	Yes
		3P	380	60	Not Available	1.15	6-90°	#10 w/GND	236 784 90	
		3P	415	50	Not Available	1.00	3	#10 w/GND	236 694 90	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#10 w/GND	236 614 90	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#10 w/GND	236 714 90	Yes
		3P	575	60	Not Available	1.15	3	#10 w/GND	236 624 90	
	Sand Fighter	3P	200-208	60	Yes	1.15	3	#8 w/GND	236 654 81	Yes
		3P	220	50	Yes	1.00	3	#8 w/GND	236 684 81	
		3P	220	50	Yes	1.00	6-90°	#10 w/GND	236 674 81	
		3P	230	60	Yes	1.15	3	#8 w/GND	236 604 81	Yes
		3P	230	60	Yes	1.15	6-90°	#10 w/GND	236 724 81	Yes
		3P	380	60	Yes	1.15	3	#10 w/GND	236 664 81	
		3P	380	60	Yes	1.15	6-90°	#10 w/GND	236 784 81	
		3P	415	50	Yes	1.00	3	#10 w/GND	236 694 81	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#10 w/GND	236 614 81	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#10 w/GND	236 714 81	
		3P	575	60	Yes	1.15	3	#10 w/GND	236 624 81	Yes
	316 SS	3P	200-208	60	Yes	1.15	3	#8 w/GND	236 654 40	
		3P	220	50	Yes	1.00	3	#8 w/GND	236 684 40	
		3P	220	50	Yes	1.00	6-90°	#10 w/GND	236 674 40	
		3P	230	60	Yes	1.15	3	#8 w/GND	236 604 40	Yes
		3P	230	60	Yes	1.15	6-90°	#10 w/GND	236 724 40	
		3P	380	60	Yes	1.15	3	#10 w/GND	236 664 40	
		3P	380	60	Yes	1.15	6-90°	#10 w/GND	236 784 40	
		3P	415	50	Yes	1.00	3	#10 w/GND	236 694 40	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#10 w/GND	236 614 40	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#10 w/GND	236 714 40	
		3P	575	60	Yes	1.15	3	#10 w/GND	236 624 40	

6" Submersible Motors Standard

6" Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Wire Size (AWG)		
25 hp 18.5 kW	Water Well	3P	200-208	60	Not Available	1.15	3	#8 w/GND	236 655 90	Yes
		3P	220	50	Not Available	1.00	3	#8 w/GND	236 685 90	
		3P	220	50	Not Available	1.00	6-90°	#10 w/GND	236 675 90	
		3P	230	60	Not Available	1.15	3	#8 w/GND	236 605 90	Yes
		3P	230	60	Not Available	1.15	6-90°	#10 w/GND	236 725 90	
		3P	380	60	Not Available	1.15	3	#10 w/GND	236 665 90	Yes
		3P	380	60	Not Available	1.15	6-90°	#10 w/GND	236 785 90	
		3P	415	50	Not Available	1.00	3	#10 w/GND	236 695 90	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#10 w/GND	236 615 90	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#10 w/GND	236 715 90	Yes
		3P	575	60	Not Available	1.15	3	#10 w/GND	236 625 90	
	Sand Fighter	3P	200-208	60	Yes	1.15	3	#8 w/GND	236 655 81	Yes
		3P	220	50	Yes	1.00	3	#8 w/GND	236 685 81	
		3P	220	50	Yes	1.00	6-90°	#10 w/GND	236 675 81	
		3P	230	60	Yes	1.15	3	#8 w/GND	236 605 81	Yes
		3P	230	60	Yes	1.15	6-90°	#10 w/GND	236 725 81	Yes
		3P	380	60	Yes	1.15	3	#10 w/GND	236 665 81	
		3P	380	60	Yes	1.15	6-90°	#10 w/GND	236 785 81	
		3P	415	50	Yes	1.00	3	#10 w/GND	236 695 81	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#10 w/GND	236 615 81	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#10 w/GND	236 715 81	
		3P	575	60	Yes	1.15	3	#10 w/GND	236 625 81	Yes
	316 SS	3P	200-208	60	Yes	1.15	3	#8 w/GND	236 655 40	
		3P	220	50	Yes	1.00	3	#8 w/GND	236 685 40	
		3P	220	50	Yes	1.00	6-90°	#10 w/GND	236 675 40	
		3P	230	60	Yes	1.15	3	#8 w/GND	236 605 40	
		3P	230	60	Yes	1.15	6-90°	#10 w/GND	236 725 40	
		3P	380	60	Yes	1.15	3	#10 w/GND	236 665 40	
		3P	380	60	Yes	1.15	6-90°	#10 w/GND	236 785 40	
		3P	415	50	Yes	1.00	3	#10 w/GND	236 695 40	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#10 w/GND	236 615 40	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#10 w/GND	236 715 40	
		3P	575	60	Yes	1.15	3	#10 w/GND	236 625 40	

6" Submersible Motors Standard

6" Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Wire Size (AWG)		
30 hp 22 kW	Water Well	3P	200-208	60	Not Available	1.15	3	#8 w/GND	236 656 90	Yes
		3P	220	50	Not Available	1.00	3	#8 w/GND	236 686 90	
		3P	220	50	Not Available	1.00	6-90°	#10 w/GND	236 676 90	
		3P	230	60	Not Available	1.15	3	#8 w/GND	236 606 90	Yes
		3P	230	60	Not Available	1.15	6-90°	#10 w/GND	236 726 90	
		3P	380	60	Not Available	1.15	3	#10 w/GND	236 666 90	Yes
		3P	380	60	Not Available	1.15	6-90°	#10 w/GND	236 786 90	
		3P	415	50	Not Available	1.00	3	#10 w/GND	236 696 90	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#10 w/GND	236 616 90	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#10 w/GND	236 716 90	Yes
		3P	575	60	Not Available	1.15	3	#10 w/GND	236 626 90	
	Sand Fighter	3P	200-208	60	Yes	1.15	3	#8 w/GND	236 656 81	Yes
		3P	220	50	Yes	1.00	3	#8 w/GND	236 686 81	
		3P	220	50	Yes	1.00	6-90°	#10 w/GND	236 676 81	
		3P	230	60	Yes	1.15	3	#8 w/GND	236 606 81	Yes
		3P	230	60	Yes	1.15	6-90°	#10 w/GND	236 726 81	Yes
		3P	380	60	Yes	1.15	3	#10 w/GND	236 666 81	
		3P	380	60	Yes	1.15	6-90°	#10 w/GND	236 786 81	
		3P	415	50	Yes	1.00	3	#10 w/GND	236 696 81	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#10 w/GND	236 616 81	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#10 w/GND	236 716 81	
		3P	575	60	Yes	1.15	3	#10 w/GND	236 626 81	Yes
	316 SS	3P	200-208	60	Yes	1.15	3	#8 w/GND	236 656 40	
		3P	220	50	Yes	1.00	3	#8 w/GND	236 686 40	
		3P	220	50	Yes	1.00	6-90°	#10 w/GND	236 676 40	
		3P	230	60	Yes	1.15	3	#8 w/GND	236 606 40	
		3P	230	60	Yes	1.15	6-90°	#10 w/GND	236 726 40	
		3P	380	60	Yes	1.15	3	#10 w/GND	236 666 40	
		3P	380	60	Yes	1.15	6-90°	#10 w/GND	236 786 40	
		3P	415	50	Yes	1.00	3	#10 w/GND	236 696 40	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#10 w/GND	236 616 40	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#10 w/GND	236 716 40	
		3P	575	60	Yes	1.15	3	#10 w/GND	236 626 40	

6" Submersible Motors Standard

6" Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Wire Size (AWG)		
40 hp 30 kW	Water Well	3P	380	60	Not Available	1.15	3	#8 w/GND	236 667 90	
		3P	380	60	Not Available	1.15	6-90°	#10 w/GND	236 787 90	
		3P	415	50	Not Available	1.00	3	#8 w/GND	236 697 90	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#8 w/GND	236 617 90	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#10 w/GND	236 717 90	
		3P	575	60	Not Available	1.15	3	#8 w/GND	236 627 90	
	Sand Fighter	3P	380	60	Yes	1.15	3	#8 w/GND	236 667 81	Yes
		3P	380	60	Yes	1.15	6-90°	#10 w/GND	236 787 81	
		3P	415	50	Yes	1.00	3	#8 w/GND	236 697 81	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#8 w/GND	236 617 81	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#10 w/GND	236 717 81	Yes
		3P	575	60	Yes	1.15	3	#8 w/GND	236 627 81	Yes
	316 SsS	3P	380	60	Yes	1.15	3	#8 w/GND	236 667 40	
		3P	380	60	Yes	1.15	6-90°	#10 w/GND	236 787 40	
		3P	415	50	Yes	1.00	3	#8 w/GND	236 697 40	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#8 w/GND	236 617 40	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#10 w/GND	236 717 40	
		3P	575	60	Yes	1.15	3	#8 w/GND	236 627 40	
50 hp 37 kW	Sand Fighter	3P	380	60	Yes	1.15	3	#8 w/GND	276 668 81	Yes
		3P	380	60	Yes	1.15	6-90°	#8 w/GND	276 788 81	
		3P	415	50	Yes	1.00	3	#8 w/GND	276 698 81	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#8 w/GND	276 618 81	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#8 w/GND	276 718 81	Yes
		3P	575	60	Yes	1.15	3	#8 w/GND	276 628 81	Yes
	316 SS	3P	380	60	Yes	1.15	3	#8 w/GND	276 668 40	
		3P	380	60	Yes	1.15	6-90°	#8 w/GND	276 788 40	
		3P	415	50	Yes	1.00	3	#8 w/GND	276 698 40	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#8 w/GND	276 618 40	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#8 w/GND	276 718 40	
		3P	575	60	Yes	1.15	3	#8 w/GND	276 628 40	
60 hp 45 kW	Sand Fighter	3P	380	60	Yes	1.15	3	#8 w/GND	276 669 81	Yes
		3P	380	60	Yes	1.15	6-90°	#8 w/GND	276 789 81	
		3P	415	50	Yes	1.00	3	#8 w/GND	276 699 81	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#8 w/GND	276 619 81	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#8 w/GND	276 719 81	Yes
		3P	575	60	Yes	1.15	3	#8 w/GND	276 629 81	Yes
	316 SS	3P	380	60	Yes	1.15	3	#8 w/GND	276 669 40	
		3P	380	60	Yes	1.15	6-90°	#8 w/GND	276 789 40	
		3P	415	50	Yes	1.00	3	#8 w/GND	276 699 40	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#8 w/GND	276 619 40	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#8 w/GND	276 719 40	
		3P	575	60	Yes	1.15	3	#8 w/GND	276 629 40	

NOTES:

1. Models designated above as Sand Fighter® are water well construction.
2. All 316 SS and Ni-Resist models are equipped with Sand Fighter sealing system.
3. All models listed above include factory-installed leads (13 ft).

6” Submersible Motors Volt-X

Applications

These motors are built for dependable operation in 6" diameter or larger water wells.

Basic Features

- Innovative Volt-X voltage exchange device
- Maximum temperature winding wire NEMA class 200
- Anti-track self-healing resin system
- Hermetically-sealed windings
- Removable Water-Bloc™ lead
- Double flange design
- Stainless steel splined shaft
- Kingsbury-type water lubricated thrust bearing
- Pressure equalizing diaphragm
- Sand slinger
- 3-lead configuration
- Copper bar rotor
- Full 3450 RPM design point
- Filter check valve

Special Options

- Sand Fighter® models are equipped with:
  - Franklin’s exclusive Sand Fighter Sealing System for sand or other abrasives well water.
  - Franklin’s exclusive on winding SubTrol® heat sensor for use with SubMonitor®.
- SubMonitor is a state-of-the-art electronic motor overload that is sold separately.
  - Mounts in the above ground panel requiring no additional wiring to the motor.
  - User friendly, field proven.
  - Protection monitors for balanced power, overload, underload, overheating, rapid cycling and more.
  - Can be used with or without a SubTrol heat sensor.
  - Supplies superior on winding heat protection when manufactured with the SubTrol heat sensor.

Consult factory for other voltage, Hertz and horsepower ratings not listed in this catalog.
Specifications are subject to change without notice. Contact Franklin Electric if current materials are required for bid specifications.

Standard 6” Motor Specifications

Hz	Ph	Hp Range	kW Range	Poles	RPM	Max. Ambient Temp.	Duty Rating
60	3	5 - 30	3.7 - 22	2	3450	86 °F / 30 °C	Continuous at 0.5 ft/sec flow past motor

6” Construction Materials

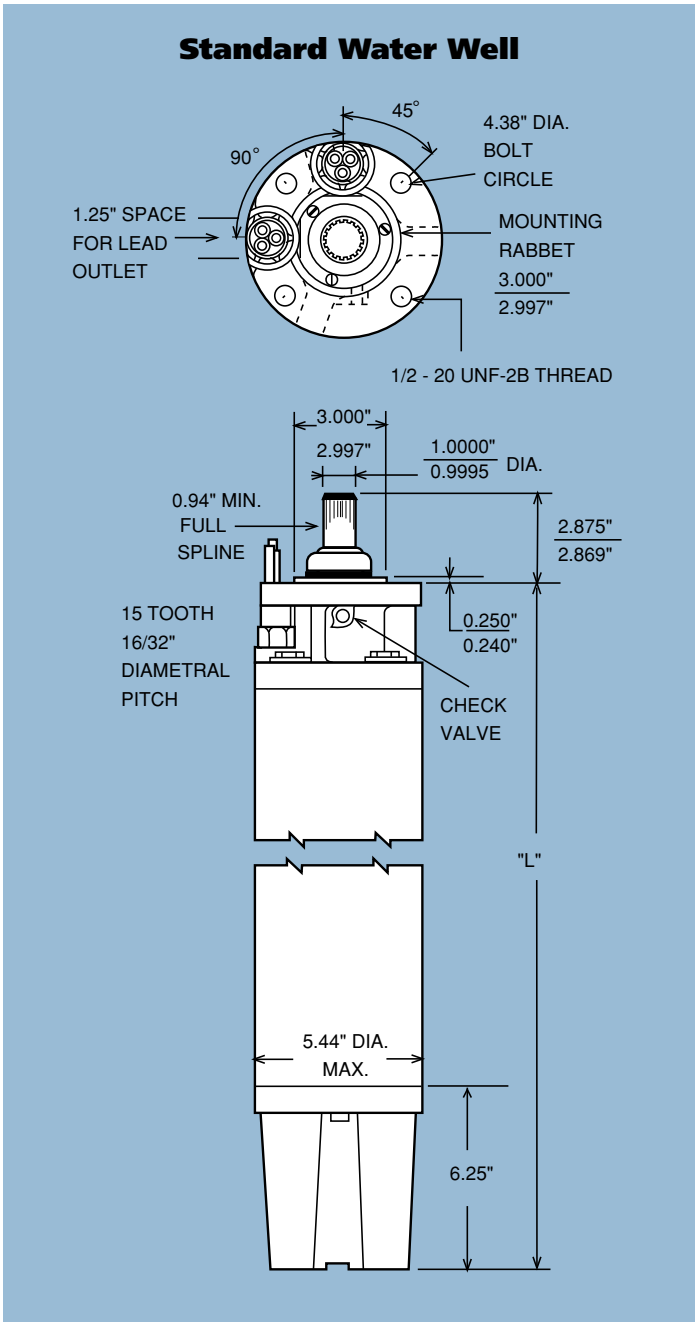
Component	Construction Type	
	Standard Water Well	Sand Fighter™
UL Insulation Class Rating	Class F	Per Standard Water Well
Motor Ambient Temperature Rating	86 °F / 30 °C	Per Standard Water Well
Stator Resin Type	FE Standard	Per Standard Water Well
Motor Fill Solution (Water Soluble/Non-Toxic)	FES91	Per Standard Water Well
Top End Bell & Thrust Housing	Epoxy Coated Gray Iron	Per Standard Water Well
On Winding SubTrol® heat sensor	No	Yes
Stator Shell	300 SS Series	Per Standard Water Well
Stator Ends	Carbon Steel	Per Standard Water Well
Shaft Extension	300 SS Series	Per Standard Water Well
Bushing	Bronze	Per Standard Water Well
Bushing Retainer	300 SS Series	Per Standard Water Well
Shaft Mechanical Seal	Carbon Ceramic Seal	Sand Fighter Seal System
Mechanical Seal Rubber Components	Nitrile	Per Standard Water Well
Diaphragm Material	Nitrile	Per Standard Water Well
Diaphragm Plate	300 SS Series	Per Standard Water Well
Diaphragm Spring	300 SS Series	Per Standard Water Well
Shaft Slinger	Nitrile	Per Standard Water Well
Lead Wire	XLPE	Per Standard Water Well
Lead Potting	Epoxy	Per Standard Water Well
Lead Jam Nut	Brass	Per Standard Water Well
Thrust Bearing Rating (86 °F / 30 °C)	3500 lbs	Per Standard Water Well
Method Of Connecting System Ground To Motor	Ground Wire In Power Lead Connector	Per Standard Water Well

Specifications subject to change without notice. Contact Franklin Electric if current material types are required for bid specifications.

6” Dimensions and Weights

Standard Three-Phase Water Well

HP	KW	“L” (inches)	Shipping Weight		Motor Carton Size (in inches)
			LBS	KG	
5	3.7	22.9	101	46	7.50 x 10.75 x 34.50
7.5	5.5	24.2	108	49	7.50 x 10.75 x 34.50
10	7.5	25.4	116	53	7.50 x 10.75 x 34.50
15	11	28.0	129	59	7.50 x 10.75 x 34.50
20	15	30.6	145	66	7.50 x 10.75 x 37.00
25	18.5	33.1	156	71	7.50 x 10.75 x 42.25
30	22	35.7	174	79	7.50 x 10.75 x 42.25



6” Submersible Motor DR56

Applications

These motors are built for dependable operation in 6" diameter or larger water wells.

Basic Features

- Up to 122 °F (50 °C) ambient temperature.
- Hermetically sealed stator
- Innovative high temperature winding encapsulation system
- 10,000 lb KINGSBURY-type thrust bearing
- FES91 Exclusive water soluble bearing lubrication
- Double-flange NEMA mounting for ease of handling and pump mounting
- Stainless steel splined shaft for maximum shaft/coupling contact
- Full 3450 RPM 60 Hz design point for superior pump performance
- SAND FIGHTER™ Sealing System
- Subtrol heat sensor standard
- Franklin Electric’s exclusive Water-Bloc™ lead connection
- 316 SS and Y-Δ designs are available, consult factory.
- Extended warranty available when registered with FE SubMonitor overload protection

Special Options

- Sand Fighter® models are equipped with:
  - Franklin’s exclusive Sand Fighter Sealing System for sand or other abrasives well water.
  - Franklin’s exclusive on winding SubTrol® heat sensor for use with SubMonitor®.
- SubMonitor is a state-of-the-art electronic motor overload that is sold separately.
  - Mounts in the above ground panel requiring no additional wiring to the motor.
  - User friendly, field proven.
  - Protection monitors for balanced power, overload, underload, overheating, rapid cycling and more.
  - Can be used with or without a SubTrol heat sensor.
  - Supplies superior on winding heat protection when manufactured with the SubTrol heat sensor.

Consult factory for other voltage, Hertz and horsepower ratings not listed in this catalog.
Specifications are subject to change without notice. Contact Franklin Electric if current materials are required for bid specifications.

6" Submersible Motor DR56

Standard 6" Motor Specifications

Hz	Ph	Hp Range	kW Range	Poles	RPM	Max. Ambient Temp.	Duty Rating
60	3	50 & 60	37 & 45	2	3450	122 °F / 50 °C	Continuous at 0.5 ft/sec flow past motor

6" Construction Materials

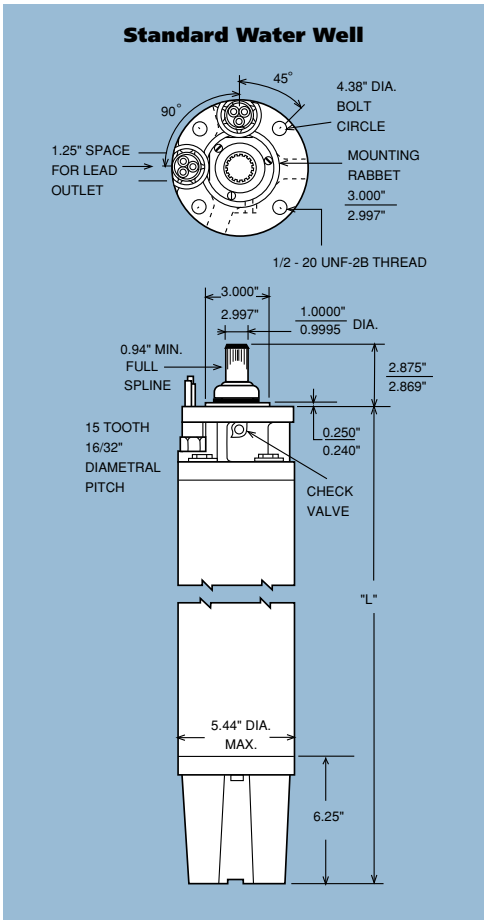
Component	Construction Type	
	Sand Fighter™	316 SS
UL Insulation Class Rating	Class F	Per Sand Fighter
Motor Ambient Temperature Rating	122 °F / 50 °C	Per Sand Fighter
Stator Resin Type	Hi-Temp	Per Sand Fighter
Motor Fill Solution (Water Soluble/Non-Toxic)	FES92	Per Sand Fighter
Top End Bell & Thrust Housing	Epoxy Coated Gray Iron	316 SS
On Winding SubTrol® heat sensor	Yes	Yes
Stator Shell	300 SS Series	316 SS
Stator Ends	Carbon Steel	316 SS
Shaft Extension	17-4 SS	17-4 SS
Bushing	Bronze	316 SS
Bushing Retainer	300 SS Series	316 SS
Shaft Mechanical Seal	Sand Fighter Seal System	Sand Fighter Seal System
Mechanical Seal Rubber Components	Viton	Viton
Diaphragm Material	Viton	Viton
Diaphragm Plate	300 SS Series	316 SS
Diaphragm Spring	300 SS Series	17-7 SS
Shaft Slinger	Viton	Viton
Lead Wire	XLPE	XCPE
Lead Potting	Epoxy	Epoxy
Lead Jam Nut	Brass	316 SS
Thrust Bearing Rating (122 °F / 50 °C)	10,000 lbs	10,000 lbs
Method Of Connecting System Ground To Motor	Ground Wire In Power Lead Connector	Per Sand Fighter

Specifications subject to change without notice. Contact Franklin Electric if current material types are required for bid specifications.

6" Dimensions and Weights

Standard Three-Phase Water Well

HP	KW	"L" (inches)	Shipping Weight		Motor Carton Size (in inches)
			LBS	KG	
50 & 60	37 & 45	64.14	335	152	8.75 x 10.50 x 71.75



HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Wire Size (AWG)		
50 hp / 60 hp	Sand Fighter	3P	380	60	Yes	1.15	3	#8 w/GND	276 029 62	Yes
		3P	380	60	Yes	1.15	6-90°	#8 w/GND	276 039 62	
		3P	415	50	Yes	1.00	3	#8 w/GND	276 049 62	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#8 w/GND	276 009 62	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#8 w/GND	276 019 62	Yes
		3P	575	60	Yes	1.15	3	#8 w/GND	276 059 62	Yes
37 kW / 45 kW	316 SS	3P	380	60	Yes	1.15	3	#8 w/GND	276 029 64	
		3P	380	60	Yes	1.15	6-90°	#8 w/GND	276 039 64	
		3P	415	50	Yes	1.00	3	#8 w/GND	276 049 64	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#8 w/GND	276 009 64	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#8 w/GND	276 019 64	
		3P	575	60	Yes	1.15	3	#8 w/GND	276 059 64	

NOTES:

1. Models designated above as Sand Fighter® are water well construction.
2. All 316 SS models are equipped with Sand Fighter sealing system.
3. All models listed above include factory-installed leads (13 ft).

6" Submersible Motor DR56

6" Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Wire Size (AWG)		
5 hp 3.7 kW	Water Well	3P	230/460	60	Not Available	1.15	3	#10 w/GND	236 310 90	No
	Sand Fighter	3P	230/460	60	Yes	1.15	3	#10 w/GND	236 310 81	No
7.5 hp 5.5 kW	Water Well	3P	230/460	60	Not Available	1.15	3	#10 w/GND	236 311 90	Yes
	Sand Fighter	3P	230/460	60	Yes	1.15	3	#10 w/GND	236 311 81	Yes
10 hp 7.5 kW	Water Well	3P	230/460	60	Not Available	1.15	3	#10 w/GND	236 312 90	Yes
	Sand Fighter	3P	230/460	60	Yes	1.15	3	#10 w/GND	236 312 81	Yes
15 hp 11 kW	Water Well	3P	230/460	60	Not Available	1.15	3	#10 w/GND	236 313 90	Yes
	Sand Fighter	3P	230/460	60	Yes	1.15	3	#10 w/GND	236 313 81	Yes
20 hp 15 kW	Water Well	3P	230/460	60	Not Available	1.15	3	#8 w/GND	236 314 90	Yes
	Sand Fighter	3P	230/460	60	Yes	1.15	3	#8 w/GND	236 314 81	Yes
25 hp 18.5 kW	Water Well	3P	230/460	60	Not Available	1.15	3	#8 w/GND	236 315 90	Yes
	Sand Fighter	3P	230/460	60	Yes	1.15	3	#8 w/GND	236 315 81	Yes
30 hp 22 kW	Water Well	3P	230/460	60	Not Available	1.15	3	#8 w/GND	236 316 90	Yes
	Sand Fighter	3P	230/460	60	Yes	1.15	3	#8 w/GND	236 316 81	Yes

6" Submersible Motors Hi-Temp 90

Applications

These motors are built for dependable operation in 6" diameter or larger water wells, in applications with higher temperature, high thrust or low flow.

Basic Features

- Able to operate in water ambients up to 194 °F (90 °C)
- In 86 °F (30 °C) ambient or less they supply 25% more downthrust and 100% more upthrust than standard product
- No flow capable when submerged in lakes or wells 12" diameter or larger and water 86 °F or less
- Double flanged NEMA mounting design
- Stainless steel splined shaft
- StatorShield™ - Franklin's six feature encapsulation system
- High capacity Kingsbury-type water lubricated thrust bearing
- Factory filled with Franklin's non-toxic water soluble fill solution
- Field replaceable lead using Franklin's exclusive Water Bloc™ technology
- Full 3450 rpm 60 Hz design point
- External sand slinger on shaft
- Sand Fighter® mechanical face seal system at shaft exit
- Copper bar rotor
- All models suitable for use with variable frequency drives (VFD)

Special Options

- SubMonitor® is a state-of-the-art electronic motor overload that is sold separately.
  - Mounts in the above ground panel requiring no additional wiring to the motor.
  - User friendly, field proven.
  - Protection monitors for balanced power, overload, underload, overheating, rapid cycling and more.
  - Can be used with or without a Subtrol heat sensor.
  - Subtrol heat sensor not available with Hi-Temp 90 motor.

Consult factory for other voltage, 0Hertz and horsepower ratings not listed in this catalog.
Specifications are subject to change without notice. Contact Franklin Electric if current materials are required for bid specifications.

6" Submersible Motors Hi-Temp 90

6" Three-Phase Hi-Temp 90 Motor Specifications

Hz	Phase	Hp Range	kW Range	Poles	RPM	Max. Ambient Temp.	Duty Rating
60	3	5 - 40	3.7 - 30	2	3450	195 °F / 90 °C	Continuous at 0.5 ft/sec flow past motor*
50	3	5 - 40	3.7 - 30	2	2875	195 °F / 90 °C	Continuous at 0.5 ft/sec flow past motor*

* Motors are also rated for continuous duty up to 86 °F (30 °C) water temperature with No FLOW in lakes or in wells 12 inches or larger in diameter.

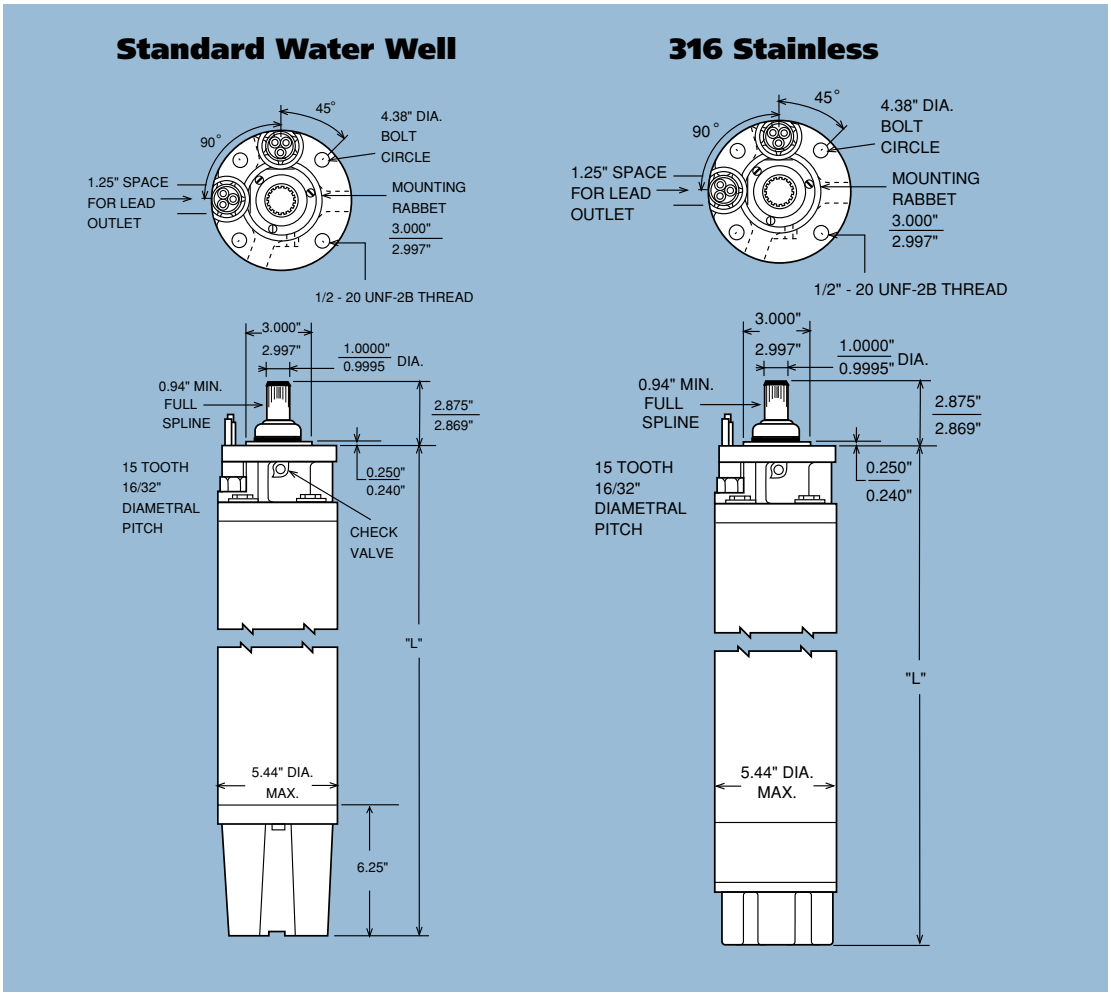
6" Hi-Temp 90 Construction Materials

	Construction Type	
Component	Hi-Temp 90C (300 SS Series Shell)	Hi-Temp 90C (316 SS Construction)
UL Insulation Class Rating	Class F	Class F
Motor Ambient Temperature Rating	194 °F / 90 °C (5-40 hp)	194 °F / 90 °C (5-40 hp)
Stator Resin Type	FE Hi-Temp	FE Hi-Temp
Motor Fill Solution (Water Soluble/Non-Toxic)	FES92	FES92
Top End Bell & Thrust Housing	Epoxy Coated Gray Iron	316 SS
On Winding SubTrol® heat sensor	Not Available	Not Available
Stator Shell	300 SS Series	316 SS
Stator Ends	Carbon Steel	316 SS
Shaft Extension	300 SS Series (5-20 hp), 17-4 SS (25-40 hp)	17-4 SS
Bushing	Bronze	316 SS
Bushing Retainer	300 SS Series	316 SS
Seal Mechanical Seal	Sand Fighter® Mechanical Seal System	Sand Fighter Mechanical Seal System
Mechanical Seal Rubber Compnents	Viton®	Viton®
Diaphragm Material	Viton®	Viton®
Diaphragm Plate	300 SS Series	316 SS
Diaphragm Spring	300 SS Series	25-6 MO SS
Shaft Slinger	Viton®	Viton®
Lead Wire	XLPO	XLPO
Lead Potting	Epoxy	Epoxy
Lead Jam Nut	Brass	316 SS
Thrust Bearing Rating	Standard 5-20 hp • 3,500 lbs Standard 25 hp • 6,000 lbs Standard 30-40 hp • 10,000 lbs	Standard 5-20 hp • 3,500 lbs Standard 25 hp • 6,000 lbs Standard 30-40 hp • 10,000 lbs
Method Of Connecting System Ground To Motor	Ground Wire In Power Lead Connector	Ground Wire In Power Lead Connector

Specifications subject to change without notice. Contact Franklin Electric if current material types are required for bid specifications.

Viton® is a registered trademark of DuPont Dow Elastomers.

6" Hi-Temp 90 Dimensions and Weights



304 SS Shell 3-Lead

HP	KW	"L" (inches)	Shipping Weight LBS	Shipping Weight KG	Motor Carton Size (in inches)
5	3.7	26.40	116	53	8.75 x 11.25 x 34.50
7.5	5.5	28.96	129	59	8.75 x 11.25 x 37.00
10	7.5	31.52	145	66	8.75 x 11.25 x 42.25
15	11	34.09	156	71	8.75 x 11.25 x 42.25
20	15	36.65	174	79	8.75 x 11.25 x 51.25
25	18.5	41.77	202	92	8.75 x 11.25 x 51.25
30	22	58.14	300	136	8.75 x 10.50 x 71.75
40	30	64.14	330	150	8.75 x 10.50 x 71.75

316 SS Shell 3-Lead

HP	KW	"L" (inches)	Shipping Weight LBS	Shipping Weight KG	Motor Carton Size (in inches)
5	3.7	26.40	116	53	8.75 x 11.25 x 34.50
7.5	5.5	28.96	129	59	8.75 x 11.25 x 37.00
10	7.5	31.52	145	66	8.75 x 11.25 x 42.25
15	11	34.09	156	71	8.75 x 11.25 x 42.25
20	15	36.65	174	79	8.75 x 11.25 x 51.25
25	18.5	41.77	202	92	8.75 x 11.25 x 51.25
30	22	58.14	300	136	8.75 x 10.50 x 71.75
40	30	64.14	330	150	8.75 x 10.50 x 71.75

6-Lead Y-Δ models available. (Add 5 lbs to shipping weight.)

6" Submersible Motors Hi-Temp 90

Hi-Temp 90 6" Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Wire Size (AWG)		
5 hp 3.7 kW	Water Well With Sand Fighter Seal	3P	200	60	Not Available	1.15	3	#8 w/GND	276 650 00	
		3P	220	50	Not Available	1.00	3	#8 w/GND	276 680 00	
		3P	220	50	Not Available	1.00	6-90°	#8 w/GND	276 670 00	
		3P	230	60	Not Available	1.15	3	#8 w/GND	276 600 00	
		3P	230	60	Not Available	1.15	6-90°	#8 w/GND	276 720 00	
		3P	380	60	Not Available	1.15	3	#8 w/GND	276 660 00	
		3P	380	60	Not Available	1.15	6-90°	#8 w/GND	276 780 00	
		3P	415	50	Not Available	1.00	3	#8 w/GND	276 690 00	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#8 w/GND	276 610 00	
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#8 w/GND	276 710 00	
		3P	575	60	Not Available	1.15	3	#8 w/GND	276 620 00	
	316 SS	3P	200	60	Not Available	1.15	3	#8 w/GND	276 650 30	
		3P	220	50	Not Available	1.00	3	#8 w/GND	276 680 30	
		3P	220	50	Not Available	1.00	6-90°	#8 w/GND	276 670 30	
		3P	230	60	Not Available	1.15	3	#8 w/GND	276 600 30	
		3P	230	60	Not Available	1.15	6-90°	#8 w/GND	276 720 30	
		3P	380	60	Not Available	1.15	3	#8 w/GND	276 660 30	
		3P	380	60	Not Available	1.15	6-90°	#8 w/GND	276 780 30	
		3P	415	50	Not Available	1.00	3	#8 w/GND	276 690 30	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#8 w/GND	276 610 30	
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#8 w/GND	276 710 30	
		3P	575	60	Not Available	1.15	3	#8 w/GND	276 620 30	
7.5 hp 5.5 kW	Water Well With Sand Fighter Seal	3P	200	60	Not Available	1.15	3	#8 w/GND	276 651 00	
		3P	220	50	Not Available	1.00	3	#8 w/GND	276 681 00	
		3P	220	50	Not Available	1.00	6-90°	#8 w/GND	276 671 00	
		3P	230	60	Not Available	1.15	3	#8 w/GND	276 601 00	
		3P	230	60	Not Available	1.15	6-90°	#8 w/GND	276 721 00	
		3P	380	60	Not Available	1.15	3	#8 w/GND	276 661 00	
		3P	380	60	Not Available	1.15	6-90°	#8 w/GND	276 781 00	
		3P	415	50	Not Available	1.00	3	#8 w/GND	276 691 00	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#8 w/GND	276 611 00	
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#8 w/GND	276 711 00	
		3P	575	60	Not Available	1.15	3	#8 w/GND	276 621 00	
	316 SS	3P	200	60	Not Available	1.15	3	#8 w/GND	276 651 30	
		3P	220	50	Not Available	1.00	3	#8 w/GND	276 681 30	
		3P	220	50	Not Available	1.00	6-90°	#8 w/GND	276 671 30	
		3P	230	60	Not Available	1.15	3	#8 w/GND	276 601 30	
		3P	230	60	Not Available	1.15	6-90°	#8 w/GND	276 721 30	
		3P	380	60	Not Available	1.15	3	#8 w/GND	276 661 30	
		3P	380	60	Not Available	1.15	6-90°	#8 w/GND	276 781 30	
		3P	415	50	Not Available	1.00	3	#8 w/GND	276 691 30	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#8 w/GND	276 611 30	
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#8 w/GND	276 711 30	
		3P	575	60	Not Available	1.15	3	#8 w/GND	276 621 30	

Hi-Temp 90 6" Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Wire Size (AWG)		
10 hp 7.5 kW	Water Well With Sand Fighter Seal	3P	200	60	Not Available	1.15	3	#8 w/GND	276 652 00	
		3P	220	50	Not Available	1.00	3	#8 w/GND	276 682 00	
		3P	220	50	Not Available	1.00	6-90°	#8 w/GND	276 672 00	
		3P	230	60	Not Available	1.15	3	#8 w/GND	276 602 00	
		3P	230	60	Not Available	1.15	6-90°	#8 w/GND	276 722 00	
		3P	380	60	Not Available	1.15	3	#8 w/GND	276 662 00	
		3P	380	60	Not Available	1.15	6-90°	#8 w/GND	276 782 00	
		3P	415	50	Not Available	1.00	3	#8 w/GND	276 692 00	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#8 w/GND	276 612 00	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#8 w/GND	276 712 00	
		3P	575	60	Not Available	1.15	3	#8 w/GND	276 622 00	
	316 SS	3P	200	60	Not Available	1.15	3	#8 w/GND	276 652 30	
		3P	220	50	Not Available	1.00	3	#8 w/GND	276 682 30	
		3P	220	50	Not Available	1.00	6-90°	#8 w/GND	276 672 30	
		3P	230	60	Not Available	1.15	3	#8 w/GND	276 602 30	
		3P	230	60	Not Available	1.15	6-90°	#8 w/GND	276 722 30	
		3P	380	60	Not Available	1.15	3	#8 w/GND	276 662 30	
		3P	380	60	Not Available	1.15	6-90°	#8 w/GND	276 782 30	
		3P	415	50	Not Available	1.00	3	#8 w/GND	276 692 30	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#8 w/GND	276 612 30	
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#8 w/GND	276 712 30	
		3P	575	60	Not Available	1.15	3	#8 w/GND	276 622 30	
15 hp 11 kW	Water Well With Sand Fighter Seal	3P	200	60	Not Available	1.15	3	#8 w/GND	276 653 00	
		3P	220	50	Not Available	1.00	3	#8 w/GND	276 683 00	
		3P	220	50	Not Available	1.00	6-90°	#8 w/GND	276 673 00	
		3P	230	60	Not Available	1.15	3	#8 w/GND	276 603 00	
		3P	230	60	Not Available	1.15	6-90°	#8 w/GND	276 723 00	
		3P	380	60	Not Available	1.15	3	#8 w/GND	276 663 00	
		3P	380	60	Not Available	1.15	6-90°	#8 w/GND	276 783 00	
		3P	415	50	Not Available	1.00	3	#8 w/GND	276 693 00	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#8 w/GND	276 613 00	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#8 w/GND	276 713 00	
		3P	575	60	Not Available	1.15	3	#8 w/GND	276 623 00	
	316 SS	3P	200	60	Not Available	1.15	3	#8 w/GND	276 653 30	
		3P	220	50	Not Available	1.00	3	#8 w/GND	276 683 30	
		3P	220	50	Not Available	1.00	6-90°	#8 w/GND	276 673 30	
		3P	230	60	Not Available	1.15	3	#8 w/GND	276 603 30	
		3P	230	60	Not Available	1.15	6-90°	#8 w/GND	276 723 30	
		3P	380	60	Not Available	1.15	3	#8 w/GND	276 663 30	
		3P	380	60	Not Available	1.15	6-90°	#8 w/GND	276 783 30	
		3P	415	50	Not Available	1.00	3	#8 w/GND	276 693 30	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#8 w/GND	276 613 30	
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#8 w/GND	276 713 30	
		3P	575	60	Not Available	1.15	3	#8 w/GND	276 623 30	

6" Submersible Motors Hi-Temp 90

Hi-Temp 90 6" Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Wire Size (AWG)		
20 hp 15 kW	Water Well With Sand Fighter Seal	3P	200	60	Not Available	1.15	3	#8 w/GND	276 654 00	
		3P	220	50	Not Available	1.00	3	#8 w/GND	276 684 00	
		3P	220	50	Not Available	1.00	6-90°	#8 w/GND	276 674 00	
		3P	230	60	Not Available	1.15	3	#8 w/GND	276 604 00	
		3P	230	60	Not Available	1.15	6-90°	#8 w/GND	276 724 00	
		3P	380	60	Not Available	1.15	3	#8 w/GND	276 664 00	
		3P	380	60	Not Available	1.15	6-90°	#8 w/GND	276 784 00	
		3P	415	50	Not Available	1.00	3	#8 w/GND	276 694 00	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#8 w/GND	276 614 00	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#8 w/GND	276 714 00	
		3P	575	60	Not Available	1.15	3	#8 w/GND	276 624 00	
	316 SS	3P	200	60	Not Available	1.15	3	#8 w/GND	276 654 30	
		3P	220	50	Not Available	1.00	3	#8 w/GND	276 684 30	
		3P	220	50	Not Available	1.00	6-90°	#8 w/GND	276 674 30	
		3P	230	60	Not Available	1.15	3	#8 w/GND	276 604 30	
		3P	230	60	Not Available	1.15	6-90°	#8 w/GND	276 724 30	
		3P	380	60	Not Available	1.15	3	#8 w/GND	276 664 30	
		3P	380	60	Not Available	1.15	6-90°	#8 w/GND	276 784 30	
		3P	415	50	Not Available	1.00	3	#8 w/GND	276 694 30	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#8 w/GND	276 614 30	
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#8 w/GND	276 714 30	
		3P	575	60	Not Available	1.15	3	#8 w/GND	276 624 30	
25 hp 18.5 kW	Water Well With Sand Fighter Seal	3P	200	60	Not Available	1.15	3	#8 w/GND	276 655 01	
		3P	220	50	Not Available	1.00	3	#8 w/GND	276 685 01	
		3P	220	50	Not Available	1.00	6-90°	#8 w/GND	276 675 01	
		3P	230	60	Not Available	1.15	3	#8 w/GND	276 605 01	
		3P	230	60	Not Available	1.15	6-90°	#8 w/GND	276 725 01	
		3P	380	60	Not Available	1.15	3	#8 w/GND	276 665 01	
		3P	380	60	Not Available	1.15	6-90°	#8 w/GND	276 785 01	
		3P	415	50	Not Available	1.00	3	#8 w/GND	276 695 01	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#8 w/GND	276 615 01	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#8 w/GND	276 715 01	
		3P	575	60	Not Available	1.15	3	#8 w/GND	276 625 01	
	316 SS	3P	200	60	Not Available	1.15	3	#8 w/GND	276 655 31	
		3P	220	50	Not Available	1.00	3	#8 w/GND	276 685 31	
		3P	220	50	Not Available	1.00	6-90°	#8 w/GND	276 675 31	
		3P	230	60	Not Available	1.15	3	#8 w/GND	276 605 31	
		3P	230	60	Not Available	1.15	6-90°	#8 w/GND	276 725 31	
		3P	380	60	Not Available	1.15	3	#8 w/GND	276 665 31	
		3P	380	60	Not Available	1.15	6-90°	#8 w/GND	276 785 31	
		3P	415	50	Not Available	1.00	3	#8 w/GND	276 695 31	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#8 w/GND	276 615 31	
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#8 w/GND	276 715 31	
		3P	575	60	Not Available	1.15	3	#8 w/GND	276 625 31	

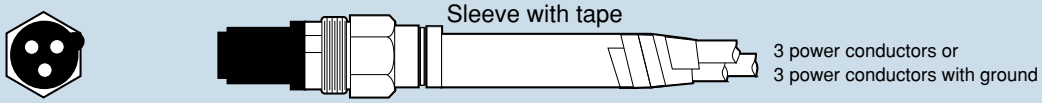
Hi-Temp 90 6" Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Wire Size (AWG)		
30 hp 22 kW	Water Well With Sand Fighter Seal	3P	200	60	Not Available	1.15	3	#8 w/GND	276 656 01	
		3P	220	50	Not Available	1.00	3	#8 w/GND	276 686 01	
		3P	220	50	Not Available	1.00	6-90°	#8 w/GND	276 676 01	
		3P	230	60	Not Available	1.15	3	#8 w/GND	276 606 01	
		3P	230	60	Not Available	1.15	6-90°	#8 w/GND	276 726 01	
		3P	380	60	Not Available	1.15	3	#8 w/GND	276 666 01	
		3P	380	60	Not Available	1.15	6-90°	#8 w/GND	276 786 01	
		3P	415	50	Not Available	1.00	3	#8 w/GND	276 696 01	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#8 w/GND	276 616 01	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#8 w/GND	276 716 01	
		3P	575	60	Not Available	1.15	3	#8 w/GND	276 626 01	
	316 SS	3P	200	60	Not Available	1.15	3	#8 w/GND	276 656 31	
		3P	220	50	Not Available	1.00	3	#8 w/GND	276 686 31	
		3P	220	50	Not Available	1.00	6-90°	#8 w/GND	276 676 31	
		3P	230	60	Not Available	1.15	3	#8 w/GND	276 606 31	
		3P	230	60	Not Available	1.15	6-90°	#8 w/GND	276 726 31	
		3P	380	60	Not Available	1.15	3	#8 w/GND	276 666 31	
		3P	380	60	Not Available	1.15	6-90°	#8 w/GND	276 786 31	
		3P	415	50	Not Available	1.00	3	#8 w/GND	276 696 31	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#8 w/GND	276 616 31	
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#8 w/GND	276 716 31	
		3P	575	60	Not Available	1.15	3	#8 w/GND	276 626 31	
40 hp 30 kW	Water Well With Sand Fighter Seal	3P	380	60	Not Available	1.15	3	#8 w/GND	276 667 01	
		3P	380	60	Not Available	1.15	6-90°	#8 w/GND	276 787 01	
		3P	415	50	Not Available	1.00	3	#8 w/GND	276 697 01	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#8 w/GND	276 617 01	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#8 w/GND	276 717 01	
		3P	575	60	Not Available	1.15	3	#8 w/GND	276 627 01	
	316 SS	3P	380	60	Not Available	1.15	3	#8 w/GND	276 667 31	
		3P	380	60	Not Available	1.15	6-90°	#8 w/GND	276 787 31	
		3P	415	50	Not Available	1.00	3	#8 w/GND	276 697 31	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#8 w/GND	276 617 31	
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#8 w/GND	276 717 31	
		3P	575	60	Not Available	1.15	3	#8 w/GND	276 627 31	

NOTES:

1. All models listed above include leads (13 ft).
2. 6-Lead wye-delta models available in additional voltage ratings. Consult factory for availability.

6” Submersible Motors Leads



6” Lead Construction Material

Component	Material
Wire	XLPE
Sleeve	Brass or 316 SS
Potting	Epoxy
Jam Nut	Brass or 316 SS

Specifications subject to change without notice. Contact Franklin Electric if current material types are required for bid specifications.

Standard XLPE Lead

Excellent resistance to ozone, abrasion, heat and oxidizing chemicals.

6" Submersible Motors Leads

Standard XLPE Lead

Fits FE Motor Rating (460 V or 575 V 60 Hz)	Jam Nut Material	Lead Length		Wire Size (AWG)	Power Wires	FE Part Number	Replacement Kit Number
		FT	M				
All 6" Ratings	Brass	13	4	#8	3 w/GND	152 671 901	305 517 901
	Brass	26	8	#8	3 w/GND	152 671 902	305 517 902
	316 SS	13	4	#8	3 w/GND	152 671 951	305 517 951
	316 SS	26	8	#8	3 w/GND	152 671 952	305 517 952
5-30 hp 3.7-22 kW	316 SS	50	15	#10	3 w/GND	152 672 955	305 518 955
	316 SS	75	23	#10	3 w/GND	152 672 957	305 518 957
	316 SS	100	30	#10	3 w/GND	152 672 960	305 518 960
	316 SS	125	38	#10	3 w/GND	152 672 962	305 518 962
	316 SS	150	45	#10	3 w/GND	152 672 965	305 518 965
5-40 hp 3.7-30 kW	316 SS	50	15	#8	3 w/GND	152 671 955	305 517 955
	316 SS	75	23	#8	3 w/GND	152 671 957	305 517 957
	316 SS	100	30	#8	3 w/GND	152 671 960	305 517 960
	316 SS	125	38	#8	3 w/GND	152 671 962	305 517 962
	316 SS	150	45	#8	3 w/GND	152 671 965	305 517 965

NOTES:

1. Refer to Franklin Application Installation Maintenance (AIM) Manual for accurate cable sizing.
2. MOTOR WARRANTY IS VOID if Franklin-supplied leads are not used.
3. Replacement leads are available in 25 ft increments up to 150 ft. Special-cut lengths may be available at an additional charge. Consult factory for price and availability.

XLPO - Hi-Temp 90 Motors

Fits FE Motor Rating (460 V or 575 V 60 Hz)	Jam Nut Material	Lead Length		Wire Size (AWG)	Power Wires	FE Part Number	Replacement Kit Number
		FT	M				
All 6" Ratings	316 SS	13	4	#8	3 w/GND	152 683 951	305 519 951
	316 SS	26	8	#8	3 w/GND	152 683 952	305 519 952
	316 SS	50	15	#8	3 w/GND	152 683 955	305 519 955
5-40 hp 3.7-30 kW	316 SS	75	23	#8	3 w/GND	152 683 957	305 519 957
	316 SS	100	30	#8	3 w/GND	152 683 960	305 519 960
	316 SS	125	38	#8	3 w/GND	152 683 962	305 519 962
	316 SS	150	45	#8	3 w/GND	152 683 965	305 519 965

NOTES:

1. Refer to Franklin Application Installation Maintenance (AIM) Manual for accurate cable sizing.
2. MOTOR WARRANTY IS VOID if Franklin-supplied leads are not used.

8” Submersible Motors Standard

Applications

These motors are built for dependable operation in vertical 8" diameter or larger water wells.

Basic Features

- Double flanged NEMA mounting design
- Stainless steel splined shaft
- StatorShield™ - Franklin’s six feature encapsulation system
- High capacity Kingsbury-type water lubricated thrust bearing
- Factory filled with Franklin’s non-toxic water soluble fill solution
- Field replaceable lead using Franklin’s exclusive Water Bloc™ technology
- Full 3525 rpm 60 Hz design point
- External sand slinger on shaft
- Mechanical face seal at shaft exit
- Copper bar rotor
- All models suitable for use with variable frequency drives (VFD)
- Franklin’s exclusive on winding SubTrol® heat sensor for use with SubMonitor®

Special Options

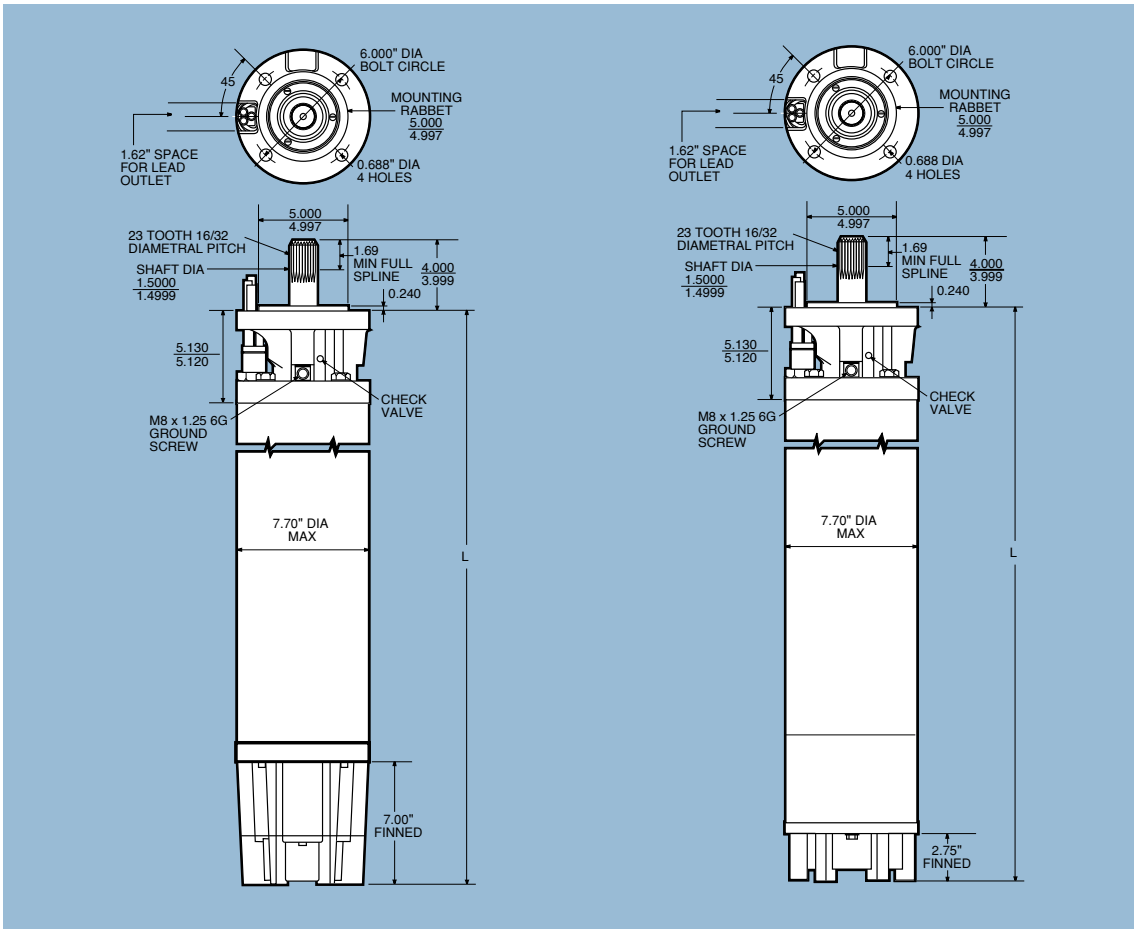
- Sand Fighter® models are equipped with:
  - Franklin’s exclusive Sand Fighter Sealing System for sand or other abrasives well water.
- 316 Stainless Steel construction models come standard with:
  - Franklin’s exclusive Sand Fighter Sealing System for sand or other abrasives well water.
  - Franklin’s exclusive on winding SubTrol™ heat sensor for use with SubMonitor.
- SubMonitor is a state-of-the-art electronic motor overload that is sold separately.
  - Mounts in the above ground panel requiring no additional wiring to the motor.
  - User friendly, field proven.
  - Protection monitors for balanced power, overload, underload, overheating, rapid cycling and more.
  - Supplies superior on winding heat protection when motor manufactured with the Subtrol heat sensor.

Consult factory for other voltage, Hertz and horsepower ratings not listed in this catalog.
Specifications are subject to change without notice. Contact Franklin Electric if current materials are required for bid specifications.

8" Dimensions and Weights

40 hp to 100 hp
Type 2.1

125 hp to 200 hp
Type 1.0



3-Lead Three-Phase Motors

HP	KW	"L" (inches)	Shipping Weight		Motor Carton Size (in inches)
			LBS	KG	
40	30	36.4	320	146	17 x 9.25 x 51
50	37	39.4	345	157	17 x 9.25 x 51
60	45	42.4	375	171	17 x 9.25 x 51
75	55	47.4	430	196	17 x 9.25 x 64
100	75	54.9	530	241	17 x 9.25 x 64
125	93	68.8	700	318	17 x 9.25 x 79
150	110	77.8	840	382	17 x 9.25 x 96
175	130	85.8	945	430	17 x 9.25 x 96
200	150	94.8	1040	473	17 x 9.25 x 108

6-Lead Y-Δ models available. (Add 5 lbs to shipping weight.)

8" Submersible Motors Standard

Standard 8" Three-Phase Motor Specifications

Hz	Phase	Hp Range	kW Range	Poles	RPM	Max. Ambient Temp.	Duty Rating
60	3	40 - 200	30 - 150	2	3525	86 °F / 30 °C	Continuous at 0.5 ft/sec flow past motor
50	3	40 - 200	30 - 150	2	2900	86 °F / 30 °C	Continuous at 0.5 ft/sec flow past motor

Higher temperature ambient motors are available in the 8" Hi-Temp motor line.

Standard 8" Construction Materials

Component	Construction Type		
	Standard Water Well (300 SS Series Shell)	Sand Fighter® Water Well (300 SS Shell)	Corrosion Resistant (316 SS Construction)
Stator Resin Type	FE Standard	Per Standard Water Well	Per Standard Water Well
Motor Fill Solution (Water Soluble/Non-Toxic)	FES91	Per Standard Water Well	Per Standard Water Well
Top End Bell & Thrust Housing	Epoxy Coated Gray Iron	Per Standard Water Well	316 SS
SubTrol® heat sensor (Mounted On Winding)	Yes	Per Standard Water Well	Per Standard Water Well
Stator Shell	300 SS Series	Per Standard Water Well	316 SS
Stator Ends	Carbon Steel	Per Standard Water Well	316 SS
Shaft Extension	17-4 SS	Per Standard Water Well	Per Standard Water Well
Bushing	Bronze	Per Standard Water Well	316 SS
Bushing Retainer	300 SS Series	Per Standard Water Well	316 SS
Shaft Mechanical Seal	Carbon Ceramic Seal (40-125 hp) Sand Fighter Seal System (150-200 hp)	Sand Fighter Seal System	Sand Fighter Seal System
Mechanical Seal Rubber Components	Nitrile	Per Standard Water Well	Per Standard Water Well
Diaphragm Material	Nitrile	Per Standard Water Well	Per Standard Water Well
Diaphragm Plate	300 SS	Per Standard Water Well	316 SS
Diaphragm Spring	300 SS	Per Standard Water Well	316 SS
Shaft Slinger	Nitrile	Per Standard Water Well	Per Standard Water Well
Lead Wire	XLPE (#8 AWG) Hypalon (#4 & #2 AWG)	Per Standard Water Well	Per Standard Water Well
Lead Potting	Epoxy	Per Standard Water Well	Per Standard Water Well
Lead Jam Nut or Compression Plate	Brass Jam Nut (40-125 hp) 316 SS Plate (150-200 hp)	Per Standard Water Well	316 SS Jam Nut (40-125 hp) 316 SS Plate (150-200 hp)
Thrust Bearing Rating (86 °F / 30 °C)	10,000 lbs	Per Standard Water Well	Per Standard Water Well
Method Of Connecting System Ground To Motor	Ground Lug On Top End Bell	Per Standard Water Well	Per Standard Water Well

Specifications subject to change without notice. Contact Franklin Electric if current material types are required for bid specifications.

8" Submersible Motors Standard

8" Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Power Wires		
40 hp 30 kW	Water Well	3P	380	60	Yes	1.15	3	#8 w/o GND	239 660 60	
		3P	380	60	Yes	1.15	6-90°	#8 w/o GND	239 680 20	
		3P	415	50	Yes	1.00	3	#8 w/o GND	239 740 60	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#8 w/o GND	239 600 60	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#8 w/o GND	239 620 20	
		3P	575	60	Yes	1.15	3	#8 w/o GND	239 610 60	
	Sand Fighter	3P	380	60	Yes	1.15	3	#8 w/o GND	239 660 85	
		3P	380	60	Yes	1.15	6-90°	#8 w/o GND	239 680 86	
		3P	415	50	Yes	1.00	3	#8 w/o GND	239 740 85	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#8 w/o GND	239 600 85	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#8 w/o GND	239 620 86	
		3P	575	60	Yes	1.15	3	#8 w/o GND	239 610 85	
	316 SS	3P	380	60	Yes	1.15	3	#8 w/o GND	239 660 62	
		3P	380	60	Yes	1.15	6-90°	#8 w/o GND	239 680 22	
		3P	415	50	Yes	1.00	3	#8 w/o GND	239 740 62	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#8 w/o GND	239 600 62	
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#8 w/o GND	239 620 22	
		3P	575	60	Yes	1.15	3	#8 w/o GND	239 610 62	
50 hp 37 kW	Water Well	3P	380	60	Yes	1.15	3	#8 w/o GND	239 661 60	
		3P	380	60	Yes	1.15	6-90°	#8 w/o GND	239 681 20	
		3P	415	50	Yes	1.00	3	#8 w/o GND	239 741 60	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#8 w/o GND	239 601 60	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#8 w/o GND	239 621 20	
		3P	575	60	Yes	1.15	3	#8 w/o GND	239 611 60	
	Sand Fighter	3P	380	60	Yes	1.15	3	#8 w/o GND	239 661 85	
		3P	380	60	Yes	1.15	6-90°	#8 w/o GND	239 681 86	
		3P	415	50	Yes	1.00	3	#8 w/o GND	239 741 85	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#8 w/o GND	239 601 85	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#8 w/o GND	239 621 86	
		3P	575	60	Yes	1.15	3	#8 w/o GND	239 611 85	
	316 SS	3P	380	60	Yes	1.15	3	#8 w/o GND	239 661 62	
		3P	380	60	Yes	1.15	6-90°	#8 w/o GND	239 681 22	
		3P	415	50	Yes	1.00	3	#8 w/o GND	239 741 62	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#8 w/o GND	239 601 62	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#8 w/o GND	239 621 22	
		3P	575	60	Yes	1.15	3	#8 w/o GND	239 611 62	

8" Submersible Motors Standard

8" Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Power Wires		
60 hp 45 kW	Water Well	3P	380	60	Yes	1.15	3	#8 w/o GND	239 662 60	
		3P	380	60	Yes	1.15	6-90°	#8 w/o GND	239 682 20	
		3P	415	50	Yes	1.00	3	#8 w/o GND	239 742 60	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#8 w/o GND	239 602 60	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#8 w/o GND	239 622 20	Yes
		3P	575	60	Yes	1.15	3	#8 w/o GND	239 612 60	Yes
	Sand Fighter	3P	380	60	Yes	1.15	3	#8 w/o GND	239 662 85	
		3P	380	60	Yes	1.15	6-90°	#8 w/o GND	239 682 86	
		3P	415	50	Yes	1.00	3	#8 w/o GND	239 742 85	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#8 w/o GND	239 602 85	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#8 w/o GND	239 622 86	
		3P	575	60	Yes	1.15	3	#8 w/o GND	239 612 85	
	316 SS	3P	380	60	Yes	1.15	3	#8 w/o GND	239 662 62	
		3P	380	60	Yes	1.15	6-90°	#8 w/o GND	239 682 22	
		3P	415	50	Yes	1.00	3	#8 w/o GND	239 742 62	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#8 w/o GND	239 602 62	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#8 w/o GND	239 622 22	
		3P	575	60	Yes	1.15	3	#8 w/o GND	239 612 62	
75 hp 55 kW	Water Well	3P	380	60	Yes	1.15	3	#4 w/o GND	239 663 60	Yes
		3P	380	60	Yes	1.15	6-90°	#4 w/o GND	239 683 20	
		3P	415	50	Yes	1.00	3	#4 w/o GND	239 743 60	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#4 w/o GND	239 603 60	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#4 w/o GND	239 623 20	Yes
		3P	575	60	Yes	1.15	3	#4 w/o GND	239 613 60	Yes
	Sand Fighter	3P	380	60	Yes	1.15	3	#4 w/o GND	239 663 85	
		3P	380	60	Yes	1.15	6-90°	#4 w/o GND	239 683 86	
		3P	415	50	Yes	1.00	3	#4 w/o GND	239 743 85	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#4 w/o GND	239 603 85	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#4 w/o GND	239 623 86	
		3P	575	60	Yes	1.15	3	#4 w/o GND	239 613 85	
	316 SS	3P	380	60	Yes	1.15	3	#4 w/o GND	239 663 62	
		3P	380	60	Yes	1.15	6-90°	#4 w/o GND	239 683 22	
		3P	415	50	Yes	1.00	3	#4 w/o GND	239 743 62	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#4 w/o GND	239 603 62	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#4 w/o GND	239 623 22	
		3P	575	60	Yes	1.15	3	#4 w/o GND	239 613 62	

8" Submersible Motors Standard

8" Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Power Wires		
100 hp 75 kW	Water Well	3P	380	60	Yes	1.15	3	#4 w/o GND	239 664 60	Yes
		3P	380	60	Yes	1.15	6-90°	#4 w/o GND	239 684 20	
		3P	415	50	Yes	1.00	3	#4 w/o GND	239 744 60	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#4 w/o GND	239 604 60	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#4 w/o GND	239 624 20	Yes
		3P	575	60	Yes	1.15	3	#4 w/o GND	239 614 60	Yes
	Sand Fighter	3P	380	60	Yes	1.15	3	#4 w/o GND	239 664 85	
		3P	380	60	Yes	1.15	6-90°	#4 w/o GND	239 684 86	
		3P	415	50	Yes	1.00	3	#4 w/o GND	239 744 85	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#4 w/o GND	239 604 85	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#4 w/o GND	239 624 86	
		3P	575	60	Yes	1.15	3	#4 w/o GND	239 614 85	
	316 SS	3P	380	60	Yes	1.15	3	#4 w/o GND	239 664 62	
		3P	380	60	Yes	1.15	6-90°	#4 w/o GND	239 684 22	
		3P	415	50	Yes	1.00	3	#4 w/o GND	239 744 62	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#4 w/o GND	239 604 62	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#4 w/o GND	239 624 22	
		3P	575	60	Yes	1.15	3	#4 w/o GND	239 614 62	
125 hp 93 kW	Water Well	3P	380	60	Yes	1.15	3	#4 w/o GND	239 165 60	
		3P	380	60	Yes	1.15	6-90°	#4 w/o GND	239 185 20	
		3P	415	50	Yes	1.00	3	#4 w/o GND	274 365 60	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#4 w/o GND	239 105 60	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#4 w/o GND	239 125 20	Yes
		3P	575	60	Yes	1.15	3	#4 w/o GND	239 115 60	Yes
	Sand Fighter	3P	380	60	Yes	1.15	3	#4 w/o GND	239 165 85	
		3P	380	60	Yes	1.15	6-90°	#4 w/o GND	239 185 86	
		3P	415	50	Yes	1.00	3	#4 w/o GND	239 365 85	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#4 w/o GND	239 105 85	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#4 w/o GND	239 125 86	
		3P	575	60	Yes	1.15	3	#4 w/o GND	239 115 85	
	316 SS	3P	380	60	Yes	1.15	3	#4 w/o GND	239 165 62	
		3P	380	60	Yes	1.15	6-90°	#4 w/o GND	239 185 22	
		3P	415	50	Yes	1.00	3	#4 w/o GND	239 365 62	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#4 w/o GND	239 105 62	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#4 w/o GND	239 125 22	
		3P	575	60	Yes	1.15	3	#4 w/o GND	239 115 62	

8" Submersible Motors Standard

8" Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Power Wires		
150 hp 110 kW	Water Well With Sand Fighter Seal	3P	380	60	Yes	1.15	3	#2 w/o GND	239 166 85	
		3P	380	60	Yes	1.15	6-90°	#4 w/o GND	239 186 86	
		3P	415	50	Yes	1.00	3	#2 w/o GND	239 366 85	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#2 w/o GND	239 106 85	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#4 w/o GND	239 126 86	Yes
		3P	575	60	Yes	1.15	3	#2 w/o GND	239 116 85	Yes
	316 SS	3P	380	60	Yes	1.15	3	#2 w/o GND	239 166 62	
		3P	380	60	Yes	1.15	6-90°	#4 w/o GND	239 186 22	
		3P	415	50	Yes	1.00	3	#2 w/o GND	239 366 62	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#2 w/o GND	239 106 62	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#4 w/o GND	239 126 22	
		3P	575	60	Yes	1.15	3	#2 w/o GND	239 116 62	
175 hp 130 kW	Water Well With Sand Fighter Seal	3P	380	60	Yes	1.15	3	#2 w/o GND	239 167 85	
		3P	380	60	Yes	1.15	6-90°	#4 w/o GND	239 187 86	
		3P	415	50	Yes	1.00	3	#2 w/o GND	239 367 85	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#2 w/o GND	239 107 85	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#4 w/o GND	239 127 86	
		3P	575	60	Yes	1.15	3	#2 w/o GND	239 117 85	
	316 SS	3P	380	60	Yes	1.15	3	#2 w/o GND	239 167 62	
		3P	380	60	Yes	1.15	6-90°	#4 w/o GND	239 187 22	
		3P	415	50	Yes	1.00	3	#2 w/o GND	239 367 62	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#2 w/o GND	239 107 62	
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#4 w/o GND	239 127 22	
		3P	575	60	Yes	1.15	3	#2 w/o GND	239 117 62	
200 hp 150 kW	Water Well With Sand Fighter Seal	3P	380	60	Yes	1.15	3	#2 w/o GND	239 168 85	
		3P	380	60	Yes	1.15	6-90°	#4 w/o GND	239 188 86	
		3P	415	50	Yes	1.00	3	#2 w/o GND	239 368 85	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#2 w/o GND	239 108 85	Yes
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#4 w/o GND	239 128 86	
		3P	575	60	Yes	1.15	3	#2 w/o GND	239 118 85	
	316 SS	3P	380	60	Yes	1.15	3	#2 w/o GND	239 168 62	
		3P	380	60	Yes	1.15	6-90°	#4 w/o GND	239 188 22	
		3P	415	50	Yes	1.00	3	#2 w/o GND	239 368 62	
		3P	460/380-415	60/50	Yes	1.15/1.00	3	#2 w/o GND	239 108 62	
		3P	460/380-415	60/50	Yes	1.15/1.00	6-90°	#4 w/o GND	239 128 22	
		3P	575	60	Yes	1.15	3	#2 w/o GND	239 118 62	

NOTES:

1. Models designated above as Sand Fighter® are water well construction.
2. All 316 SS models are equipped with Sand Fighter sealing system.
3. All models listed above include factory installed leads (13 ft).
4. Motor leads do not include ground.

8" Submersible Motors Hi-Temp 75

Applications

These motors are built for dependable operation in vertical 8" diameter or larger wells, in applications with higher temperature, higher thrust or low flow.

Basic Features

- Able to operate in water temperatures up to 167 °F (75 °C)
- In 86 °F (30 °C) ambient or less they supply 25% more downthrust and upthrust than standard product
- No flow capable when submerged in lakes or wells 14" diameter or larger and water 86 °F or less
- Double flanged NEMA mounting design
- Stainless steel splined shaft
- StatorShield™ - Franklin's six feature encapsulation system
- High capacity Kingsbury-type water lubricated thrust bearing
- Factory filled with Franklin's non-toxic water soluble fill solution
- Field replaceable lead using Franklin's exclusive Water Bloc™ technology
- Full 3525 rpm 60 Hz design point
- External sand slinger on shaft
- Sand Fighter® mechanical face seal system at shaft exit
- Copper bar rotor
- All models suitable for use with variable frequency drives (VFD)

Special Options

- SubMonitor® is a state-of-the-art electronic motor overload that is sold separately.
  - Mounts in the above ground panel requiring no additional wiring to the motor.
  - User friendly, field proven.
  - Protection monitors for balanced power, overload, underload, overheating, rapid cycling and more.
  - Subtrol heat sensor not available with High-Temp 75 motor.

Consult factory for other voltage, Hertz and horsepower ratings not listed in this catalog.
Specifications are subject to change without notice. Contact Franklin Electric if current materials are required for bid specifications.

8" Submersible Motors Hi-Temp 75

Hi-Temp 75 8" Three-Phase Motor Specifications

Hz	Phase	Hp Range	kW Range	Poles	RPM	Max. Ambient Temp.	Duty Rating
60	3	40 - 150	30 - 110	2	3525	167 °F / 75 °C	Continuous at 0.5 ft/sec flow past motor*
50	3	40 - 150	30 - 110	2	2900	167 °F / 75 °C	Continuous at 0.5 ft/sec flow past motor*

* Motors are also rated for continuous duty in 86 °F (30 °C) maximum water temperature with No FLOW in lakes or in wells 14 inches or larger in diameter.

Hi-Temp 75 8" Construction Materials

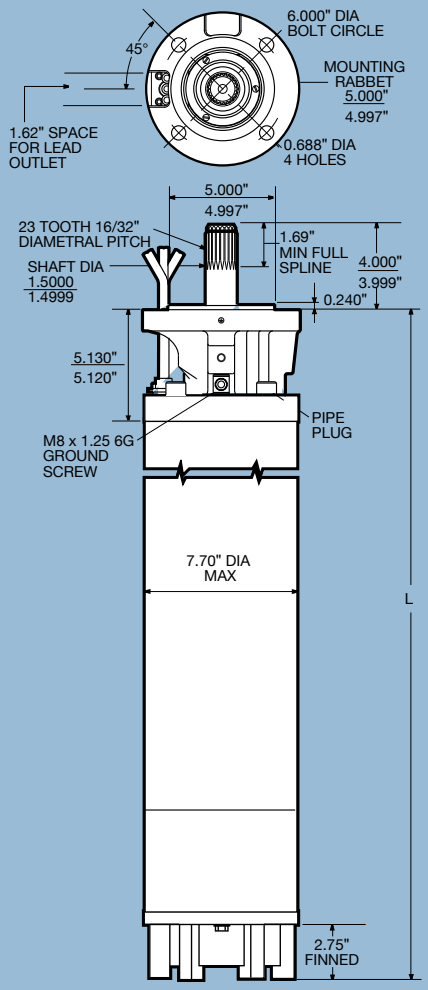
Component	Construction Type	
	Hi-Temp 75 (300 SS Series Shell)	Hi-Temp 75 (316 SS Construction)
UL Insulation Class Rating	Class F	Class F
Motor Ambient Temperature Rating	167 °F / 75 °C	167 °F / 75 °C
Stator Resin Type	FE Hi-Temp	FE Hi-Temp
Motor Fill Solution (Water Soluble/Non-Toxic)	FES92	FES92
Top End Bell & Thrust Housing	Epoxy Coated Gray Iron	316 SS
SubTrol® heat sensor (Mounted On Winding)	No	No
Stator Shell	300 SS Series	316 SS
Stator Ends	Carbon Steel	316 SS
Shaft Extension	17-4 SS	17-4 SS
Bushing	Bronze	316 SS
Bushing Retainer	300 SS Series	316 SS
Shaft Mechanical Seal	Sand Fighter® Seal System	Sand Fighter Seal System
Mechanical Seal Rubber Components	Viton®	Viton®
Diaphragm Material	Viton®	Viton®
Diaphragm Plate	316 SS	316 SS
Diaphragm Spring	316 SS	316 SS
Shaft Slinger	Viton®	Viton®
Lead Wire	XLPO	XLPO
Lead Potting	Epoxy	Epoxy
Lead Jam Nut or Compression Plate	316 SS Plate (150-200 hp)	316 SS Plate (150-200 hp)
Thrust Bearing Rating (86 °F / 30 °C)	12,500 lbs (86 °F / 30 °C) 10,000 lbs (167 °F / 75 °C)	12,500 lbs (86 °F / 30 °C) 10,000 lbs (167 °F / 75 °C)
Method Of Connecting System Ground To Motor	Ground Lug On Top End Bell	Ground Lug On Top End Bell

Specifications subject to change without notice. Contact Franklin Electric if current material types are required for bid specifications.

Viton® is a registered trademark of DuPont Dow Elastomers.

8" Hi-Temp 75 Dimensions and Weights

40 hp to 150 hp
Type 1.0



Three-Phase Motors

HP	KW	"L" (inches)	Shipping Weight LBS	Shipping Weight KG	Motor Carton Size (in inches)
40	30	44.8	400	181	17 x 9.25 x 51
50	37	49.8	455	206	17 x 9.25 x 64
60	45	57.3	555	252	17 x 9.25 x 64
75	55	68.8	700	318	17 x 9.25 x 79
100	75	77.8	840	382	17 x 9.25 x 96
125	93	85.8	945	430	17 x 9.25 x 96
150	110	94.8	1040	473	17 x 9.25 x 108

8" Submersible Motors Hi-Temp 75

8" Hi-Temp 75 Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Wire Size		
40 hp 30 kW	Water Well With Sand Fighter Seal	3P	380	60	Not Available	1.15	3	#2 w/o GND	279 160 90	
		3P	380	60	Not Available	1.15	6-90°	#2 w/o GND	279 180 90	
		3P	415	50	Not Available	1.00	3	#2 w/o GND	279 360 90	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#2 w/o GND	279 100 90	
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#2 w/o GND	279 120 90	
		3P	575	60	Not Available	1.15	3	#2 w/o GND	279 110 90	
	316 SS	3P	380	60	Not Available	1.15	3	#2 w/o GND	279 160 92	
		3P	380	60	Not Available	1.15	6-90°	#2 w/o GND	279 180 92	
		3P	415	50	Not Available	1.00	3	#2 w/o GND	279 360 92	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#2 w/o GND	279 100 92	
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#2 w/o GND	279 120 92	
		3P	575	60	Not Available	1.15	3	#2 w/o GND	279 110 92	
50 hp 37 kW	Water Well With Sand Fighter Seal	3P	380	60	Not Available	1.15	3	#2 w/o GND	279 161 90	
		3P	380	60	Not Available	1.15	6-90°	#2 w/o GND	279 181 90	
		3P	415	50	Not Available	1.00	3	#2 w/o GND	279 361 90	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#2 w/o GND	279 101 90	
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#2 w/o GND	279 121 90	
		3P	575	60	Not Available	1.15	3	#2 w/o GND	279 111 90	
	316 SS	3P	380	60	Not Available	1.15	3	#2 w/o GND	279 161 92	
		3P	380	60	Not Available	1.15	6-90°	#2 w/o GND	279 181 92	
		3P	415	50	Not Available	1.00	3	#2 w/o GND	279 361 92	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#2 w/o GND	279 101 92	
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#2 w/o GND	279 121 92	
		3P	575	60	Not Available	1.15	3	#2 w/o GND	279 111 92	
60 hp 45 kW	Water Well With Sand Fighter Seal	3P	380	60	Not Available	1.15	3	#2 w/o GND	279 162 90	
		3P	380	60	Not Available	1.15	6-90°	#2 w/o GND	279 182 90	
		3P	415	50	Not Available	1.00	3	#2 w/o GND	279 362 90	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#2 w/o GND	279 102 90	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#2 w/o GND	279 122 90	
		3P	575	60	Not Available	1.15	3	#2 w/o GND	279 112 90	
	316 SS	3P	380	60	Not Available	1.15	3	#2 w/o GND	279 162 92	
		3P	380	60	Not Available	1.15	6-90°	#2 w/o GND	279 182 92	
		3P	415	50	Not Available	1.00	3	#2 w/o GND	279 362 92	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#2 w/o GND	279 102 92	
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#2 w/o GND	279 122 92	
		3P	575	60	Not Available	1.15	3	#2 w/o GND	279 112 92	

8" Hi-Temp 75 Models

HP (KW)	Construction	Description							Model	Stock Status
		PH	Volts	HZ	Subtrol Heat Sensor	S.F.	# Leads	Wire Size		
75 hp 55 kW	Water Well With Sand Fighter Seal	3P	380	60	Not Available	1.15	3	#2 w/o GND	279 163 90	
		3P	380	60	Not Available	1.15	6-90°	#2 w/o GND	279 183 90	
		3P	415	50	Not Available	1.00	3	#2 w/o GND	279 363 90	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#2 w/o GND	279 103 90	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#2 w/o GND	279 123 90	
		3P	575	60	Not Available	1.15	3	#2 w/o GND	279 113 90	
	316 SS	3P	380	60	Not Available	1.15	3	#2 w/o GND	279 163 92	
		3P	380	60	Not Available	1.15	6-90°	#2 w/o GND	279 183 92	
		3P	415	50	Not Available	1.00	3	#2 w/o GND	279 363 92	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#2 w/o GND	279 103 92	
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#2 w/o GND	279 123 92	
		3P	575	60	Not Available	1.15	3	#2 w/o GND	279 113 92	
100 hp 75 kW	Water Well With Sand Fighter Seal	3P	380	60	Not Available	1.15	3	#2 w/o GND	279 164 90	
		3P	380	60	Not Available	1.15	6-90°	#2 w/o GND	279 184 90	
		3P	415	50	Not Available	1.00	3	#2 w/o GND	279 364 90	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#2 w/o GND	279 104 90	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#2 w/o GND	279 124 90	
		3P	575	60	Not Available	1.15	3	#2 w/o GND	279 114 90	
	316 SS	3P	380	60	Not Available	1.15	3	#2 w/o GND	279 164 92	
		3P	380	60	Not Available	1.15	6-90°	#2 w/o GND	279 184 92	
		3P	415	50	Not Available	1.00	3	#2 w/o GND	279 364 92	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#2 w/o GND	279 104 92	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#2 w/o GND	279 124 92	
		3P	575	60	Not Available	1.15	3	#2 w/o GND	279 114 92	
125 hp 93 kW	Water Well With Sand Fighter Seal	3P	380	60	Not Available	1.15	3	#2 w/o GND	279 165 90	
		3P	380	60	Not Available	1.15	6-90°	#2 w/o GND	279 185 90	
		3P	415	50	Not Available	1.00	3	#2 w/o GND	279 365 90	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#2 w/o GND	279 105 90	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#2 w/o GND	279 125 90	
		3P	575	60	Not Available	1.15	3	#2 w/o GND	279 115 90	
	316 SS	3P	380	60	Not Available	1.15	3	#2 w/o GND	279 165 92	
		3P	380	60	Not Available	1.15	6-90°	#2 w/o GND	279 185 92	
		3P	415	50	Not Available	1.00	3	#2 w/o GND	279 365 92	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#2 w/o GND	279 105 92	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#2 w/o GND	279 125 92	
		3P	575	60	Not Available	1.15	3	#2 w/o GND	279 115 92	
150 hp 110 kW	Water Well With Sand Fighter Seal	3P	380	60	Not Available	1.15	3	#2 w/o GND	279 166 90	
		3P	380	60	Not Available	1.15	6-90°	#2 w/o GND	279 186 90	
		3P	415	50	Not Available	1.00	3	#2 w/o GND	279 366 90	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#2 w/o GND	279 106 90	Yes
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#2 w/o GND	279 126 90	
		3P	575	60	Not Available	1.15	3	#2 w/o GND	279 116 90	
	316 SS	3P	380	60	Not Available	1.15	3	#2 w/o GND	279 166 92	
		3P	380	60	Not Available	1.15	6-90°	#2 w/o GND	279 186 92	
		3P	415	50	Not Available	1.00	3	#2 w/o GND	279 366 92	
		3P	460/380-415	60/50	Not Available	1.15/1.00	3	#2 w/o GND	279 106 92	
		3P	460/380-415	60/50	Not Available	1.15/1.00	6-90°	#2 w/o GND	279 126 92	
		3P	575	60	Not Available	1.15	3	#2 w/o GND	279 116 92	

NOTES: 1. All models listed above include leads (13 ft). 2. Motor leads do not include ground.

8" Submersible Motor Leads

FIGURE 1: Standard 8 AWG Lead

Motor construction for 40, 50 & 60 hp

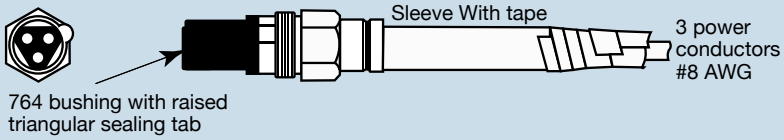


FIGURE 2: Standard 4 AWG Lead

Motor construction for 75, 100 & 125 hp

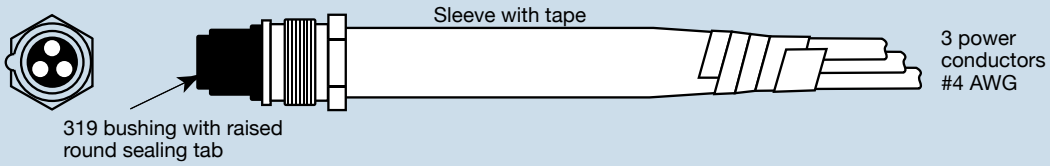


FIGURE 3: Standard 2 AWG Lead

Motor construction for 150, 175 & 200 hp lead clamping plate is a separate part and can be reused

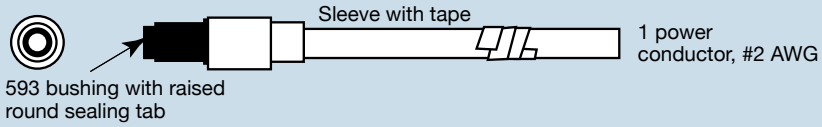
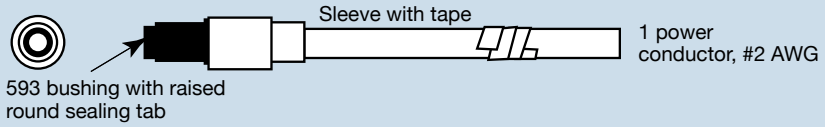


Figure	Fits FE Motor Rating (460 V or 575 V 60 Hz)	Jam Nut Material	Lead Length		Wire Size (AWG)	Power Conductor Per Connector	FE Part Number	Replacement Kit Number
			FT	M				
1	40-60 hp 30-45 kW	Brass	13	4	#8	3 (1 Shipped) No Ground	152 698 901	305 516 901
		Brass	26	8	#8	3 (1 Shipped) No Ground	152 698 902	305 516 902
		316 SS	13	4	#8	3 (1 Shipped) No Ground	152 698 950	305 516 950
		316 SS	26	8	#8	3 (1 Shipped) No Ground	152 698 951	305 516 951
2	75-125 hp 55-93 kW	Brass	13	4	#4	3 (1 Shipped) No Ground	165 238 901	305 210 901
		Brass	26	8	#4	3 (1 Shipped) No Ground	165 238 924	305 210 924
		316 SS	13	4	#4	3 (1 Shipped) No Ground	165 238 903	305 210 903
		316 SS	26	8	#4	3 (1 Shipped) No Ground	165 238 928	305 210 928
3	150-200 hp 110-150 kW	316 SS	13	4	#2	1 (3 Shipped) No Ground	165 617 901	305 315 901
		316 SS	26	8	#2	1 (3 Shipped) No Ground	165 617 902	305 315 902

FIGURE 4: Hi-Temp 75C

Motor construction for all hp lead clamping plate is a separate part and can be reused



8" 125 °C XLPO Hi-Temp 75C and Booster Motor Leads

Fits FE Motor Rating (460 V Or 575 V 60 Hz)	Jam Nut Material	Lead Length		Wire Size (AWG)	Power Wires	FE Part Number	Replacement Kit Number
		FT	M				
All Ratings	316 SS	13	4	#2	1 (3 Shipped) No Ground	165 617 901	305 315 901
	316 SS	26	8	#2	1 (3 Shipped) No Ground	165 617 902	305 315 902

8" Lead Construction Materials

Component	Material
Wire	RHW Hypalon 75°, or XLPO 125 ˚C
Sleeve	Brass or 316 SS
Potting	Epoxy
Jam Nut or Clamp Plate	Brass or 316 SS

Specifications subject to change without notice. Contact Franklin Electric if current material types are required for bid specifications.

Submersible Motor Control Boxes

Applications

QUICK DISCONNECT (QD) & CAPACITOR RUN CONTROL (CRC) – These control boxes are designed for use with Franklin 3-wire single-phase submersible motors through 1 hp.

STANDARD & DELUXE – These control boxes are designed for use with Franklin 3-wire single-phase submersible motors from 1 through 15 hp. Recommended for water systems that use pressure switches, level switches, or other pilot devices. Deluxe boxes (only) contain magnetic line contactors carefully matched to the motor rating, eliminating the need for external line contactors.

Basic Features – All Boxes

- Suitable for outdoor mounting
- Capacitor Start / Capacitor Run design (except QD boxes)
- UL Listed for US and Canada (60 Hz models)

Basic Features – Standard & Deluxe Boxes

- Heavy duty box-type terminals accept up to AWG #2 wire
- External access to overload resets
- Multiple-size knockouts
- User-friendly connection diagrams
- Easy access to grounding lugs

Single-Phase Control Box Specifications

Box Type	HZ	Hp Range	Kw Range	Enclosure	Terminal Block		Mag Contactor	Agency Approvals
					Terminals	Max Wire		
Quick Disconnect (QD)	60	1/3 - 1	0.25 - 0.75	NEMA 3R, IP23	5	AWG 10	No	UL listed for US and Canada
Quick Disconnect (QD)	50	1/3 - 1	0.25 - 0.75	NEMA 3R, IP23	5	AWG 10	No	CSA Certified
Capacitor Run Control (CRC)	60	1/2 - 1	0.37 - 0.75	NEMA 3R, IP23	5	AWG 10	No	UL listed for US and Canada
Standard (S)	60	1 - 10	0.75 - 7.5	NEMA 3R, IP23	5	AWG 2	No	UL listed for US and Canada
Standard (S)	50	1.5 - 5	0.75 - 3.7	NEMA 3R, IP23	5	AWG 2	No	CSA Certified
Deluxe (D)	60	2 - 15	1.5 - 11	NEMA 3R, IP23	6	AWG 2	Yes	UL listed for US and Canada
Extra Large Deluxe (D-XL)	60	15	11	NEMA 3R, IP23	5	AWG 00	Yes	UL listed for US and Canada

Submersible Motor Control Boxes

Enclosure – Quick Disconnect (QD) & Capacitor Run Control (CRC) Boxes

- **Knockouts:**
  - Bottom: Two 0.88" knockouts and one 1.31" knockout.
  - Side: One 0.88" knockout and one 1.31" knockout on each side.
- **Terminal Block:** five terminals provided for wiring up to AWG #10 wire.

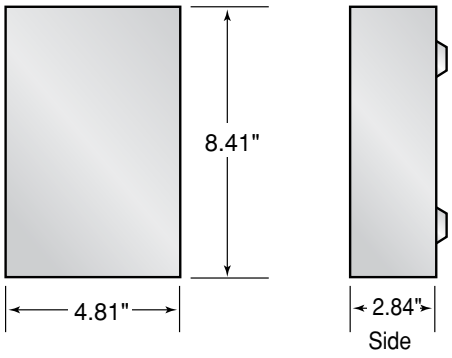
Quick Disconnect (QD) Control Boxes

HP	KW	Shipping Weight		Motor Carton Size (in inches)	Enc. Size
		LBS	KG		
1/3	0.25	4	1.8	5.5 x 3.25 x 9	QD
1/2	0.37	4	1.8	5.5 x 3.25 x 9	QD
3/4	0.55	4	1.8	5.5 x 3.25 x 9	QD
1	0.75	4	1.8	5.5 x 3.25 x 9	QD

Capacitor Run Control (CRC) Boxes

HP	KW	Shipping Weight		Motor Carton Size (in inches)	Enc. Size
		LBS	KG		
1/2	0.37	5	2.3	5.5 x 3.25 x 9	QD
3/4	0.55	5	2.3	5.5 x 3.25 x 9	QD
1	0.75	5	2.3	5.5 x 3.25 x 9	QD

QD Box Dimensions



Submersible Motor Control Boxes

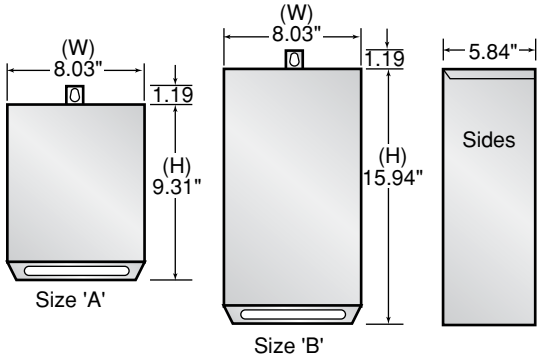
Enclosure – Standard & Deluxe Boxes

- **Knockouts:** Two 1.31" diameter holes for 1" conduit connection. One 1.75" knockout for 1.25" conduit. One 0.88" knockout for 0.5" conduit connection.
- **Terminal Block:** six terminals provided for wiring up to AWG 2 wire.

Standard Control Boxes

HP	KW	Shipping Weight LBS	Shipping Weight KG	Motor Carton Size (in inches)	Enc. Size
1.5	1.1	7	3.2	8.125 x 6.25 x 11.25	A
2	1.5	7	3.2	8.125 x 6.25 x 11.25	A
3	2.2	7	3.2	8.125 x 6.25 x 11.25	A
5 (60 Hz)	3.7	8	3.6	8.125 x 6.25 x 11.25	A
5 (50 Hz)	3.7	8	3.6	8.125 x 6.25 x 18	B
7.5	5.5	12	5.5	8.125 x 6.25 x 18	B
10	7.5	14	6.4	8.125 x 6.25 x 18	B

Standard & Deluxe Dimensions



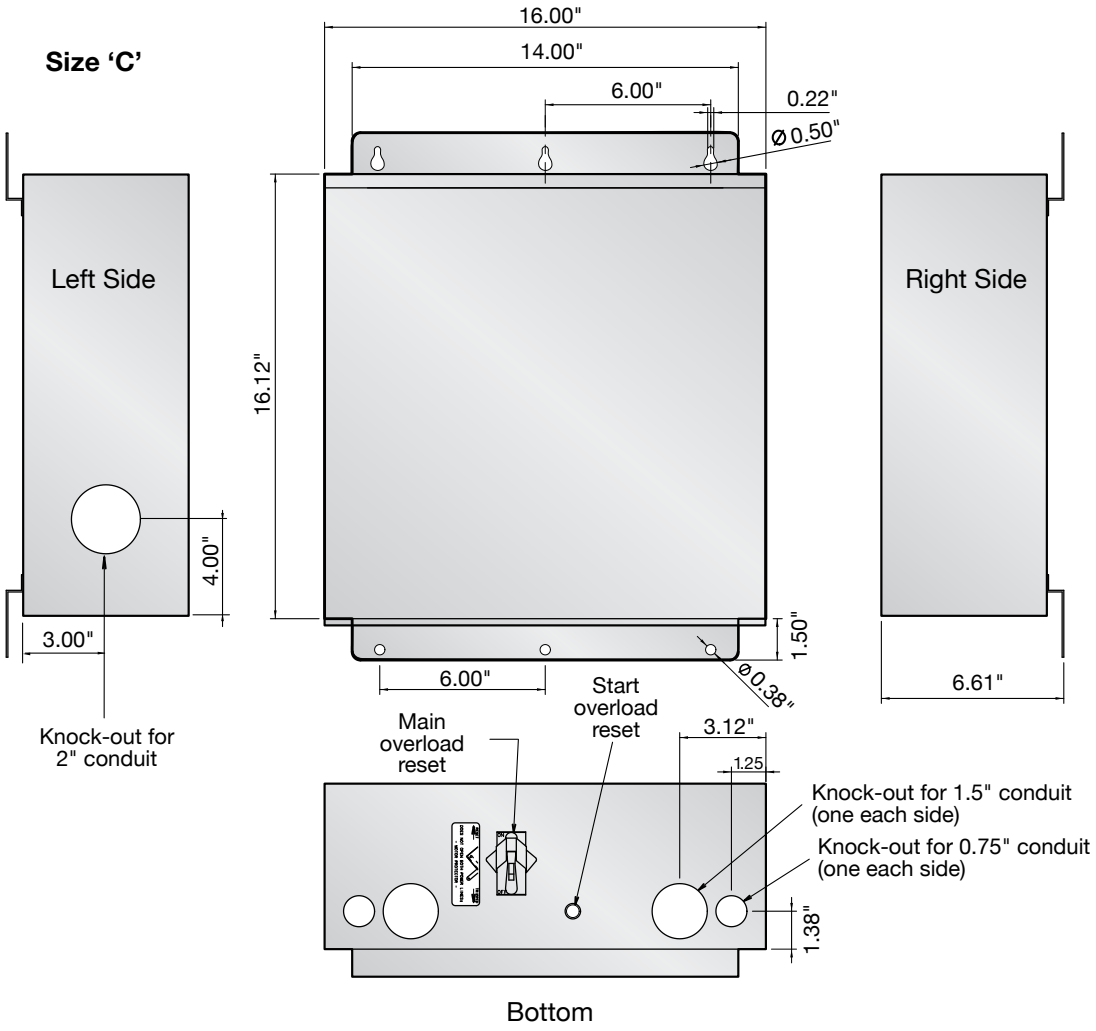
Deluxe Control Boxes

HP	KW	Shipping Weight LBS	Shipping Weight KG	Motor Carton Size (in inches)	Enc. Size
2	1.5	7.0	3.2	8.125 x 6.25 x 11.25	A
3	2.2	7.3	3.3	8.125 x 6.25 x 11.25	A
5	3.7	11.2	5.1	8.125 x 6.25 x 18	B
7.5	5.5	13.1	6.0	8.125 x 6.25 x 18	B
10	7.5	14.7	6.7	8.125 x 6.25 x 18	B
15	11	16.5	7.5	8.125 x 6.25 x 18	B
15 (XL)	11	28.0	12.7	16 x 7.125 x 19	C

Enclosure – Extra Large Deluxe (D-XL) Boxes

- **Knockouts:**
  - Bottom: two knockouts for 0.75" conduit, and two for 1.5" conduit.
  - Side: one knockout for 2" conduit.
- **Terminal Block:** two terminals provided for incoming power and three terminals provided for drop cable for conductors from AWG 14 to 00.
- **Control Switch Terminal Block:** accepts conductors from AWG 20 to 6.

Size 'C'



Submersible Motor Control Boxes

Control Box Models

HP (KW)	Description				Model	Stock Status
	PH	Volts	HZ	Type		
⅓ hp (0.25 kW)	1P	115	60	Q	280 102 4915	Yes
	1P	220	50	Q	280 353 0115	Yes
	1P	230	60	Q	280 103 4915	Yes
½ hp (0.37 kW)	1P	115	60	Q	280 104 4915	Yes
	1P	220	50	Q	280 355 0115	Yes
	1P	230	60	Q	280 105 4915	Yes
	1P	230	60	CRC	282 405 5015	Yes
¾ hp (0.55 kW)	1P	220	50	Q	280 357 0115	Yes
	1P	230	60	Q	280 107 4915	Yes
	1P	230	60	CRC	282 407 5015	Yes
1 hp (0.75 kW)	1P	220	50	Q	280 358 0115	Yes
	1P	230	60	Q	280 108 4915	Yes
	1P	230	60	CRC	282 408 5015	Yes
1.5 hp (1.1 kW)	1P	220	50	S	282 350 8110	Yes
	1P	230	60	S	282 300 8110	Yes
2 hp (1.5 kW)	1P	220	50	S	282 351 8110	Yes
	1P	230	60	S	282 301 8110	Yes
	1P	230	60	D	282 301 8310	Yes
3 hp (2.2 kW)	1P	220	50	S	282 352 8110	Yes
	1P	230	60	S	282 302 8110	Yes
	1P	230	60	D	282 302 8310	Yes
5 hp (3.7 kW)	1P	220	50	S	282 253 9010	Yes
	1P	230	60	S	282 113 8110	Yes
	1P	230	60	D	282 113 9310	Yes
7.5 hp (5.5 kW)	1P	230	60	S	282 201 9210	Yes
	1P	230	60	D	282 201 9310	Yes
10 hp (7.5 kW)	1P	230	60	S	282 202 9230	Yes
	1P	230	60	D	282 202 9330	Yes
15 hp (11 kW)	1P	230	60	D	282 203 9330	Yes
	1P	230	60	D-XL	282 203 9621	Yes

NOTES:

Q = Quick Disconnect Control Box
CRC = Capacitor Run Control Box
S = Standard Control Box
D = Deluxe Control Box
D-XL = Extra Large Deluxe Control Box

Control Box Parts

QD Service Box

Applications

Franklin Electric's QD service box is a service tool that provides capability to measure motor amps and line voltage with the motor running. The QD service box fits between the base and cover of an installed QD control box.

Features

- Compatible with any Franklin Electric QD or CRC control box
- Meter jacks for measuring voltage while the motor is running
- Clamp-on ammeter access to all three motor leads for installations with jackted cable or conduit
- Easy to use

Compatible With	Part Number
All QD & CRC Control Box Ratings	305 510 901

QD Control Box Parts - 60 Hz

HP Voltage Model No.	Rating	No. Req.	Component Part No.	Kit Order No.
1/3 hp - 115 V 280 102 4915	Start Capacitor 159-191 MFD, 110 V	1	275 464 125	305 207 925
	QD Relay	1	223 415 905	305 101 905
1/3 hp - 230 V 280 103 4915	Start Capacitor 43-53 MFD, 220 V	1	275 464 126	305 207 926
	QD Relay	1	223 415 901	305 101 901
1/2 hp - 115 V 280 104 4915	Start Capacitor 250-300 MFD, 125 V	1	275 464 201	305 207 951
	QD Relay	1	223 415 906	305 101 906
1/2 hp - 230 V 280 105 4915	Start Capacitor 59-71 MFD, 220 V	1	275 464 105	305 207 905
	QD Relay	1	223 415 902	305 101 902
3/4 hp - 230 V 280 107 4915	Start Capacitor 86-103 MFD, 220 V	1	275 464 118	305 207 918
	QD Relay	1	223 415 903	305 101 903
1 hp - 230 V 280 108 4915	Start Capacitor 105-126 MFD, 220 V	1	275 464 113	305 207 913
	QD Relay	1	223 415 904	305 101 904
1/2 hp - 230 V CRC 282 405 5015	Start Capacitor 43-53 MFD, 220 V	1	275 464 126	305 207 926
	Run Capacitor 15 MFD, 370 V	1	156 362 101	305 203 907
	QD Relay	1	223 415 912	305 105 901
3/4 hp - 230 V CRC 282 407 5015	Start Capacitor 59-71 MFD, 220 V	1	275 464 105	305 207 905
	Run Capacitor 23 MFD, 370 V	1	156 362 102	305 203 908
	QD Relay	1	223 415 913	305 105 902
1 hp - 230 V CRC 282 408 5015	Start Capacitor 86-103 MFD, 220 V	1	275 464 118	305 207 918
	Run Capacitor 23 MFD, 370 V	1	156 362 102	305 203 908
	QD Relay	1	223 415 914	305 105 903

Submersible Motor Control Boxes

QD Control Box Parts - 50 Hz

HP Voltage Model No.	Rating	No. Req.	Component Part No.	Kit Order No.
1/3 hp - 220 V 280 353 0115	Start Capacitor 43-53 MFD, 220 V	1	275 461 123	305 205 923
	Capacitor Overload Assembly	1	151 033 957	305 218 957
	Relay 220 V	1	155 031 112	305 213 912
1/2 hp - 220 V 280 355 0115	Start Capacitor 43-53 MFD, 220 V	1	275 461 123	305 205 923
	Capacitor Overload Assembly	1	151 033 957	305 218 957
	Relay 220 V	1	155 031 112	305 213 912
3/4 hp - 220 V 280 357 0115	Start Capacitor 59-71 MFD, 220 V	1	275 461 108	305 205 908
	Capacitor Overload Assembly	1	151 033 918	305 218 918
	Relay 220 V	1	155 031 112	305 213 912
1 hp - 220 V 280 358 0115	Start Capacitor 86-103 MFD, 220V	1	275 461 106	305 205 906
	Capacitor Overload Assembly	1	151 033 906	305 218 906
	Relay 220 V	1	155 031 112	305 213 912

Replacement Parts for Older Style QD Control Boxes

Description	Rating	No. Req.	Component Part No.	Kit Order No.
Voltage Relay Kit	115 Volt with bracket and screws	1	155 031 901	305 102 901
	230 Volt with bracket and screws	1	155 031 902	305 102 902
	208 Volt with bracket and screws	1	155 031 903	305 102 903
Capacitor Overload Assembly	1/3 hp, 115 Volt	1	151 033 973	305 218 973
	1/3 hp, 230 Volt	1	151 033 974	305 218 974
	1/2 hp, 115 Volt	1	151 033 975	305 218 975
	1/2 hp, 230 Volt	1	151 033 976	305 218 976
	3/4 hp, 230 Volt	1	151 033 978	305 218 978
	1 hp, 230 Volt	1	151 033 979	305 218 979
	1.5 hp, 230 Volt	1	151 033 980	305 218 980
Overload Kit	1/3 hp, 115 Volt	1	NA	305 100 901
	1/3 hp, 230 Volt	1	NA	305 100 902
	1/2 hp, 115 Volt	1	NA	305 100 903
	1/2 hp, 230 Volt	1	NA	305 100 904
	3/4 hp, 230 Volt	1	NA	305 100 905
	1 hp, 230 Volt	1	NA	305 100 906

NOTE: Some Franklin motors, controls and parts are not stock items and may need to be special ordered.

Control Box Parts

Standard Control Box Parts - 60 Hz

HP Size Model No.	Rating	No. Req.	Component Part No.	Kit Order No.
1/1.5 hp - 4" 282 300 8110	Start Capacitor 105-126 MFD, 220 V	1	275 464 113	305 207 913
	Run Capacitor 15 MFD, 370 V	1	155 328 101	305 204 901
	Start Overload	1	275 411 114	305 215 914
	Start Overload	1	275 411 113	305 215 913
	Relay - 230 V*	1	155 031 102	305 213 902
2 hp - 4" 282 301 8110	Start Capacitor 105-126 MFD, 220 V	1	275 464 113	305 207 913
	Run Capacitor 20 MFD, 370 V	1	155 328 103	305 204 903
	Start Overload	1	275 411 117	305 215 917
	Run Overload	1	275 411 113	305 215 913
	Relay - 230 V*	1	155 031 102	305 213 902
3 hp - 4" 2823028110	Start Capacitor 208-250 MFD, 220 V	1	275 463 123	305 206 923
	Run Capacitor 45 MFD, 370 V	1	155 327 109	305 203 909
	Start Overload	1	275 411 118	305 215 918
	Run Overload	1	275 411 115	305 215 915
	Relay - 230 V*	1	155 031 102	305 213 902
5 hp - 4" & 6" 282 113 8110	Start Capacitor 270-324 MFD, 330 V	1	275 468 119	305 208 919
	Run Capacitor 40 MFD, 370 V	2	155 327 114	305 203 914
	Start Overload	1	275 411 119	305 215 919
	Run Overload	1	275 406 102	305 214 902
	Relay - 230V*	1	155 031 601	305 213 961
7.5 hp - 6" 282 201 9210	Start Capacitor 270-324 MFD, 330 V	1	275 468 119	305 208 919
	Start Capacitor 216-259 MFD, 330 V	1	275 468 118	305 208 918
	Run Capacitor 45 MFD, 370 V	1	155 327 109	305 203 909
	Start Overload	1	275 411 102	305 215 902
	Run Overload	1	275 406 122	305 214 922
	Relay - 230V*	1	155 031 601	305 213 961
10 hp - 6" 282 202 9230	Start Capacitor 270-324 MFD, 330 V	1	275 468 119	305 208 919
	Start Capacitor 130-154 MFD, 330 V	1	275 463 120	305 206 920
	Start Capacitor 216-259 MFD, 330 V	1	275 468 118	305 208 918
	Run Capacitor 35 MFD, 370 V	2	155 327 102	305 203 902
	Start Overload	1	275 406 103	305 214 903
	Run Overload	1	155 409 101	155 409 101
	Relay - 230V*	1	155 031 601	305 213 961
All	Lightning Arrestor	1	150 814 902	150 814 902
208 V Relay *	Relay 1.5-3 hp (replaces 155031102)	1	155 031 103	305 213 903
	Relay 5-15 hp (replaces 155031601)	1	155 031 602	305 213 904

Standard Control Box Parts - 50 Hz

HP Voltage Model No.	Rating	No. Req.	Component Part No.	Kit Order No.
1.5 hp - 220 V 282 350 8110	Start Capacitor 105-126 MFD, 220 V	1	275 464 113	305 207 913
	Run Capacitor 10 MFD, 370 V	1	155 328 102	305 203 909
	Overload Assembly - Run	1	275 411 114	305 215 914
	Relay 220 V	1	155 031 112	305 213 912
2 hp - 220 V 282 351 8110	Start Capacitor 189-227 MFD, 220 V	1	275 468 115	305 208 915
	Run Capacitor 20 MFD, 370V	1	155 328 103	305 204 903
	Overload Assembly - Run	1	275 411 102	305 215 902
	Overload Assembly - Start	1	275 411 106	305 215 906
	Relay 220 V	1	155 031 112	305 213 912
3 hp - 220 V 282 352 8110	Start Capacitor 270-324 MFD, 220 V	1	275 468 119	305 208 919
	Run Capacitor 35 MFD, 370 V	1	155 327 102	305 203 902
	Overload Assembly - Run	1	275 406 107	305 214 907
	Overload Assembly - Start	1	275 411 107	305 215 907
	Relay 220 V	1	155 031 112	305 213 912
5 hp - 220 V 282 253 9010	Start Capacitor 189-227 MFD, 220 V	2	275 468 115	305 208 915
	Run Capacitor 30 MFD, 220 V	1	155 327 101	305 203 901
	Run Capacitor 45 MFD, 220 V	1	155 327 109	305 203 909
	Overload Assmbly - Run	1	275 406 102	305 214 902
	Overload Assembly - Start	1	275 411 102	305 215 902
	Relay 220 V	1	155 031 112	305 213 912

NOTES: Some Franklin motors, controls and parts are not stock items and may need to be special ordered.

* For 208 V systems or where line voltage is between 200 V and 210 V a low voltage relay and larger cable are required:

- Use relay part number 155 031 103 in place of 155 031 102 on 1.5 through 3 hp applications.
- Use relay 115 031 602 for 5-15 hp applications.
- Use the next size larger cable than is specified in the 230 V table.
- Boost transformers are an alternative to special relay and cable.

Control Box Parts

Deluxe Control Box Parts

HP Size Model No.	Rating	No. Req.	Component Part No.	Kit Order No.
2 hp - 4" 282 301 8310	Start Capacitor 105-126 MFD, 220 V	1	275 464 113	305 207 913
	Run Capacitor 20 MFD, 370 V	1	155 328 103	305 204 903
	Start Overload	1	275 411 117	305 215 917
	Run Overload	1	275 411 113	305 215 913
	Contactor	1	155 325 102	305 226 901
	Relay - 230 V*	1	155 031 102	305 213 902
3 hp - 4" 282 302 8310	Start Capacitor 208-250 MFD, 220 V	1	275 463 111	305 206 911
	Run Capacitor 45 MFD, 370 V	1	155 327 109	305 203 909
	Start Overload	1	275 411 118	305 215 918
	Run Overload	1	275 411 115	305 215 915
	Contactor	1	155 325 102	305 226 901
	Relay - 230 V*	1	155 031 102	305 213 902
5 hp - 4" & 6" 282 113 9310	Start Capacitor 270-324 MFD, 330 V	1	275 468 119	305 208 919
	Run Capacitor 40 MFD, 370 V	2	155 327 114	305 203 914
	Start Overload	1	275 411 119	305 215 919
	Run Overload	1	275 406 102	305 214 902
	Contactor	1	155 326 101	305 347 903
	Relay - 230 V*	1	155 031 601	305 213 961
7.5 hp - 6" 282 201 9310	Start Capacitor 270-324 MFD, 330 V	1	275 468 119	305 208 919
	Start Capacitor 216-259 MFD, 330 V	1	275 468 118	305 208 918
	Run Capacitor 45 MFD, 370 V	1	155 327 109	305 203 909
	Start Overload	1	275 411 102	305 215 902
	Run Overload	1	275 406 121	305 214 921
	Contactor	1	155 326 102	305 347 902
	Relay - 230 V*	1	155 031 601	305 213 961
10 hp - 6" 282 202 9330	Start Capacitor 270-324 MFD, 330 V	1	275 468 119	305 208 919
	Start Capacitor 130-154 MFD, 330 V	1	275 463 120	305 206 920
	Start Capacitor 216-259 MFD, 330 V	1	275 468 118	305 208 918
	Run Capacitor 35 MFD, 370 V	2	155 327 102	305 203 902
	Start Overload	1	275 406 103	305 214 903
	Run Overload	1	155 409 101	155 409 101
	Contactor	1	155 326 102	305 347 902
	Relay - 230 V*	1	155 031 601	305 213 961
15 hp - 6" 282 203 9330	Start Capacitor 270-324 MFD, 330 V	2	275 468 119	305 208 919
	Start Capacitor 161-193 MFD, 330 V	1	275 463 122	305 206 912
	Run Capacitor 45 MFD, 370 V	3	155 327 109	305 203 909
	Start Overload	1	275 406 103	305 214 903
	Run Overload	1	155 409 102	155 409 102
	Contactor	1	155 429 101	305 347 901
	Relay - 230 V*	1	155 031 601	305 213 961
15 hp - 6" 282 203 9621 X-Large Enclosure	Start Capacitor 350-420 MFD, 330 V	2	275 468 120	305 208 920
	Run Capacitor 45 MFD, 370 V	3	155 327 109	305 203 909
	Start Overload	1	275 406 103	305 214 903
	Run Overload	1	155 409 102	155 409 102
	Contactor	1	155 429 101	305 347 901
	Relay - 230 V*	2	155 031 601	305 213 961
All	Lightning Arrestor	1	150 814 902	150 814 902
208 V Relay*	Relay 1.5-3 hp (replaces 155 031 102)	1	155 031 103	305 213 903
	Relay 5-15 hp (replaces 155 031 601)	1	155 031 602	305 213 904

NOTES: Some Franklin motors, controls and parts are not stock items and may need to be special ordered.

* For 208 V systems or where line voltage is between 200 V and 210 V a low voltage relay and larger cable are required:

- Use relay part number 155 031 103 in place of 155 031 102 on 1.5 through 3 hp applications.
- Use relay 115 031 602 for 5-15 hp applications.
- Use the next size larger cable than is specified in the 230 V table.
- Boost transformers are an alternative to special relay and cable.

Single-Phase Motor Protection

Single-Phase Protection Devices

Applications

These protection devices are designed to protect Franklin Electric single-phase motors from the various conditions listed below.

QD Pumptec is designed to easily plug into any Franklin QD Relay Control Box.

	QD Pumptec	Pumptec IR	Pumptec-Plus
Air or Gas Locked Pump (Cavitation)	■	■	■
Broken Shaft or Coupling	■	■	■
Clogged Well Screen	■	■	■
Drop in Water Level	■	■	■
Faulty Check Valve		■	■
High Voltage	■	■	■
Low Voltage	■	■	■
Low Yield Wells	■	■	■
Rapid Cycling		■	■
Water Logged Tank		■	■
Worn Pump Parts	■	■	■

QD Pumptec

Exclusively designed for Franklin QD Relay Control Boxes, QD Pumptec is a solid state sensing device that monitors motor load and incoming power to automatically shut off a Franklin single-phase, 3-wire motor when related fault conditions are detected. QD Pumptec easily plugs into 3-wire Franklin QD Control Boxes with no additional wiring or tools required.

Pumptec IR

Pumptec is a microcomputer-based device that monitors motor load and power line conditions to provide protection against dry well conditions, waterlogged tanks and abnormal line voltage conditions. Pumptec interrupts power to the motor whenever the load drops quickly or below a preset level. Indicator lights provide complete system status.

Pumptec-Plus

The Pumptec-Plus solid state pump protection system is designed for 1/2 to 5 hp single-phase submersible pump motors. Pumptec-Plus protects against a variety of fault conditions. Run and fault lights make diagnosis quick and easy. Push button Snap Shot™ calibration makes Pumptec-Plus simple to install and an effective troubleshooting tool.

Single-Phase Motor Protection

Single-Phase Electronic Protection Device Specifications

Product	HP Range	KW Range	Volts	HZ	Reset Time	Agency Approvals
Pumptec W/ IR Control	1/3 - 1.5	0.25 - 1.1	115/230	60/50	Adjustable (2-120 Minutes)	UL/cUL Listed
Pumptec-Plus	1/2 - 5.0	0.37 - 3.7	230	60	Adjustable (1-240 Minutes or Manual)	UL/cUL Listed
Pumptec-Plus	1/2 - 5.0	0.37 - 3.7	220	50	Adjustable (1-240 Minutes or Manual)	UL/cUL Listed
QD Pumptec	1/3 - 1.0	0.25 - 0.75	230	60	Adjustable (2-240 Minutes)	UL/cUL Listed

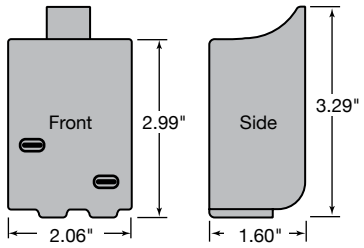
Models

Product	Description				Model	Stock Status
	PH	HP	Volts	HZ		
Pumptec W/ IR Control	1P	1/3 - 1.5	115/230	60/50	580 002 0600	Yes
Pumptec-Plus	1P	1/2 - 5.0	230	60	580 006 0100	Yes
	1P	1/2 - 5.0	220	50	580 006 0500	Yes
QD Pumptec	1P	1/3 - 1.0	230	60	580 007 0600	Yes

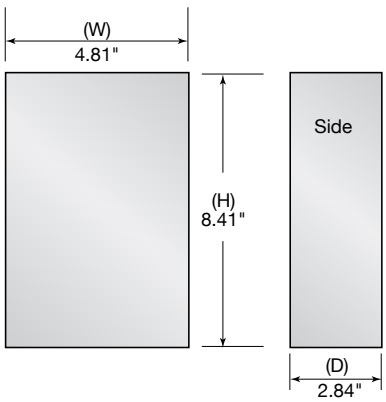
Single-Phase Protection Devices

Product	Shipping Weight		Motor Carton Size (In Inches)
	LBS	KG	
Pumptec W/ IR Control	3	1.3	5.25 x 8.875 x 3.25
Pumptec-Plus	7	3.1	8.25 x 11.25 x 6.25
QD Pumptec	<1	<0.05	4.25 x 2.375 x 2.25

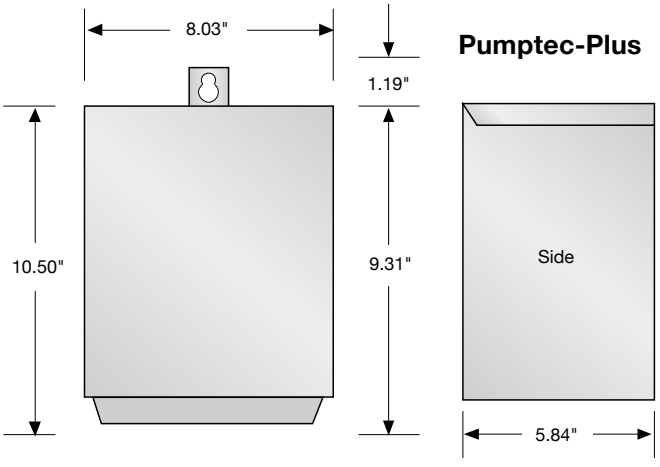
QD Pumptec



Pumptec IR



Pumptec-Plus



Three-Phase Control Panels

Applications

Franklin's heavy duty three-phase panels are optimized for water and irrigation applications. The spacious layout makes installation and maintenance simple and easy, so there's no need to spend time wrestling with wires and adding components is easy. With a Franklin three-phase control panel, you can be sure that your system is set-up according to Franklin's recommendations.

Franklin Electric three-phase control panels are available from 3 to 200 hp, in ratings from 200 to 575 Volts.

Basic Features

- UL approved, heavy-duty NEMA 3R enclosure
- Class R fusible disconnect
- Service entrance rated
- Lightning arrestor
- Motor logic or Franklin SubMonitor protected
- NEMA contactor
- Door wind hinge
- Pilot device and alarm terminal block
- H-O-A switch
- Manual push-to-start switch
- Easy hook-up

Three-Phase Control Panels

Models

HP	Description	Volts	HZ	Amps	Model	WT
3 hp	Motor Logic	200	60	6-18	281 101 2203	56
		230	60	6-18	281 101 3303	56
		460	60	3-9	281 101 4402	56
		575	60	3-9	281 101 5502	56
	Sub-Monitor	200	60	All	281 101 2200	59
		230	60	All	281 101 3300	59
		460	60	All	281 101 4400	59
		575	60	All	281 101 5500	59
5 hp	Motor Logic	200	60	9-27	281 101 2204	56
		230	60	9-27	281 104 3304	56
		460	60	3-9	281 101 4402	56
		575	60	3-9	281 101 5502	56
	Sub-Monitor	200	60	All	281 101 2200	59
		230	60	All	281 101 3300	59
		460	60	All	281 101 4400	59
		575	60	All	281 101 5500	59
7.5 hp	Motor Logic	200	60	15-45	281 104 2206	60
		230	60	15-45	281 104 3306	60
		460	60	6-18	281 101 4403	56
		575	60	6-18	281 101 5503	56
	Sub-Monitor	200	60	All	281 104 2200	63
		230	60	All	281 104 3300	63
		460	60	All	281 101 4400	59
		575	60	All	281 101 5500	59
10 hp	Motor Logic	200	60	15-45	281 104 2206	60
		230	60	15-45	281 104 3306	60
		460	60	9-27	281 101 4404	56
		575	60	6-18	281 101 5503	56
	Sub-Monitor	200	60	All	281 104 2200	63
		230	60	All	281 104 3300	63
		460	60	All	281 101 4400	59
		575	60	All	281 101 5500	59
15 hp	Motor Logic	200	60	45-135	281 204 2208	147
		230	60	30-90	281 204 3308	145
		460	60	15-45	281 104 4406	60
		575	60	15-45	281 104 5506	60
	Sub-Monitor	200	60	All	281 204 2200	150
		230	60	All	281 204 3300	148
		460	60	All	281 103 4400	63
		575	60	All	281 104 5500	59
20 hp	Motor Logic	200	60	30-90	281 205 2208	145
		230	60	30-90	281 205 3308	145
		460	60	15-45	281 104 4406	60
		575	60	15-45	281 104 5506	60
	Sub-Monitor	200	60	All	281 205 2200	148
		230	60	All	281 205 3300	148
		460	60	All	281 103 4400	63
		575	60	All	281 104 5500	59

HP	Description	Volts	HZ	Amps	Model	WT
25 hp	Motor Logic	200	60	30-90	281 206 2208	145
		230	60	30-90	281 206 3308	145
		460	60	15-45	281 104 4406	60
		575	60	15-45	281 104 5506	60
	Sub-Monitor	200	60	All	281 206 2200	148
		230	60	All	281 206 3300	148
		460	60	All	281 104 4400	63
		575	60	All	281 104 5500	63
30 hp	Motor Logic	200	60	45-135	281 207 2209	147
		230	60	45-135	281 207 3309	147
		460	60	30-90	281 104 4407	145
		575	60	30-90	281 204 5507	145
	Sub-Monitor	200	60	All	281 207 2200	151
		230	60	All	281 207 3300	151
		460	60	All	281 106 4400	148
		575	60	All	281 204 5500	148
40 hp	Motor Logic	460	60	30-90	281 205 4408	145
		575	60	30-90	281 204 5507	145
	Sub-Monitor	460	60	All	281 205 4400	148
		575	60	All	281 204 5500	148
50 hp	Motor Logic	460	60	30-90	281 206 4408	145
		575	60	30-90	281 205 5508	145
	Sub-Monitor	460	60	All	281 206 4400	148
		575	60	All	281 205 5500	148
60 hp	Motor Logic	460	60	45-135	281 207 4409	147
		575	60	45-135	281 307 5510	147
	Sub-Monitor	460	60	All	281 207 4400	150
		575	60	All	281 307 5500	150
75 hp	Motor Logic	460	60	45-135	281 207 4409	147
		575	60	45-135	281 307 5510	147
	Sub-Monitor	460	60	All	281 207 4400	150
		575	60	All	281 307 5500	150
100 hp	Motor Logic	460	60	90-270	281 308 4411	390
		575	60	45-135	281 307 5510	147
	Sub-Monitor	460	60	All	281 308 4400	393
		575	60	All	281 307 5500	150
125 hp	Motor Logic	460	60	90-270	281 309 4411	390
		575	60	90-270	281 309 5511	390
	Sub-Monitor	460	60	All	281 309 4400	393
		575	60	All	281 309 5500	393
150 hp	Motor Logic	460	60	90-270	281 310 4412	390
		575	60	90-270	281 309 5511	390
	Sub-Monitor	460	60	All	281 310 4400	393
		575	60	All	281 309 5500	393
175 hp	Motor Logic	460	60	90-270	2813104412	390
		575	60	90-270	2813105512	390
	Sub-Monitor	460	60	All	2813104400	393
		575	60	All	2813105500	393
200 hp	Motor Logic	460	60	18-540	2813114413	660
		575	60	90-270	2813105512	390
	Sub-Monitor	460	60	All	2813114400	663
		575	60	All	2813105500	393

Three-Phase Control Panel Accessories

225 552 107

Omega CN7500 Digital Reader for PT100 Sensor*

The Omega CN7500 digital reader displays the temperature from Franklin Electric's PT100. The PT100 is a precision platinum wire resistor that is optional in Franklin's six- and eight-inch motors as a temperature input for process control equipment. The CN7500 digitally displays the temperature and can be set for certain temperature ranges. It trips the panel contactor in an over-temperature condition and resets the contactor once the temperature returns to the desired level.

See page 85 for PT100 sensor details

* Due to space limitations, only auxiliary contacts and/or padlock attachments are available for NEMA 1 and 2 panels when a PT100 reader is selected. Requires a control circuit transformer. Refer to the chart below.

Control Circuit Transformers

Control circuit transformers convert the supply voltage required to power a piece of equipment to a voltage that is needed for various control circuits (pilot lights, selector switches, push buttons, etc.). The line voltage supplying the equipment is converted to control voltage by the transformer, eliminating the need to bring in a second source of power. (NOTE: Fuses are not supplied.)

Part #	Nema Size	Primary	Secondary	Volt Amps
225552131	1	240	120	100
225552141	1	480	120	100
225552132	2	240	120	100
225552142	2	480	120	100
225552133	3	240	120	150
225552143	3	480	120	150
225552134	4	240	120	300
225552144	4	480	120	300
225552135	5	240	120*	50
225552145	5	480	120*	50

NOTE:

For additional voltages, please specify both primary and secondary voltages.

* Equipped with a NEMA rated AC control relay (open style) with two normally-open convertible instantaneous contacts (8501 XO20 Relay).

Pilot Lights

Mounted on the enclosure door, the pilot light indicates when power is on/off or when a motor is in operation. It can easily be seen from the front of the panel. Choose your color to fit your application.

Part #	Nema Rated	Size	Lens Color
225552101	Yes	30 mm	Red
225552102	Yes	30 mm	Green
225552103	Yes	30 mm	Amber
225552104	Yes	30 mm	Clear

Three-Phase Control Panel Accessories — Cont.

225 552 110

Contacts

When adding control devices, auxiliary contacts may be required. These contacts mount on the side of the contactor and include one normally-open and one normally-closed auxiliary contact.

225 552 105

Padlock Attachment for H-O-A Switch

The padlock attachment allows the owner to lock the hand-off auto switch in the “on” or “off” position to prevent tampering with the pump panel.

225 552 171

Analog Style Elapsed Time Meter

The elapsed time meter keeps track of the total running time of the motor in hours. It is ideal for applications which require routine maintenance. Requires a control circuit transformer. Refer to the chart on page 70.

SubMonitor

See page 72-73 for details.

c UL ®

225 552 108

cUL Rating

Panels can be equipped with the cUL rating to meet Canadian requirements.

Three-Phase Motor Protection

SubMonitor® Three-Phase Protection

Applications

SubMonitor is designed to protect three-phase pumps by monitoring current, voltage and motor temperature* using three integrated current transformers. A face mounted digital display provides real-time current and voltage readings for all three legs and allows the user to set up the SubMonitor quickly and easily.

Protects Against

- Under/Overload
- Under/Overvoltage
- Current unbalance
- Overheated motor (Subtrol-equipped)
- False s tart (chattering)
- Phase reversal

Features

- Quick, menu-driven set-up
- Digital display shows voltage and current on all three legs at once
- Fault messages in easily understandable text
- Rated for 190 to 600 Volts
- No need for additional turns around the CT or to add external CTs
- Password protection option
- Din rail mounting option
- Stored fault, setting changes and pump run-time information easily accessed through display head
- Detachable NEMA 3R display unit easily mounted on panel door
- Turn-and-push adjustment knob
- Base unit can operate independent of detachable head
- UL and cUL listed
- Lead free

Three-Phase Electronic Protection Device Specifications

Input Voltage ..... 190 – 600 VAC
Frequency ..... 60/50 Hz
Motor Service Factor Amps..... 5 to 350 Amps
Maximum Conductor Size Through Sensors
Max Diameter .....0.920 in. (23 mm)
Trip Response
Motor Under/Overload, Under/Overvoltage, Overheat, Unbalance .....3 seconds
Control Circuit Rating .....1.5 Amp AC, up to 600 V
Signal Circuit Rating.....1 Amp AC, up to 250 V
Wiring Terminals
Wire Gauge ..... #12 to #18 AWG
Tighten to .....4.5 in-lbs
Weight (SubMonitor)..... 3.3 lbs/1.5 kg
Carton Size (Std. Unit).....7.75 in x 11.5 in x 6.75 in (19.7 cm x 29.2 cm x 17.1 cm)
Shipping Weight (Std. Unit)..... 3.5 lbs/1.5 kg
Agency Approval.....UL and cUL listed

* For motors equipped with a Subtrol heat sensor

Three-Phase Motor Protection

SubMonitor® Three-Phase Protection

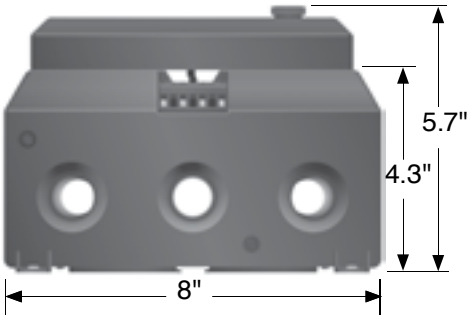
Models

Product	Description				Model	Stock Status
	PH	Max Amps Range	Volts	HZ		
SubMonitor Standard	3	5 - 350	190 - 600	60/50	586 000 5000	Yes
SubMonitor Premium	3	5 - 350	190 - 600	60/50	586 000 5100	Yes
Display	N/A	N/A	N/A	N/A	225 190 902	Yes
Base Only	N/A	N/A	N/A	N/A	225 210 902	Yes

Dimensions and Weights

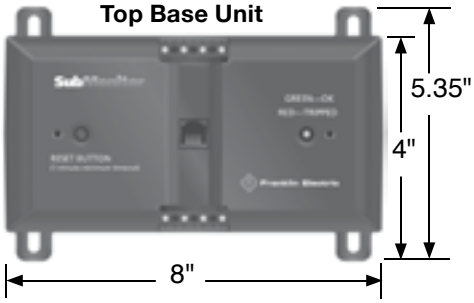
Shipping Weight		Motor Carton Size (In Inches)
LBS	KG	
3.3	1.5	7.75 x 11.5 x 6.75

Front Base Unit



Detachable Display Unit

Top Base Unit



Display

- Real-time display of voltage and current for each leg.
- Easy menu-driven setup and adjustment of monitoring parameters.

SubMonitor Accessory

585 001 1100

D3 Data Download Tool

D3 is a service tool that provides the capability to download data from SubMonitor and transfer that data to a PC.

Includes:

- D3 unit
- Transfer software
- USB cable

Constant Pressure Controllers

Applications

Franklin Electric's constant pressure controllers use state-of-the-art technology to provide constant water pressure through variable speed control of submersible water well pumps.

Features — All Controllers

- Constant water pressure with a wide range of pressure settings
- NEMA 3R (Outdoor), NEMA 4 (Outdoor), NEMA 1 (Indoor), and NEMA 0 enclosures
- Easy installation
- Soft start feature prevents water hammer and increases motor life
- Works with small pressure tanks or existing larger tanks
- Smart Reset® technology allows well recovery before restarting the pump
- Single-phase input power with three-phase motor performance (see next page for details)
- Excellent radio frequency interference shielding
- UL and cUL listed
- Built-in Diagnostics and Protection
  - Surge protection
  - Underload
  - Undervoltage
  - Locked pump
  - Open circuit
  - Short circuit
  - Overheated controller

Constant Pressure Controllers

Features — MonoDrive & MonoDriveXT

- Selectable hp rating: MonoDrive (½, ¾ and 1 hp), MonoDriveXT (1.5 and 2 hp)
- Easy installation – remove the 3-wire control box and install the MonoDrive
- Can retrofit existing systems – no need to pull the pump
- NEMA 4 and NEMA 1 enclosure
- Single-phase, 3-wire Franklin Electric motor

Features — SubDrive2W

- Selectable hp rating: (½, ¾ and 1 hp)
- Easy retrofit installation – remove the pressure switch and install the SubDrive2W
- Can retrofit existing systems – no need to pull the pump or motor
- NEMA 3R enclosure
- Single-phase, 2-wire Franklin Electric motor

Constant Pressure Controls Specifications

		MonoDrive	MonoDriveXT
Model No. (Enclosure*)	(N1)	587 020 3110	587 020 4110
	(N4)	587 020 3114	587 020 4114
Input (From Power Source)			
Voltage		190-260 V 1-Phase	190-260 V 1-phase
Frequency		60/50 Hz	60/50 Hz
Max Amps (RMS)		5.7 A (½ hp), 8.7 A (¾ hp), 11 A (1 hp)	13 A (1.5 hp), 16 A (2 hp)
Power Factor		1 (Constant)	1 (Constant)
Output (To Motor)			
Voltage		Variable/1-Phase	Variable/1-phase
Frequency		Variable (30-60 Hz)	Variable (30-60 Hz)
Max Amps (RMS)		4.0 A (½ hp), 6.6 A (¾ hp), 9.0 A (1 hp)	10 A (1.5 hp), 12 A (2 hp)
For Use With:			
Pump Rating		½, ¾ or 1 hp (Selectable)	1.5 or 2 hp (Selectable)
Motor Rating		½, ¾ or 1 hp, 230 VAC (1-Phase)	1.5 or 2 hp, 230 VAC (1-phase)
Pressure Sensor (Included)		External	External
Controller Weight	(N1)	15.00 lbs (6.80 kg)	17.50 lbs (7.94 kg)
	(N4)	24.14 lbs (10.95 kg)	28.32 lbs (12.84 kg)
Carton Size (H x W x D)	(N1)	16½ x 12⅜ x 9" 41.9 x 31.4 x 22.9 cm	16½ x 12⅜ x 9" 41.9 x 31.4 x 22.9 cm
	(N4)	17½ x 16⅜ x 11⅜" 44.5 x 41.6 x 28.9 cm	17½ x 16⅜ x 11⅜" 44.5 x 41.6 x 28.9 cm
Shipping Weight	(N1)	19.23 lbs (8.72 kg)	21.28 lbs (9.65 kg)
	(N4)	30.91 lbs (14.02 kg)	35.09 lbs (15.92 kg)

		SubDrive2W
Model No. (Enclosure*)	(N3R)	587 020 3223
Input (From Power Source)		
Voltage		230 V (±10%) 1-phase
Frequency		60/50 Hz
Max Amps (RMS)		<14 A
Power Factor		N/A
Output (To Motor)		
Voltage		Variable/1-phase/FE Motor
Frequency		Variable (30-60 Hz)
Max Amps (RMS)		6.0 A (½ hp), 8.0 A (¾ hp), 9.8 A (1 hp)
For Use With:		
Pump Rating		½, ¾ or 1 hp (Selectable)
Motor Rating		½, ¾ or 1 hp, 230 VAC (1-phase), 60 Hz
Pressure Sensor (Included)		External
Controller Weight		15.00 lbs (6.80 kg)
Carton Size (H x W x D)		12¼ x 16½ x 9" 31.1 x 41.9 x 22.9 cm
Shipping Weight		18.00 lbs (8.2 kg)

*N1 = NEMA 1 (Indoors), N4 = NEMA 4 (Outdoors), N3R = NEMA 3R (Outdoors)

Features — SubDrive75, SubDrive100, SubDrive150 & SubDrive300

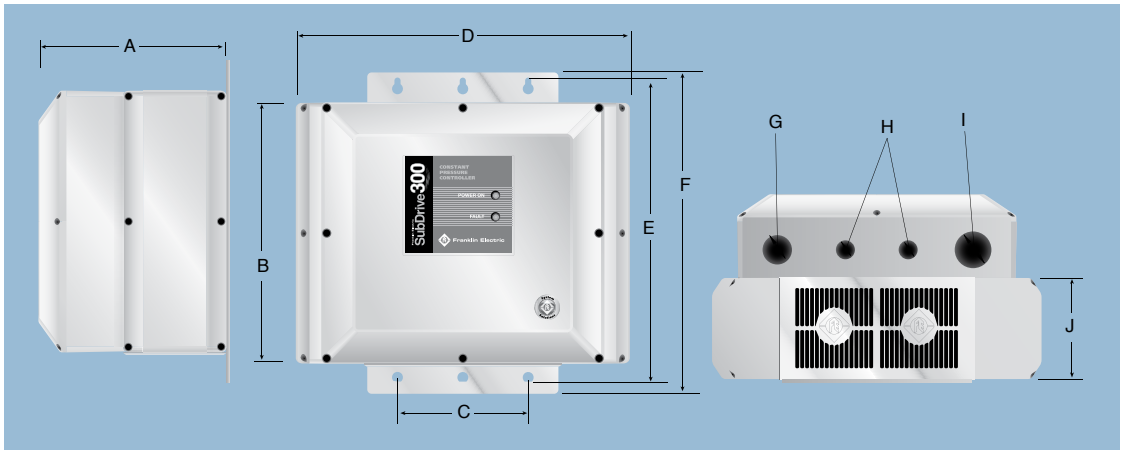
- Works with a standard three-phase Franklin Electric submersible motor
- NEMA 4 & NEMA 1 enclosure
- Three-phase performance with single-phase input
  - High starting torque
  - More efficient
  - Smooth running

Constant Pressure Controls Specifications

		SubDrive75	SubDrive100	SubDrive150	SubDrive300
Model No. (Enclosure*)	(N1)	587 020 3380	587 020 4100	587 020 4150	N/A
	(N4)	587 020 3384	587 020 4104	587 020 4154	587 020 6300
Input (From Power Source)					
Voltage		190-260 V 1-phase	190-260 V 1-phase	190-260 V 1-phase	220-260 V 1-phase
Frequency		60/50 Hz	60/50 Hz	60/50 Hz	60/50 Hz
Max Amps (RMS)		11 A	19 A	23 A	36 A
Power Factor		1 (Constant)	1 (Constant)	1 (Constant)	1 (Constant)
Output (To Motor)					
Voltage		Variable/3-phase	Variable/3-phase	Variable/3-phase	Variable/3-phase
Frequency		Variable (30-80 Hz)	Variable (30-80 Hz)	Variable (30-80 Hz)	Variable (30-80 Hz)
Max Amps (RMS)		5.9 A	8.1 A	10.9 A	17.8 A
For Use With:					
Pump Rating		¾, 1 or 1.5 hp (Selectable)	1, 1.5 or 2 hp (Selectable)	1.5, 2 or 3 hp (Selectable)	3 or 5 hp (Selectable)
Motor Rating		1.5 hp, 230 VAC (3-Phase)	2 hp, 230 VAC (3-Phase)	3 hp, 230 VAC (3-Phase)	5 hp, 230 VAC (3-Phase)
Pressure Sensor (Included)		External	External	External	External
Controller Weight	(N1)	15.00 lbs (6.80 kg)	17.50 lbs (7.94 kg)	17.50 lbs (7.94 kg)	N/A
	(N4)	24.14 lbs (10.95 kg)	28.32 lbs (12.84 kg)	28.32 lbs (12.84 kg)	35.15 lbs (15.94 kg)
Carton Size (H x W x D)	(N1)	16½ x 12⅜ x 9" 41.9 x 31.4 x 22.9 cm	16½ x 12⅜ x 9" 41.9 x 31.4 x 22.9 cm	16½ x 12⅜ x 9" 41.9 x 31.4 x 22.9 cm	N/A
	(N4)	17½ x 16⅜ x 11⅜" 44.5 x 41.6 x 28.9 cm	17½ x 16⅜ x 11⅜" 44.5 x 41.6 x 28.9 cm	17½ x 16⅜ x 11⅜" 44.5 x 41.6 x 28.9 cm	19⅞ x 17½ x 14¼" 50.5 x 44.5 x 36.2 cm
Shipping Weight	(N1)	19.23 lbs (8.72 kg)	21.28 lbs (9.65 kg)	21.28 lbs (9.65 kg)	N/A
	(N4)	30.91 lbs (14.02 kg)	35.09 lbs (15.92 kg)	35.09 lbs (15.92 kg)	40.95 lbs (18.57 kg)

*N1 = NEMA 1 (Indoors), N4 = NEMA 4 (Outdoors)

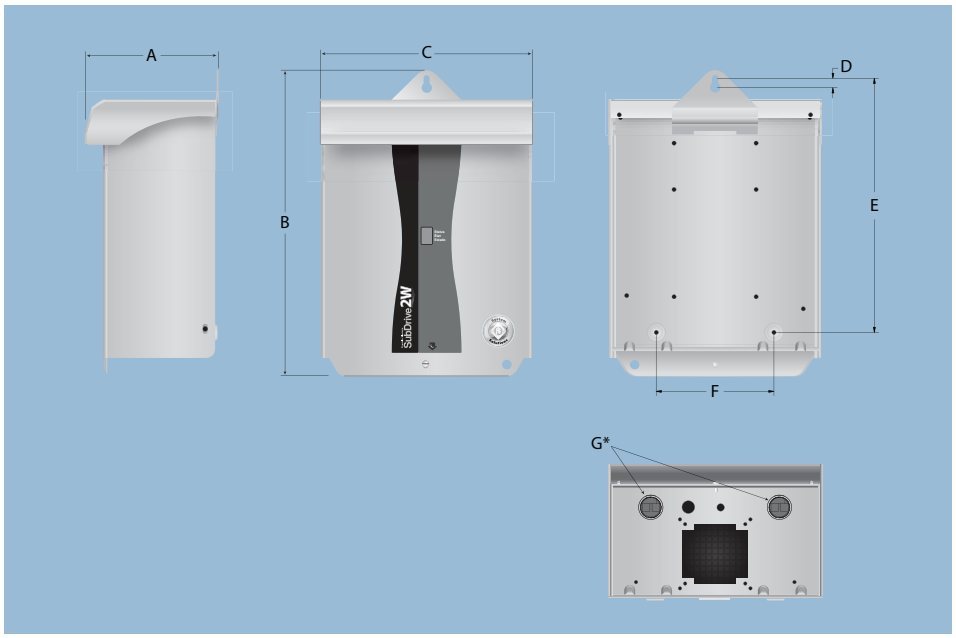
SubDrive300



NEMA 4 Dimensions (approximate)

NEMA 4	A	B	C	D	E	F	G	H	I	J
Dimension	8.75" (22.23 cm)	12" (30.48 cm)	6" (15.24 cm)	15.34" (38.96 cm)	14" (35.56 cm)	14.75" (37.47 cm)	1.37" (3.48 cm)	0.885" (2.25 cm)	1.71" (4.34 cm)	4.75" (12.07 cm)
Conduit Size	-	-	-	-	-	-	1	½	1¼	-

SubDrive2W

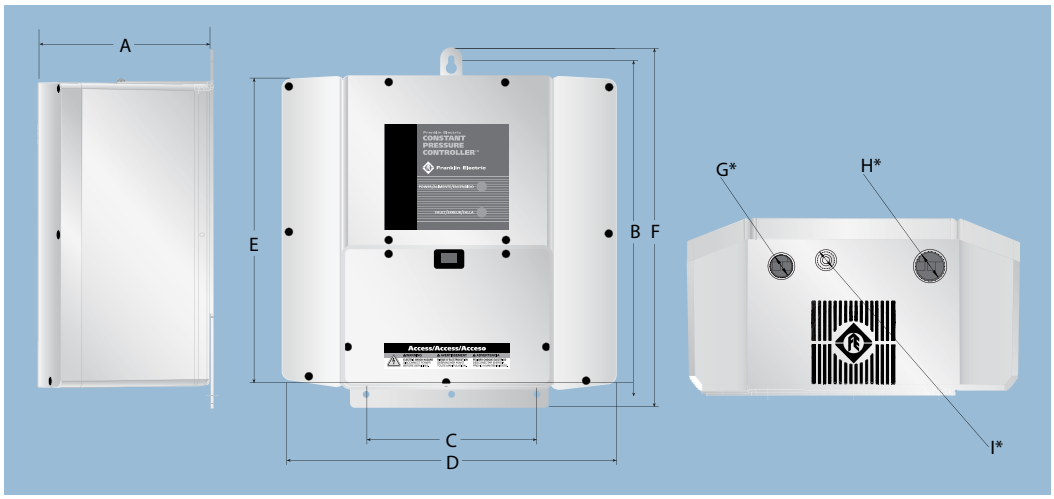


NEMA 3R Dimensions (approximate)

NEMA 3R	A	B	C	D	E	F	G
Dimension	6.20" (15.75 cm)	14.27" (36.25 cm)	9.91" (25.71 cm)	.44" (1.12 cm)	11.87" (30.15 cm)	5.5" (13.97 cm)	.88" / 1.13" (2.24 cm) / (2.87 cm)
Conduit Size	-	-	-	-	-	-	½ / ¾

* Use knock-outs as required.

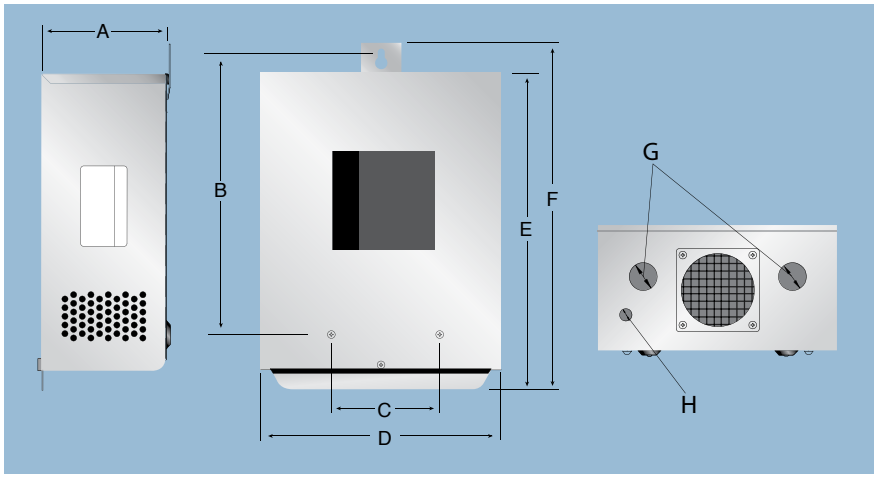
SubDrive75/100/150/MonoDrive/MonoDriveXT



NEMA 4 Dimensions (approximate)

NEMA 4	A	B	C	D	E	F	G	H	I
Dimension	7.25" (18.42 cm)	12.6" (32.0 cm)	7" (17.78 cm)	13.6" (34.5 cm)	12.5" (31.75 cm)	14.8" (37.6 cm)	0.875" / 1.100" (0.22 cm) / (2.80 cm)	1.100" / 1.375" (2.8 cm) / (3.50 cm)	closed / 0.473" / 0.875" closed / (1.20 cm) / (2.22 cm)
Conduit Size	-	-	-	-	-	-	½ / ¾	¾ / 1	½

SubDrive75/100/150/MonoDrive/MonoDriveXT



NEMA 1 Dimensions (approximate)

NEMA 1	A	B	C	D	E	F	G	H
Dimension	5.25" (13.34 cm)	11.5" (29.21 cm)	5.5" (13.97 cm)	9.75" (24.77 cm)	12.8" (32.51 cm)	14" (35.56 cm)	1.12" (2.84 cm)	0.5" (1.27 cm)
Conduit Size	-	-	-	-	-	-	¾	-

* Use knock-outs as required.

SubDrive HPX

Applications

SubDrive HPX facilitates constant pressure, pressure cycling, flow control, switch control and tank level control.

The SubDrive HPX offers a complete system for single-phase applications requiring 5 to 40 hp and three-phase applications requiring 5 to 200 hp, coupled with a Franklin Electric pump and motor. The graphic display terminal allows installers to easily transition through menus, minimizing programming time. The Franklin Electric SubDrive HPX is ideal for a variety of surface and submersible pump applications.

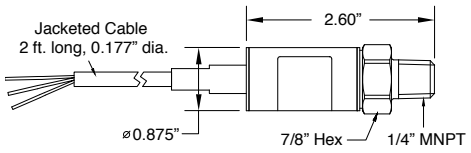
Features

- UL, CE, C-TICK and CUL listed
- Easy installation
- Quick setup
- Push and turn selector
- Available in NEMA 0 and NEMA 1
- Graphic display terminal
- Pressure transducer
- Optional surge arrestor on input power
- Optional conduit kit
- Easy access terminals
- Optional replacement fan kit
- Optional output load reactors
- Optional input line reactors
- Can be placed in enclosure

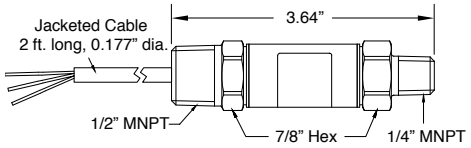
Drive Specifications

Drive Specifications	
Input From Power Source	
Voltage	200 V - 575 V 3-phase; 230 V 1-phase
Frequency	50/60 Hz
Max Amps (RMS)	SubDrive HPX Specific
Output To Motor	
Voltage	Adjusts with frequency
Frequency	Variable (up to 60 Hz)
Max Amps (RMS)	SubDrive HPX Specific
Pressure Setting	
Factory Preset	Application Specific/SubDrive HPX Settings
Operating Conditions	
Operating Temperature	+14 °F to +122 °F (-10 °C to +50 °C)
Storage Temperature	-13 °F to +158 °F (-25 °C to +70 °C)
Relative Humidity	5% - 95% Noncondensating
Controller Size	
NEMA 0	Refer to operator manual
NEMA 1	Refer to operator manual
For Use With	
Pump Rating	Match to motor rated hp
FE Motor Rating	3-phase motor

Standard



Conduit Connector



Available for 60 Hz only.

Pressure Transducer		
Figure	**PSI**	**Part Number**
Standard	100	225653901
	150	225653902
	200	225653903
	250	225653904
Conduit Connector (60 Hz only)	100	225653905
	150	225653906
	200	225653907
	250	225653908

Please contact your local distributor for availability of transducers.

CAUTION: Adhere to the safety guidelines (maximum pressure rating) of the pressure tanks in the system, while making sure to install the tank and sensor per applicable codes and also including a pressure relief valve.

Ordering Information

Volt (HZ)	Output Amps	Model	Conduit Kit	Controller Dimensions (IN/CM)	Weight
200 (60 Hz)	27.5	588 102 0275	225937903	6.9 x 8.3 x 11.6 in / 17.5 x 21 x 29.5 cm	12 lbs / 5 kgs
	33	588 102 0330	225937904	11.6 x 8.3 x 8.4 in / 29.5 x 21 x 21 cm	15 lbs / 7 kgs
	54	588 102 0540	225937905	11.6 x 8.3 x 8.4 in / 29.5 x 21 x 21 cm	15 lbs / 7 kgs
	66	588 102 0660	225937905	15.8 x 9.1 x 9.3 in / 40 x 23 x 23.6 cm	19 lbs / 9 kgs
	75	588 102 0750	225937906	16.5 x 9.5 x 10.2 in / 42 x 24 x 25.9 cm	42 lbs / 19 kgs
	88	588 102 1200	225937917	21.7 x 12.6 x 11.4 in/55 x 32 x 26.9 cm	86 lbs / 39 kgs
	120	588 102 1200	225937917	21.7 x 12.6 x 11.4 in/55 x 32 x 26.9 cm	86 lbs / 39 kgs
220 (50 Hz)	17.5	588 102 0175	225937902	26 x 13.8 x 21 cm	6 kg / 12 lbs
	27.5	588 102 0275	225937903	17.5 x 21 x 29.5 cm	5 kg / 12 lbs
	33	588 102 0330	225937904	29.5 x 21 x 21 cm	7 kg / 15 lbs
	54	588 102 0540	225937905	40 x 23 x 23.6 cm	9 kg / 20 lbs
	66	588 102 0660	225937905	40 x 23 x 23.6 cm	9 kg / 20 lbs
	75	588 102 0750	225937906	42 x 24 x 25.9 cm	19 kg / 42 lbs
	88	588 102 0880	225937906	42 x 24 x 25.9 cm	19 kg / 42 lbs
230 (60 Hz)	27.5	588 102 0275	225937903	6.9 x 8.3 x 11.6 in / 17.5 x 21 x 29.5 cm	12 lbs / 5 kgs
	33	588 102 0330	225937904	11.6 x 8.3 x 8.4 in / 29.5 x 21 x 21 cm	16 lbs / 7 kgs
	54	588 102 0540	225937905	11.6 x 8.3 x 8.4 in / 29.5 x 21 x 21 cm	20 lbs / 9 kgs
	66	588 102 0660	225937905	15.8 x 9.1 x 9.3 in / 40 x 23 x 23.6 cm	20 lbs / 9 kgs
	75	588 102 0750	225937906	16.5 x 9.5 x 10.2 in / 42 x 24 x 25.9 cm	42 lbs / 19 kgs
	120	588 102 1200	225937917	21.7 x 12.6 x 11.4 in / 55 x 32 x 26.9 cm	86 lbs / 39 kgs
380 (50 Hz)	10.5	588 104 0105	225937902	26 x 13.8 x 21 cm	6 kg / 12 lbs
	14.3	588 104 0143	225937903	17.5 x 21 x 29.5 cm	5 kg / 12 lbs
	17.6	588 104 0176	225937903	17.5 x 21 x 29.5 cm	5 kg / 12 lbs
	27.7	588 104 0277	225937904	29.5 x 21 x 21 cm	7 kg / 15 lbs
	33	588 104 0330	225937905	40 x 23 x 23.6 cm	9 kg / 20 lbs
	41	588 104 0410	225937905	40 x 23 x 23.6 cm	9 kg / 20 lbs
	48	588 104 0480	225937906	42 x 24 x 25.9 cm	19 kg / 42 lbs
	66	588 104 0660	225937907	55 x 32 x 26.9 cm	39 kg / 86 lbs
	79	588 104 0790	225937907	63.3 x 32 x 31.3 cm	44 kg / 97 lbs
	94	588 104 0940	225937908	63.3 x 32 x 31.3 cm	44 kg / 97 lbs
	116	588 104 1160	225937908	63.3 x 32 x 31.3 cm	44 kg / 97 lbs
	160	588 104 1600	225937908	63.3 x 32 x 31.3 cm	44 kg / 97 lbs
	215	588 104 2150	225937909	91.9 x 32 x 24.9 cm	74 kg / 163 lbs
	259	588 104 2590	225937910	102.1 x 35.9 x 29.7 cm	80 kg / 176 lbs
	314	588 104 3140	225937911	118.4 x 34 x 28.4 cm	110 kg / 243 lbs
460	7.6	588 104 0105	225937902	10.2 x 5.4 x 8.3 in / 26 x 13.8 x 21 cm	12 lbs / 6 kgs
	11	588 104 0143	225937903	6.9 x 8.3 x 11.6 in / 17.5 x 21 x 29.5 cm	12 lbs / 5 kgs
	14	588 104 0176	225937903	6.9 x 8.3 x 11.6 in / 17.5 x 21 x 29.5 cm	12 lbs / 5 kgs
	21	588 104 0277	225937904	11.6 x 8.3 x 8.4 in / 29.5 x 21 x 21 cm	15 lbs / 7 kgs
	27	588 104 0330	225937905	15.8 x 9.1 x 9.3 in / 40 x 23 x 23.6 cm	20 lbs / 9 kgs
	34	588 104 0410	225937905	15.8 x 9.1 x 9.3 in / 40 x 23 x 23.6 cm	20 lbs / 9 kgs
	40	588 104 0480	225937906	16.5 x 9.5 x 10.2 in / 42 x 24 x 25.9 cm	42 lbs / 19 kgs
	52	588 104 0660	225937907	21.7 x 12.6 x 11.4 in / 55 x 32 x 26.9 cm	86 lbs / 39 kgs
	65	588 104 0790	225937907	21.7 x 12.6 x 11.4 in / 55 x 32 x 26.9 cm	86 lbs / 39 kgs
	77	588 104 0940	225937908	24.9 x 12.6 x 12.3 in / 63.3 x 32 x 31.3 cm	97 lbs / 44 kgs
	96	588 104 1160	225937908	24.9 x 12.6 x 12.3 in / 63.3 x 32 x 31.3 cm	97 lbs / 44 kgs
	124	588 104 1600	225937908	24.9 x 12.6 x 12.3 in / 63.3 x 32 x 31.3 cm	97 lbs / 44 kgs
	179	588 104 1790	225937909	24.9 x 12.6 x 12.3 in / 63.3 x 32 x 31.3 cm	132 lbs / 60 kgs
	215	588 104 2150	225937909	36.2 x 12.6 x 9.8 in / 91.9 x 32 x 24.9 cm	163 lbs / 74 kgs
	259	588 104 2590	225937910	40.2 x 14.2 x 11.7 in / 102.1 x 35.9 x 29.7 cm	176 lbs / 80 kgs
	314	588 104 3140	225937911	46.6 x 13.4 x 11.2 in / 118.4 x 34 x 28.4 cm	243 lbs / 110 kgs

Ordering Information

Volt (HZ)	Output Amps	Model	Conduit Kit	Controller Dimensions (IN/CM)	Weight
575 (60 Hz)	9	588 105 0090	225937906	9.5 x 16.5 x 10.2 in / 24 x 42 x 23.6 cm	66 lbs / 30 kgs
	11	588 105 0110	225937906	9.5 x 16.5 x 10.2 in / 24 x 42 x 23.6 cm	66 lbs / 30 kgs
	17	588 105 0170	225937906	9.5 x 16.5 x 10.2 in / 24 x 42 x 23.6 cm	66 lbs / 30 kgs
	22	588 105 0220	225937906	9.5 x 16.5 x 10.2 in / 24 x 42 x 23.6 cm	66 lbs / 30 kgs
	27	588 105 0270	225937906	9.5 x 16.5 x 10.2 in / 24 x 42 x 23.6 cm	66 lbs / 30 kgs
	32	588 105 0320	225937906	9.5 x 16.5 x 10.2 in / 24 x 42 x 23.6 cm	66 lbs / 30 kgs
	41	588 105 0410	225937908	12.6 x 24.8 x 12.32 in / 32 x 63 x 31.3 cm	99 lbs / 45 kgs
	52	588 105 0520	225937908	12.6 x 24.8 x 12.32 in / 32 x 63 x 31.3 cm	99 lbs / 45 kgs
	62	588 105 0620	225937908	12.6 x 24.8 x 12.32 in / 32 x 63 x 31.3 cm	99 lbs / 45 kgs
	77	588 105 0770	225937908	12.6 x 24.8 x 12.32 in / 32 x 63 x 31.3 cm	99 lbs / 45 kgs
	99	588 105 0990	225937908	12.6 x 24.8 x 12.32 in / 32 x 63 x 31.3 cm	99 lbs / 45 kgs
	125	588 105 1250	225937911	13.4 x 46.6 x 11.2 in / 34 x 119 x 28.5 cm	242 lbs / 110 kgs
	150	588 105 1500	225937911	13.4 x 46.6 x 11.2 in / 34 x 119 x 28.5 cm	242 lbs / 110 kgs
	220	588 105 2200	225937911	13.4 x 46.6 x 11.2 in / 34 x 119 x 28.5 cm	242 lbs / 110 kgs
	290	588 105 2900	225937913	23.4 x 46.6 x 21.3 in / 59.5 x 119 x 54 cm	418 lbs / 190 kgs

Input Line Reactors

Model Number	Dimensions (L x W x D)	Weight
225930939	24 x 16.9 x 18.4 in / 60.96 x 42.88 x 46.69 cm	64 lbs / 29 kg
225930942	24 x 16.9 x 18.4 in / 60.96 x 42.88 x 46.69 cm	72 lbs / 33 kg
225930945	24 x 16.9 x 18.4 in / 60.96 x 42.88 x 46.69 cm	100 lbs / 45 kg
225930948	31 x 14.3 x 17.8 in / 78.74 x 36.35 x 45.09 cm	143 lbs / 65 kg

NOTES: Drive manufacturer mandates an input line reactor for all 125 - 200 HP 575 V submersibles. An input line reactor is required for all 60 Hz single-phase applications.

Output Load Reactors

Model Number	Dimensions (L x W x D)	Weight
225930901	8 x 8 x 6 in / 20.32 x 20.32 x 15.24 cm	4 lbs / 2 kg
225930902	8 x 8 x 6 in / 20.32 x 20.32 x 15.24 cm	4 lbs / 2 kg
225930903	8 x 8 x 6 in / 20.32 x 20.32 x 15.24 cm	4 lbs / 2 kg
225930904	8 x 8 x 6 in / 20.32 x 20.32 x 15.24 cm	3 lbs / 1 kg
225930905	8 x 8 x 6 in / 20.32 x 20.32 x 15.24 cm	4 lbs / 2 kg
225930906	8 x 8 x 6 in / 20.32 x 20.32 x 15.24 cm	4 lbs / 2 kg
225930907	8 x 8 x 6 in / 20.32 x 20.32 x 15.24 cm	5 lbs / 2 kg
225930908	8 x 8 x 6 in / 20.32 x 20.32 x 15.24 cm	4 lbs / 2 kg
225930909	8 x 8 x 6 in / 20.32 x 20.32 x 15.24 cm	7 lbs / 3 kg
225930910	8 x 8 x 6 in / 20.32 x 20.32 x 15.24 cm	8 lbs / 4 kg
225930911	8 x 8 x 6 in / 20.32 x 20.32 x 15.24 cm	11 lbs / 5 kg
225930912	8 x 8 x 6 in / 20.32 x 20.32 x 15.24 cm	13 lbs / 6 kg
225930913	8 x 8 x 6 in / 20.32 x 20.32 x 15.24 cm	9 lbs / 4 kg
225930914	8 x 8 x 6 in / 20.32 x 20.32 x 15.24 cm	10 lbs / 5 kg
225930915	8 x 8 x 6 in / 20.32 x 20.32 x 15.24 cm	18 lbs / 8 kg
225930916	8 x 8 x 6 in / 20.32 x 20.32 x 15.24 cm	9 lbs / 4 kg
225930917	8 x 8 x 6 in / 20.32 x 20.32 x 15.24 cm	12 lbs / 5 kg

Output Load Reactors Cont'd

Model Number	Dimensions (L x W x D)	Weight
225930918	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	16 lbs / 7 kg
225930919	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	11 lbs / 5 kg
225930920	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	14 lbs / 6 kg
225930921	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	20 lbs / 9 kg
225930922	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	14 lbs / 6 kg
225930923	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	16 lbs / 7 kg
225930924	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	30 lbs / 14 kg
225930925	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	23 lbs / 10 kg
225930926	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	28 lbs / 13 kg
225930927	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	39 lbs / 18 kg
225930928	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	24 lbs / 11 kg
225930929	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	27 lbs / 12 kg
225930930	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	41 lbs / 19 kg
225930931	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	43 lbs / 20 kg
225930932	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	51 lbs / 23 kg
225930933	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	61 lbs / 28 kg
225930934	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	47 lbs / 21 kg
225930935	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	51 lbs / 23 kg
225930936	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	74 LS / 34 kg
225930937	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	29 lbs / 13 kg
225930938	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	62 lbs / 28 kg
225930939	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	64 lbs / 29 kg
225930940	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	42 lbs / 19 kg
225930941	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	51 lbs / 23 kg
225930942	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	72 lbs / 33 kg
225930943	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	49 lbs / 22 kg
225930944	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	67 lbs / 31 kg
225930945	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	100 lbs / 45 kg
225930946	24 x 16.88 x 18.38 in / 60.96 x 42.88 x 46.69 cm	68 lbs / 31 kg
225930947	31 x 14.31 x 17.75 in / 78.74 x 36.35 x 45.09 cm	106 lbs / 48 kg
225930948	31 x 14.31 x 17.75 in / 78.74 x 36.35 x 45.09 cm	143 lbs / 65 kg
225930949	31 x 14.31 x 17.75 in / 78.74 x 36.35 x 45.09 cm	110 lbs / 50 kg
225930950	31 x 14.31 x 17.75 in / 78.74 x 36.35 x 45.09 cm	125 lbs / 57 kg
225930951	31 x 14.31 x 17.75 in / 78.74 x 36.35 x 45.09 cm	190 lbs / 86 kg
225930952	31 x 14.31 x 17.75 in / 78.74 x 36.35 x 45.09 cm	100 lbs / 45 kg
225930953	31 x 14.31 x 17.75 in / 78.74 x 36.35 x 45.09 cm	155 lbs / 70 kg
225930954	31 x 14.31 x 17.75 in / 78.74 x 36.35 x 45.09 cm	200 lbs / 91 kg
225930955	31 x 14.31 x 17.75 in / 78.74 x 36.35 x 45.09 cm	120 lbs / 55 kg
225930956	40 x 23.31 x 21.75 in / 101.6 x 59.21 x 55.25 cm	180 lbs / 82 kg
225930957	40 x 23.31 x 21.75 in / 101.6 x 59.21 x 55.25 cm	290 lbs / 132 kg
225930958	40 x 23.31 x 21.75 in / 101.6 x 59.21 x 55.25 cm	160 lbs / 73 kg
225930959	40 x 23.31 x 21.75 in / 101.6 x 59.21 x 55.25 cm	250 lbs / 114 kg
225930960	40 x 23.31 x 21.75 in / 101.6 x 59.21 x 55.25 cm	290 lbs / 132 kg
225930961	40 x 23.31 x 21.75 in / 101.6 x 59.21 x 55.25 cm	200 lbs / 91 kg
225930962	40 x 23.31 x 21.75 in / 101.6 x 59.21 x 55.25 cm	310 lbs / 141 kg
225930963	40 x 23.31 x 21.75 in / 101.6 x 59.21 x 55.25 cm	430 lbs / 195 kg

SubDrive Accessories

SubDrive Duplex Alternator

The SubDrive Alternator allows a water system to alternate between two parallel pumps controlled by separate SubDrives or MonoDrives. The user-selected switching interval balances the run time of each pump system to evenly disperse the workload. In addition, when demand exceeds the capacity of one pumping system, the other system comes online to supplement production. The SubDrive Alternator can be used with any SubDrive or MonoDrive controller.

Franklin Part Number: 585 001 2000

Input (From Power Source)	Voltage	115 VAC
	Frequency	60 Hz
Pressure Setting*	Factory Preset	50 psi
	Adjustment Range	25-80 psi
Approximate Controller Size (NEMA 4)	Outer Dimensions	5.8 x 5.8 x 3.6" (14.7 x 14.7 x 9.1 cm)
	Weight	1.3 lbs (0.59 kg)

* Pressure sensors must be set at least 3 psi apart.

SubDrive/MonoDrive Fan Kits

Installers can remove the fan and make an attempt to clean the fan by removing any particles that may restrict movement. In applications where the fan cannot be cleaned or freed from particles, or is damaged or malfunctioning, the fan replacement kit is an easy and inexpensive fix.

NEMA 4

Controller	Kit Part Number
MonoDrive SubDrive75	225 635 901
MonoDriveXT SubDrive100 SubDrive150	225 635 902
SubDrive300	External cooling fans 225 635 903
	Internal stirring fan 225 635 904

NEMA 3R

Controller	Kit Part Number
SubDrive2W	225 635 910

HPX NEMA 0 and NEMA 1

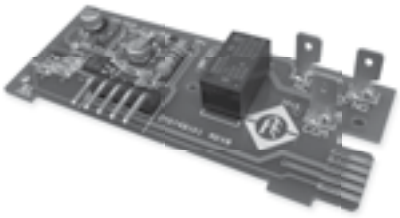
Controller	Kit Part Number
SubDrive HPX	225935904
	225935905
	225935906
	225935907
	225935908
	225935909
	225935910
	225935911
	225935912
	225935913
	225935915
	225935919

NEMA 1

Controller	Size	Kit Part Number
SubDrive75 and MonoDrive	3.15 in (80 mm)*	225 635 905
SubDrive75 and MonoDrive	3.62 in (92 mm)*	225 635 908
SubDrive100/150 and MonoDriveXT	3.15 in (80 mm)*	225 635 907
SubDrive100/150 and MonoDriveXT	3.62 in (92 mm)*	225 635 909

* Outside measurement of fan

SubDrive Accessories



Auxiliary Relay Communications Board

The auxiliary relay communications board is available for use with the SubDrive/MonoDrive NEMA 4 (excluding SubDrive300) constant pressure controllers. The auxiliary relay board provides run-indication relay contacts. The relays can be used to communicate the state of the drive (running or idle) to auxiliary equipment (water treatment) or to utilize multiple sensors (tank drawdown kit).

Franklin Part Number: 225755901

Tank Drawdown Kit

The tank drawdown kit is available for use with the SubDrive2W, SubDrive300 and the SubDrive/MonoDrive NEMA 4 with an auxiliary relay board installed utilizing the relay contacts. The kit is intended to allow the SubDrive system to utilize water from a tank during low flow applications.

Franklin Part Number: 225770901

Heatsink Cover Kit

The heatsink cover kit is available for use with the SubDrive/MonoDrive NEMA 4 constant pressure controllers. The kit is a grill to protect the top of the unit's heat sink from intrusion from animials or debris when mounted outside.

Franklin Part Number: 225805901

Direct Burial Cable

The direct burial cable kits are for use with the SubDrive/MonoDrive constant pressure controllers as a connection to the pressure sensors. The direct burial cable can be used for applications that require the sensor cable to be buried and extends the allowable length of the pressure sensor connection from 100 ft (30.5 m) to 300 ft (91.5 m).

Description	Franklin Part Number
Direct Burial Kit - 10 ft (3 m)	225800901
Direct Burial Kit - 30 ft (9 m)	225800902
Direct Burial Kit - 100 ft (30.5 m)	225800903

SubDrive2W Air Filter Kit

The Air Filter Kit is available for use with the SubDrive2W NEMA 3R. The kit is designed to allow the SubDrive2W system enclosure to be equipped with air filters that prevent contaminates or debris from entering the electronics.

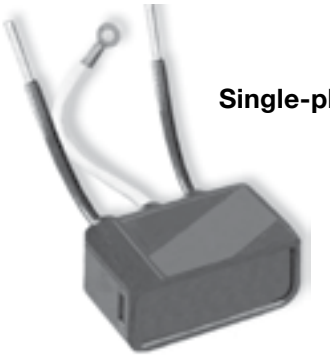
Franklin Part Number: 225 835 901

Submersible Motor Accessories

Surge Arrestors

Applications

These surge arrestors or their equivalents are highly recommended for protecting submersible motors from a variety of commonly occurring high voltage spikes which can damage the motor insulation system and cause motor winding failure. These arrestors will not, as is true of any surge protection equipment, protect the motor from a direct lightning strike.



Single-phase

Three-phase

Motor Type	No. Required Per Motor	Franklin Part Number
Single-phase	1*	150 814 902
Three-phase	1**	155 440 902

NOTES:

*Single-phase surge arrestor number 150 814 902 can be used on supply voltage systems up to 125 Volts to ground.

**Three-phase surge arrestor number 155 440 902 can be used on supply voltage systems up to 650 Volts to ground.

PT100 Sensors

Applications

The PT100 is a precision platinum wire resistor that is specified occasionally as a temperature input for process control equipment. A jacketed control lead must be run from the PT100 lead to the above-ground equipment. The above-ground equipment is not available from Franklin Electric and is typically part of a custom panel or data acquisition system.

PT100 sensor retrofit kits from Franklin Electric come with complete instructions and allow for easy field installation.

The PT100 is not approved as motor overload protection. Motor warranty will be void if agency approved motor overload protection is not installed as required by Franklin Electric's Application Installation Maintenance (AIM) Manual.

PT100-6"

PT100-8"

Kit Number	Franklin Part Number	For Use With Motor Types	Insulation	Lead Information			
				Temperature Rating	Wire Size	Length	
						Feet	Meters
305 327 901	165 608 901	6" (1/2 - 20 Threads)*	PVC	60 °C	AWG 20	29	8
305 327 903	165 608 903	6" (1/2 - 13 Threads)*	PVC	60 °C	AWG 20	29	8
305 326 902	165 624 902	8" (40 to 100 hp)	PVC	60 °C	AWG 20	29	8
305 326 901	165 624 901	8" (125 to 200 hp)	PVC	60 °C	AWG 20	29	8

NOTES:

*6-inch motor PT100 selection:
Oct. 2001 and earlier date coded motors use the 1/2-20 thread PT100.
Nov. 2001 date coded motors have thread type verified for correct selection.
Dec. 2001 and later date coded motors use the 1/2-13 thread PT100.

Couplings

Applications

Franklin Electric offers this line of motor-pump couplings for maximum customer convenience in matching the Franklin motor to a variety of pump shafts. Couplings are designed to transmit the pump thrust to the motor in order to provide maximum benefits from the Franklin internal thrust bearing construction.

Hardened stainless steel spacer discs in the 4" and 6" couplings assure positive bearing between motor and pump shafts and assure full support for downward thrust created by the pump.

8" couplings DO NOT contain hardened spacer discs, since the motor shaft itself is hardened.

All couplings include Allen head 300 series stainless steel set screws.

#416 Stainless Steel Couplings

Motor Size	Pump Shaft Dia.	Stainless Steel Key (Included) WxDxL	Coupling Part Number
4"	3/4	3/16 x 1/8 x 1 3/8	151 551 911
6"	3/4	3/16 x 1/8 x 1 3/4	151 935 902
6"	7/8	1/4 x 3/16 x 1 3/4	151 935 901
6"	1	1/4 x 3/16 x 1 3/4	151 935 909
8"	1	1/4 x 1/4 x 2	151 922 901
8"	1 3/16	1/4 x 1/4 x 2	151 922 906
8"	1 3/16	5/16 x 5/16 x 2	151 922 902
8"	1 1/4	5/16 x 5/16 x 2	151 922 903
8"	1 1/2	3/8 x 3/8 x 2	151 922 904

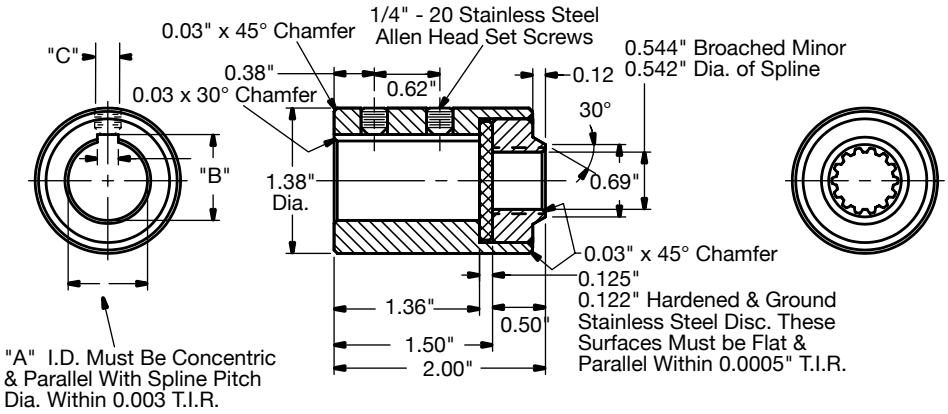
#316 Stainless Steel Couplings

Motor Size	Pump Shaft Dia.	Stainless Steel Key (Included) WxDxL	Coupling Part Number
4"	3/4	3/16 x 1/8 x 1 3/8	151 551 931
6"	3/4	3/16 x 1/8 x 1 3/4	151 935 922
6"	7/8	1/4 x 3/16 x 1 3/4	151 935 921
6"	1	1/4 x 3/16 x 1 3/4	151 935 929
8"	1 3/16	1/4 x 1/4 x 2	151 922 926
8"	1 1/4	5/16 x 5/16 x 2	151 922 923
8"	1 1/2	3/8 x 3/8 x 2	151 922 924
8"	1 11/16	3/8 x 3/8 x 2	151 922 929

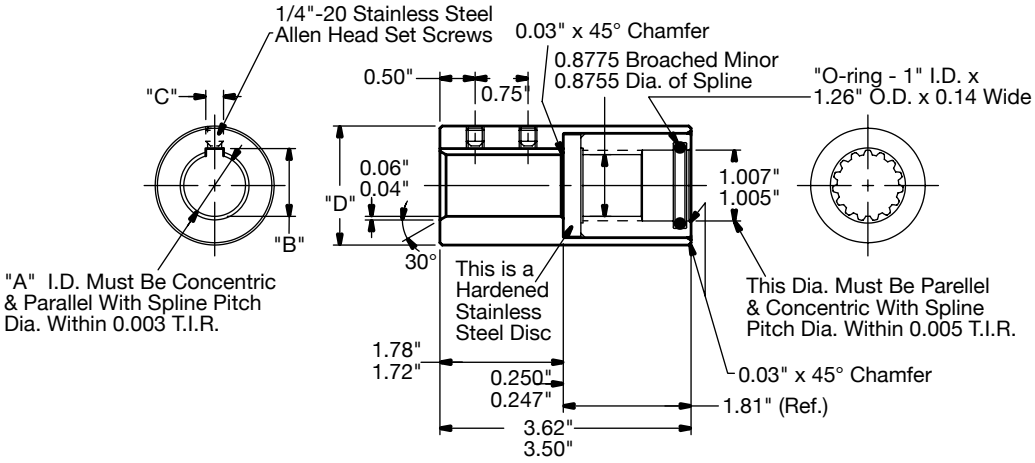
NOTE:

316 SS couplings are normally used with corrosion-resistant motors.

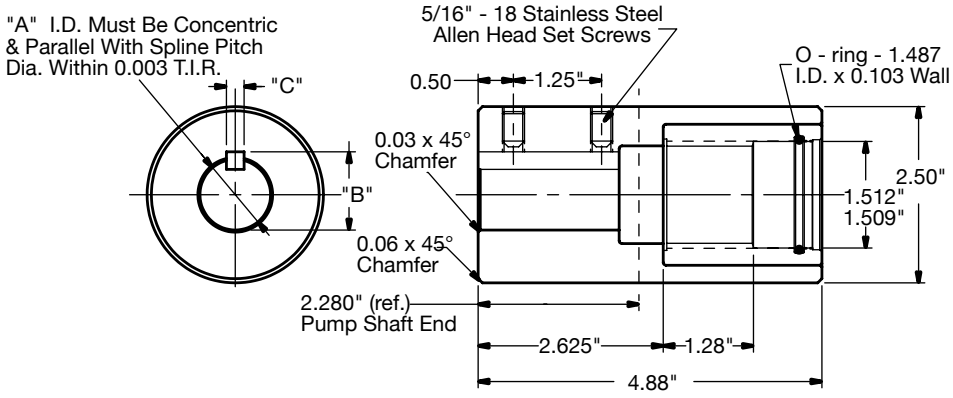
4" Coupling



6" Coupling



8" Coupling



Special Services

Special testing services are available for motors purchased from Franklin Electric. These services must be specified at time of order and will result in additional lead time.

Performance Test - Calibrated Motor
1/3 - 3 hp, 4" Dia. motor
5 - 10 hp, 4" Dia. motor
5 - 60 hp, 6" Dia. motor
40 - 200 hp, 8" Dia. motor

Submergence Performance Test
1/3 - 2 hp, 4" Dia. motor @ 1000 PSI (2-W 500 PSI)
3 - 10 hp, 4" Dia. motor @ 1000 PSI
5 - 30 hp, 6" Dia. motor @ 1000 PSI
40 - 60 hp, 6" Dia. motor @ 1000 PSI
8" Dia. motor @ 1000 PSI

ATTENTION!
IMPORTANT INFORMATION FOR INSTALLERS OF THIS EQUIPMENT!

This equipment is intended for installation by technically qualified personnel. Failure to install it in compliance with national and local electrical codes, and within Franklin Electric recommendations, may result in electrical shock or fire hazard, unsatisfactory performance, and equipment failure. Franklin installation information is available from pump manufacturers and distributors, and directly from Franklin Electric.
Call Franklin toll free 800-348-2420 for information.

WARNING

Serious or fatal electrical shock may result from failure to connect the motor, control enclosures, metal plumbing, and all other metal near the motor or cable, to the power supply ground terminal using wire no smaller than motor cable wires. To reduce risk of electrical shock, disconnect power before working on or around the water system. Do not use motor in swimming areas.

ATTENTION!
INFORMATIONS IMPORTANTES POUR L'INSTALLATEUR DE CET EQUIPEMENT.

Cet equipement doit etre intalle par un technicien qualifie. Si l'installation n'est pas conforme aux lois nationales ou locales ainsi qu'aux recommandations de Franklin Electric, un choc electrique, le feu, une performance non acceptable, voire meme le non-fonctionnement peuvent survenir. Un guide d'installation de Franklin Electric est disponible chez les manufacturiers de pompes, les distributeurs, ou directement chez Franklin. Pour de plus amples renseignements, appelez sans frais le 800-348-2420.

AVERTISSEMENT

Un choc electrique serieux ou meme mortel est possible, si l'on neglige de connecter le moteur, la plomberie metallique, boites de controle et tout metal proche du moteur a un cable allant vers une alimentation d'energie avec borne de mise a la terre utilisant au moins le meme calibre que les fils du moteur. Pour reduire le risque de choc electrique. Couper le courant avant de travailler pres ou sur le system d'eau. Ne pas utiliser ce moteur dans une zone de baignade.

ATENCION!
INFORMACION PARA EL INSTALADOR DE ESTE EQUIPO.

Para la instalacion de este equipo, se requiere de personal tecnico calificado. El no cumplir con las normas electricas nacionales y locales, asi como con las recomendaciones de Franklin Electric durante su instalacion, puede ocasionar, un choque electrico, peligro de un incendio, operacion defectuosa e incluso la descompostura del equipo. Los manuales de instalacion y puesta en marcha de los equipos, estan disponibles con los distribuidores, fabricantes de bombas o directamente con Franklin Electric. Puede llamar gratuitamente para mayor informacion al telefono 800-348-2420.

ADVERTENCIA

Puede ocurrir un choque electrico, serio o fatal debido a una erronea coneccion del motor, de los tableros electricos, de la tuberia, de cualquier otra parte metalica que esta cerca del motor o por no utilizar un cable para tierra de calibre igual o mayor al de la alimentacion. Para reducir el riesgo de choque electric, desconectar la alimentacion electrica antes de iniciar a trabajar en el sistema hidraulico. No utilizar este motor en albercas o areas en donde se practique natacion.

TOLL FREE HELP FROM A FRIEND

1.800.348.2420

1.260.827.5102 (FAX)

Franklin Electric
400 East Spring Street, Bluffton, Indiana 46714
Tel: 260.824.2900 • Fax: 260.824.2909

www.franklin-electric.com

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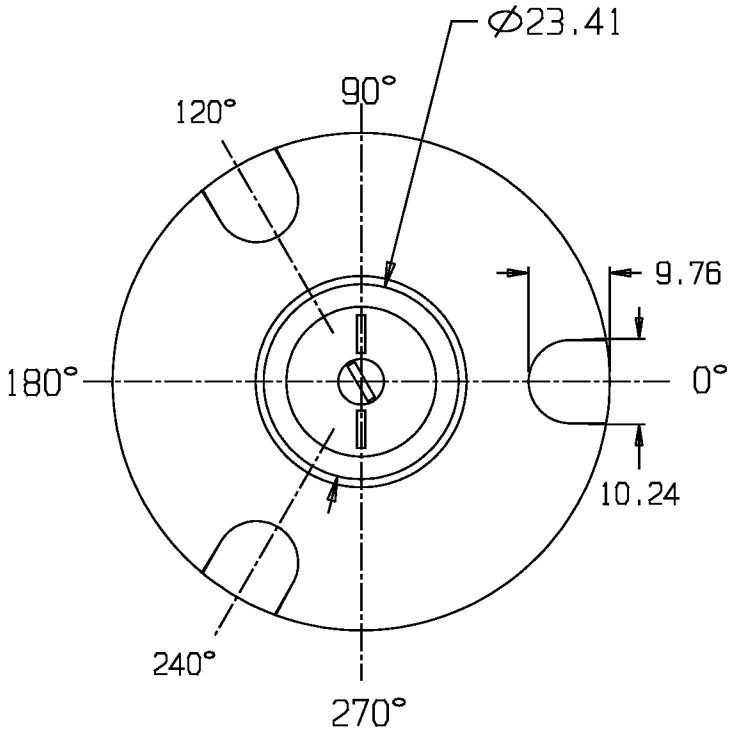
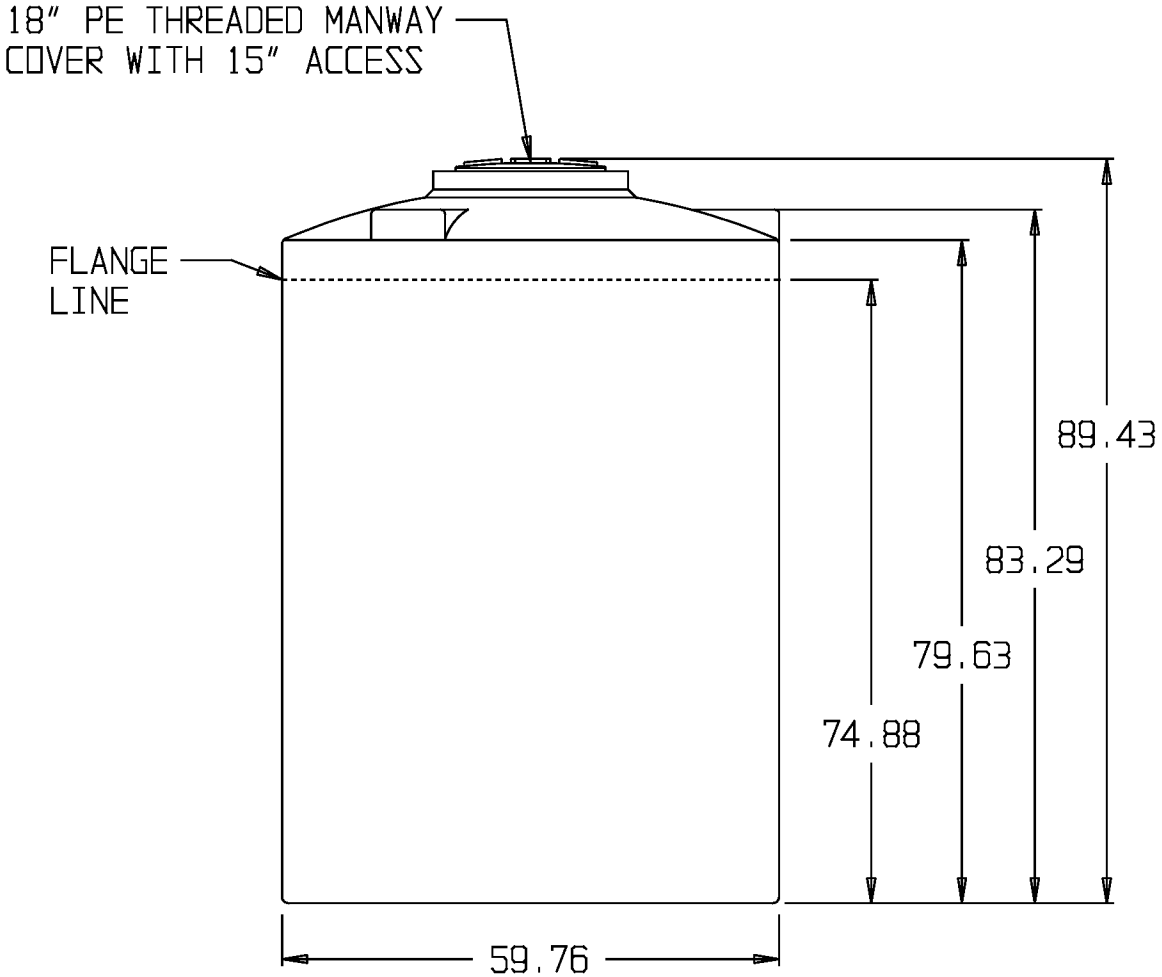




SNYDER INDUSTRIES INC.

* BASE FITTINGS TO BE LEFT INSTALLED AT TIME OF SHIPMENT PER SII PROCEDURE
* Consult Snyder's Guidelines for Use and Installation prior to delivery. Available on-line at www.snydernet.com

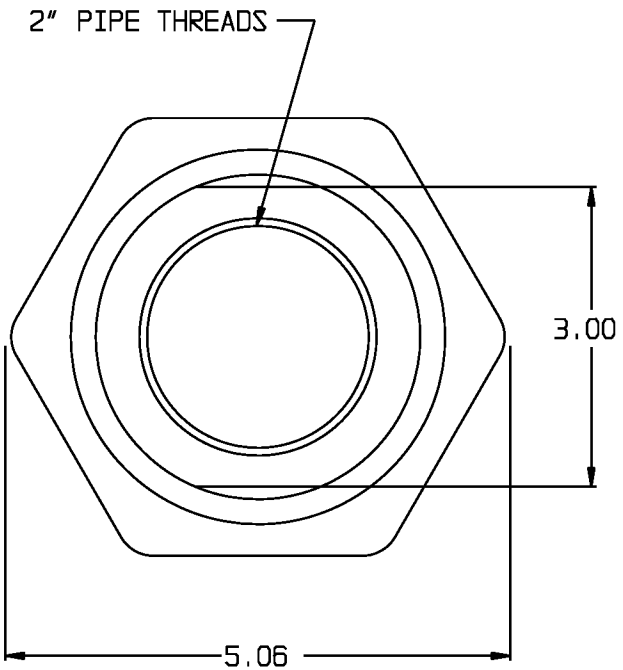
(all dimensions in inches)

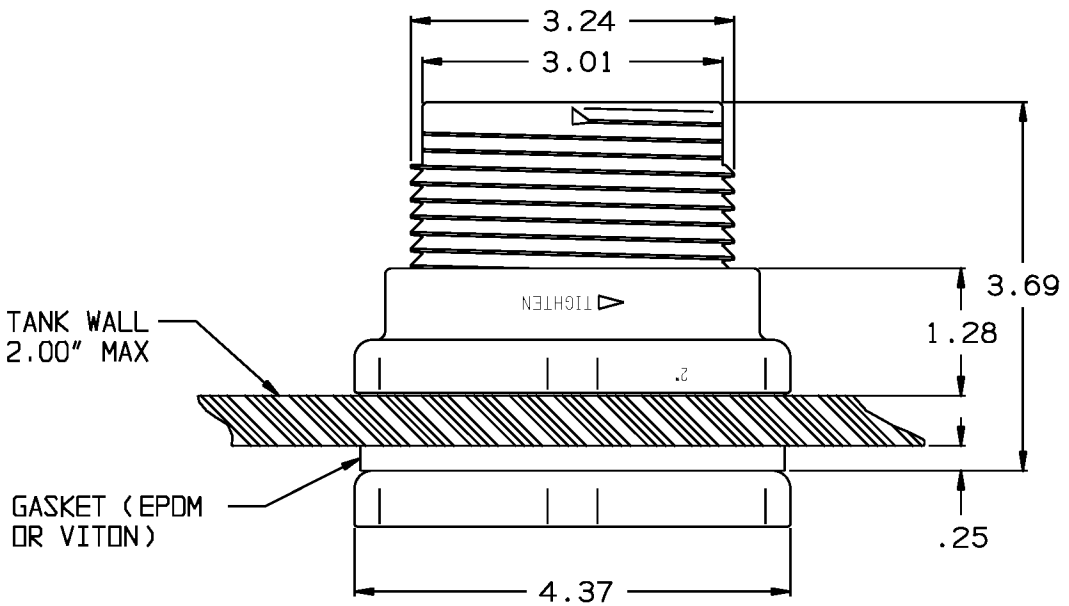
1,000 GALLON FLAT BOTTOM TANK

PART # TANK: 1831000N--

REF#: 0000 08/30/05

(all dimensions in inches)



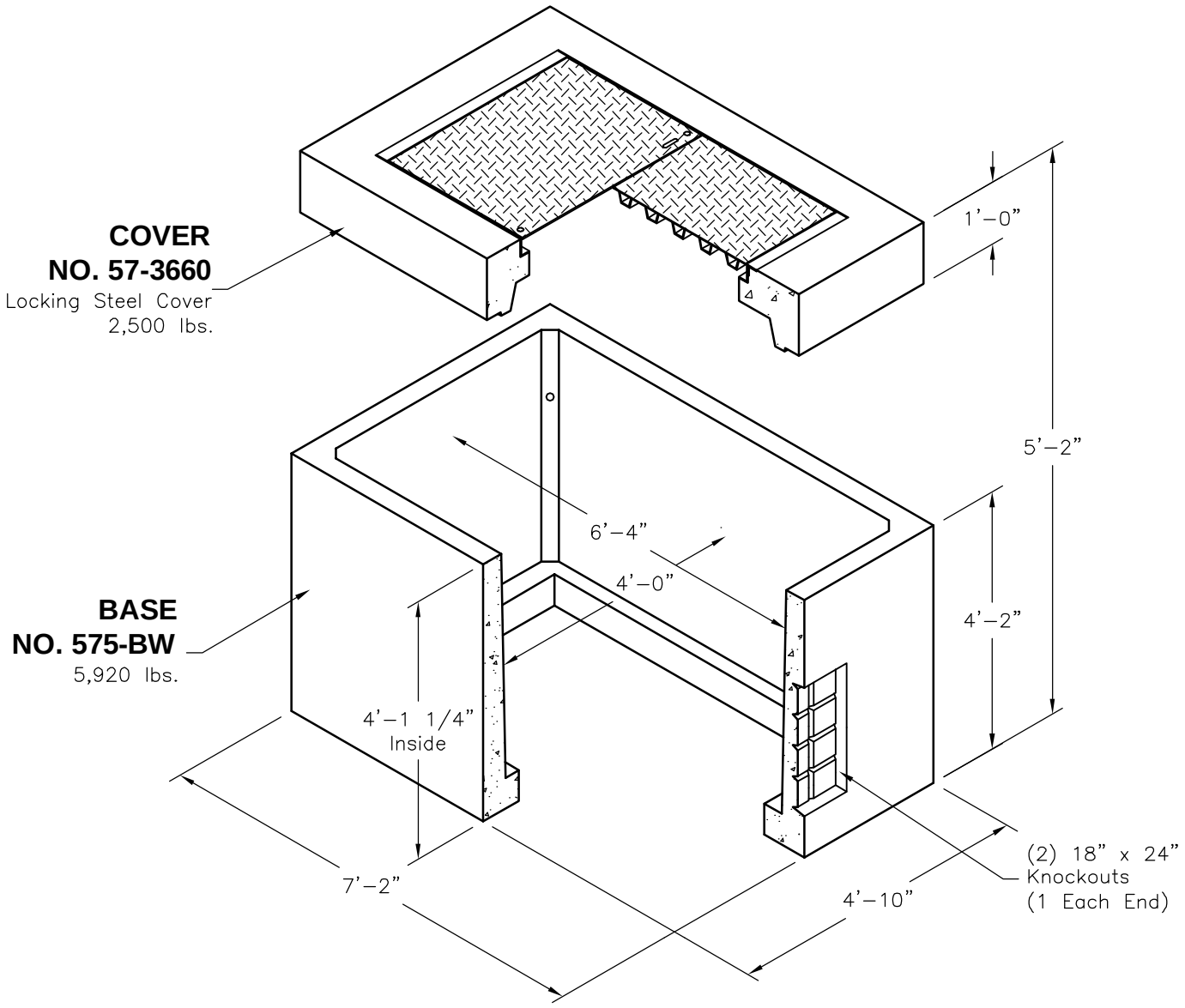


MATERIAL	EPDM	VITON	STYLE
PVC	34200015	34700238	SOCxTHD
CPVC	34400119	34700753	SOCxTHD
PP	34100051	34700171	THDxTHD

2" THREADED BULKHEAD STYLE FITTINGS

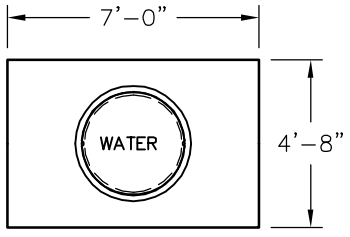
SNYDER INDUSTRIES INC.

FILE: 2THREAD.ckd 11/02/09

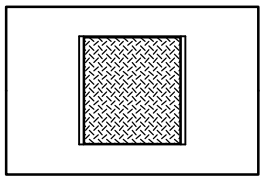


OPTIONAL COVERS

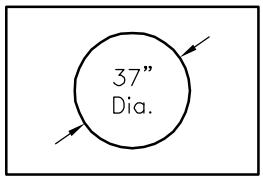
(For other available covers see Covers section)



Cast Iron Frame and Cover
No. 57–32CI
3,650 lbs.



Locking Steel Cover
No. 57–332P
3,450 lbs.



Concrete w/Hole
No. 57–37C
3,350 lbs.

SCALE: 3/8"=1'–0"

Oldcastle Precast®
Utility Vault
411 E. Frye Rd., Chandler, Arizona 85225
Tel: (480) 963-2678 Fax: (480) 899-1937

575-WA

FILE NAME: 040UWV575WAI.DWG

ISSUE DATE: JUNE, 2001

www.oldcastleprecast.com

4'-0" x 6'-4" x 4'-1 1/4" ID WATER METER VAULT STANDARD LAYOUT

HOME

DESCRIPTION

Link-Seal® modular seals are considered to be the premier method for permanently sealing pipes of any size passing through walls, floors and ceilings. In fact, any cylindrical object may be quickly, easily and permanently sealed, as they pass through barriers, by the patented Link-Seal® modular seal design.

Ductile iron, concrete, metal as well as plastic pipes may be hydrostatically sealed within walls to hold up to 20 psig (40 feet of static head). Electrical or telecommunications cable may be sealed within conduit as they enter vaults or manholes. The annular space between carrier pipes passing through casings may be sealed against the entry of water, soil or backfill material.

With a wide variety of hardware/ elastomer combinations, Link-Seal modular seals are easily configured to achieve the best possible match for service conditions encountered. High temperature seals, fire seals (Factory Mutual Approved) and oil resistant seals may be ordered to meet special or unique service applications. For the system approach, metal or non-conductive Century-Line® sleeves with water stops may be ordered with Link-Seal modular seals to ensure correct positioning and a water tight seal of the installation within poured concrete walls.

Link-Seal modular seals are also available for a wide variety of special applications, temperature extremes, exotic chemical combinations and for “out of round” or non-centered applications. Please contact factory for your special application.

TOP

BENEFITS/FEATURES

Saves time and money...

- Link-Seal modular seals install in up to 75% less time compared to lead-oakum joints, hand fitted flashings, mastics or casing boots.

Positive hydrostatic seal...

- Link-Seal modular seals are rated at 20 psig (40 feet of head), which exceeds the performance requirements of most applications.

Long seal life...

- Link-Seal modular seals are designed for use as a permanent seal. Seal elements are specially compounded to resist aging and attack from ozone, sunlight, water and a wide range of chemicals.

Maximum protection against corrosion...

- Standard fasteners have a two-part zinc dichromate and proprietary corrosion inhibiting coating.

Certification/Approvals...

- Factory Mutual Fire Approvals.
- Also a wide variety of approvals from various Federal agencies, associations, code groups, laboratories and organizations.

ISO Quality Assurance...

- Link-Seal modular seals are manufactured in an ISO 9001:2000 certified facility.

Configure a Link-Seal modular seal to match your application...

- 16 sizes, color coded EPDM, Nitrile, & Silicone elastomers may be used with various hardware options to match performance characteristics with service conditions.

TOP

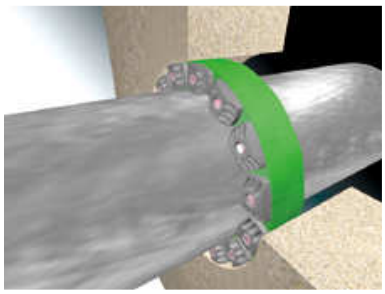
- Corrosion resistant 316 stainless steel available for maximum corrosion protection.

TYPICAL APPLICATIONS

Century-Line® Model CS Sleeves in Combinantion with “low durometer” EPDM (blue) Link-Seal® Modular Seals

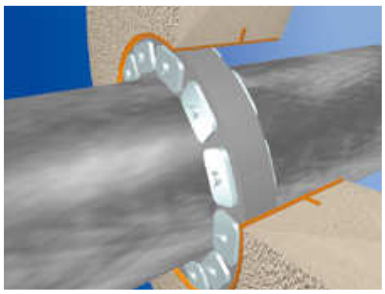
Century-Line® Model CS Sleeves are ideal for poured wall construction. Made of HDPE thermoplastic, they are lightweight and easy to handle. Molded-in waterstop and reinforcing ribs serve to anchor the sleeve in the wall and resist pour forces. Nailer end caps are provided to make placement in forms simple and accurate. Sleeves are available in 16 diameters, up to 25”, and any length. In the event of a field change they can be shortened with ordinary hand tools.

Pre-cast or Cored Wall Openings in Combination with Nitrile (green) Link-Seal® Modular Seals



Link-Seal® Modular Seals are also commonly installed in cored wall openings or pre-cast openings such as those formed by use of Cell-Cast® Disks for pipe penetration hole forms. See Cell-Cast Disk (page 4) or contact PSI for more information.

Model WS Steel Sleeves in Combination with Silicone (grey) Link-Seal® Modular Seals



Model WS Steel Sleeves are made from heavy-wall welded or seamless pipe. A full circle waterstop plate acts as positive water seal and anchor to prevent thrust movement. The 2” collar (water-stop) is continuously welded on both sides. Model WS is available in a wide range of diameters and any length. Sleeves are protected by a coating of red primer. Hot dip galvanizing is available on request.

Typical Applications

- Mechanical Contractors - Interior Piping Systems
- Floor Sleeves
- Wall Sleeves
- Manhole Pipe Entry Seals
- Waste Treatment Plants
- Cased Road Crossings
- Elevator Shafts
- Power Generating Dams
- Thermal Storage Systems
- Fire Protection Wall Penetrations
- Cased Railroad Crossings
- Electrical Isolation of Pipes
- Precast Concrete Pipe Seals
- Insulated Pipe Seals
- Dual Containment Seals
- Marine Applications
- Noise Dampening
- Flexible Sign & Pole Supports
- Electrical Isolation of Pipe Supports for Corrosion Protection
- Mining
- Pulp & Paper
- Decorative Fountains
- Bank Tube Transfer Systems
- Pool Contractors
- Electrical Contractors
- Marine Applications
- Waste & Water Treatment
- Telecommunications
- Railway Crossings
- Valve Pits
- Refrigeration Buildings
- Overhead Signs
- Guard Post Assemblies
- Power Generation Dams
- Offshore Oil Rigs
- High Pressure Tank Guards
- Underground Steel Tanks
- Centuryline Applications
- Precast Concrete Manufacturers
- Perimeter Berm Installations Around Tank Farms
- Flow Restrictors in Sewer Maintenance
- Fluid Overflow Devices
- Noise and Sway Dampener
- Through Deck Fire Breaks
- Parking Garage Column Protectors
- Cable TV Installations
- Bridge Construction
- Septic Tank Installations
- Coal Preparation Plants
- Pile Driving Operations
- Flag Pole Installations
- Driving Contractors
- Tunneling Operations

TOP

LINK-SEAL® MODULAR SEAL AND HARDWARE OPTIONS

Model "C" or "L" Link-Seal Modular Seal

Suitable for use in water, direct ground burial and atmospheric conditions. Provides electrical insulation where cathodic protection

Type: Standard
Seal Element:EPDM (Black), EPDM (Blue)
Pressure Plates: Composite
Bolts & Nuts: Steel with 2-part Zinc

Go To Ordering

is required.
Color: Black or Blue

Dichromate & Proprietary Corrosion Inhibiting Coating
Temp. Range: -40 to +250F. (-40 to +121C.)*
* = Sustained operation near temperature limits may affect life expectancy.

Go To Ordering

Model "S-316" Link-Seal Modular Seal

For chemical processing waste water treatment. EPDM rubber is resistant to most inorganic acids and alkalis, some organic chemicals (acetone, alcohol, ketones).
Color: Black or Blue

Type: Stainless
Seal Element: EPDM (Black), EPDM (Blue)
Pressure Plates: Composite
Bolts & Nuts: 316 Stainless Steel
Temp. Range: -40 to +250F. (-40 to +121C.)*
* = Sustained operation near temperature limits may affect life expectancy.

Go To Ordering

Model "O" Link-Seal Modular Seal

Nitrile rubber is resistant to oils, fuel and many solvents (gasoline, motor oil, kerosene, methane, jet fuel, hydraulic fluid, water, etc.).
Color: Green

Type: Oil Resistant
Seal Element: Nitrile (Green)
Pressure Plates: Composite
Bolts & Nuts: Steel with 2-part Zinc Dichromate & Proprietary Corrosion Inhibiting Coating
Temp. Range: -40 to +210F. (-40 to +99C.)*
* = Sustained operation near temperature limits may affect life expectancy.

Go To Ordering

Model "OS-316" Link-Seal Modular Seal

Combination of oil-resistant rubber and stainless steel hardware.
Color: Green

Type: Oil Resistant
Seal Element: Nitrile (Green)
Pressure Plates: Composite
Bolts & Nuts: 316 Stainless Steel
Temp. Range: -40 to +210F. (-40 to +99C.)*
* = Sustained operation near temperature limits may affect life expectancy.

Go To Ordering

Model "T" Link-Seal Modular Seal

Silicone rubber is ideal for temperature extremes. "T" model is Factory Mutual approved.
Color: Grey

Type: High/Low Temperature
Seal Element: Silicone (Grey)
Pressure Plates: Steel Zinc Dichromate
Bolts & Nuts: Steel with 2-part Zinc Dichromate & Proprietary Corrosion Inhibiting Coating
Temp. Range: -67 to +400F. (-55 to +204C.)*
* = Sustained operation near temperature limits may affect life expectancy.

Go To Ordering

Model "FD/FS" Link-Seal Modular Seal

Double seal for added protection.
Color: Grey

Type: Fire Seals
Seal Element: Silicone (Grey)
Pressure Plates: Steel Zinc Dichromate
Bolts & Nuts: Steel with 2-part Zinc Dichromate & Proprietary Corrosion Inhibiting Coating
Temp. Range: -67 to +400F. (-55 to +204C.)*
* = Sustained operation near temperature limits may affect life expectancy.

SPECIFICATIONS

Material Properties of Link-Seal Modular Seal Elements				
PROPERTY	**ASTM METHOD**	**EPDM (EPDM L)**	**NITRILE**	**SILICONE**
Hardness (shore A)	D-2240	50 ±5 (40 ±5)	50 ±5	50 ±5
Tensile	D-412	1450 psi	1300 psi	860 psi
Elongation	D-412	400%	300%	250%
Compression Set	S-395	15% 22 hrs. @ 158ºF (70ºC)	45% 22 hrs. @ 212ºF (100ºC)	40% 22 hrs. @ 350ºF (177ºC)
Specific Gravity	D-297	1.10	1.15	1.40

Material Properties of Composite Pressure Plates		
PROPERTY	**ASTM METHOD**	**VALUE**
Izod Impact - Notched	D-256	2.05 ft-lb/in
Tensile Strength @ Yield	D-638	20,000 psi
Tensile Strength - Break	D-638	20,250 psi
Flexural Strength @ Yield	D-790	30,750 psi
Flexural Modulus	D-790	1,124,000 psi
Elongation, Break	D-638	11.07%
Specific Gravity	D-792	1.38
Moisture Content	--	0.18%

Bolt & Nut Specifications	
Standard: Carbon Steel	Carbon steel, zinc dichromated per ASTM B633 with an additional corrosion inhibiting proprietary organic coating. (passes 1470 hour salt spray test) Tensile Strength = 60,000 psi, minimum.
Option: Stainless Steel	ANSI Type = 316, Per ASTM F593-95 Tensile Strength = 85,000 psi, average.

Modular/Mechanical Seal and Sleeve Specification

Typical Specification

1.0 Penetration Seals

Use a modular, mechanical seal, consisting of rubber links shaped to continuously fill the annular space between the pipe and the wall opening. Link-Seal® pressure plates shall be molded of glass reinforced nylon. Hardware shall be mild steel with a 60,000 psi minimum tensile strength and 2-part Zinc Dichromate coating per ASTM B-633 and Organic Coating, tested in accordance with ASTM B-117 to pass a 1,500-hour

2.0 Sleeves and Wall Openings

A. For diameters up to 24.81" install molded non-metallic high density polyethylene sleeves (HDPE) with integral hollow, molded water-stop ring four inches larger than the outside diameter of the sleeve itself. End caps and reinforcing ribs, domestically manufactured in an approved ISO-9001:2000 facility. Century-Line® Sleeve as manufactured by Pipeline Seal & Insulator, Inc, Houston, TX., or engineered pre-

salt spray test (or 316 Stainless Steel). Coloration shall be throughout elastomer for positive field inspection. Each link shall have permanent identification of the size and manufacturer's name molded into the pressure plate and sealing element. The Contractor will submit to verify the modular seals are domestically manufactured at a plant with a current ISO-9001:2000 registration. Copy of ISO-9001:2000 registrations shall be a submittal item. PSI-Thunderline/ Link-Seal® Modular Seal as manufactured by Pipeline Seal & Insulator, Inc, Houston, TX, or pre-approved equal.

approved equal.

B. For openings from 29.25" to 64.74" in diameter, use a modular hole-forming system consisting of interlocking HDPE plastic discs, domestically manufactured in an ISO-9001:2000 facility. The system shall provide a round hole in conformance with Link Seal® Modular Seal sizing data. Cell-Cast® Hole Forming Discs as manufactured by Pipeline Seal & Insulator, Inc, Houston, TX, or engineer pre-approved equal.

Consideration of brands other than mentioned above shall be submitted to the Engineer for evaluation at least 10 days prior to bid due date and shall include evidence of a minimum of 25 years of successful in-service application of the mechanical seal, as well as current ISO-9001:2000 registration.

TOP

WARRANTY

All products are warranted against failure caused by manufacturing defects for a period of one year. Any product found to be so defective and returned within one year from date of shipment will be replaced without charge. The above warranty is made in lieu of, and we disclaim, any and all other warranties, expressed or implied, including the warranties of merchantability and fitness for a particular purpose, and buyer agrees to accept the products without any such warranties. We hereby disclaim any obligation or liability for consequential damages, labor costs or any other claims or liabilities of any kind whatsoever.

TOP

HOW TO ORDER

The best way to quickly and easily size Link-Seal® Modular Seals is to use the on-line Seal-Finder™ program. Just click on the adjacent logo and you'll find how easy it is to size both Link-Seal® Modular Seals and Century-Line® Sleeves.

Click here for more detailed ordering instructions included in our 12 page selection guide.

Click here for even more detailed ordering instructions included in our 32 page engineering manual.

Click here for sizing charts when using Link-Seal® Modular

Click here for sizing charts when using Link-Seal® Modular

Click here for sizing charts when using Link-Seal® Modular

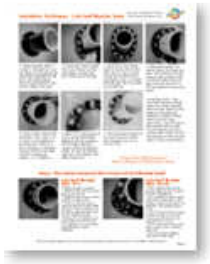
Seals specifically with **Century-Line® Sleeves.**

Seals specifically with **WS Steel Sleeves.**

Seals specifically with **Cast or Core Bit Drilled Holes.**

TOP

INSTALLATION INSTRUCTIONS



Click here for complete step-by-step instructions with photographs detailing how to install the Link-Seal® Modular Seal.

Click here for complete step-by-step instructions with photographs detailing how to install Century-Line® Sleeves.

Click here for complete step-by-step instructions with photographs detailing how to install Cell-Cast® Disks.

TOP

Pipeline Seal and Insulator, Inc.
6525 Goforth Street, Houston, TX 77021 U.S.A.
Telephone: 713-747-6948 • Toll Free: 800-423-2410
Fax: 713-747-6948 • info@psipsi.com

S19-310, S19-310F, S19-310FSS, S19-310SB
Combination Drench Shower/Eyewash Unit

- Complies with American National Standard Z358.1-2009
- Galvanized Steel Protected with BradTect® Safety Yellow Coating or All Stainless Steel (S19-310FSS)
- Combination Units may be Top-Supplied or Mid-Supplied
- Universal Identification Sign and Inspection Tag Included
- Full, One-Year Warranty
- Patent Pending

CERTIFIED MODEL Z358.1-2009

Specifications

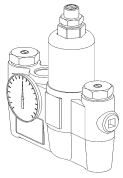
Combination Drench Shower/Eyewash Unit saves space and fits easily into any work environment. Shower valve operates quickly by a pull rod with a triangular handle. Shower provides a superior washdown with a more even spray pattern. Eyewash operated by a large, highly visible push handle. Safe, steady water flow under varying water supply conditions from 30–90 PSI is assured by integral flow control in the sprayhead assembly. NOTE: The ANSI Z358.1 standard requires an uninterruptible supply of flushing fluid at a minimum 30 PSI flowing pressure.

cUPC Approved:
S19-310, S19-310F, S19-310FSS and S19-310SB are certified to comply with the requirements of the Uniform Plumbing Code and the National Plumbing Code of Canada by the International Association of Plumbing and Mechanical Officials (IAPMO).

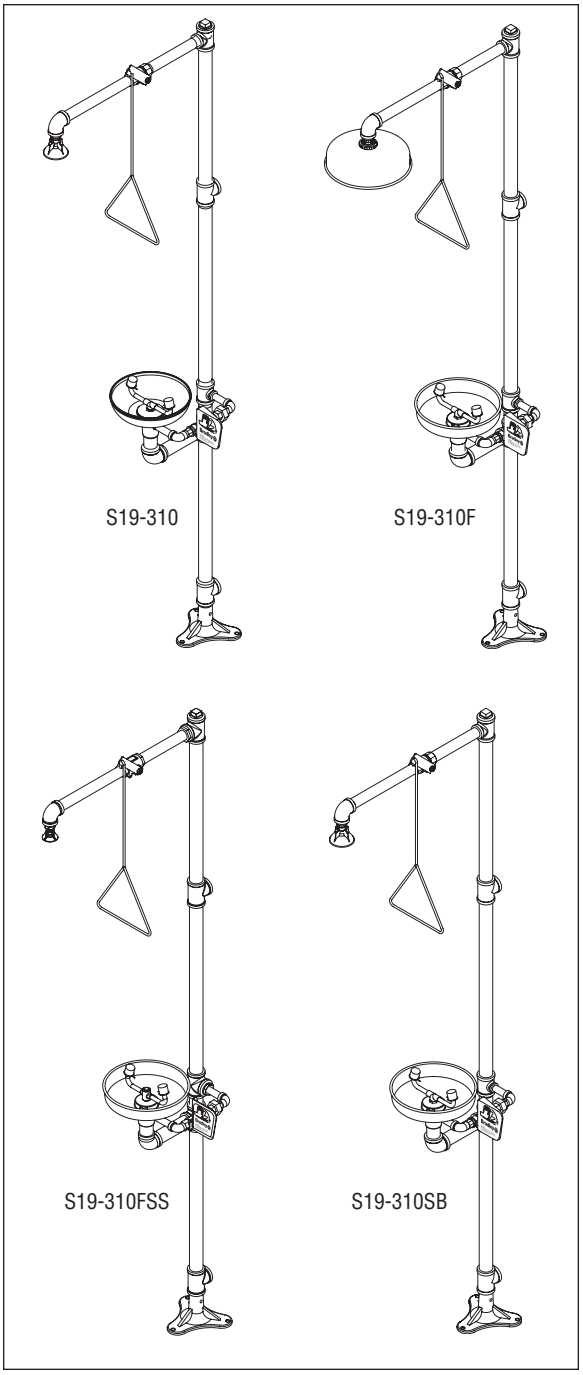
This plumbing fixture is not intended to dispense water for human consumption through drinking or for preparation of food or beverages.

Model	Description
☐ **S19-310**	Drench Shower/Eyewash - **Plastic Showerhead and Bowl**
☐ **S19-310F**	Drench Shower/Eyewash - **Stainless Steel Showerhead Shroud and Bowl**
☐ **S19-310FSS**	Drench Shower/Eyewash - **All Stainless Steel**
☐ **S19-310SB**	Drench Shower/Eyewash - **Plastic Showerhead and Stainless Steel Bowl**
☐ **S19-2100**	Navigator EFX25 - Emergency Thermostatic Mixing Valve

Recommended Option:
Navigator S19-2100 EFX25
Emergency Thermostatic Mixing Valve
NAVIGATOR



Satisfies ANSI Z358.1-2009
tepid water requirements.

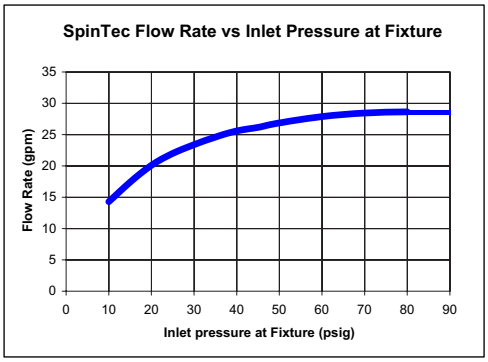


P.O. Box 309, Menomonee Falls, WI 53052-0309
Phone: 800.BRADLEY (800.272.3539) Fax: 262.251.5817
bradleycorp.com

Standard Equipment

SpinTec™ Showerhead

Standard showerhead is 3.1" (78.7mm) diameter highly visible yellow impact-resistant plastic (Model S19-310F includes a 10¾" [273mm] diameter corrosion-resistant stainless steel shroud). High performance corrosion-resistant stainless steel showerhead measures 2" (51mm) in diameter (S19-310FSS only). SpinTec drench showerhead features integral 26 GPM flow control, conserving water and helping to accurately size your tepid water system.



Shower Valve

Chrome-plated brass 1" NPT stay-open ball valve. Operated by a stainless steel rod with triangular handle. S19-310FSS is all stainless steel.

Eye Wash Bowl

10" (254mm) diameter yellow impact-resistant plastic or 10¾" (273mm) diameter corrosion-resistant stainless steel.

Standard Sprayhead Assembly

Chrome-plated brass sprayhead with twin soft-flow eyewash heads and protective sprayhead covers. Safe, steady water flow under varying water supply conditions from 30–90 PSI is assured by integral flow control in the sprayhead assembly. S19-310FSS is stainless steel.

Eyewash Valve

Chrome-plated brass ½" NPT stay-open ball valve. Hand operated by highly visible safety yellow PVC push handle. S19-310FSS is all stainless steel.

Pipe and Fittings

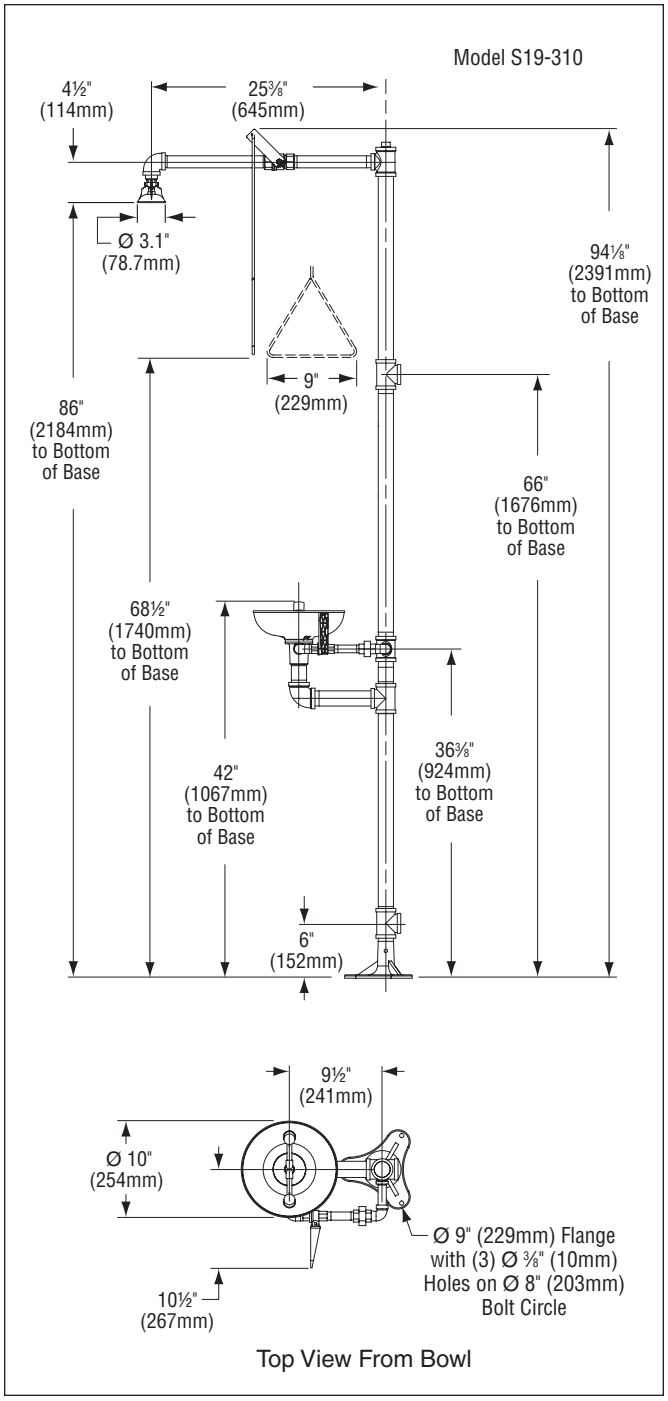
1¼" galvanized steel with BradTect® safety yellow coating. S19-310BFSS is stainless steel.

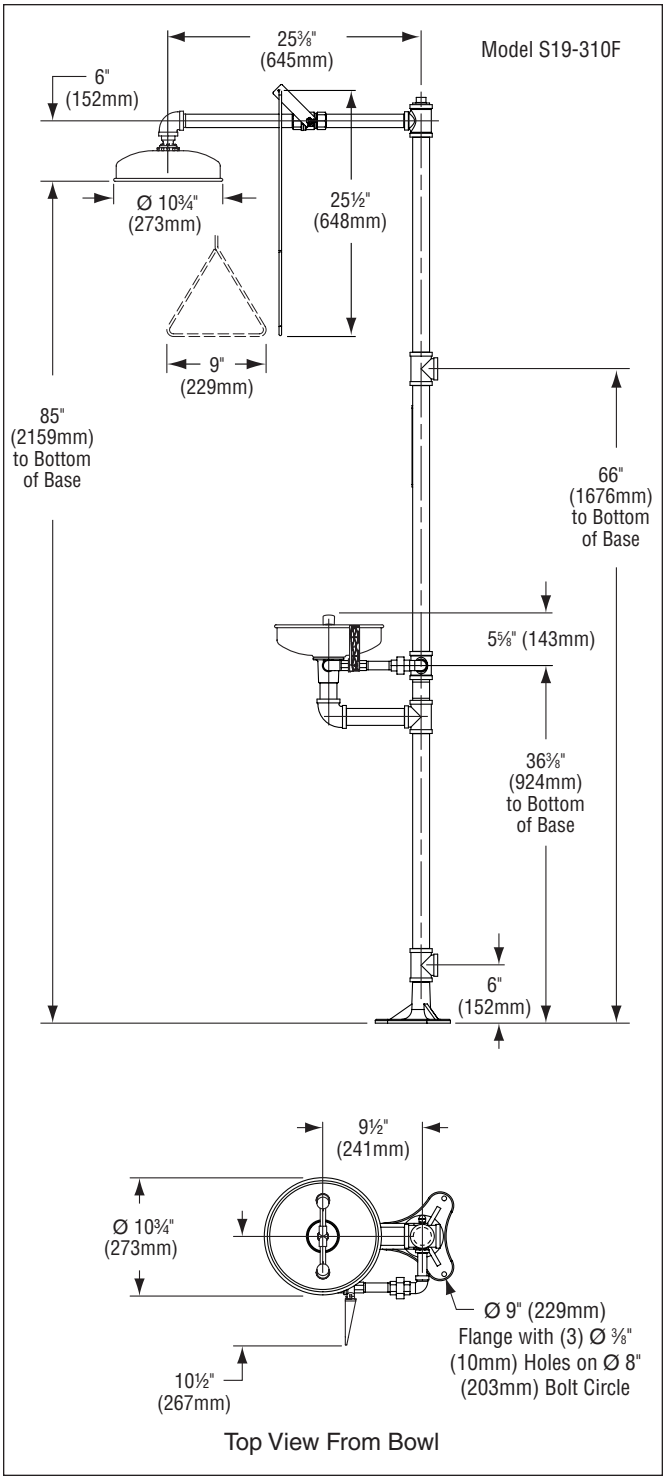
Water Supply

1¼" NPT.

Local codes may require the installation of a backflow prevention valve to complete proper installation. Compliance with local codes is the responsibility of the installer. Valve must be tested annually to verify that it is functioning properly. Backflow prevention valves are not included with the fixture and may be supplied by the contractor or purchased from Bradley Corporation.

P.O. Box 309, Menomonee Falls, WI 53052-0309
Phone: 800.BRADLEY (800.272.3539) Fax: 262.251.5817
bradleycorp.com

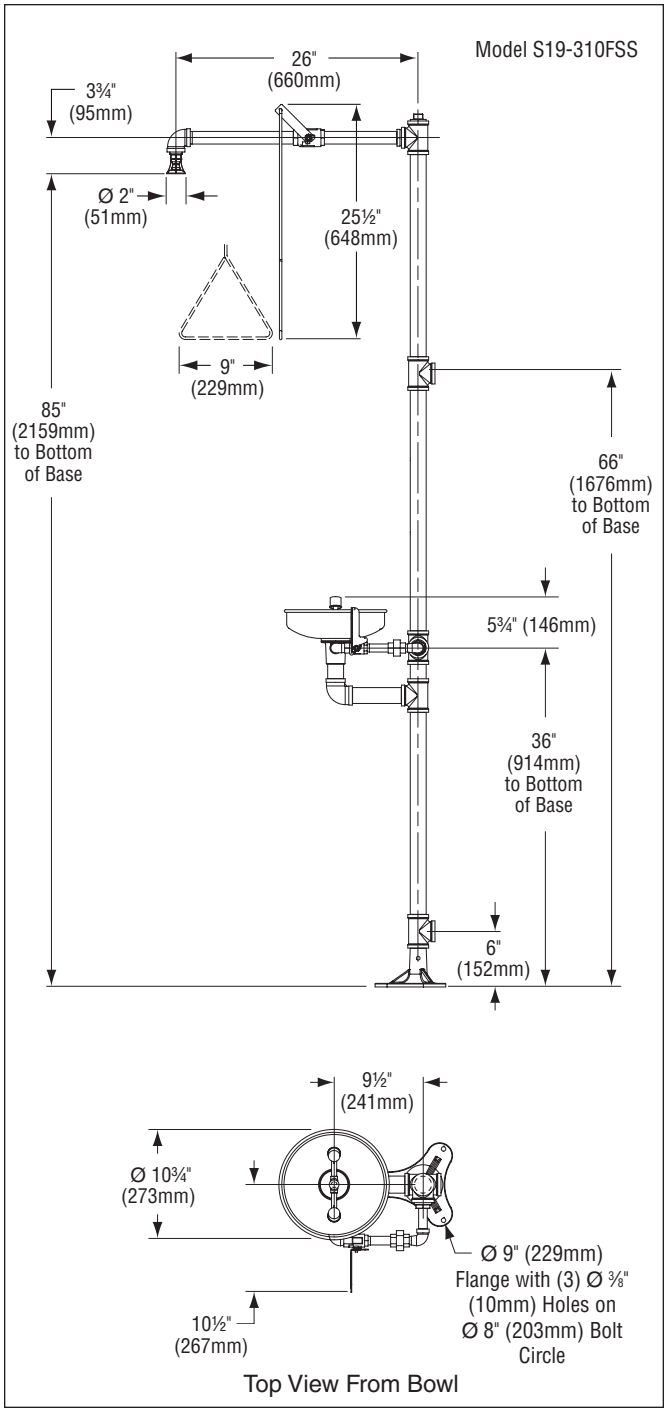


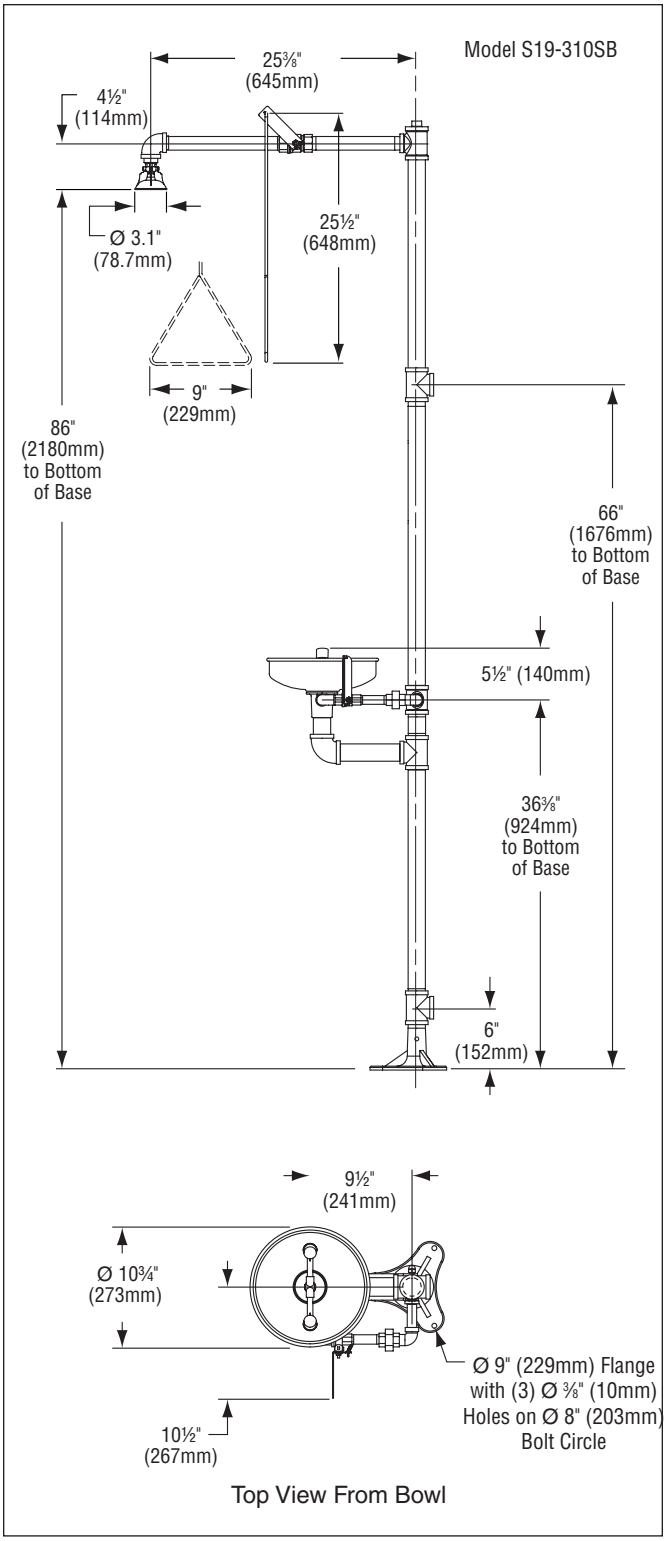


All dimensions assume standard thread engagement. Variations in manufacturing allow for +/- ⅛" (3mm) per threaded joint. To find the tolerance of a dimension, add the number of thread joints in between a dimension and multiply it by ⅛" (3mm).

P.O. Box 309, Menomonee Falls, WI 53052-0309
Phone: 800.BRADLEY (800.272.3539) Fax: 262.251.5817
bradleycorp.com

S19-310, S19-310F, S19-310FSS, S19-310SB
Combination Drench Shower/Eyewash Unit





All dimensions assume standard thread engagement. Variations in manufacturing allow for +/- ⅛"(3mm) per threaded joint. To find the tolerance of a dimension, add the number of thread joints in between a dimension and multiply it by ⅛" (3mm).

P.O. Box 309, Menomonee Falls, WI 53052-0309
Phone: 800.BRADLEY (800.272.3539) Fax: 262.251.5817
bradleycorp.com

LITHONIA LIGHTING®

Catalog Number	
Notes	
Type	

FEATURES & SPECIFICATIONS

INTENDED USE

For entrances, stairwells, corridors and other pedestrian areas.

CONSTRUCTION

Rear housing is rugged, corrosion-resistant, die-cast aluminum. Front cover is one-piece UV-resistant injection molded polycarbonate, internally painted. Captive external hardware is specially treated for corrosion resistance and includes slotted hex-head and tamperproof fasteners.

FINISH

Dark bronze (DDB) corrosion-resistant polyester powder.

OPTICAL

One-piece die-formed reflector is diffused aluminum. Refractor is clear UV stabilized polycarbonate, providing **IES cutoff** distribution and maximum lateral light output. Front cover is sealed and gasketed to inhibit the entrance of outside contaminants.

ELECTRICAL

Compact fluorescent ballasts are multi-volt (120-277) electronic high power factor. UL Listed. Four-pin (26DTT, 26TRT, 32TRT and 42TRT) positive latching thermoplastic socket.

All components are heat-sinked directly to the cast housing for maximum heat dissipation.

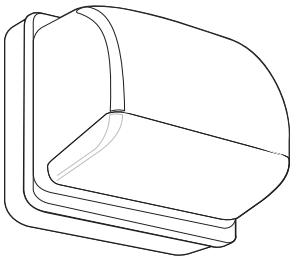
INSTALLATION

Mount to any vertical surface or to a 4" outlet box. Back access through gasketed slot. Top wiring access through 1/2" threaded conduit entry. (Through-wiring requires use of a conduit tee).

LISTING

UL listed for wet locations. IP65 rated. UL Listed to US and Canadian safety standards (see Options). NOM Certified.

Note: Specifications subject to change without notice.



Cutoff Mini Wall-Packs

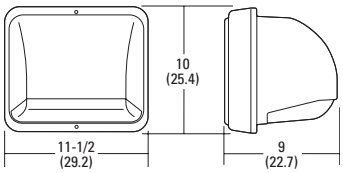
TWAC

COMPACT FLUORESCENT
26-42TRT

Specifications

Height: 10 (25.4)
Width: 11-1/2 (29.2)
Depth: 9 (22.7)
*Weight: 10 lbs. (4.53kg)

*Weight as configured example below.
Specifications are in inches (cm) unless otherwise noted.



ORDERINGINFORMATION For shortes lead times, configure product using **standard options (shown in bold).**

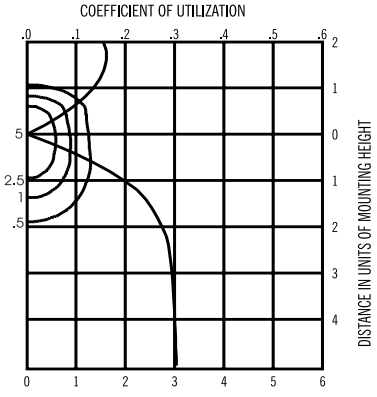
Example: TWAC 42TRT MVOLT LPI

TWAC						
Series	**Wattage**	**Voltage**	**Ballast**	**Options**	**Finish**	**Lamp[7]**
TWAC	26DTT 26TRT 32TRT **42TRT**	**120** **277** **347** **MVOLT[1]**	**(blank)** Electronic 0ºF	Shipped installed in fixture GMF Internal slow-blow fusing EC Emergency circuit[2] DC12 Emergency circuit 12 volt (35 watt lamp included)[3] DC2012 Emergency circuit 12 volt (20 watt lamp included)[3] 2DC12 Emergency circuit 12 volt (2 35 watt lamp included)[3] 2DC2012 Emergency circuit 12 volt (2 20 watt lamp included)[3] **CSA** Listed and labeled to comply with Canadian Standards NOM NOM Certified (consult factory) PE Photocell[4] Shipped separately[5] WG Wire guard	**(blank)** Dark bronze DNA Natural aluminum DBL Black DMB Medium bronze DWH White DSS Sandstone CR Enhanced corrosion-resistant finish[6] CRT Non-stick protective coating[6]	**LPI** Lamp included **L/LP** Less lamp

NOTES:

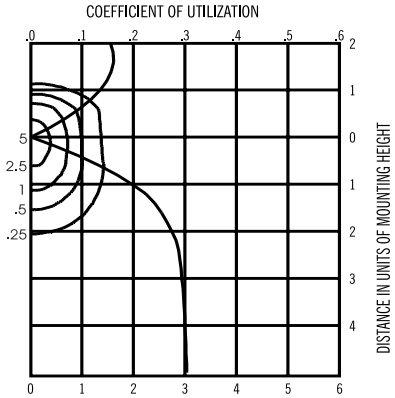
1 Optional multi-volt electronic ballast capable of operating any line voltage from 120-277V.
2 Maximum allowable wattage lamp included.
3 Not available with EC or NOM.
4 Not available with MVOLT.
5 May be ordered as an accessory as TWAWG U.
6 Finish applied to housing only.
7 Must be specified (35K lamp with LPI).

TWAC 32TRT Test No. LTL8361



32W Compact Fluorescent lamp, 3200 rated lumens. Footcandle values based on 20' mounting height, Distribution , cutoff.

TWAC 42TRT Test No. LTL8339



42W Compact Fluorescent lamp, 5200 rated lumens. Footcandle values based on 20' mounting height, Distribution , cutoff.

Mounting Height Correction Factor

(Multiply the fc level by the correction factor)

8 ft. = 6.25
10 ft.= 4.00
12 ft.= 2.78
15 ft.= 1.78

$$\left(\frac{\text{Existing Mounting Height}}{\text{New Mounting Height}}\right)^2 = \text{Correction Factor}$$

OUTDOOR: One Lithonia Way Conyers, GA 30012 Phone: 770.922.9000 Fax: 770-918-1209 www.lithonia.com

LITHONIA LIGHTING®

Catalog Number	
Notes	
Type	

FEATURES & SPECIFICATIONS

INTENDED USE

Ideal where high brightness and good illumination levels are required such as retail, light industrial and warehouses.

ATTRIBUTES

Available in one lamp or two lamp configuration.

CONSTRUCTION

Heavy-duty channel, die-formed from code-gauge steel.

Sturdy channel cover secured by captive quarter-turn latch for easy access to wireway.

Combination endplate/channel connector furnished with each fixture.

FINISH

Five-stage iron phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with high-gloss, baked white enamel.

ELECTRICAL

Thermally protected, resetting, Class P, UL Listed and CSA Certified ballast is standard. Sound rating depends on lamp/ballast combination.

AWM, TFN, THHN wire throughout, rated for required temperatures.

INSTALLATION

For unit or row installations, surface or suspended mounting.

LISTING

UL listed to US and Canadian safety standards. Optional: Mexico NOM.

Damp location listed.

Listed for 25 degree C ambient temperature.

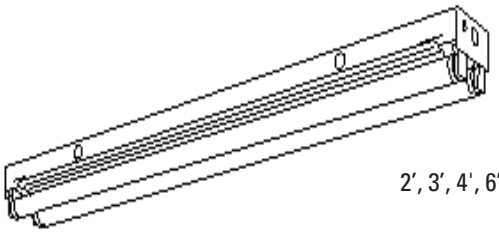
WARRANTY

Guaranteed for one year against mechanical defects in manufacture.

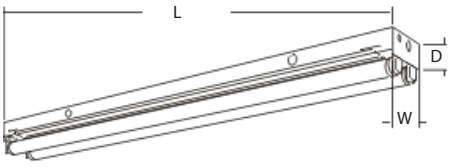
Specifications subject to change without notice.

General-Purpose Strip

C



2', 3', 4', 6' and 8' length
1 or 2 lamps



Specifications

Length: 24" (61.0)
36" (91.4)
48" (121.9)
72" (182.9)
96" (243.8)

Width: 4-3/8" (11.1)

Fixture Depth: 2-/16" (5.2)

All dimensions are inches (centimeters).

ORDERING INFORMATION Lead times will vary dependning upon options selected. Consult your sales representative.

Example: C 2 32 MVOLT GEB10IS

C				
Series	**Number of lamps**	**Lamp type**	**Voltage**	**Options**
C **General-purpose strip** For tandem double length unit, add prefix T. Example: TC	1 **2** lamp not included	T8 17 17W T8 (24") 25 25W T8 (36") **32** 32W T8 (48") 96T8 59W T8 slimline (96") T12 Slimline 36 30W slimline (36") 48 38W slimline (48") 72 55W slimline (72") **96** 75W slimline (96") T12 20 20W T12 (24") 30 30W T12 (36") 40 40W T12 (48")	MVOLT[1,2] 120 277 347 others available	**GEB** Electronic ballasts, ≤20%THD[3] **GEB10IS** Electronic ballasts, ≤10%THD instant start[1,2] GEB10RS T8 electronic ballast, ≤10%THD, rapid start BILP High-efficiency ballast, .78bf (low), instant start BINP T8 high-performance ballast, .88bf (normal), instant start BIHP T8 high-performance ballast, 1.20bf (high), instant start[4] 1/4 One four-lamp ballast[5] **EL** Emergency battery pack (nominal 300 lumens) GLR Internal fast-blow fuse (add X for external)[6] GMF Internal slow-blow fuse (add X for external)[6] PLR_ Plug-in wiring; specify 1, 2, or 3 branch circuits and hot wires (A = Black, B = Red, C = Blue, AB or AC) TILW Tandem in-line wiring CW Cold-weather ballast: 0 degree F starting temp CSA CSA Certified (only required for 347V) NOM NOM Certified

Accessories: *Order as separate catalog number.*

SQ_	Swivel stem hanger (specify length in 2" increments)	HRC1®	Hooker T-bar hanger (1-1/2" from ceiling).
1B	Ceiling spacer (adjusts from 1-1/2" to 2-1/2" from ceiling)	WGCSMR	Wireguard, 4' white for symmetric reflector.[7]
CONLGC	12" screw-on channel connector	WGCASR	Wireguard, 4' white for asymmetric reflector.[7]
WGCU NST	Wireguard, 4' white.[7]	CSMR 48	Symmetric reflector, 4' white, 7" aperture.[7]
HC36	Chain hangers (1 pair, 36" long)	CASR 48	Asymmetric reflector, 4' white, 5-3/4" wide.[7]
HRC®	Hooker T-bar hanger (flush to ceiling)		

NOTES:
1 MVOLT standard for 120-277V applications, 50-60 mhz operation. Some options require voltage specified.
2 T8 lamps only.
3 Slimline lamps only.
4 Not available in 347V.
5 Not available in slimline.
6 Specify voltage.
7 Order two for 8' fixtures.

MOUNTING DATA

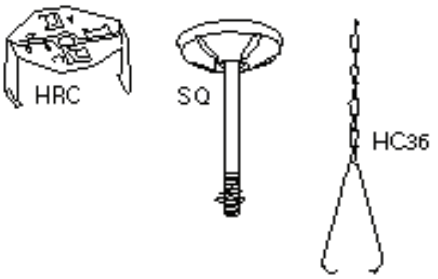
For unit or row installation, surface or suspended mounting.

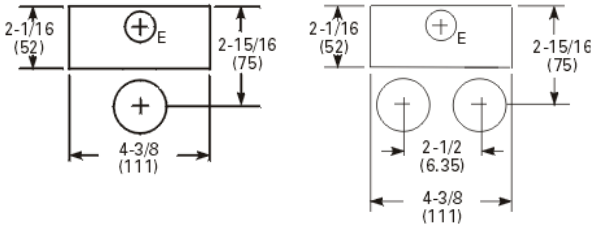
Unit installation — Minimum of two hangers required.

Row installation — Two hangers per channel required. One per fixture plus one per row if CONLGC installed.

Hooker® (HRC) and HC Hangers — Minimum two per channel (unit and row)

See ACCESSORIES below for hanging devices.





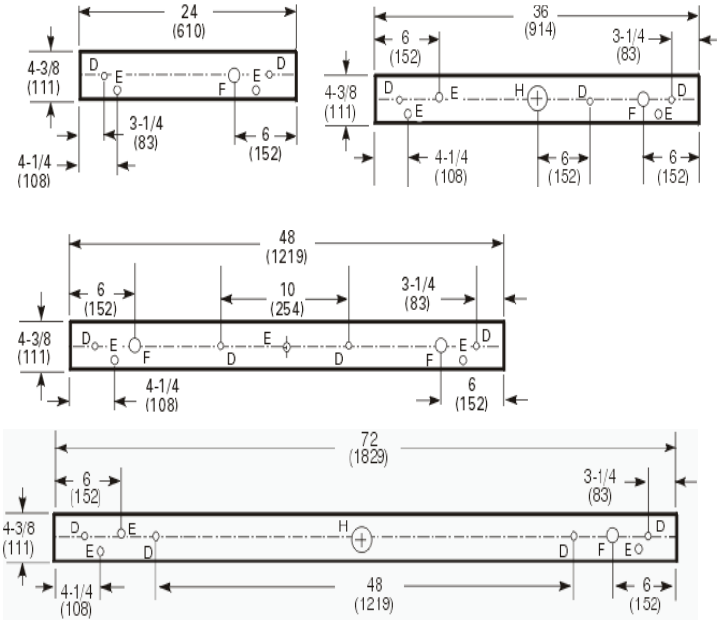
D = 11/16 (17) Dia.K.O.
E = 7/8 (22) Dia.K.O.
F = 1-1/4 (32) Dia.K.O.
H = 2 (51) Dia.K.O.

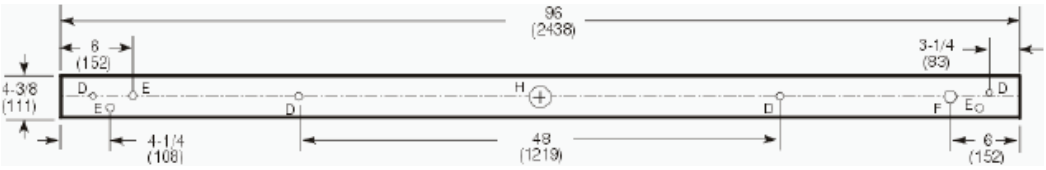
DIMENSIONS

Inches (millimeters). Subject to change without notice.

48", 72" and 96" have only two 7/8" K.O.'s 6" from each end

24" and 36" have only two 7/8" K.O.'s 3-1/4" from each end





PHOTOMETRICS

Calculated using the zonal cavity method in accordance with IESNA LM41 procedure. Floor reflectances are 20%. Lamp configurations shown are typical. All data based on 25°C. Full photometric data on these and other configurations available upon request.

C 2 32
TEST NO: LTL 5181
LUMENS PER LAMP: 2900

Coefficients of Utilization

RCR	pf 20% pc 80% pw 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0		106	106	106	102	102	102	93	93	93
1		89	84	79	85	80	76	78	74	71
2		76	68	62	72	66	60	66	61	56
3		65	57	50	62	55	49	57	51	45
4		57	48	42	55	47	40	50	43	38
5		51	42	35	48	40	34	44	37	32
6		45	36	30	43	35	29	40	33	28
7		41	32	26	39	31	25	36	29	24
8		37	29	23	35	28	22	33	26	21
9		34	26	20	32	25	20	30	23	19
10		31	23	18	30	23	18	28	21	17

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	842.1	14.5	15.6
0° - 40°	1435.8	24.8	26.7
0° - 60°	2810.1	48.4	52.2
0° - 90°	4362.5	75.2	81.0
90° - 180°	1021.0	17.6	19.0
0° - 180°	5383.6	92.8	100.0

C 2 96
TEST NO: LTL 18310
LUMENS PER LAMP: 6300

Coefficients of Utilization

RCR	pf 20% pc 80% pw 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0		103	103	103	98	98	98	90	90	90
1		86	82	78	82	78	74	75	72	69
2		74	67	61	70	64	59	64	59	55
3		64	56	49	61	54	48	56	49	44
4		56	47	41	53	46	40	49	42	37
5		49	41	35	47	39	34	43	37	31
6		44	36	30	42	34	29	39	32	27
7		40	32	26	38	30	25	35	28	24
8		36	28	23	35	27	22	32	25	21
9		33	25	20	32	25	20	29	23	19
10		30	23	18	29	22	18	27	21	17

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1785.8	14.2	15.7
0° - 40°	3042.4	24.1	26.8
0° - 60°	5944.0	47.2	52.3
0° - 90°	9027.5	71.6	79.4
90° - 180°	2341.8	18.6	20.6
0° - 180°	11369.4	90.2	100.0

Energy (Calculated in accordance with NEMA standard LE-5)

LER.FL	ANNUAL ENERGY COST*	LAMP DESCRIPTION	LAMP LUMENS	BALLAST FACTOR	WATTS
86.2	$2.79	(2)T8 F32	2900	.88	55

* Comparative yearly lighting energy cost per 1000 lumens

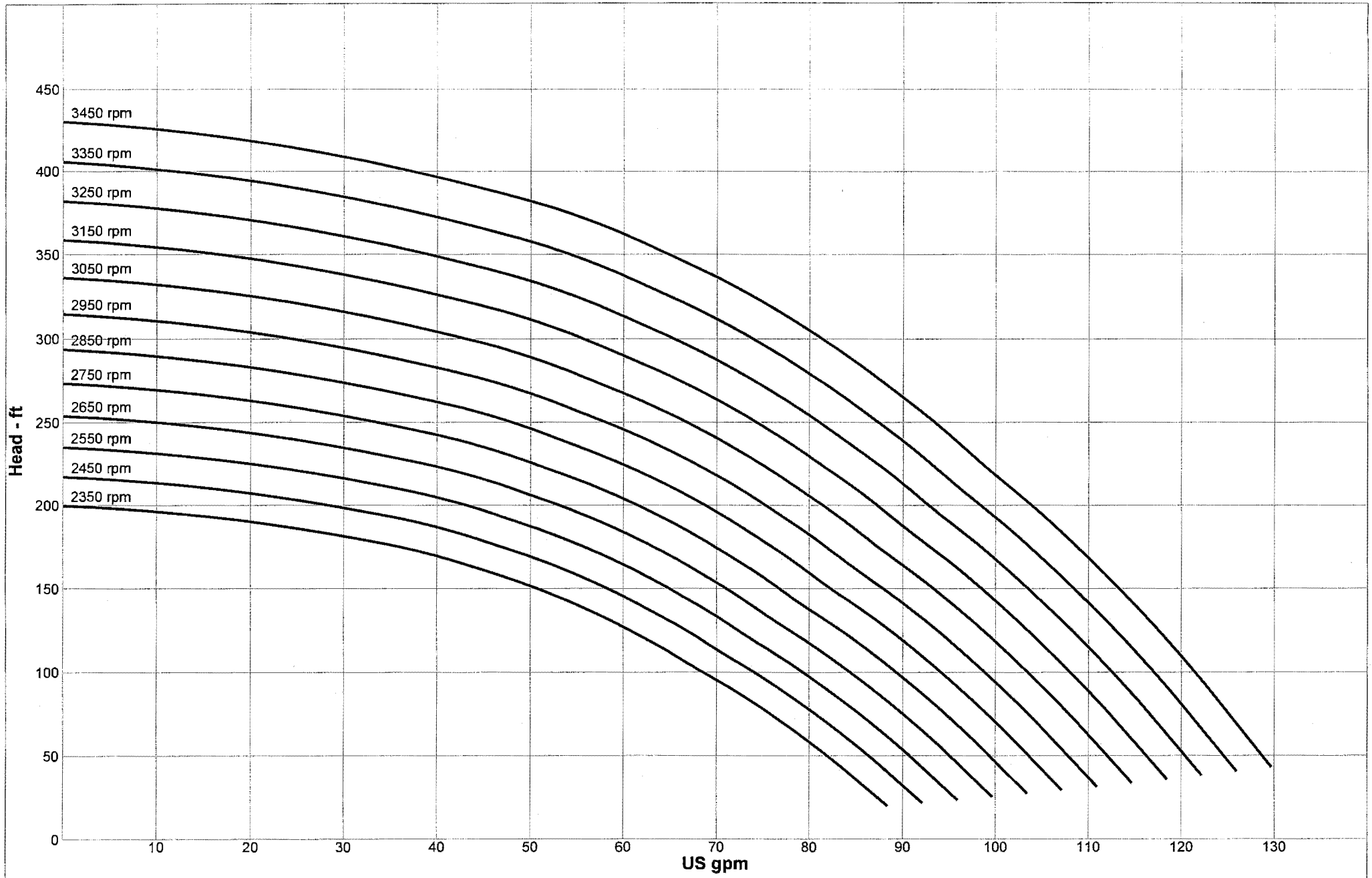
Energy (Calculated in accordance with NEMA standard LE-5)

ORDERING INFORMATION	LER.FL	ANNUAL ENERGY COST*	LAMP DESCRIPTION	LAMP LUMENS	BALLAST FACTOR	WATTS
C 2 32 MVOLT GEB10IS	77.6	$3.09	F32T8/735	2800	.88	59
C 2 32 MVOLT BILP	93.6	$2.56	F32T8/835/HT8	3100	.78	48

* Comparative yearly lighting energy cost per 1000 lumens

LITHONIA LIGHTING®
An AcuityBrands Company

FLUORESCENT: One Lithonia Way Conyers, GA 30012 Phone: 800.858.7763 Fax: 770-929-8789 www.lithonia.com



Company: Pump Systems Inc.
Name: Dave Martz
1/28/2014

SIMFLO PUMPS INC.
Catalog: Simflo Pumps 60HZ, Vers 1
VERTTURBINE - 3600

Size: SP4S 14 stage
Speed: 2350 - 3450 rpm
Dia: 3.062 in
Curve:

SIMFLO PUMPS®

Pump Data Sheet - SIMFLO PUMPS INC.

Company: Conestoga-Rovers & Associates
Name: 56th Street and Earll Drive DM-40
Date: 9/14/2011

Pump:

Size: SE7C (3 stage)

Type: VERTTURBINE
Synch speed: 3600 rpm

Speed: 3450 rpm
Dia: 5.58 in

Curve:

Impeller:

Specific Speeds:

Ns: 2355
Nss: ---

Dimensions:

Suction: 6 in
Discharge: 5 in

Vertical Turbine:

Bowl size: 7 in
Max lateral: 0.562 in
Thrust K factor: 4.3 lb/ft

Pump Limits:

Temperature: ---
Pressure: 330 psi g
Sphere size: 0.531 in

Power: ---
Eye area: ---

Search Criteria:

Flow: 550 US gpm

Head: 273 ft

Fluid:

Water
SG: 1
Viscosity: 0.8565 cP

Temperature: 80 °F
Vapor pressure: 0.5072 psi a
Atm pressure: 14.7 psi a

NPSHa: ---

Motor:

Standard: US
Enclosure: TYPE_1

Size: 60 hp
Speed: 3600
Frame: ----

Sizing criteria: Max Power on Design Curve

---- Data Point ----

Flow:	550 US gpm
Head:	278 ft
Eff:	79.8%
Power:	48.4 hp
NPSHr:	22.8 ft

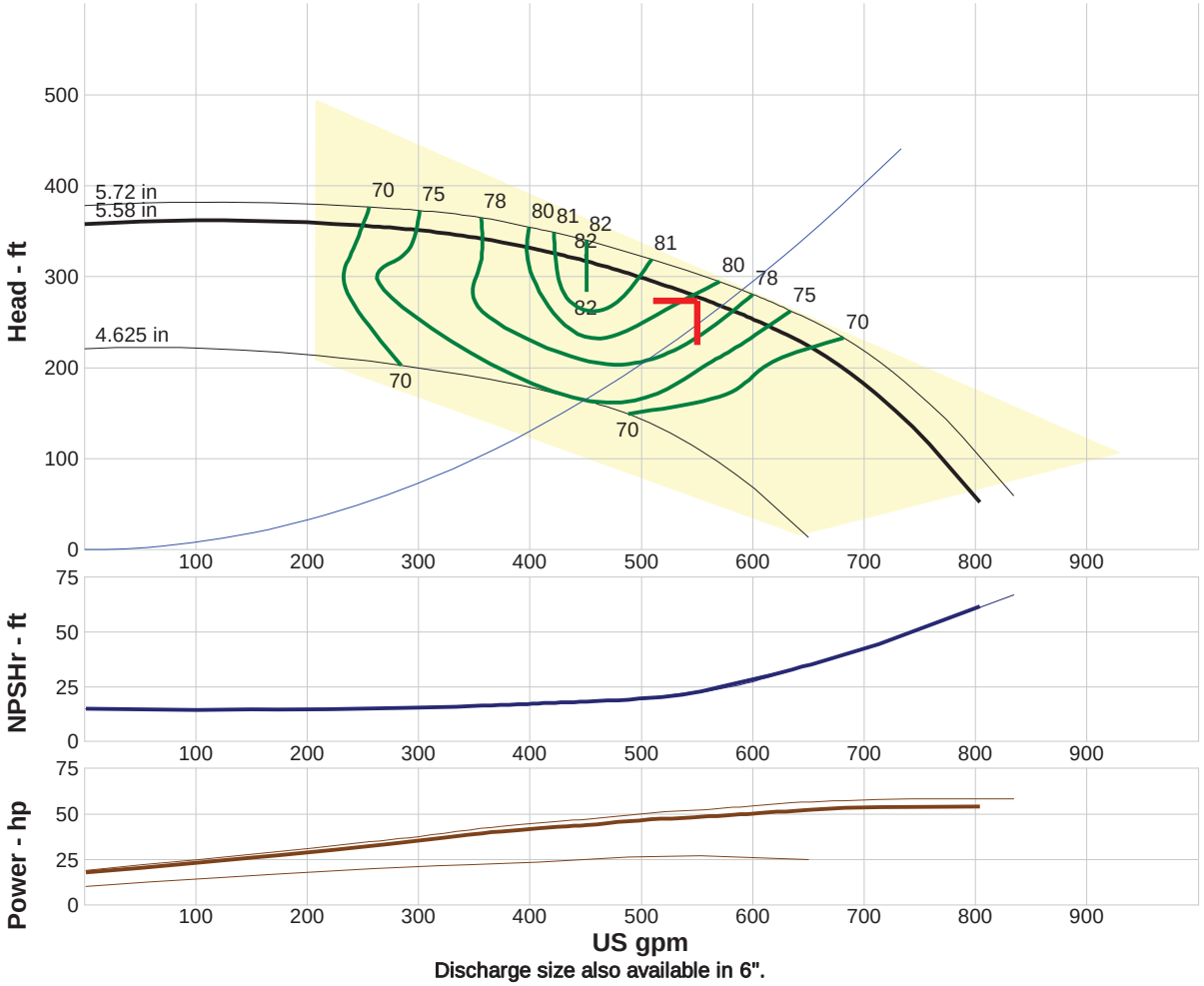
---- Design Curve ----

Shutoff head:	358 ft
Shutoff dP:	155 psi
Min flow:	---
BEP:	82% @ 450 US gpm

NOL power:
54.2 hp @ 804 US gpm

-- Max Curve --

Max power:
58.4 hp @ 834 US gpm



Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
660	3450	213	67.2	52.5	36.7
550	3450	278	79.8	48.4	22.8
440	3450	320	81.6	43.6	18.1
330	3450	346	76.6	37.6	16
220	3450	357	61.8	30.4	15.1

Appendix H

Siemens Initial Isotherm Carbon Breakthrough Data

LIQUID PHASE ISOTHERM DESIGN PARAMETERS

Water Flow Rate 1100.00000 gpm

LIQUID PHASE DESIGN

Component Name	*Concentration*	*#GAC/1000 gallons of water*
ETHENE,TETRACHLORO- (PCE)	1.3200 ppbw	0.0042
TOLUENE	4.1500 ppbw	0.0066
ETHENE,TRICHLORO- (TCE)	36.5000 ppbw	0.0467

Total Carbon Usage Estimated at Breakthrough

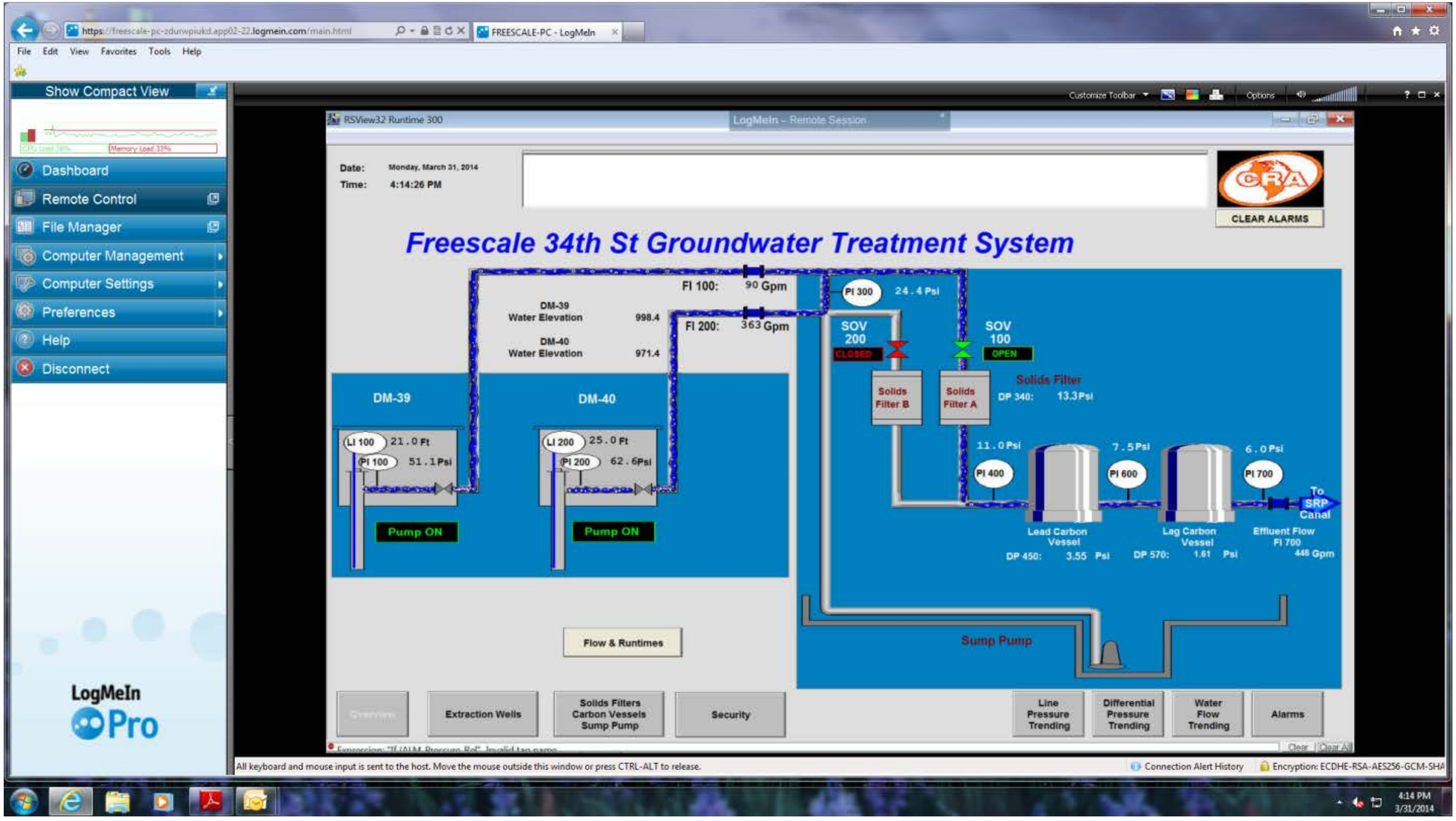
91.1478 #GAC/day

0.0575 #GAC/1000 gallons of water

The above carbon usage estimates are based on both experimental data as well as predictive models. Actual carbon usage rates observed at various stages of breakthrough depend on many factors, and may therefore differ from the above estimates. Please contact Westates Carbon Products for further assisitance.

Appendix I

SCADA Screen Images


https://freescale-pc-zdurwpiukd.app02-22.logmein.com/main.html
FREESCALE-PC - LogMeIn
File Edit View Favorites Tools Help
Show Compact View
Dashboard
Remote Control
File Manager
Computer Management
Computer Settings
Preferences
Help
Disconnect
LogMeIn Pro
RSView32 Runtime 300
LogMeIn - Remote Session
Customize Toolbar
Options
Date: Monday, March 31, 2014
Time: 4:14:26 PM
CLEAR ALARMS
Freescale 34th St Groundwater Treatment System
FI 100: 90 Gpm
FI 200: 363 Gpm
DM-39 Water Elevation 998.4
DM-40 Water Elevation 971.4
DM-39
DM-40
LI 100 21.0 Ft
PI 100 51.1 Psi
LI 200 25.0 Ft
PI 200 62.6 Psi
Pump ON
Pump ON
PI 300 24.4 Psi
SOV 200 CLOSED
SOV 100 OPEN
Solids Filter B
Solids Filter A
Solids Filter
DP 340: 13.3 Psi
11.0 Psi
PI 400
7.5 Psi
PI 600
6.0 Psi
PI 700
To SRP Canal
Lead Carbon Vessel
DP 450: 3.55 Psi
Lag Carbon Vessel
DP 570: 1.61 Psi
Effluent Flow FI 700
446 Gpm
Sump Pump
Flow & Runtimes
Overview
Extraction Wells
Solids Filters Carbon Vessels Sump Pump
Security
Line Pressure Trending
Differential Pressure Trending
Water Flow Trending
Alarms
All keyboard and mouse input is sent to the host. Move the mouse outside this window or press CTRL-ALT to release.
Connection Alert History
Encryption: ECDHE-RSA-AES256-GCM-SHA
4:14 PM
3/31/2014

https://freescale-pc-zdurwpiukd.app02-22.logmein.com/main.html

FREESCALE-PC - LogMeIn

File Edit View Favorites Tools Help

Show Compact View

CPU Load 34% Memory Load 33%

Dashboard

Remote Control

File Manager

Computer Management

Computer Settings

Preferences

Help

Disconnect

LogMeIn Pro

Customize Toolbar Options

RSView32 Runtime 300

LogMeIn - Remote Session

Date: Monday, March 31, 2014

Time: 4:15:01 PM

Extraction Wells

CLEAR ALARMS

SOV 100 Open

SOV 200 Closed

Pump ON

Pump ON

FAL 100 Set Pt 20.0 GPM FI 100: 92.2 Gpm

To Filters

FAL 200 Set Pt 100.0 GPM FI 200: 356.8 Gpm

Water Elevation 998.3

LI 100 20.9 Feet

PI 100 51.3 Psi

DM-39

Water Elevation 971.4

LI 200 25.0 Feet

PI 200 61.7 Psi

DM-40

DM 39 Pump Low Level Cut Off 15.0

DM 39 Restart Span 25.0

PAL 100 Set Pt 2.0

PAH 100 Set Pt 100.0

DM 40 Pump Low Level Cut Off 15.0

DM 40 Restart Span 25.0

PAL 200 Set Pt 2.0

PAH 200 Set Pt 100.0

Transducer Setup

DM - 39

Auto Off Hand

Level Control 20.9 Ft

Level SP

SP 20.0

Output 100

Manual Speed Setpoint 100 %

DM - 40

Auto Off Hand

Level Control 25.0 Ft

Level SP

SP 25

Output 73.2

Manual Speed Setpoint 100 %

Overview | Extraction Wells | Solids Filters Carbon Vessels Sump Pump | Security | Line Pressure Trending | Differential Pressure Trending | Water Flow Trending | Alarms

Expression: "If (ALM_Pressure_Rel" Invalid tag name Clear Clear All

All keyboard and mouse input is sent to the host. Move the mouse outside this window or press CTRL-ALT to release.

Connection Alert History

Encryption: ECDHE-RSA-AES256-GCM-SHA

4:15 PM 3/31/2014

https://freescale-pc-eltaamcecu.app02-22.logmein.com/main.html

FREESCALE-PC - LogMeIn

File Edit View Favorites Tools Help

Show Compact View

CPU Load 33% Memory Load 34%

Dashboard

Remote Control

File Manager

Computer Management

Computer Settings

Preferences

Help

Disconnect

LogMeIn Pro

Customize Toolbar Options

RSView32 Runtime 300

LogMeIn - Remote Session

Date: Monday, March 31, 2014

Time: 4:26:37 PM

CLEAR ALARMS

Solids Filters, Carbon Vessels, Sump Pump

Solids Filter DP 340: 13.17 psi
DPAH 340 Set Pt 25.00 psi

Lead Carbon DP 450: 3.50 psi
DPAH 450 Set Pt 25.00 psi

Lag Carbon DP 570: 1.47 psi
DPAH 570 Set Pt 20.00 psi

From Wells

PI 300

PAH 300 Set Pt 50.00 psi
Influent Pressure 24.15 psi
PAL 300 Set Pt 3.00 psi

SOV 200

CLOSED

Open

Solids Filter B

Solids Filter A

SOV 100

OPEN

Close

Lead Carbon Pressure 10.98 psi

Lag Carbon Pressure 7.48 psi

PI 400

PI 600

PI 700

Effluent Pressure 6.02 psi
PAH 700 Set Pt 50.00 psi

To Outfall

Lead Carbon Vessel

Lag Carbon Vessel

Effluent Flow 448.17 gpm
FAL 700 Set Pt 50.00 gpm

DM-39 ON

DM-40 ON

Effluent Flow Totalizer
52324 gallons

Sump Pump

Overview | Extraction Wells | Solids Filters Carbon Vessels Sump Pump | Security | Line Pressure Trending | Differential Pressure Trending | Water Flow Trending | Alarms

Expression: "If (ALM_Pressure_Rel" Invalid tag name

Clear Clear All

Connection Alert History

Encryption: ECDHE-RSA-AES256-GCM-SHA

4:27 PM
3/31/2014


https://freescale-pc-kflrnzbszz.app02-22.logmein.com/main.html
FREESCALE-PC - LogMeIn
File Edit View Favorites Tools Help
Show Compact View
Dashboard
Remote Control
File Manager
Computer Management
Computer Settings
Preferences
Help
Disconnect
LogMeIn Pro
Customize Toolbar
Options
RSView32 Runtime 300
LogMeIn - Remote Session
Date: Monday, March 31, 2014
Time: 4:31:38 PM
CRA
CLEAR ALARMS
CLEAR SECURITY ALARMS
Status Indicators
Intrusion Detected
Motion Detectors Tripped
Facility Door Switch Tripped
MCC Door Switch Tripped
Security Keyswitch Disabled
Motion Detector Disabled
Facility Door Switches Disabled
MCC Door Switches Disabled
Facility Alarm Horn Disabled
MCC Alarm Horn Disabled
Security Controls
Facility Lights On
Lights Off
West Motion Detector Off
Middle Motion Detector Off
East Motion Detector Off
Facility Door Switches Off
MCC Door Switches Off
Facility Alarm Horn Off
MCC Alarm Horn Off
Overview
Extraction Wells
Solids Filters Carbon Vessels Sump Pump
Security
Line Pressure Trending
Differential Pressure Trending
Water Flow Trending
Alarms
Clear
Clear All
All keyboard and mouse input is sent to the host. Move the mouse outside this window or press CTRL-ALT to release.
Connection Alert History
Encryption: ECDHE-RSA-AES256-GCM-SHA
4:32 PM
3/31/2014

https://freescale-pc-kflrnzbszz.app02-22.logmein.com/main.html

FREESCALE-PC - LogMeIn

File Edit View Favorites Tools Help

Show Compact View

CPU Load 12% Memory Load 34%

- Dashboard
- Remote Control
- File Manager
- Computer Management
- Computer Settings
- Preferences
- Help
- Disconnect

LogMeIn Pro

Customize Toolbar Options

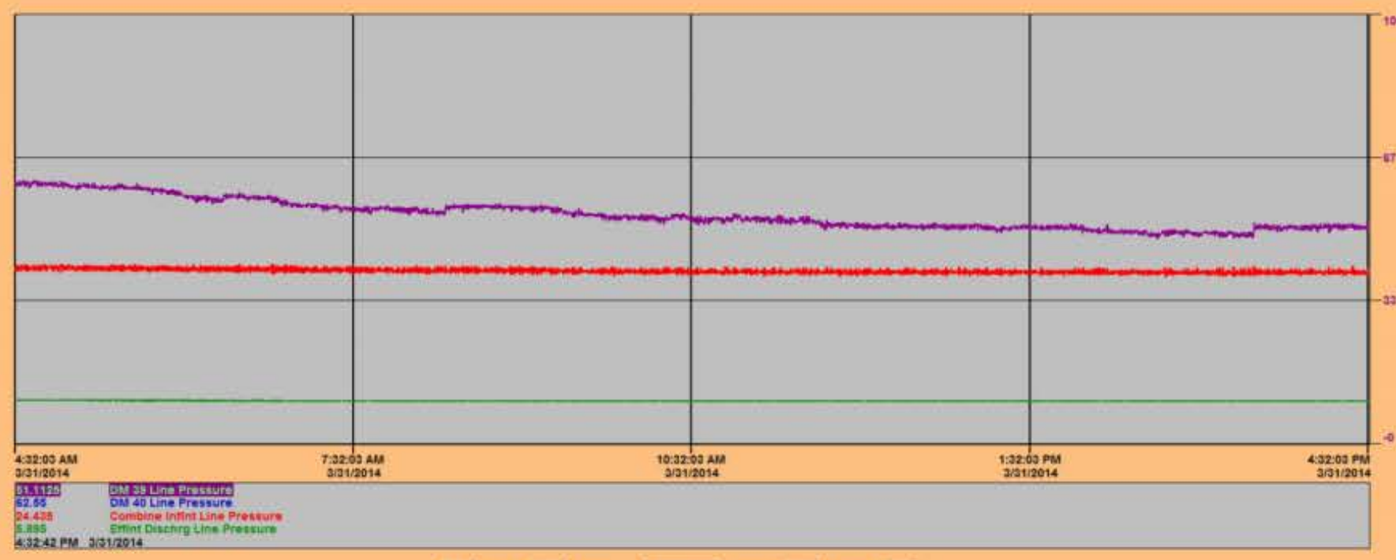
RSView32 Runtime 300

LogMeIn - Remote Session

Date: Monday, March 31, 2014
Time: 4:32:19 PM

CLEAR ALARMS

Line Pressure



Oldest Data | Scroll Backward | Paused | Scroll Forward | Newest Data

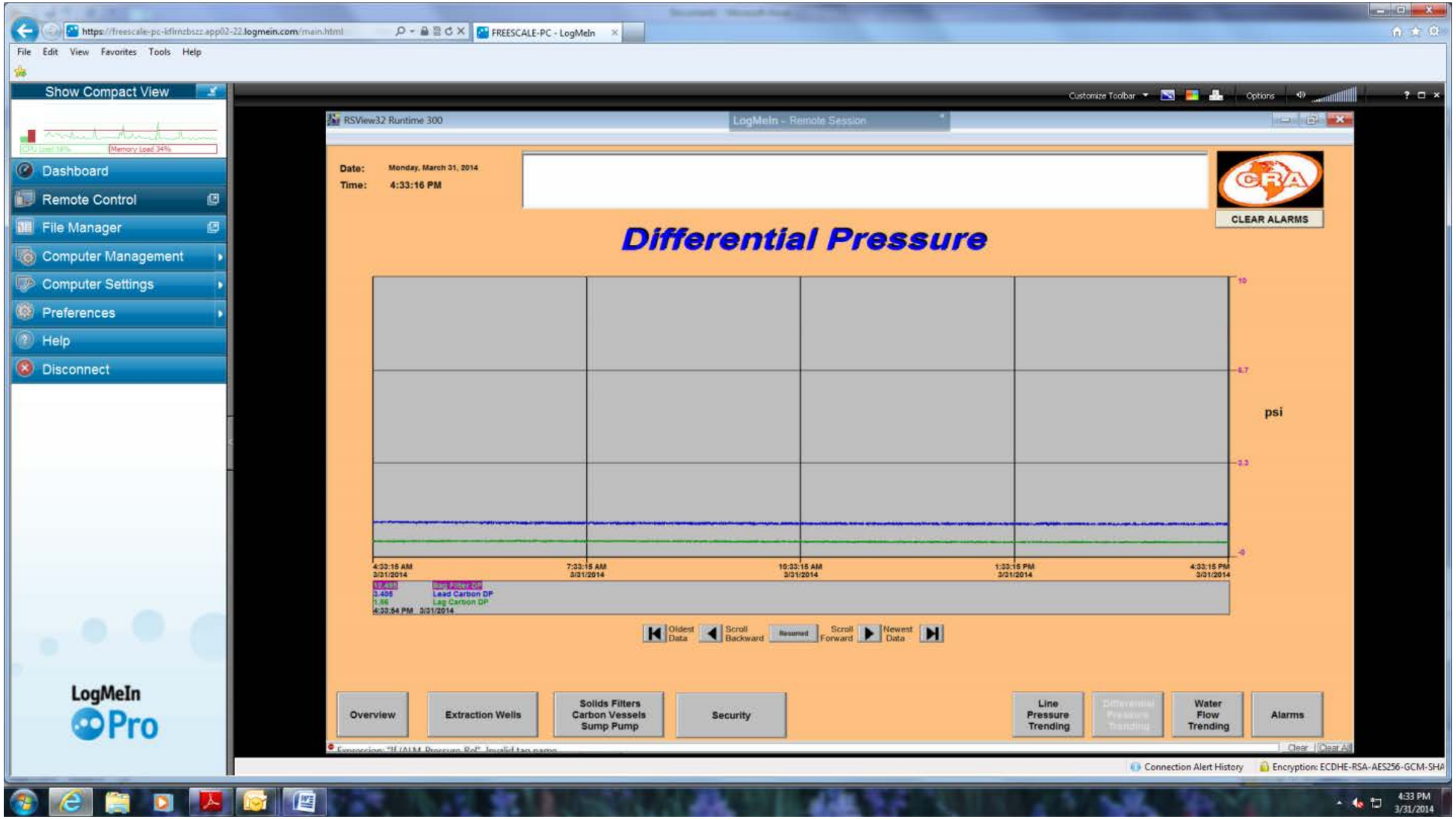
Overview | Extraction Wells | Solids Filters Carbon Vessels Sump Pump | Security | Line Pressure Trending | Differential Pressure Trending | Water Flow Trending | Alarms

Expression: "If (AIM.Pressure.Rel" Invalid tag name

Clear | Clear All

Connection Alert History | Encryption: ECDHE-RSA-AES256-GCM-SHA

4:32 PM 3/31/2014


https://freescale-pc-kflrnzbszz.app02-22.logmein.com/main.html
FREESCALE-PC - LogMeIn
File Edit View Favorites Tools Help
Show Compact View
Dashboard
Remote Control
File Manager
Computer Management
Computer Settings
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Help
Disconnect
LogMeIn Pro
Customize Toolbar
Options
RSView32 Runtime 300
LogMeIn - Remote Session
Date: Monday, March 31, 2014
Time: 4:33:16 PM
CLEAR ALARMS
Differential Pressure
psi
10
6.7
3.3
0
4:33:15 AM 3/31/2014
7:33:15 AM 3/31/2014
10:33:15 AM 3/31/2014
1:33:15 PM 3/31/2014
4:33:15 PM 3/31/2014
Lead Carbon DP
Lag Carbon DP
4:33:54 PM 3/31/2014
Oldest Data
Scroll Backward
Resumed
Scroll Forward
Newest Data
Overview
Extraction Wells
Solids Filters Carbon Vessels Sump Pump
Security
Line Pressure Trending
Water Flow Trending
Alarms
Clear
Clear All
Connection Alert History
Encryption: ECDHE-RSA-AES256-GCM-SHA
4:33 PM
3/31/2014

https://freescale-pc-kflrnzbszz.app02-22.logmein.com/main.html

FREESCALE-PC - LogMeIn

File Edit View Favorites Tools Help

Show Compact View

CPU Load 34% Memory Load 34%

Dashboard

Remote Control

File Manager

Computer Management

Computer Settings

Preferences

Help

Disconnect

LogMeIn Pro

Customize Toolbar Options

RSView32 Runtime 300

LogMeIn - Remote Session

Date: Monday, March 31, 2014

Time: 4:33:56 PM

CLEAR ALARMS

Water Flow

500
400
300
200
100
-0.0
gpm

4:33:34 AM 3/31/2014
7:33:34 AM 3/31/2014
10:33:34 AM 3/31/2014
1:33:34 PM 3/31/2014
4:33:34 PM 3/31/2014

93.434 DM 39 Flow
246.28 DM 40 Flow
444.715 Effluent Flow
4:34:14 PM 3/31/2014

Oldest Data | Scroll Backward | Paused | Scroll Forward | Newest Data

Overview | Extraction Wells | Solids Filters Carbon Vessels Sump Pump | Security | Line Pressure Trending | Differential Pressure Trending | Water Flow Trending | Alarms

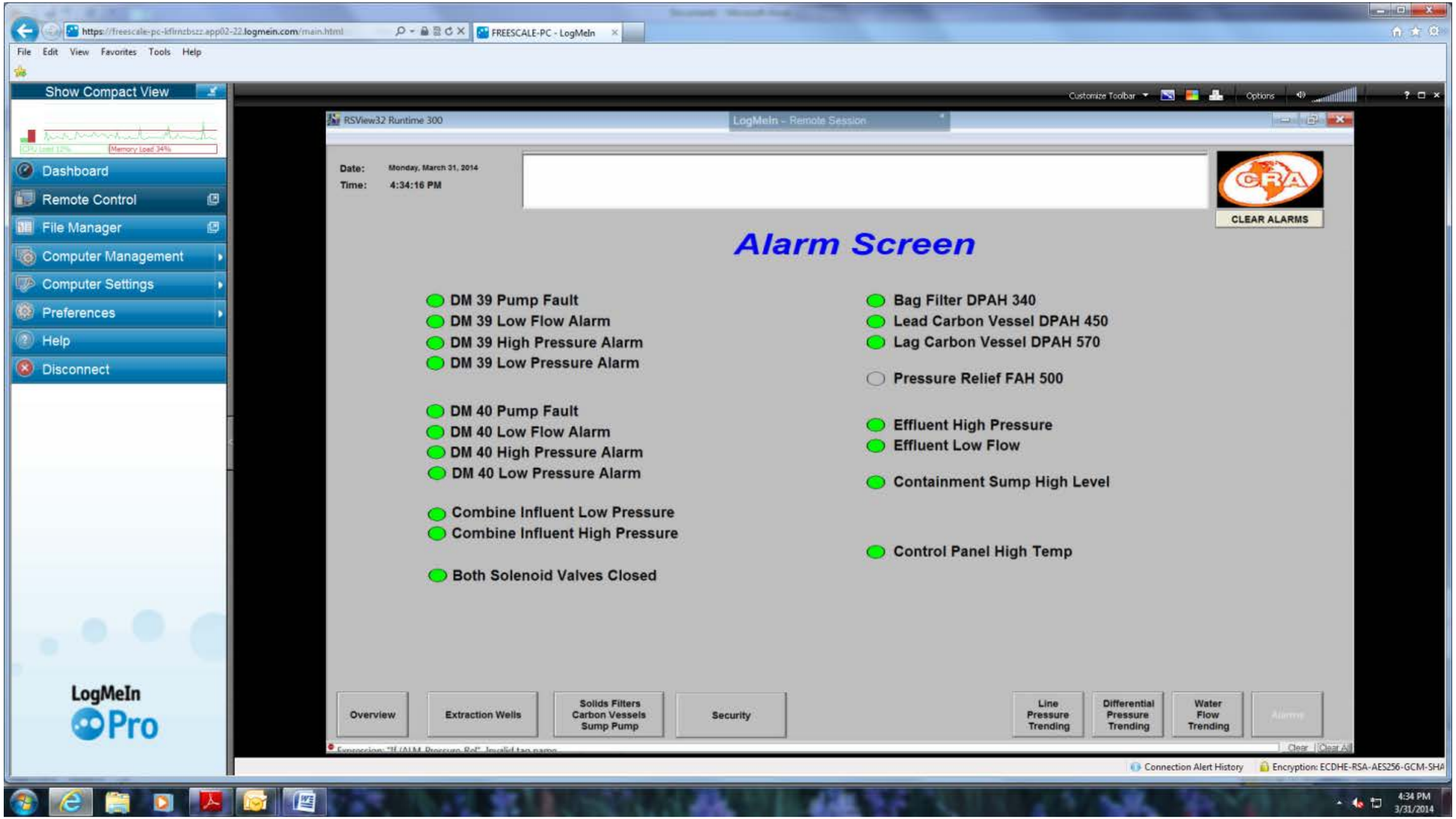
File does not exist. Display failed to open Water Flow Trend Mega

Clear | Clear All

Connection Alert History

Encryption: ECDHE-RSA-AES256-GCM-SHA

4:34 PM
3/31/2014


https://freescale-pc-kflrnzbszz.app02-22.logmein.com/main.html
FREESCALE-PC - LogMeIn
File Edit View Favorites Tools Help
Show Compact View
Dashboard
Remote Control
File Manager
Computer Management
Computer Settings
Preferences
Help
Disconnect
LogMeIn Pro
Customize Toolbar
Options
RSView32 Runtime 300
LogMeIn - Remote Session
Date: Monday, March 31, 2014
Time: 4:34:16 PM
CLEAR ALARMS
Alarm Screen
DM 39 Pump Fault
DM 39 Low Flow Alarm
DM 39 High Pressure Alarm
DM 39 Low Pressure Alarm
DM 40 Pump Fault
DM 40 Low Flow Alarm
DM 40 High Pressure Alarm
DM 40 Low Pressure Alarm
Combine Influent Low Pressure
Combine Influent High Pressure
Both Solenoid Valves Closed
Bag Filter DPAH 340
Lead Carbon Vessel DPAH 450
Lag Carbon Vessel DPAH 570
Pressure Relief FAH 500
Effluent High Pressure
Effluent Low Flow
Containment Sump High Level
Control Panel High Temp
Overview
Extraction Wells
Solids Filters Carbon Vessels Sump Pump
Security
Line Pressure Trending
Differential Pressure Trending
Water Flow Trending
Alarms
Clear
Clear All
Connection Alert History
Encryption: ECDHE-RSA-AES256-GCM-SHA
4:34 PM
3/31/2014


https://freescale-pc-kflrnzbszz.app02-22.logmein.com/main.html
FREESCALE-PC - LogMeIn
File Edit View Favorites Tools Help
Show Compact View
Dashboard
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LogMeIn Pro
RSView32 Runtime 300
LogMeIn - Remote Session
Customize Toolbar
Options
Date: Monday, March 31, 2014
Freescale[100.100.100.60]
DVR Information
Current Time : 2014/03/31 16:36:02
Site Name Freescale
IP Address 100.100.100.60
ID Admin
Channel 2
Status Live
System Channel Date/Time Event
RSView32 Runtime 300
Connection Alert History
Encryption: ECDHE-RSA-AES256-GCM-SHA
4:36 PM
3/31/2014