

Final Draft  
Operation and Maintenance Manual

**Reduction-Coagulation-Filtration  
Chromium(VI) Removal  
Demonstration Facility**  
City of Glendale, California

**AECOM Project No. 114116.01**

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### ACRONYMS AND ABBREVIATIONS

µg/L	microgram per liter
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWWA	American Water Works Association
CalOSHA	California Occupation Health and Safety Administration
CDM	CDM Constructors, Inc.
CDPH	California Department of Health Services
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
City	City of Glendale
CP	control panel
CPVC	chlorinated polyvinyl chloride
Cr(III)	trivalent chromium
Cr(VI)	hexavalent chromium
CWET	California Water Extraction Test
DOT	Department of Transportation
EMT	Emergency Medical Technician
Fe	iron
Fe <sup>+2</sup>	ferrous iron
Fe <sup>+3</sup>	ferric iron
GAC	granular activated carbon
gpm	gallon per minute
GOU	Glendale Operable Unit
GWP	Glendale Water and Power
GWTP	Glendale Water Treatment Plant
HASP	Health and Safety Plan
HMI	Human-Machine Interface
HOH	HAND-OFF-HMI
MCL	maximum contaminant level
MSDS	material safety data sheet
NA	not applicable
NOU	North Operable Unit
NSF	National Sanitation Foundation
NSP	no setpoint
NTU	nephelometric turbidity unit
O&M	operation and maintenance
ORP	oxidative-reductive potential
PCE	tetrachloroethene (perchloroethylene)
pH	negative log of the hydrogen ion concentration
PHG	public health goal
PLC	programmable logic controller
PMP	preventative maintenance program
PPE	personal protective equipment
psi	pound per square inch
psig	pound per square inch, gauge
PVC	polyvinyl chloride
QAAPP	Quality Assurance Project Plan

**ACRONYMS AND ABBREVIATIONS**

RCF Facility	Reduction, Coagulation Filtration Chromium(VI) Removal Demonstration Facility
RCF	reduction, coagulation, filtration
RCRA	Resource Conservation and Recovery Act
SCADA	supervisory control and data acquisition
SOP	standard operating procedure
TCE	trichloroethylene
TCLP	Toxicity Characteristic Leaching Procedure
TCP	1,2,3-trichloropropane
TSS	total suspended solids
USEPA	United States Environmental Protection Agency
VFD	variable frequency drive
VOC	volatile organic compound
WBA Facility	Weak-Base Anion Exchange Chromium(VI) Removal Demonstration Facility

## 1. INTRODUCTION

AECOM prepared this Operation and Maintenance Manual (O&M Manual) for the Reduction, Coagulation Filtration (RCF) Chromium(VI) [Cr(VI)] Removal Demonstration Facility (RCF Facility) for the city of Glendale (City).

### 1.1 BACKGROUND

The City of Glendale's groundwater supply in the San Fernando Valley has been contaminated with a wide variety of chemicals, including hexavalent chromium, trichloroethylene (TCE), tetrachloroethene (PCE), 1,2,3-trichloropropane (TCP), and others, mainly as a result of the improper disposal of industrial waste products.

In Glendale and other cities such as Los Angeles and Burbank in the San Fernando Valley, public concern about Cr(VI) in the groundwater supply led the City to embark on a multi-phase study to identify and install Cr(VI) treatment in anticipation of a Cr(VI) maximum contaminant level (MCL) lower than the current total chromium MCL in California.

The Phase III Demonstration-scale study will finalize the treatment evaluation, residuals assessment, and cost estimate development through the implementation of two, Cr(VI)-removal technologies. For the demonstration facilities, the City selected the construction of the demonstration RCF Facility adjacent to the existing Glendale Water Treatment Plant to treat water from the North Operable Unit (NOU) at a rate of 100-gallons per minute (gpm) by reduction with ferrous sulfate, coagulation, and filtration system and the Weak-Base Anion Exchange Facility (WBA Facility) to treat water from Well GS-3 at a design capacity of 425 gpm.

The purpose of this project is to demonstrate the effectiveness of the RCF process in removing Cr(VI) to low part-per-billion levels. The system will be operated for one year under the Proposition 50 grant and other available grants. Treated water will be put to beneficial use by serving Glendale's consumers.

### 1.2 MANUAL SCOPE AND ORGANIZATION

This Manual is intended to allow owners and operators of the facility to easily establish and have available in a common location the necessary site information, procedures, manuals and charts used by and for:

- Plant personnel (employees and contractors) as ready reference for support and guidance in emergency situations, plant operations (including startup and shutdown), and maintenance activities.
- Record keeping associated with the required inspection and maintenance activities.
- The authority having jurisdiction to verify the continuing safety of the facility.

Before using this Manual, all facility personnel should be familiar with its organization and contents. The Record Drawings (presented in Appendix A) are available to all facility personnel to familiarize themselves with the design and operation of the Treatment System.

This Manual was written for water systems personnel and assumes a substantial level of knowledge and competence of the operator as required by the City and the California Department of Public Health (CDPH).



## 2. SAFETY CONSIDERATIONS AND EMERGENCY RESPONSE

Site health and safety and emergency response procedures are addressed in the Health and Safety Plan (HASP) and site-specific Draft Contingency Plan prepared under separate cover. General safety considerations and emergency response procedures are presented in this section.

### 2.1 CAUTIONS

- No maintenance of any kind should be performed on any part of the treatment plants without prior reference to the Manual, and the appropriate manufacturer's manual(s).
- Non-routine maintenance, such as component overhaul, is not covered in this Manual. Proper preventative maintenance should be performed regularly. Failure to do so could result in premature failure and pose a significant safety hazard. Consult the manufacturer before attempting any detailed maintenance procedure not covered in the Manual.
- In order to prevent hydraulic shock and possible damage to pipes, valves and other fittings, all valves must be opened and closed slowly. Maximum pressures listed in the Manual and/or on vessels, should not be exceeded for any reason. Possible rupture and other damage may result, endangering human life.
- All Federal, State, and local regulations for occupational health and human safety must be strictly enforced and adhered to by all personnel at the facility.
- All pump shafts and other moving parts must be covered by appropriate shields. The entire facility, especially the concrete pads, must be kept clean and free of obstructions, spills, and foreign materials.
- This Manual is NOT a substitute for good judgment and common sense. All personnel performing operations and maintenance at this facility should have proper training and supervision prior to working on this site.

### 2.2 WARNINGS

Failure to adhere to the following warnings could result in severe injury or death:

- Before opening electrical enclosures, disconnecting electrical wires or disconnecting pipes and valves, all power supplies must be disconnected following appropriate lock-out/tag-out procedures outlined in the HASP, and pressure must be relieved in the vessels.
- All safety devices and interlocks must be in place prior to operation of the equipment.
- Never remove any safety and cautionary tags on the equipment. Strict adherence to all warnings must be enforced.

### 2.3 EMERGENCY EQUIPMENT INFORMATION

An emergency eyewash and shower is located next to the backwash tank, at the northeast corner.

**Table 2-1: General and Emergency Information**

Facility Name:	Reduction-Coagulation-Filtration Chromium-VI Removal Demonstration Facility		
Street Address:	800 Flower Street		
City, State, Zip Code:	Glendale, California, 91201		
Facility Telephone Number:	818-550-5975		
Owner/Operator:	Glendale Water and Power		
Address:	Glendale, California		
Representative:	Peter Kavounas		
Title:	Assistant General Manager		
Telephone:	818 548-2137		
CDM Project Manager:	Dan Hutton		
Telephone:	562 577-1212		
Chief Plant Operator	Charles Cron (CDM)		
Telephone:	818-550-5975	Mobile:	562-755-0905
System Designer and Equipment Supplier:	Layne Christensen Company		
Contact:	Brian Hayes, Project Manager		
Telephone:	909-390-2833 x277	Mobile:	Fax:
Waste Management Vendor:	To Be Determined		
Contact:			
Telephone:		Mobile:	Fax:

**Local Emergency Responder Contact Information**

Organization / Agency	Telephone
<b>EMERGENCY</b> Police	911
Fire Department	911
Ambulance (EMT will determine appropriate hospital for treatment)	911
Hospital, Glendale Memorial (Use by site personnel is only for non-emergency cases)	818- 502-1900
Poison Control Center (if a toxic substance has been ingested, inhaled, injected through or come in contact with the skin)	800-222-1222
National Response Center (for toxic chemical and oil spills)	800-424-8802

Notes:  
EMT = Emergency Medical Technician







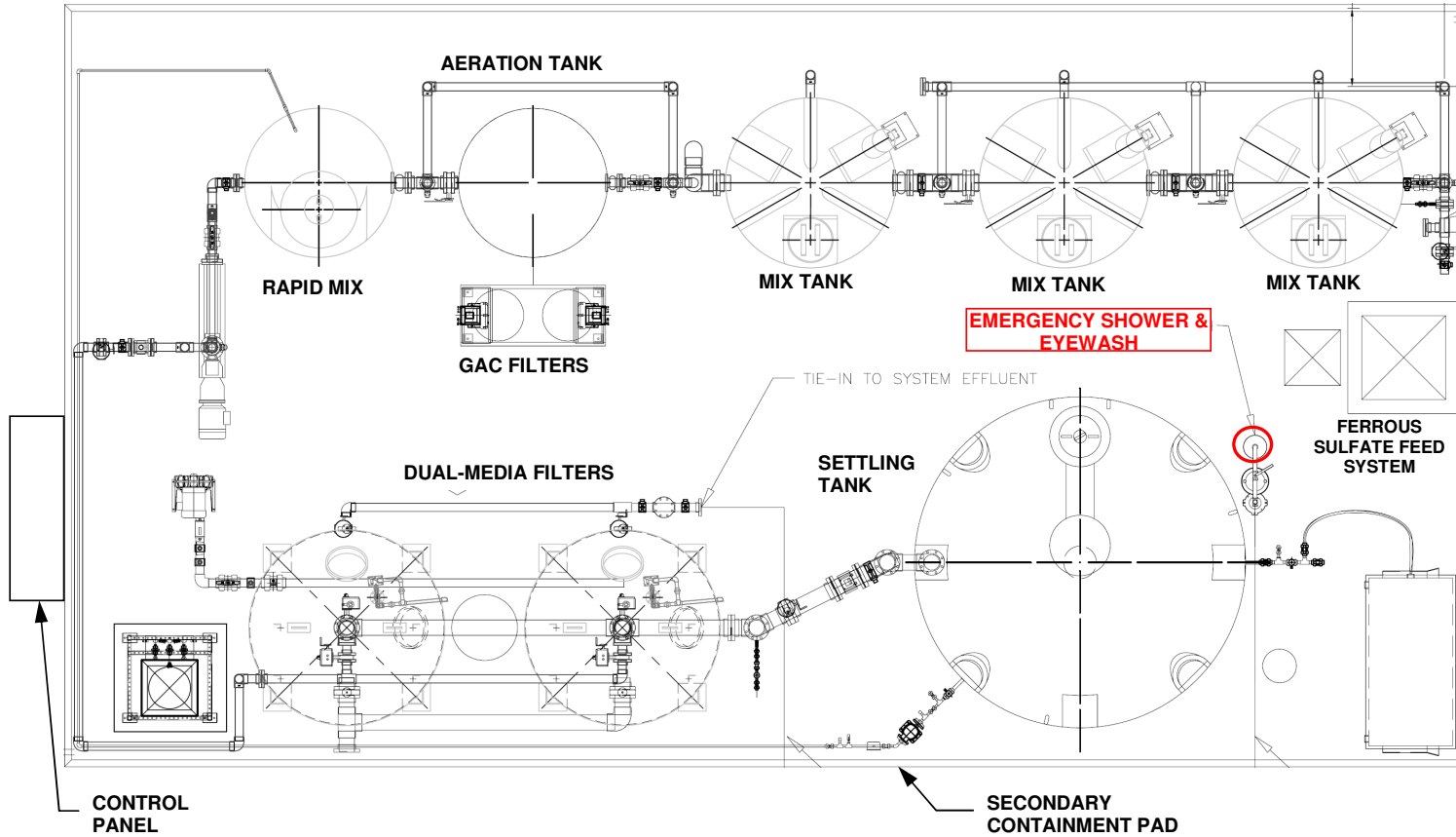


Figure 2-1: Treatment System Layout



## 2.4 GENERAL SAFETY

One of the principal responsibilities of the facility staff is to ensure that proper procedures are followed to avoid injuries. Total elimination of accidents must be a primary objective, because lower standards tend to tolerate accidents rather than prevent them.

Managerial personnel must encourage safety-conscious work habits among facility staff members. However, all employees have a joint responsibility to follow, and therefore, make safety procedures work. All personnel are expected to become familiar with the location and operation of all facility safety equipment.

Failure to adhere to the following safety guidelines could result in severe injury or death and/or damage to equipment and facilities:

- No maintenance of any kind is to be performed on any part of this system without prior reference to this manual, and the appropriate manufacturer's manual(s). Non-routine maintenance, such as component overhaul, is not covered in this manual but must be covered using task-specific task hazard analyses. Proper preventive maintenance must be performed regularly. Failure to do so may result in premature failure and pose a significant safety hazard. Consult the manufacturer before attempting any detailed maintenance procedures not covered in this manual.
- In order to prevent hydraulic shock and possible damage to pipes, valves and other fittings, all valves must be opened and closed slowly. Maximum pressures listed in this manual, in manufacturer's literature, and/or on the vessels, should not be exceeded for any reason. Possible rupture and other damage may result, endangering human life or health.
- All applicable Federal, State and local regulations for occupational health and human safety must be strictly enforced and adhered to by all personnel at the facility. All pump shafts and other moving parts must be covered by appropriate guards. Each facility component walking or working area should be kept clean and free of obstructions.
- The O&M Manual is NOT a substitute for good judgment and common sense. No maintenance may be performed, and no operation may be initiated, by personnel without proper training and supervision.
- Before opening electrical enclosures, disconnecting electrical wires or disconnecting pipes and valves, all power supplies must be disconnected and/or pressure must be relieved in the pipes or vessels.
- All energy and isolating safety devices must be locked and tagged-out prior to servicing any equipment. All lockout and tag out procedures are to be documented and logs kept of all uses of such procedures.
- Never remove any safety and/or cautionary tags on the equipment. Strict adherence to all warnings must be enforced.

To reduce or eliminate hazards, practice the following safety guidelines:

- Block, flag, and/or isolate equipment being worked on to protect personnel from being injured, and make use of tags and lockouts to inform other personnel that repair work is in progress.
- Exercise care where slippery conditions exist.
- While working in confined spaces, proper safety procedures, safety harnesses, and standby help must be utilized and/or provided, consistent with California Occupational Health and Safety Administration's (CalOSHA) standard for confined spaces (8CCR5157).
- Keep safety, rescue, and first aid equipment close by.

## 2.5 MACHINERY

Anywhere machinery is in operation, a potentially hazardous situation exists. For safety, rotating or reciprocating shafts, rods, eccentrics, belt drives, couplings, fly wheels, and gears should be adequately protected by shields or guards to prevent any contact with the moving part.

Severe injuries or death can occur as the result of mishandling tools, machinery, and electrical equipment. To eliminate or reduce hazard, practice the following safety guidelines for machinery:

- Use positive lockout mechanisms and tagging procedures at electrical motor control centers and at remote or local control stations.
- Train all operating personnel in the correct use of machinery.
- Keep and use welding equipment in an assigned safe area away from combustibles. Shield such equipment properly to protect employees from eye injuries due to electric arcs or hot metals. A welding/burning (hot work) permit is required in all areas before striking an arc or lighting a torch in accordance with applicable CalOSHA regulations.
- Restrict the use of pneumatic, explosive-activated, high-speed or machine shop tools to properly trained mechanics.
- Properly maintain all mechanical equipment and work areas.
- Use warning signs at all openings or where machinery is being repaired.
- Institute a preventive maintenance program for all machinery.
- Use proper hearing protection when working in areas where the noise level exceeds 90 decibels.

## 2.6 ATMOSPHERIC HAZARDS

Dangerous oxygen deficiency exists at atmospheric concentrations below 19.5 percent oxygen by volume. Normal air contains approximately 21 percent oxygen. Oxygen deficiency can exist with or without the presence of an explosive, toxic, or noxious gas. Atmospheric hazards can exist in the tanks and filter vessels, and confined space restrictions are in effect during any work within the vessels.

To eliminate or reduce hazards caused by atmospheric conditions, the following O&M procedures must be used:

- Assign two or more workers trained in the potential hazards while working under conditions or in locations where those hazards exist.
- Use and maintain adequate ventilation systems.
- Test air quality with appropriate equipment before entering confined spaces and while physically inside the confined spaces.
- If workers are to enter a vessel containing treatment media, appropriate sampling and work procedures for potentially low oxygen spaces shall be followed, including applicable Federal and State requirements.

## 2.7 ELECTRICAL HAZARDS

A number of different voltages are used at the facility. All electrical systems are hazardous, and the hazard increases as the voltage increases, especially around electrical control centers, transformers, and energized circuits in damp and wet locations. To eliminate or reduce hazards, the following electrical safety practices are required:

- Schedule a regular and organized program of preventive maintenance of all electrical equipment.
- Ensure proper training of operator and maintenance personnel in the use of electrical machinery and equipment.
- To extinguish fires in electrical equipment, use only non-conducting extinguishing agents to minimize shock hazard to the operator. Use agents that do not permanently damage the equipment; e.g., carbon dioxide is preferred to dry chemical extinguishers. If feasible, de-energize the electrical equipment before attempting to extinguish a fire to eliminate hazards associated with accidental contact with electrical conductors.
- Properly size and set electrical overload devices that will function when an overload or a short circuit occurs.
- Use safety tools, special devices, and protective clothing when working on or near energized circuits.
- Allow only authorized and qualified electricians to work on any part of the electrical system.
- Ensure that electrical controls, switch boxes, and distribution panels are properly identified and easily accessible.
- Use wood or other non-conductors for ladders and do not attempt to work with or handle energized connections and conductors without locking out the equipment first.
- Allow only a licensed electrician to work on electrical equipment.
- Use emergency stop buttons to isolate electrical equipment at locations remote from the main control center. Do not depend on a lockout STOP push button when working with electrical equipment.
- Lockout and tag at the branch circuit breakers, and at all remote and local control stations.

## 2.8 HAZARDOUS MATERIALS

Hazardous materials such as concentrated acids and caustic solutions are used during vessel disinfection and may be used during other operations at the facility. The following procedures are to be followed by managers and workers when around hazardous materials:

- Complete a task hazard analysis prior to the work to identify all potential hazards and safety procedures.
- Ensure that all workers are aware of the hazardous conditions and are trained to perform the work.
- Ensure that all necessary personal protective equipment (PPE) is available and that all personnel doing the work are properly fitted with all the necessary PPE.
- Clearly delineate the area where the work will be performed with signs and/or caution tape to warn other persons present of the hazardous work being performed and exclude all non-necessary personnel from the immediate work area.

Ensure that all Material Safety Data Sheets (MSDS) are available on site during the work and that everyone doing the work is familiar with established emergency procedures.



### 3. FACILITY AND REGULATORY REQUIREMENTS

#### 3.1 FACILITY OPERATING PARAMETERS

During normal operation, water quality and process-related parameters should be maintained as close as possible to values required to ensure safe and efficient operation of the RCF Facility. A list of operating parameters for the treatment system is provided in Table 3-1. The final operating parameters will be specified in the drinking water permit issued by CDPH.

**Table 3-1: RCF Facility Operating Parameters**

Parameter	Value
RCF system influent and design flow rate	100 gpm <sup>1</sup>
Cr(VI) and total Cr concentration limits in facility effluent	1 µg/L
Maximum Fe to Cr(VI) dosing ratio	25:1
Maximum filter headloss	100 inches of water (5 psi)
Turbidity of combined filter effluent	0.30 NTU

Notes:

- <sup>1</sup> 95 gpm from well water plus 5 gpm recycle flow
- µg/L = micrograms per liter
- Fe = iron
- Cr(VI) = hexavalent chromium
- gpm = gallons per minute
- NTU = nephelometric turbidity unit

#### 3.2 DRINKING WATER STANDARDS

The CDPH sets the drinking water standards for the State while the United States Environmental Protection Agency (USEPA) sets Federal standards. In cases where the standards are different, the most stringent standard applies. The City also sets its own internal requirements for wellhead treatment systems, though these are not enforceable by either the Federal or State governments. The RCF Facility is a temporary facility and does not require a permit amendment. It operates under a letter of authorization from the CDPH. The treatment requirements and effluent contaminant concentrations match those specified in the CDPH Permit No. 04-15-00PA-000. Both the letter of authorization and the permit are provided in Appendix B. Table 3-2 compares standards from the USEPA, the CDPH, and the City.

**Table 3-2: Comparison of Drinking Water Standards**

Constituent	Units	USEPA <sup>1</sup>	CDPH	GWP <sup>2</sup>
Total Chromium	µg/L	100	50	5
Cr(VI)	µg/L	–	– <sup>3</sup>	5

Notes:

- µg/L = microgram per liter
- CDPH = California Department of Public Health
- GWP = Glendale Water and Power
- USEPA = United States Environmental Protection Agency

<sup>1</sup> USEPA. 2003. National Primary and Secondary Drinking Water Standards. EPA 816-F-03-016. June.

<sup>2</sup> City of Glendale treatment system design criterion and treatment target.

<sup>3</sup> OEHHA is in the process of establishing a public health goal (PHG).

### 3.3 SEWER DISCHARGE LIMITS

Untreated well water, treated water, and backwash wastewater will, from time to time, be discharged to the sanitary sewer via the sump at the Glendale Water Treatment Plant (GWTP). The relevant sewer discharge limits are provided in Table 3-3.

**Table 3-3: Sewer Discharge Limits and Influent Contaminant Concentrations**

Constituent	Units	Discharge Limit	Raw Well Water
Total Chromium <sup>3</sup>	mg/L	10	0.017, 0.044 <sup>1</sup>
Cr(VI)	mg/L	—	0.060 (GN-2) <sup>2</sup>
			0.070 (GN-3) <sup>2</sup>
VOCs	mg/L	—	0.215, 0.465 <sup>3</sup>

Notes:

mg/L milligram per liter

VOC volatile organic compound

<sup>1</sup> Average concentrations in Wells GN-2 and GN-3, respectively, from February 2000 to May 2009.

<sup>2</sup> Maximum chromium(VI) concentrations.

<sup>3</sup> Total maximum concentrations of TCE, PCE, 1,2,3-TCP in Wells GN-2, and GN-3, respectively.

### 3.4 PERSONNEL AND STAFFING REQUIREMENTS

The RCF Facility normally operates on a continuous basis (24 hours per day) when the City-operated wells are in operation. The RCF Facility is operated and maintained by operators who have been listed and certified with the CDPH. The facility must be operated in a safe manner and in compliance with all treatment requirements and discharge limitations.

The RCF Facility will be operated and maintained by the City. Shift operators for the treatment system will be determined by the City. The City has previously filed a list of operators and their certifications with the CDPH. Normal operation will require daily site visits by a shift operator to monitor and adjust operating parameters. Certain operating parameters are read by the Supervisory Control and Data Acquisition (SCADA) system and displayed remotely at the GWTP for monitoring. Additional personnel may be required to assist in other tasks such as collecting samples and/or performing filter backwash.

### 3.5 OTHER REGULATIONS AND STANDARDS

The treatment system, along with water mains and appurtenances must be disinfected in accordance with the following standards:

- American Water Works Association (AWWA) Standard C653, Disinfection of Water Treatment Plants,
- AWWA Standard C651, Standard for Disinfecting Water Mains, and
- National Sanitation Foundation (NSF) Standard 60 for Drinking Water Treatment Chemicals or equivalent standard.



## 4. TREATMENT FACILITY DESCRIPTION

### 4.1 PROCESS DESCRIPTION

In the RCF process, Cr(VI) is first reduced to trivalent chromium [Cr(III)] with the addition of excess ferrous iron ( $\text{Fe}^{+2}$ ), which is oxidized to ferric iron ( $\text{Fe}^{+3}$ ) by the electron transfer during the reduction of Cr(VI) and by dissolved oxygen present in the water. Ferrous iron doses found to be acceptable in Phase II testing ranged from 1.5 to 2.5 mg/L for reducing 100  $\mu\text{g/L}$  of Cr(VI) to less than 5 $\mu\text{g/L}$ . Cr(III) either precipitates, forms a co-precipitate with the ferric iron, or adsorbs onto the ferric floc. The ferric iron/Cr(III) particles form larger flocs during the aeration and coagulation stages (with the use of a NSF 60 certified polymer).

Particles are then removed by filtration through two, dual-media filters arranged in parallel for alternate operation. A backwash system is used to periodically send water upflow through the dual-media filter not in use to clean the filter media and remove the floc particles. Figure 4-1 shows a process flow diagram of the RCF treatment system. The demonstration-scale RCF system has a design capacity of 100 gpm. The system will initially treat water blended from the four NOU wells. When the pipeline for GN-3 is completed (expected in December 2009), it will treat groundwater from Well GN-3.

The entire system is mounted on a concrete pad with elevated sidewalls to serve as containment spills or leaks. A level switch located inside the sump in the containment pad alerts operators at the control panel that it is filling with liquid.

**NOTE: Liquids inside the sump and containment pad shall not be discharged unless approved by the Project Manager.**

The site piping materials are Schedule 80 polyvinyl chloride (PVC) for above grade piping and cement mortar line and coated ductile iron pipe for below grade piping. Exposed PVC is painted to protect against ultraviolet light. The velocities in the piping must be maintained below 5 feet per second in PVC piping to protect against surge. Exposed valves are PVC butterfly valves. Buried valves are ductile-iron, body-resilient, wedge, gate valves.



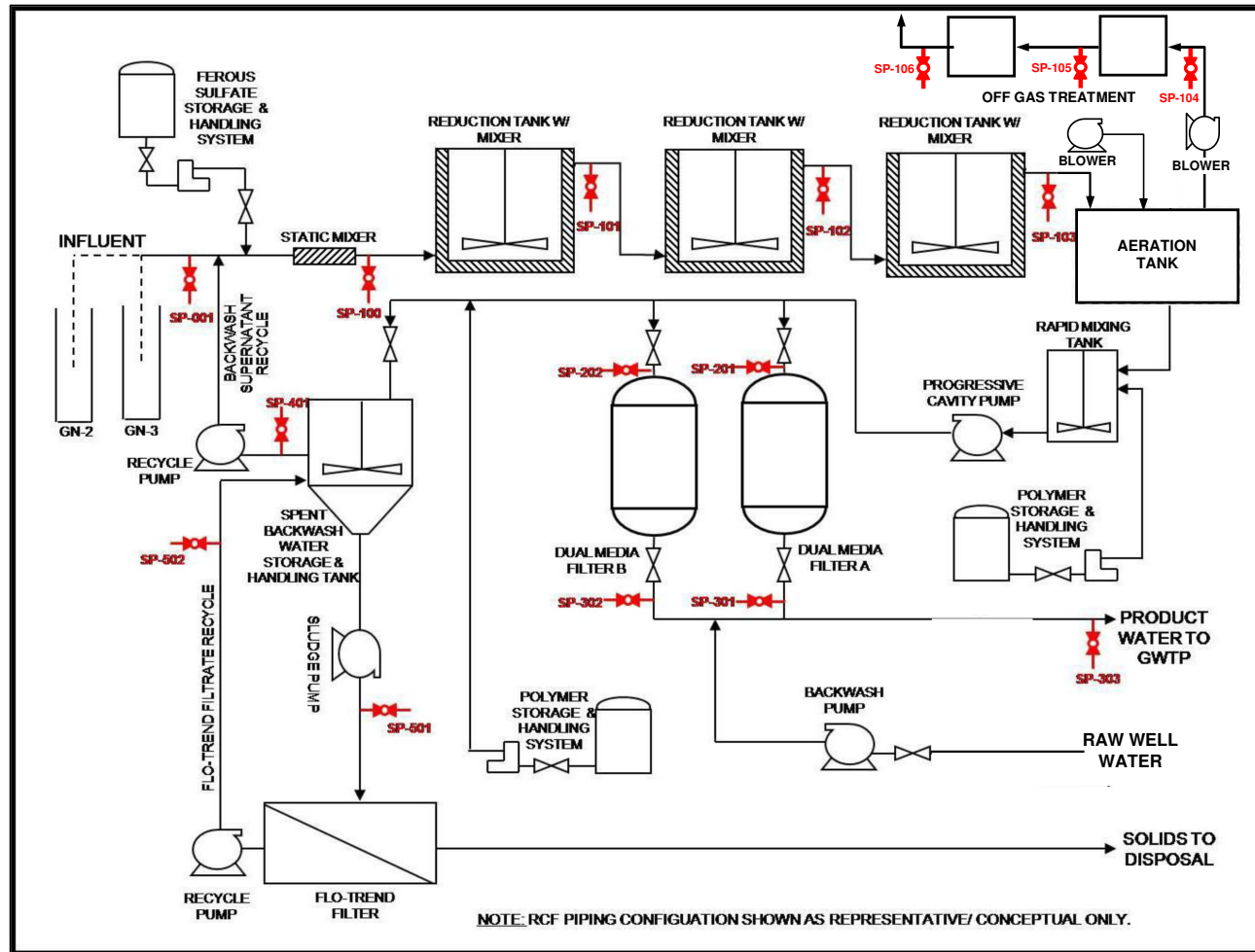


Figure 4-1: RCF Treatment System Process Flow Diagram



## 5. PROCESS MONITORING AND CONTROL

The RCF Facility is an automated system that has an option of selecting its equipment (i.e. pumps, blowers, fans, and valves) in manual control operation. The plant's automation features include automatic backwash sequencing and duration, and monitoring numerous plant conditions with appropriate alarms and shutdowns should an aberrant condition occur.

The RCF Facility has a single main control panel with a Human Machine Interface (HMI) to allow operator input and communication with the system. The plant's instrumentation and control equipment includes pressure and flow instrumentation to monitor flow rate, throughput, and differential pressure. The system also monitors differential pressure across each filter and the media trap. The plant has a level sensor to monitor backwash tank level and scales for the chemical feed tanks. Process variables are transmitted via SCADA system to the GWTP control room.

Critical equipment is interlocked by hardwiring directly to control devices. Operating conditions that exceed interlock setpoints either trigger an alarm or equipment shutdown. The specific alarm conditions must be returned to normal operation before the individual alarm condition can be reset and the plant restarted.

The control system description is provided in Appendix C. Table 5-1 summarizes the instrumentation equipment and control setpoints (listed by tag number, as shown on the process and instrumentation diagram found in the Record Drawings in Appendix A), and actions triggered by those setpoints.

The wells supplying the raw groundwater are normally controlled via the existing SCADA system in an automatic-remote manner with manual-remote operation possible from the GWTP control room and local control at the well. The well pumps are equipped with variable-frequency drives that are automatically controlled to match the plant flow rate setpoint.

**Table 5-1: Instrumentation and Control Functions**

Instrument Tag Number	Description	Operating Range	Setpoint	Responses and Interlocks
<b>GENERAL</b>				
LSH101	High Level Sensor for Containment Pad	NA	mid-height of containment curb	Treatment system is shutdown and an alarm is activated with output to the control panel and SCADA system for local and remote monitoring, respectively.
<b>REDUCTION AND AERATION SYSTEM</b>				
FCV500	Flow Control Valve		Controlled by LT100	Adjusts the plant influent flow rate based on the liquid level in the Rapid Mix Tank.
LT/LI100	Level Transmitter/ Indicator for Rapid Mix Tank	—	—	Controls valve FCV500 to maintain liquid in Rapid Mix Tank above a certain level.
	Rapid Mix Tank High Level Alarm	0 – 6 feet	4 feet	An alarm is activated on the CP with output to SCADA system for remote monitoring.
	Rapid Mix Tank Low Level Alarm	0 – 6 feet	3 ft. 4 in.	An alarm is activated on the CP with output to SCADA system for remote monitoring. Ferrous sulfate pump P800 is shut down.
LSL100	Level Switch Low on Rapid Mix Tank Low Level	N/A	21 inches	Interlocks with P100. Shuts down P100
LSH100	Level Switch High on Rapid Mix Tank High Level	N/A	57 inches	Interlocks with FCV500. Closes FCV500
<b>CHEMICAL FEED SYSTEMS</b>				
LT800	Level Transmitter for Ferrous Sulfate Feed Tank	—	—	Ferrous Sulfate Feed Tank level is detected by a scale. Transmits signal to CP and SCADA system for local and remote monitoring, respectively. PLC controls polymer feed pumps.
	Ferrous Sulfate Tank Low Level	—	6 inches	A notification alarm is activated on the CP with output to SCADA system for remote monitoring.
	Ferrous Sulfate Tank Low Low Level	—	3 inches	Ferrous Sulfate Feed Pump (P800) stops. An alarm is activated on the CP with output to SCADA system for remote monitoring.
LT810	Level Transmitter for Polymer Feed Tank (Rapid Mix Tank supply)	—	—	Polymer Feed Tank level is detected by a scale. Transmits signal to CP and SCADA system for local and remote monitoring, respectively. PLC controls polymer feed pumps.
	Polymer Tank Low Level	—	6 inches	A notification alarm is activated on the CP with output to SCADA system for remote monitoring.

Instrument Tag Number	Description	Operating Range	Setpoint	Responses and Interlocks
LT810	Polymer Tank Low Low Level	—	3 inches	Polymer Feed Pump (P810) stops. An alarm is activated on the CP with output to SCADA system for remote monitoring.
	Level Transmitter for Polymer Feed Tank (Settling Tank supply)	—	—	Polymer Feed Tank level is detected by a scale. Transmits signal to CP and SCADA system for local and remote monitoring, respectively. PLC controls polymer feed pumps.
	Polymer Tank Low Level	—	9 inches	A notification alarm is activated on the CP with output to SCADA system for remote monitoring.
	Polymer Tank Low Low Level	—	3 inches	Polymer Feed Pump (P810) stops. An alarm is activated on the CP with output to SCADA system for remote monitoring.
<b>FILTRATION SYSTEM</b>				
FIT/FIC500	Flow Indicator, Transmitter, Controller for Influent to Filter Vessels	80-120 gpm	100 gpm	Measures, displays, and controls flow rate of influent to filter vessels. Modulates the speed of drive VFD-100 that drives the progressive cavity pump P100.
VFD100 (P100)	Variable Frequency Drive for Progressive Cavity Pump P100	—	Controlled by FIT500	Drives pump P100 that transfers the process water from the Rapid Mix Tank to the Filter Vessels.
AE/AIT760	Oxidative/Reduction Potential Analyzer, Indicator, Transmitter	—	NA	Measures and displays oxidative/reductive potential of influent water to Filter Vessels. Transmits signal to CP and SCADA system for local and remote monitoring, respectively.
	ORP High Alarm	0 – 1000 mV	0 – 1000 mV	An alarm is activated on the CP with output to SCADA system for remote monitoring.
	ORP Low Alarm	0 – 1000 mV	0 – 1000 mV	An alarm is activated on the CP with output to SCADA system for remote monitoring.
	ORP Low Low Alarm	NA	0 – 1000 mV	An alarm is activated on the CP with output to SCADA system for remote monitoring and treatment system is shut down.
FIT/FQI800	Flow Indicator, Transmitter, Totalizer for Filter Vessel Drawdown	—	Drawdown complete at 1,250 gal	Measures and displays flow from drawdown of Filter Vessels. Transmits signal to CP and SCADA system for local and remote monitoring, respectively. Controls the stop/start operation of Transfer Pump, P101 by determining the water volume drained from the vessels.
PDIT101	Pressure Differential Indicator, Transmitter for Filter Vessels	3.5 – 10 psig	NA	Measures and displays the pressure differential across the Filter Vessels. Transmits signal to CP and SCADA system for local and remote monitoring, respectively.

Instrument Tag Number	Description	Operating Range	Setpoint	Responses and Interlocks
	Backwash Initiation Differential Pressure	3.5 – 10 psig	10 psig	Triggers backwash cycle when backwash control is in automatic. Overrides all backwash modes in automatic.
	System High DP Alarm		0 – 16 psid	An alarm is activated on the CP with output to SCADA system for remote monitoring.
	System High High DP Alarm		0 – 18 psid	An alarm is activated on the CP with output to SCADA system for remote monitoring and treatment system is shut down.
PDIS401	Pressure Differential Indicator, Switch		15 psig	Measures and displays the pressure differential across the Media Trap. Shuts down the treatment system if the setpoint is exceeded.
FIT/FIC300	Flow Indicator, Transmitter for Blower Output	8-80 SCFM	66 SCFM	Measures and displays air flow from backwash blower. Transmits signal to CP and SCADA system for local and remote monitoring, respectively. Modulates the speed of drive VFD300 that drives Blower, B102.
FIT/FIC600	Flow Indicator, Transmitter, Controller for Filter Vessel Backwash		465 gpm	Measures and displays backwash flow rate. Modulates Flow Control Valve, FCV600, to adjust the backwash flow rate to the setpoint. Transmits signal to CP and SCADA system for local and remote monitoring and control, respectively.
AIT/AE400	Turbidity Meter, Transmitter on System Effluent	0-100 NTU	1 NTU	Measures the turbidity of the treatment system effluent. Transmits signal to CP and SCADA system for local and remote monitoring, respectively.
	Filter Turbidity High Alarm	5 – 10 NTU	5 – 10 NTU	An alarm is activated on the CP with output to SCADA system for remote monitoring.
	Filter Turbidity High High Alarm	5 – 10 NTU	5 – 10 NTU	An alarm is activated on the CP with output to SCADA system for remote monitoring and treatment system is shut down.
<b>BACKWASH SYSTEM</b>				
AIT/AE600	Turbidity Meter, Transmitter for Backwash Water from Filter Vessels	0.0001-4000 NTU	NA	Measures the turbidity of backwash water from the Filter Vessels.
AIT/AE700	Turbidity Meter, Transmitter for Decant Water		NA	Measures the turbidity of the Decant Water from the Settling Tank. Transmits signal to CP and SCADA system for local and remote monitoring, respectively.



Instrument Tag Number	Description	Operating Range	Setpoint	Responses and Interlocks
	Decant Turbidity High Alarm	0 – 100 NTU	0 – 100 NTU	An alarm is activated on the CP with output to SCADA system for remote monitoring.
	Decant Turbidity High High Alarm	0 – 100 NTU	90 NTU	An alarm is activated on the CP with output to SCADA system for remote monitoring and Decant Pump P701 is shut down.
LT/LI1700	Level Transmitter, Indicator for Settling Tank		NSP	Measures and displays liquid level in Settling Tank. Transmits signal to CP and SCADA system for local and remote monitoring, respectively.
LSL1700	Level Switch Low on Backwash Tank	NA	0	Interlocks with P701. Shuts down P701 An alarm is activated on the CP with output to SCADA system for remote monitoring.
LSH1700	Level Switch High on Backwash Tank	NA	12 ft. 6 in.	Prevents system from backwashing at high level. An alarm is activated on the CP with output to SCADA system for remote monitoring.
FIT/FIA700	Flow Indicator, Transmitter for Decant Water		NA	Measures and displays Decant Water flow rate. Alarms on High and Low Flow An alarm is activated on the CP with output to SCADA system for remote monitoring.
LSH716	Level Switch High on Sludge Treatment Tank High Level		3 feet	An alarm is activated on the CP with output to SCADA system for remote monitoring. Interlocks with V714. Closes V714

Notes:  
CP = control panel  
PLC = programmable logic controller

NA = not applicable  
NSP = no setpoint  
SCADA = supervisory control and data acquisition

VFD = variable frequency drive



## 6. PLANT OPERATIONS

### 6.1 FACILITY SHUTDOWN AND START-UP

#### 6.1.1 Initial Facility Start-up

Initial start-up of the facility after construction is a one-time event that requires special procedures that include testing for treatment adequacy to satisfy CDPH requirements for drinking water. The initial start-up plan is provided in Appendix D. Initial start up includes filter media flushing and disinfection, the standard operating procedures (SOPs) for which are included in Appendix E.

#### 6.1.2 Chemical Solution Makeup

A sufficient quantity of ferrous sulfate solution is necessary for proper operation of the plant. Once mixed, the ferrous sulfate should be removed and replaced if it has been more than 30 days since mixing. Used ferrous sulfate should be transferred into a suitable container that can be sealed for offsite transport and disposal. Mixing quantities can be found in Table 6-1.

Polymer solution is used to coagulate and settle solids/sludge created duration the treatment process. Due to the low concentrations required, two dilution steps are required, as shown in Table 6-1. Once mixed, the shelf life of polymer is limited, as shown in the Table.

#### 6.1.3 Short-term Shutdown and Start-up

Short-term shutdowns apply to shut downs in which no water flows through the filter vessels lasting less than 24 hours and are typical of minor system equipment maintenance and repairs. During short-term shutdowns the vessels are not drained or emptied of media and there is no need to perform bacteriological testing upon start-up.

The treatment system will start depending on the water level in the Rapid Mix Tank in which is located the level transmitter that controls the influent valve (FCV500). When the plant is ONLINE and in AUTOMATIC mode, and the water level is below the setpoint, the valve will open to allow water into the system. When the liquid level in the Rapid Mix Tank reaches the setpoint, the variable frequency drive (VFD)-controlled progressive cavity pump (P100) will modulate to maintain the level setpoint, pumping water through the filter vessels that is in service. Aeration blowers will start when the level control valve (FCV500) is in modulation control.

##### 1. Pre-Start-up Checks.

These tasks must be performed by the operator prior to placing any portion of the system, or equipment in operation. The tasks must be performed at least 48 hours prior to beginning start-up operations in order to allow time for troubleshooting in the event of problems.

- a. Ensure all chemical storage tanks are filled and verify that all feed systems are functioning properly.
- b. Clean and calibrate instruments if necessary.
- c. Verify that all isolation valves to process instrumentation are open.
- d. Check and clean or replace granular activated carbon (GAC) air filters, media trap and/or cone strainer as necessary.

**Table 6-1: Table of Chemical Dosage Rates**

	Ferrous sulfate	Polymer – filter aid	Polymer – settling aid																								
<b>Chemical</b>	FeSO <sub>4</sub>	Ciba MAGNAFLOC E38	Ciba MAGNAFLOC E38																								
<b>Chemical Dose</b>	25:1 Fe-to-Cr6 mass ratio (Example: 2.5 mg/L Fe for 100 ug/L Cr6)	0.1 mg/L	1.0 mg/L																								
<b>Chemical Strength</b>	5 to 7% as Fe (i.e., 50,000 to 70,000 mg/L)	As shipped: 28% active polymer  Stock solution – 0.5-1.0% (recommended storage - 2-4 days; approx. 1 gallon) <ul style="list-style-type: none"> <li>Dilute full-strength polymer (Example: To prepare 0.5% stock, add 135 mL into 2 gal of water)</li> </ul> Feed solution – 0.05-0.1% (recommended storage - 1-2 days approx, 10 gallons) <ul style="list-style-type: none"> <li>Dilute stock by 10x (i.e., 1 gal of stock into 9 gal of water)</li> </ul>	Refer to adjoining column																								
<b>Chemical Density</b>	9.92 lbs/ gal	8.4 lbs/ gal	Refer to adjoining column																								
<b>Dose Rate</b>	Dose x flow rate ÷ (solution concentration x density) = chemical dose rate  Example: 2.5 mg/L x 0.144 MGD x 8.34 lb-L/kg-gal ÷ (0.05 x 9.92 lb/gal) = 6.05 gal/day = 0.25 gal/hr	Dose x flow rate ÷ (solution concentration x density) = chemical dose rate  Example: Assuming the feed solution is 0.05%: 0.1 mg/L x 0.144 MGD x 8.34 lb-L/kg-gal ÷ (0.005 x 8.4 lb/gal) = 2.9 gal/day = 0.12 gal/hr																									
<b>Dose/Concentration</b>	<table border="1"> <thead> <tr> <th>Cr6 Concentration</th> <th>FeSO<sub>4</sub> Feedrate</th> </tr> </thead> <tbody> <tr><td>5 ug/L</td><td>0.0125 gal/hr</td></tr> <tr><td>10 ug/L</td><td>0.025 gal/hr</td></tr> <tr><td>20 ug/L</td><td>0.050 gal/hr</td></tr> <tr><td>30 ug/L</td><td>0.075 gal/hr</td></tr> <tr><td>40 ug/L</td><td>0.10 gal/hr</td></tr> <tr><td>50 ug/L</td><td>0.13 gal/hr</td></tr> <tr><td>60 ug/L</td><td>0.15 gal/hr</td></tr> <tr><td>70 ug/L</td><td>0.23 gal/hr</td></tr> <tr><td>80 ug/L</td><td>0.18 gal/hr</td></tr> <tr><td>90 ug/L</td><td>0.23 gal/hr</td></tr> <tr><td>100 ug/L</td><td>0.25 gal/hr</td></tr> </tbody> </table>	Cr6 Concentration	FeSO <sub>4</sub> Feedrate	5 ug/L	0.0125 gal/hr	10 ug/L	0.025 gal/hr	20 ug/L	0.050 gal/hr	30 ug/L	0.075 gal/hr	40 ug/L	0.10 gal/hr	50 ug/L	0.13 gal/hr	60 ug/L	0.15 gal/hr	70 ug/L	0.23 gal/hr	80 ug/L	0.18 gal/hr	90 ug/L	0.23 gal/hr	100 ug/L	0.25 gal/hr		
Cr6 Concentration	FeSO <sub>4</sub> Feedrate																										
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90 ug/L	0.23 gal/hr																										
100 ug/L	0.25 gal/hr																										
<b>Notes</b>		Feed solution must be prepared by adding product to water. Solutions must be homogenized thoroughly.																									

2. Verify that the wells supplying water to the facility are in operation.
3. Verify that all equipment HAND-OFF-HMI (HOH) switches on the CP are in HMI (automatic) mode.
4. Verify that air blowers for aeration tank or in AUTOMATIC and filter vessels are in ONLINE and AUTOMATIC mode in the HMI and the backwash cycle is in the desired mode (i.e. manual, flow throughput, or timer)

#### 6.1.4 Long-term Shutdown and Start-up

For facility or system shutdowns that last more than 24 hours, the filter vessels must be kept full of water and flushed with a continuous stream of water draining to the sewer to discourage bacterial contamination and biological growth on the media.

When the facility is ready to be put back on line the following steps are followed.

1. Pre-Start-up Checks

These tasks must be performed by the operator prior to placing any portion of the system, or equipment in operation. The tasks must be performed at least 48 hours prior to beginning start-up operations in order to allow time for troubleshooting in the event of problems.

- a. Ensure all chemical storage tanks are filled and verify that all feed systems are functioning properly.
  - b. Clean and calibrate instruments if necessary.
  - c. Verify that all isolation valves to process instrumentation are open.
  - d. Check and clean or replace GAC air filters and media trap as necessary.
2. Perform media flushing and disinfection in accordance with the SOPs in Appendix E.
  3. Flush the media with water to remove residual chlorine to less than 0.5 ppm.
  4. Collect two water samples from the vessel effluent at 30-minute intervals and test for the presence or absence of total coliform bacteria and *E. coli* bacteria. If any of the samples show the presence of coliform, one of the following procedures shall be followed before placing the unit or facility in service.
    - i) Take repeat samples at least 24 hours apart until consecutive samples do not show the presence of coliform.
    - ii) Disinfect the media following the procedure outlined in Appendix E before placing on line.
  5. Verify that the wells supplying water to the facility are in operation.
  6. Verify that all equipment HOH switches on the CP are in HMI (automatic) mode.
  7. Verify that air blowers for aeration tank or in AUTOMATIC and filter vessels are in ONLINE and AUTOMATIC mode in the HMI and the backwash cycle is in the desired mode (i.e. manual, flow throughput, or timer).

## 6.2 CONTINUOUS OPERATION

The facility is designed to operate automatically with minimal operator intervention except for collecting samples, monitoring process parameters, and filling process chemical containers. As

described in the Control System Description in Appendix C, the filters can be operated in one of two modes when online; automatic or manual.

In AUTOMATIC mode, all on-off valves will open and close depending on the operating sequence of the filter vessel. The VFD-controlled progressive cavity pump (P100) will modulate to match the flow set point and the water level in the Rapid Mix Tank.

In Manual mode, the operator can manually operate all on-off valves of the filter vessel via the HMI. The operator must make sure the desired position of the on-off valves when they are selected to MANUAL.

The configurations of process control valves in service (forward operation) and backwash operation of the filter vessels is provided in Table 6-2.

**Table 6-2: Valve Configuration – Normal Operation**

Valve	Vessel No. 1 in Service Vessel No. 2 in Backwash	Vessel No. 2 in Service Vessel No. 1 in Backwash
V101	OPEN	CLOSED
V102	OPEN	CLOSED
V103	CLOSED	OPEN
V104	CLOSED	OPEN
V106 <sup>1</sup>	CLOSED	MODULATED
V108 <sup>2</sup>	CLOSED	MODULATED
V201	CLOSED	OPEN
V202	CLOSED	OPEN
V203	OPEN	CLOSED
V204	OPEN	CLOSED
V206 <sup>1</sup>	MODULATED	CLOSED
V208 <sup>2</sup>	MODULATED	CLOSED

Notes:

<sup>1</sup> Valves V106 and 206 are modulated to regulate air flow into the vessel during the backwash cycle.

<sup>2</sup> Valves V108 and V208 are modulated to regulate the draining of filter vessel prior to scrubbing with air.

Filter backwash is also initiated automatically in this mode based on the backwash trigger specified in the PLC; either flow throughput, or timer. Filter backwash can also be initiated manually if so specified in the PLC.

All setpoints and operating modes are set through the HMI on the control panel.

**NOTE: THE ENTIRE FACILITY CAN BE SHUT DOWN AT ANY TIME BY PRESSING THE RED BUTTON ON THE FRONT OF THE CONTROL PANEL.**

### 6.3 OPERATION WITH GN-3 WELLFIELD

The treatment plant is designed to operate with water obtained from the main feed line to the Glendale Operable Unit (GOU) treatment plant. An alternate water source from the GN-3 pipeline is also being provided, which has higher CR6 concentrations. The ferrous sulfate feed rate will need to be adjusted to correspond with the higher concentrations.

To change the water source from the GOU plant influent to the GN-3 pipeline, Valve V-XX is closed and Valve V-YY is opened, as shown on Drawing C-2 in Appendix A. To change the water source back to the GOU influent, Valve V-YY is closed and V-XX is opened. The ferrous sulfate feed rate is

**Comment [LED1]:** Will need to provide valve numbering on record drawings.

changed by adjusting the ferrous sulfate feed pump to the rates that can be determined by Table 6-1.

#### 6.4 EMERGENCY PLANT SHUTDOWN

In case of emergency the plant can be shut down by pressing the red button on the main control panel.



Figure 6-1: Emergency System Shutdown Button





## 7. MONITORING AND SAMPLING PLAN

The draft monitoring and sampling plan was provided by Malcolm Pirnie (Malcolm Pirnie 2008a). Evaluation of the RCF system for Cr(VI) removal at the demonstration scale will focus on the measurement of key chemical and process parameters to fully test the utility of the treatment process.

The sections below provide an overview of the data collection and study protocol for the operation of the RCF Facility, which includes monitoring parameters, locations, frequency, and analytical approach. The comprehensive data collection and management plan is contained within the Quality Assurance Project Plan (QAPP) (Malcolm Pirnie 2008b). The QAPP is provided as Appendix F in this document. Water samples are routinely collected by City employees. All analyses are performed by a State-certified, drinking-water analytical laboratory, using an approved quality control program.

### 7.1.1 Process-related Parameters

Process-related parameters are monitored and recorded to evaluate the operations of the RCF system. The process-related parameters include flow rate, chemical feed rate, and pressure buildup through the filter columns. Treatment residuals are also categorized as process-related parameters in the study.

Table 7-1 identifies the process parameters that will be monitored at each location and associated monitoring frequencies. It should be noted that the demonstration-scale RCF system will be designed to operate automatically with minimal operators' supervision. As a result, some of the process-related parameters will be monitored and recorded continuously and the data will be transmitted to the GWTP via the SCADA system. However, system operators are still required to follow the monitoring plan as specified in Table 7-1 to ensure the completeness of the operational data.

The treatment residual – dewatered sludge captured on the passive filtration system – will be assessed at certified laboratory to confirm disposal options using the Toxicity Characteristic Leaching Procedure (TCLP, USEPA Method 1311 as mandated by 40 CFR 261) and the California Waste Extraction Test (CWET). The Phase II pilot-scale testing indicated that the sludge would be classified as hazardous waste in the State of California because total Cr concentration in the leachate exceeded the regulatory limit during CWET.

The quantity of dewatered sludge captured on the passive filtration system is also determined during the study. Tare weight of the passive filter is determined or provided by the vendor before any sludge loading. The gross weight of the filter with dewatered sludge is also determined each time an off-site disposal occurs. The net weight of dewatered sludge can thus be calculated by subtracting the tare weight from the gross weight and the daily sludge production rate can be calculated by dividing the net weight by the filter operation duration. In addition, the dewatered sludge is sent to a certified laboratory for moisture content determination. As a result, the solids content (dry weight) of the dewatered sludge can be calculated.

**Table 7-1: Monitoring and Sampling Schedule for Process-Related Parameters**

Equipment Tag No.	Process-related parameters	Frequency
FIT500	Influent water flow rate and total volume	Once Daily
LT800	Ferrous sulfate injection rate and liquid level	Once Daily
P810, LT810	Raw water polymer injection rate and liquid level	Once Daily
PI000	Dual media filter inlet pressure	Once Daily
PDIT101	Dual media filter differential pressure	Once Daily
PDIS401	Media trap differential pressure	Once Daily

Equipment Tag No.	Process-related parameters	Frequency
FQI800	Drawdown flow rate and total volume	Once every backwash cycle
FIT600	Backwash water flow rate and total volume	Once every backwash cycle
P811, LT810	Backwash polymer injection rate and liquid level	Once every backwash cycle
FIT700	Backwash supernatant recycle flow rate and total volume	Once every backwash cycle
Sludge treatment vessel	Settled backwash solids total volume	Once every backwash cycle
Filtrate transfer sump	Flo-Trend filtrate recycle total volume	Once every backwash cycle
Sludge treatment vessel	Dewatered sludge total quantity	Once every off-site disposal
PI002	Off gas treatment inlet pressure	Once Daily
PI003	Off gas treatment influent pressure, temperature, and flow rate	Once Daily

### 7.1.2 Chemical and Physical Parameters

Chemical and physical parameters are monitored to assess the effectiveness of water treatment and proper operation of the facility. Critical water quality parameters for the demonstration-scale RCF Facility are listed in Table 7-3 as well as air quality parameters for the off gas treatment system. Sample locations are shown on Figure 7-1.

### 7.1.3 Off-gas Treatment Sampling

Off-gas Treatment samples will be collected to monitor the effectiveness of the treatment system. Samples will be collected at the inlet, midpoint and outlet of the system in SUMMA canisters. Duplicate samples will be collected at a rate of 10 percent. Samples will be analyzed for VOCs using USEPA Method TO14 (modified) and will be submitted for analysis in accordance with the QAPP. Table 7-2 lists the chemical parameters to be tested and the types of containers and preservation methods to be used.

**Table 7-2: Requirements for Soil-Vapor Sample Preservation, Maximum Holding Time, and Containers**

Analyte	Analytical Method	Preservation	Maximum Holding Time	Number x Sample Container Type
VOCs	EPA TO14 (Modified)	Shade from sunlight	72 hours <sup>a</sup>	1x SUMMA canister

Notes:

<sup>a</sup> From sample collection to analysis.

Samples collected in SUMMA canisters will be obtained from the appropriate sample port by connecting the evacuated canister to the port with a gas-tight fitting. The canister will be opened until the gauge indicates pressure equalization. The port will then be closed and the canister disconnected.

**Table 7-3: Sampling Schedule for Chemical Parameters**

Sample Point	Laboratory Analysis				Field Analysis							
	Cr(VI)	Total Cr	TSS	VOC	Cr(VI)	Total Fe	Fe <sup>2+</sup>	Turbidity	pH/Temp <sup>1</sup>	ORP	VOCs	
SP-001	1/W	1/W	—	—	1/W	1/M	1/M	1/M	Continuous	Continuous		
SP-100	—	—	—	—	—	1/W	1/W	—	—	—		
SP-101 <sup>2</sup>	—	—	—	—	—	1/D, 1/W	1/D, 1/W	—	1/W	—		
SP-102	—	—	—	—	—	1/M	1/M	—	1/W	—		
SP-103 <sup>2</sup>	1/W	—	—	1/W	—	1/D, 1/W	1/D, 1/W	—	1/W	1/W		
SP-104 <sup>2</sup>	—	—	—	1/W, 1/M	—	—	—	—	—	—	1/M	
SP-105 <sup>2</sup>	—	—	—	1/W, 1/M	—	—	—	—	—	—	1/M	
SP-106 <sup>2</sup>	—	—	—	1/W, 1/M	—	—	—	—	—	—	1/M	
SP-201	—	—	—	—	—	—	—	—	1/W	1/W		
SP-202	—	—	—	—	—	—	—	—	1/W	1/W		
SP-301 <sup>2</sup>	1/D, 1/W	1/D, 1/W	—	—	1/W	1/D, 1/W	1/W	Continuous	1/M	1/M		
SP-302 <sup>2</sup>	1/W	1/D, 1/W	—	—	1/W	1/D, 1/W	1/W	Continuous	1/M	1/M		
SP-303	1/W	1/W	—	—	1/W	1/W	1/W	Continuous	1/W	1/W		
SP-401	1/W	1/W	—	—	1/W	1/W	1/W	1/W	1/M	1/M		
SP-501	—	—	1/M	—	—	—	—	—	—	—		
SP-502	1/W	1/W	—	—	1/M	1/M	1/M	1/W	1/M	1/M		

Notes:

1/M = once per month

1/W = once per week

1/D = once per day

<sup>1</sup> pH and temperature will be monitored at the same frequency because the pH meter selected for the RCF study has temperature compensation function to ensure more accurate measurement.

<sup>2</sup> Samples collected daily for first week of operation and weekly thereafter.



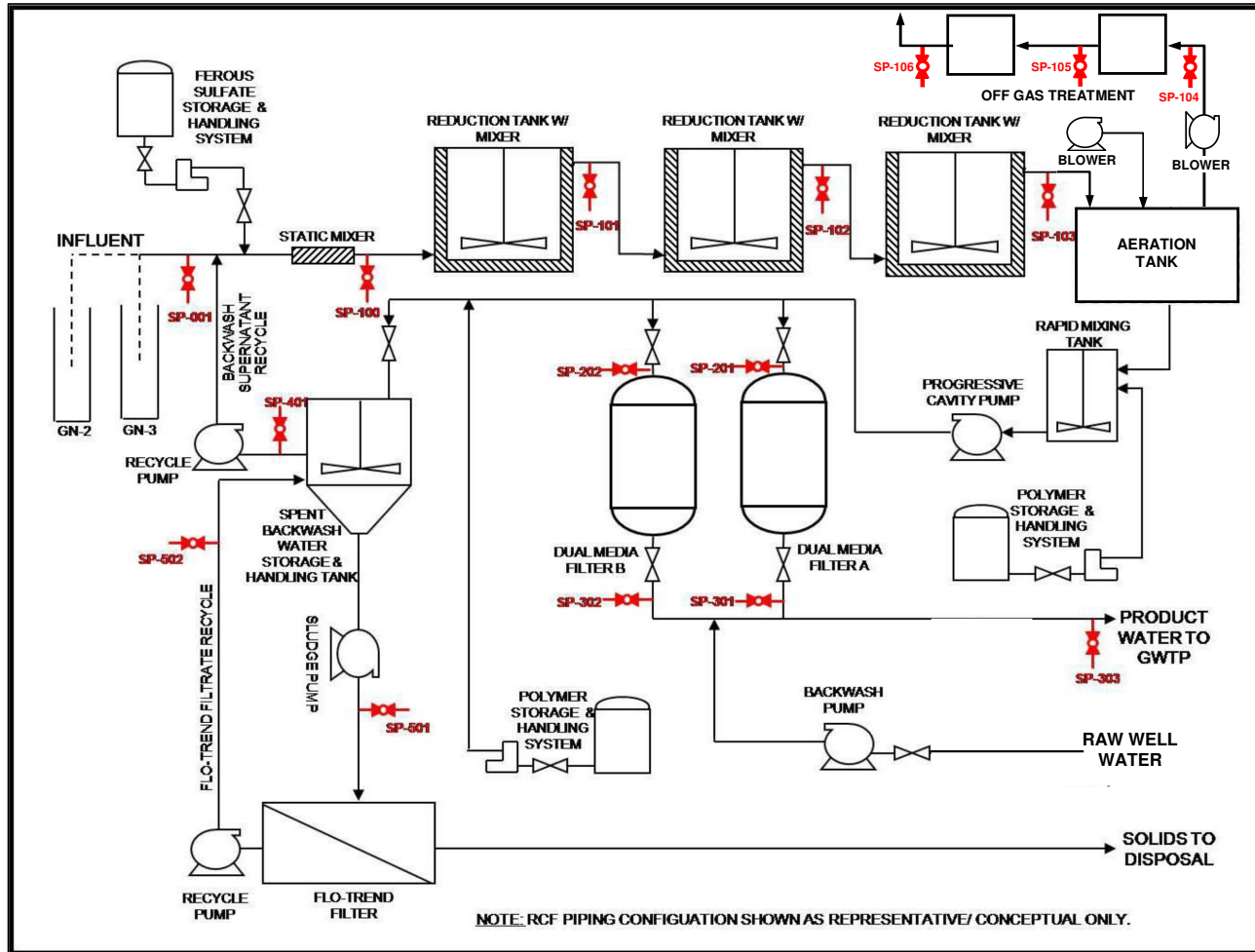


Figure 7-1: Sampling Locations for Chemical and Physical Parameters (highlighted in red) (Malcolm Pirnie, 2008b)



## 8. MAINTENANCE PLAN

A complete and effective maintenance plan is necessary to attain and maintain safe, effective, and efficient facility operation and continuously acceptable facility performance.

The treatment facility must be monitored daily for proper operation. Operational activities and tasks that must be performed on a routine basis are part of the overall maintenance plan. The basic features of the plan include the following:

- A list of routine duties that provide the minimum requirements for operators of the plant.
- System maintenance programs that provide proper planning, scheduling and implementation information, as well as preventive, operational and corrective maintenance tasks.
- A record-keeping system that provides immediate access to necessary equipment data and information, manufacturers' instructions, and records of previous repairs.

The maintenance plan is kept as simple and logical as possible. It is not to be rigid, but is continually subject to review, updating, and improvement, based on past operating observations and experiences.

### 8.1 ROUTINE DUTIES

The following is a list of recommended duties to be performed on a routine basis. These are minimum requirements and are not intended to be a complete list of duties.

**NOTE: The operator must follow the site safety plan, including wearing the proper personal PPE when performing tasks at the treatment facility and following confined space entry requirements. Where applicable, lockout/tag out of equipment to a zero energy state must be done to ensure equipment does not operate during maintenance.**

- Monitor plant process for proper operation
- Fill out log sheets as required
- Maintain daily log book
- Maintain field notebook
- Maintain records in compliance with CDPH requirements
- Perform and document periodic maintenance as required by City standard procedures, and as recommended by the individual equipment manufacturer
- Document alarm conditions.

Appendix G includes check lists to be used for daily and weekly inspections.

### 8.2 SYSTEM MAINTENANCE

Well-planned and scheduled system maintenance reduces unscheduled equipment breakdown, extends equipment life, and allows more efficient use of labor. Such a maintenance management system also provides information for solving maintenance problems. An overall management program should be developed by the maintenance supervisor contingent on available staffing and hours of facility operation.

Competent operations staff must be properly qualified, trained, and must be thoroughly aware of all safety hazards and appropriate emergency response procedures.

### 8.2.1 Preventive Maintenance Program

A successful preventive maintenance program (PMP) requires that equipment be inspected and serviced regularly following the manufacturers' instructions in the manuals for each piece of equipment. The operator uses the information from the O&M manuals to prepare routine preventive maintenance schedules, which are compatible with the lubrication schedule, since these operations can normally be performed at the same time. A preventive maintenance plan for the major equipment that includes maintenance frequencies is provided in Table 8-1.

The following list summarizes the general equipment maintenance guidelines:

- Be continually alert for any unusual conditions, equipment malfunctions, and early warning signs of impending failures, such as noise, vibrations, hunting or surging, leaks, smoke, odor, heat, etc. These should be reported to the maintenance personnel as quickly as possible.
- Inspect all operating equipment at regular intervals to see that all bolts and nuts are kept tight and that correct adjustments and alignments of couplings are maintained. Equipment and surrounding areas must be kept clean and free of dirt. Machined surfaces must be cleaned, free of rust spots, and protected with paint or a heavy grease preservative.
- Do not attempt to work or make adjustments on moving equipment. Either the breaker at the MCC or the pushbutton at the machine must be locked out before work is begun on the equipment, and properly tagged at all locations by the maintenance personnel. Simple bearing lubrication, however, can often be performed while the machine is operating.
- Keep all electric motors free from dirt, dust and moisture. Check to be sure that operating spaces are free from articles which may obstruct air circulation. Check for excess grease and oil leakage from bearings.
- Most ball bearing failures are caused by over-greasing. In order to protect against this and to provide proper lubrication, the following is recommended:
  - a. clean exterior of bearing housing and grease fitting;
  - b. remove grease fitting and drain plug;
  - c. use a rod or wire to break up any grease if grease has hardened at the drain plug. **Note: This is to be done only when equipment is not operating and has been locked out and tagged out.**
  - d. replace grease fitting and, with equipment running and bearing at operating temperature, apply grease with a low pressure gun until all of the old grease is forced out of the equipment;
  - e. operate equipment as required to allow excess grease to work out before replacing the drain plug.
- Plan and schedule all lubrication, maintenance, and work orders to minimize the required number of equipment outages.
- Lubrication of moving parts is one of the most important routine functions of a PMP. Each lubrication point on all equipment is marked or tagged to indicate correct lubricant and frequency of lubrication.

It is very important that plant operators and maintenance personnel routinely come in contact with every piece of equipment in the facility. Such routine maintenance provides a good "first line" for reporting equipment trouble and thus requires careful consideration.

Maintenance personnel should also become familiar with the format of equipment troubleshooting information presented in this manual, as well as in the manufacturer's service manuals, to keep equipment down time to a minimum.



**Table 8-1: Preventive Maintenance Plan**

Maintenance Task	Frequency	Justification and Reference Document	Responsible Party	Action By
<b>Reduction and Aeration System</b>				
Lubricate bearings of mixer, blower and associated motors	4-6 months	Manufacturer's Recommendation	GWP	Operator
Replace bearings, seals, and wear rings of mixer and blower	2 years	Standard Practice	GWP	Contractor
Replace motor bearings, seals, and gaskets of mixer and blower	2 years	Standard Practice	GWP	Contractor
Replace off gas treatment filters	As needed	As needed	GWP	Contractor
<b>Chemical Feed System</b>				
Inspect polymer and ferrous sulfate scale operation and calibration (tare)	Monthly	Standard Practice	GWP	Operator
Inspect operation of polymer mixer	Daily	Standard Practice	GWP	Operator
Check calibration of metering pumps	Annually	Standard Practice	GWP	Operator
<b>Filtration System</b>				
Lubricate bearings of PC and Drawdown pumps, backwash blower, and associated motors	4-6 months	Manufacturer's Recommendation	GWP	Operator
Replace bearings, seals, and wear rings of PC and Drawdown pumps, and backwash blower	2 years	Standard Practice	GWP	Contractor
Replace motor seals and gaskets for PC and Drawdown pumps and backwash blower.	2 years	Standard Practice	GWP	Contractor
<b>Filtration Vessel Maintenance</b>				
Exchange media (changeout)	As needed	Concentration or Pressure Driven	GWP	Resin supplier
Internal inspection of vessel with entry (check gaskets and coatings)	Every change-out	Standard Practice	GWP	Contractor
Inspect manway gaskets	Every Change-out	Standard Practice	GWP	Operator
Inspect entire vessels for leaks, corrosion, missing parts, and coating damage.	Monthly	Standard Practice	GWP	Operator
Inspect and clean media trap	Based on DP	Standard Practice	GWP	Operator
Service air/vacuum relief valve	Annually	Standard Practice	GWP	Contractor
<b>Backwash System</b>				
Lubricate decant pump and motor bearings	4-6 months	Manufacturer's Recommendation	GWP	Operator
Replace decant pump seals and wear rings	2 years	Standard Practice	GWP	Contractor

Maintenance Task	Frequency	Justification and Reference Document	Responsible Party	Action By
Replace decant pump-motor bearings, seals, and gaskets	2 years	Standard Practice	GWP	Contractor
Inspect and clean cone strainer	Following Backwash	Standard Practice	GWP	Operator
Inspect Sludge Mate for damage or leaks	Monthly	Standard Practice	GWP	Operator
<b>Valves</b>				
Inspect valves and pressure relief valves for proper operation and leaks	Monthly	Standard practice	GWP	Operator
Exercise automatic and manual valves	During facility shutdown	Standard practice	GWP	Operator
<b>Piping</b>				
Inspect for leaks, corrosion, and damage	Semi-annually	Visual Inspection	GWP	Operator
<b>Instrumentation and Control</b>				
Calibrate flow meters	Annually	Standard Practice	GWP	Contractor
Test pressure and differential pressure switches, level switches, solenoid valves, controls, and interlocks	Annually	Standard Practice	GWP	Operator
Zero all pressure gauges	Annually	Standard Practice	GWP	Operator
Clean and calibrate ORP and turbidity meters	Monthly	Standard Practice	GWP	Operator
<b>Electrical</b>				
Tighten wire connections in electrical cabinets and vacuum cabinet interiors	Annually	Manufacturer's Recommendation	GWP	Operator
Check temperatures on electrical cabinets	Daily	Standard Practice	GWP	Operator
Replace air filters for air conditioners on electrical cabinets	Annually	Manufacturer's Recommendation	GWP	Operator
<b>Miscellaneous</b>				
Replace sludge bin liner (sock)	Every third removal of sludge	Standard Practice	GWP	Operator
Verify operation of lighting and lighting controls	Annually	Standard Practice	GWP	Operator
Inspect and clean sumps and drains	Semi-annually	Standard Practice	GWP	Operator
Perform housekeeping and plant cleanup	As needed	Standard Practice	GWP	Operator
Replace air conditioner air filters for VFDs and MCC	Annually	Manufacturer's Recommendation	GWP	Operator

Notes:  
DP = differential pressure  
PC = progressive cavity

ORP = oxidative, reductive potential  
GWP = Glendale, Water and Power

### 8.3 SPARE PARTS

The plant will be in operation for about one year and will therefore be covered by the manufacturers' and supplier's warranties. As such, no spare parts are necessary for the duration of the demonstration project.

One month supplies of calibration solutions for the ORP meter and turbidimeter must be kept in local storage for routine maintenance of the instruments.

Equipment data sheets for the major pieces of equipment are provided in Appendix G.

### 8.4 RECORD KEEPING AND REPORTING

Data collection and reporting are an essential part of the operation of the facility. Accurate record keeping is required to comply with regulatory requirements and is used to assist in long-term planning.

Complete and accurate maintenance records must be kept on all equipment. These records are used for quick access to information needed regarding past maintenance practices, machinery adjustments and repairs, parts lists, and equipment service contacts. Periodic reviews of these records indicate improvements that can be made to the overall maintenance management program.

#### 8.4.1 Records

At a minimum, a file of the following records must be kept at the City operations office:

- Daily operating log sheet, containing the following information:
- Facility operating conditions (flow rates [total and per module or vessel], pressure readings, alarm conditions, etc.)
- MSDS, where applicable
- Completed chain of custody forms
- Laboratory reports of analytical results from off-site laboratories
- Maintenance records of equipment, including calibration information
- All applicable and current permits and licenses
- All CDPH permits and other CDPH requirements
- Emergency response procedures and contact information
- Operator certifications
- Vendor records.

Important items to be recorded in the maintenance log include name of equipment, recommended lubricant, frequency of application, equipment inspection instructions, inspection intervals, and any additional special instructions. The operator uses this information to prepare schedules for weekly, monthly, quarterly, and semi-annual lubrication of equipment.

All records shall be kept on file for a minimum of five (5) years. Water quality records shall be kept on file for a minimum of ten (10) years.

#### **8.4.2 Operating Logs**

The RCF Facility is inspected on a daily basis, and operation records must be maintained. Daily records include operational parameters such as flow rates through each treatment vessel and total flow rates for the treatment facility.

The daily records include any scheduled or unscheduled shutdown of the treatment systems, the duration of the shutdown, the cause of the shutdown, and resolution of the situation that caused the shutdown.

#### **8.4.3 Maintenance Logs**

Each major piece of equipment has an equipment data sheet and a maintenance log. This log contains the equipment number and name and a complete history of all past maintenance and repair.

Whenever work is performed, the date of work, initials of the maintenance worker, type of repair(s), time out of operations, probable cause of breakdown (if known), comments of maintenance mechanic, and parts replaced are noted in the log.

#### **8.4.4 Additional Records**

Additional maintenance records include:

- Motor Service Record. Completed for every electrical motor and used to record data from motor testing.
- Tickler File. A reminder file prepared for items requiring monthly, quarterly, semi-annual or annual service.
- Service Report. A report completed by an operator or mechanic when equipment is taken out of service because of failure, malfunction, or obvious need for inspection.

### **8.5 MONTHLY REPORTING**

The City is responsible for submitting a monthly report to the CDPH containing the operations records for the month, including the following information:

- Daily flow rate;
- Total volume of water treated and delivered to distribution during the month;
- Copies of water quality test results; and
- Any emergency and/or scheduled plant operation interruption, including the date, time, duration, location, cause of the interruption, and resolution of the interruption.

### **8.6 ANNUAL REPORT**

After one year of the treatment plant operation, the City must prepare and submit a report to the CDPH, with an evaluation of the performance of the treatment plant. The report shall detail any proposed changes to the operations plans or to the monitoring plan.

**Table 8-2: Troubleshooting Guide for RCF Facility**

<b>Fault Condition</b>	<b>Cause</b>	<b>Remedy</b>
<b>CONTAINMENT PAD</b>		
Containment liquid level alarm (LSH101)	Liquid in containment pad from rainfall	Open pad drain to discharge to storm drain.
	Leak from filters or appurtenances	Shut down plant and repair leak. Liquid in containment pad must be pumped by vac-truck to backwash tank or for disposal elsewhere.
<b>REDUCTION AND AERATION SYSTEM</b>		
High liquid level (LT/LI100 and/or LSH100)	Problem with plant inlet valve FCV500	Place valve control in HAND mode and adjust setpoint to see if valve is operating. This will determine if the problem is with the PLC or the valve.  Check valve operation and initiate repairs if necessary
	Problem with level sensor and control loop for valve FCV500	Place valve control in HAND mode and adjust setpoint to see if valve is operating. This will determine if the problem is with the PLC or the valve.  Place in HAND mode and initiate repairs
	Problem with pump P100	Check operation of pump P100
Low liquid level (LT/LI100 and/or LSL100)	Problem with plant inlet valve FCV500	Place valve control in HAND mode and adjust setpoint to see if valve is operating. This will determine if the problem is with the PLC or the valve.  Check valve operation and initiate repairs if necessary
	Problem with level sensor and control loop for valve FCV500	Place valve control in HAND mode and adjust setpoint to see if valve is operating. This will determine if the problem is with the PLC or the valve.  Place in HAND mode and initiate repairs
	Groundwater supply wells are shut off	Check operation of groundwater wells
<b>CHEMICAL FEED SYSTEMS</b>		
Low liquid level (LT800, LT810, LT811)	Chemical storage tanks are nearly empty	Initiate order of chemicals
	Malfunctioning scale	Check operation and calibration of scale
	Malfunctioning feed pumps	Check operation of feed pumps
	Improper chemical feed setpoint	Check chemical feed setpoints
<b>FILTRATION SYSTEM</b>		
ORP High Alarm		
ORP Low Alarm		

<b>Fault Condition</b>	<b>Cause</b>	<b>Remedy</b>
High Differential Pressure Alarm (PDIT101)	Silt build up inside filters and backwash is not in AUTO mode	Backwash filters manually or place backwash in AUTO mode
	Downstream valves are closed	Check and open downstream valves
Media trap high differential pressure (PDIS401)	If the trap contains a small amount of material (i.e., resin) this be due to accumulation over time of fines from the vessels.	Shut down plant and clean basket strainer in trap.
	If a large amount of resin is observed, this is an indication of a problem with the WBA vessels such as a broken nozzle or a misplaced nozzle gasket.	Shut down plant and investigate the problem.
High Filter Effluent Turbidity Alarm (AE/AIT400)	Particulate matter escaping filters through septa	Shut down plant and investigate the problem.
<b>BACKWASH SYSTEM</b>		
High Backwash Effluent Turbidity Alarm (AE/AIT600)	Backwash flow rate is too high thereby entraining filter media with backwash	Adjust backwash flow rate
Low Level Alarm for Backwash Tank (LSL1700)	Backwash tank control is in HAND mode	Place backwash control in AUTO mode
	Problem with level transmitter and/or control loop	Place backwash tank control in HAND mode and adjust setpoint to see if valve is operating. This will determine if the problem is with the PLC or the valve.  Place in HAND mode and initiate repairs
	Leak in tank	Check tank for leaks
High Level Alarm for Backwash Tank (LSH1700)	Backwash tank control is in HAND mode	Place backwash control in AUTO mode
	Problem with level transmitter and/or control loop	Place backwash tank control in HAND mode and adjust setpoint to see if valve is operating. This will determine if the problem is with the PLC or the valve.  Place in HAND mode and initiate repairs
<b>LEAKS</b>		
Miscellaneous Leaks	Improperly tightened bolts	Tighten flange bolts
	Damaged or dirty seals	Replace/clean gaskets, seals, as appropriate
Air Release Valve Leaks	Valve failure	Replace valve
	Media in air release valve	Close shut-off valve and open to clear  Disassemble and clean valve

Fault Condition	Cause	Remedy
<b>FLOW METERS</b>		
No Display	No power to flow meter	Check circuit breaker Check power at flow meter Check fuses at flow meter





## 9. WASTE MANAGEMENT

The purpose of this section is to ensure that all wastes are properly characterized prior to disposal. The demonstration facility is part of a Superfund site and falls under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Section 121(d)(3) of the CERCLA applies to any CERCLA response action involving the off-site transfer of any hazardous substance, pollutant or contaminant (CERCLA wastes). The transfer and disposal of CERCLA wastes must abide by the Off-Site Rule set forth in the National Contingency Plan (40 Code of Federal Regulations [CFR] 300.440). All CERCLA wastes must be transferred to a CERCLA-approved facility.

### 9.1 WASTE STREAMS

The waste streams generated at the facility include dewatered sludge captured on the passive filtration system and spent GAC from the off-gas treatment system.

The steps required for disposing of waste is as follows:

1. Characterize the waste,
2. Submit a waste profile with the disposal company for approval,
3. Select waste transportation and disposal contractors,
4. Prepare Waste Disposal Documents (Hazardous Waste Manifest or Bill of Lading),
5. Oversee waste loading and sign waste disposal documents,
6. Follow-up to receive copies of documents and disposal/destruction certificates.

### 9.2 WASTE CHARACTERIZATION

Treatment residuals are analyzed to confirm disposal options as described in Section 7.1.1. The Phase II pilot-scale testing indicated that the sludge would be classified as hazardous waste in the State of California because total Cr concentration in the leachate exceeded the regulatory limit during CWET. The spent GAC shall be disposed of before the concentration of VOCs or other contaminants render it hazardous waste.

Wastes generated as a result of ongoing remediation or treatment operations must be profiled once every two years and whenever any of the following circumstances occurs:

- A change occurs in the process that produces the waste (e.g. – a new chemical constituent is discovered, the treatment process is changed),
- A change in the treatment media is made (e.g. – a new media vendor or type is used),
- A waste was tainted by inadvertent mixing of the waste with another waste,
- A change occurred in the hazardous waste regulations that apply to the waste.

Characterization involves collecting samples and having them analyzed by a certified lab. The types of samples and analyses required for the types of waste generated at this facility are listed in Table 9-1.

**Table 9-1: Waste Sampling and Analysis**

Waste	Sample type	Analysis <sup>1</sup>
Dewatered sludge	Grab sample	Wet weight, moisture content, Title 22 metals, VOCs on dewatered sludge, (TCLP and CWET if necessary)
Spent GAC	Grab sample from the lead filter	Wet weight, moisture content, Title 22 metals, VOCs, (TCLP and CWET if necessary).

Notes:  
ASTM = American Society of Testing and Materials  
CWET = California Waste Extraction Test  
TCLP = Toxicity Characteristic Leaching Procedure  
VOC = volatile organic compound

Analytical Methods:  
TCLP: EPA Method 1311  
CWET: CWET (Title 22 Metals)  
Total Metals: EPA Method 6010B and 7471A  
VOCs: EPA Method 8260B

Waste can be classified as follows:

- Non-hazardous: the waste has few restrictions for disposal and can go to a non-regulated disposal facility. A bill of lading is sufficient for transporting and disposing the waste.
- California-hazardous: The waste is considered hazardous in California and must go to a regulated facility. A hazardous waste manifest must accompany the waste to the disposal facility and a certificate of disposal or destruction is necessary.
- Federal Hazardous: The waste is a Resource Conservation and Recovery Act (RCRA) hazardous waste and must be disposed of at a RCRA-approved facility. A waste manifest must accompany the waste to the disposal facility and a certificate of disposal or destruction is necessary.

### 9.3 WASTE PROFILES

Waste profiles are obtained from the disposal contractor or accepting facility. The laboratory results from the characterization step are transferred onto the profile forms along with physical characteristics of the waste and information about the generator.

The profiles are submitted to the acceptance facility once completed and signed for review and approval. The accepting facility will determine whether they are permitted to receive the waste based on the information on the profile.

### 9.4 WASTE HANDLING, TRANSPORTATION, AND DISPOSAL

Based on the waste classification determination a waste disposal company (accepting facility) and waste management vendor (handler and transporter) are selected. Note that the same company may perform both roles.

The waste management contractor for the City's RCF Facility is responsible for the following:

- collecting samples,
- submitting the samples to the laboratory for analysis,
- preparing waste profiles and submitting them to the City for review,
- submitting waste profiles to disposal vendors for review and selecting a vendor,
- preparing the waste disposal documents and submitting to the City for approval, and
- transporting the waste to the appropriate facility meeting all DOT requirements.

NOTE: Verify that the waste disposal and management companies are approved by the City of Glendale.

The dewatered sludge is transported offsite in liquid waste tanker truck or vac-truck.

A City employ or designee must oversee waste handling on the day it is transported off site and sign the bills of lading or manifests. Only City employees are permitted to sign waste manifests unless specifically authorized. Minimum requirements for signing manifests will include Department of Transportation Basic Hazmat Employee Training, HM-181, per 49 CFR, Part 172.704 (Subpart H).

## 9.5 DOCUMENTATION

Documentation requirements for transportation and disposal by waste type are as follows:

- Non-hazardous: A bill of lading is sufficient for transporting and disposing the waste.
- California-hazardous: A hazardous waste manifest must accompany the waste to the disposal facility and a certificate of disposal or destruction is necessary.
- Federal Hazardous: A waste manifest must accompany the waste to the disposal facility and a certificate of disposal or destruction is necessary.

One signed copy of shipping papers or bill of lading is required per truckload of super sacks.

Upon shipment off-site, a copy of the shipping papers is given to the plant operator. The operator will make additional copies, as needed, to: [a] provide one copy to the Project Manager; and [b] retain one in the facility's files.

A certificate of destruction from the disposal facility will be issued to the City within 30 days of waste destruction.

Waste characterization analytical results, the generator copy of the waste manifest, chain of custody forms, transportation, and destruction records (including certificates of destruction) shall be placed on file within 30 days of record finalization for any wastes transported and disposed. Waste disposal documents must be retained on record for a minimum of ten (10) years.



## 10. REFERENCES

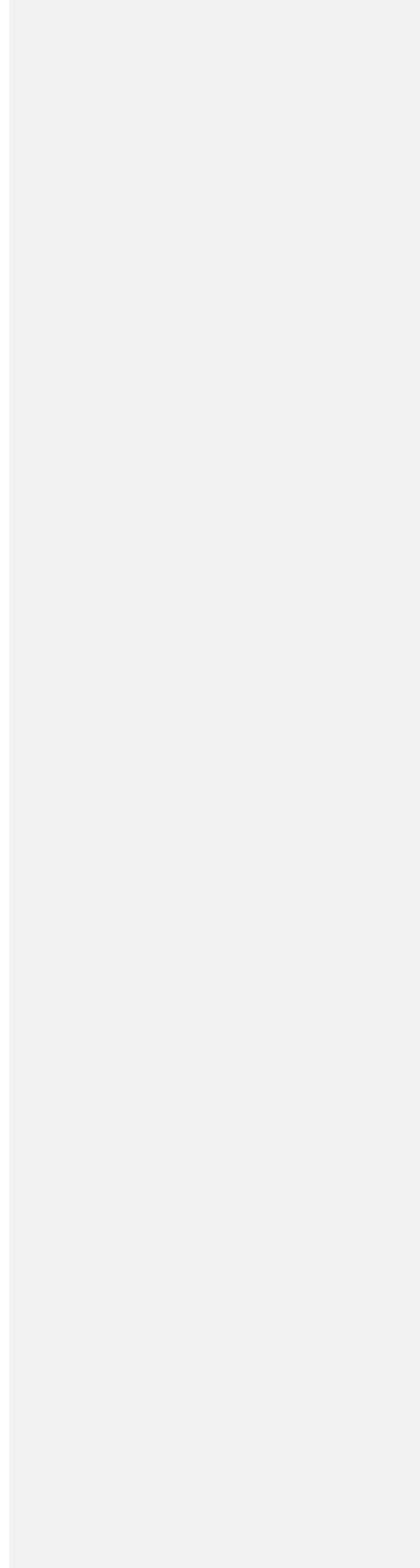
Malcolm Pirnie, Inc. 2008a. Experimental Design for Hexavalent Chromium Removal using Reduction with Ferrous Sulfate, Coagulation, Filtration (RCF): A Demonstration-Scale Study. Santa Monica. June.

Malcolm Pirnie, Inc. 2008b. The Treatment of Hexavalent Chromium in the City of Glendale Ground Water Supply: Phase III Demonstration-Scale Reduction with Ferrous Sulfate, Coagulation, Filtration (RCF) Treatment Technology Evaluation – Quality Assurance Project Plan. Santa Monica. June 16.

City of Glendale, Water and Power. 2009. Supplemental Information on the RCF Chromium Removal Demonstration Facility. July 29.



**Appendix A  
Record Drawings**







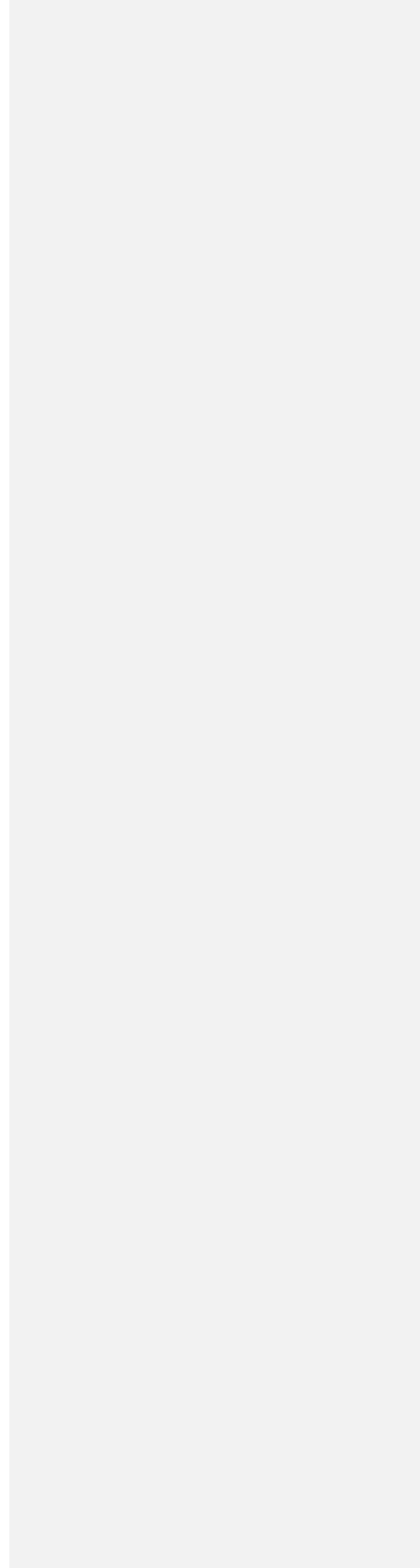
**Appendix B**  
**California Department of Health Services Amendment to the**  
**Domestic Water Supply Permit for System No. 04-15-00PA-000**

**Comment [DLP2]:** Need official title

[To be included when completed.]

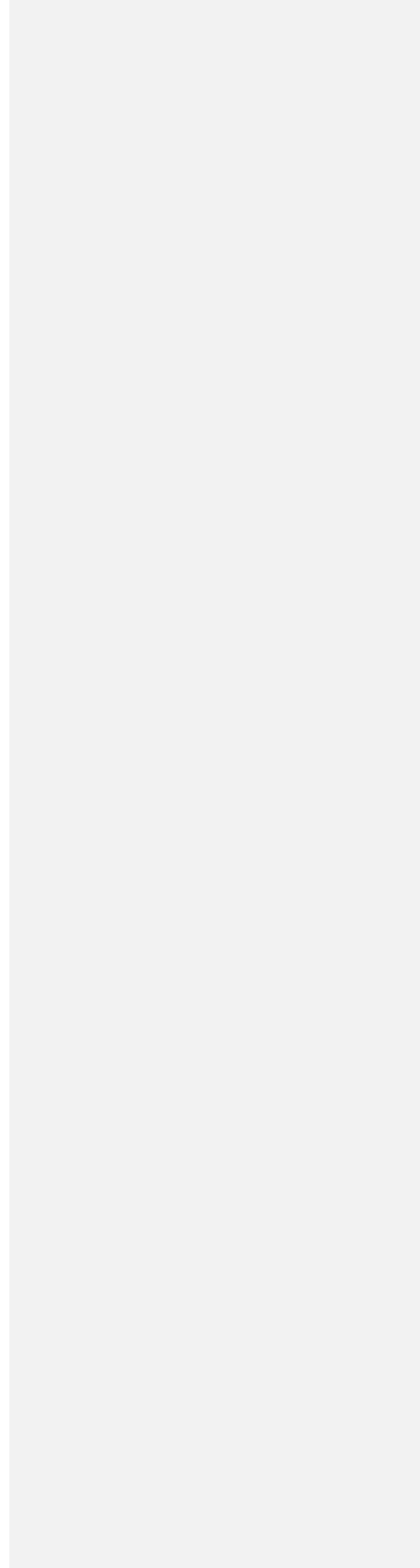


**Appendix C**  
**Control System Description**



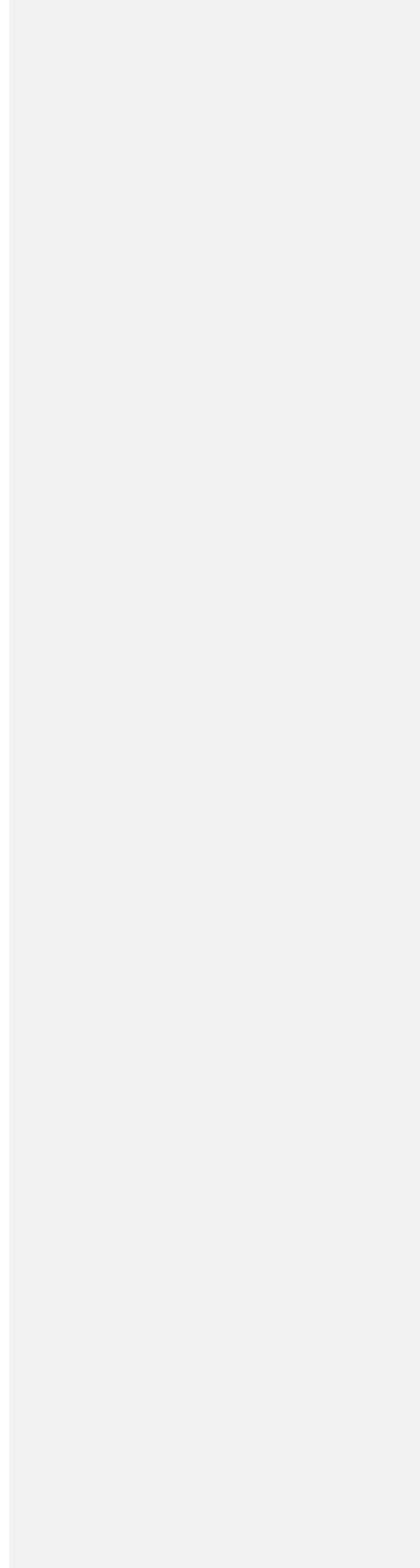


**Appendix D**  
**Initial Start-up Plan**





**Appendix E**  
**Standard Operating Procedures**





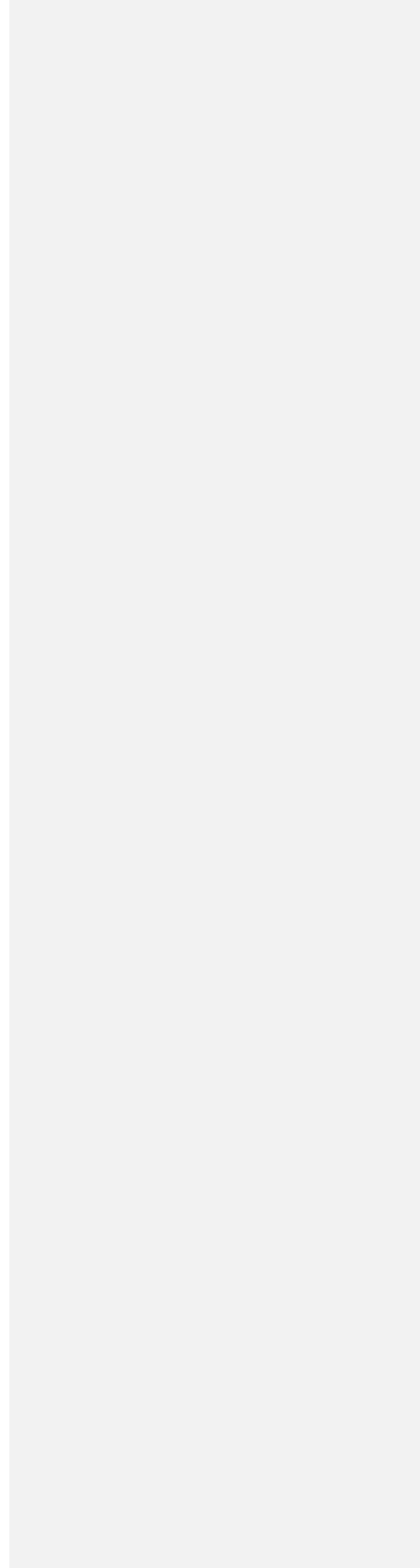


**Standard Operating Procedures**

1. Procedure for Initial Flushing of Anthracite and Sand Media
2. Procedure for Initially Chlorinating Laynox Media

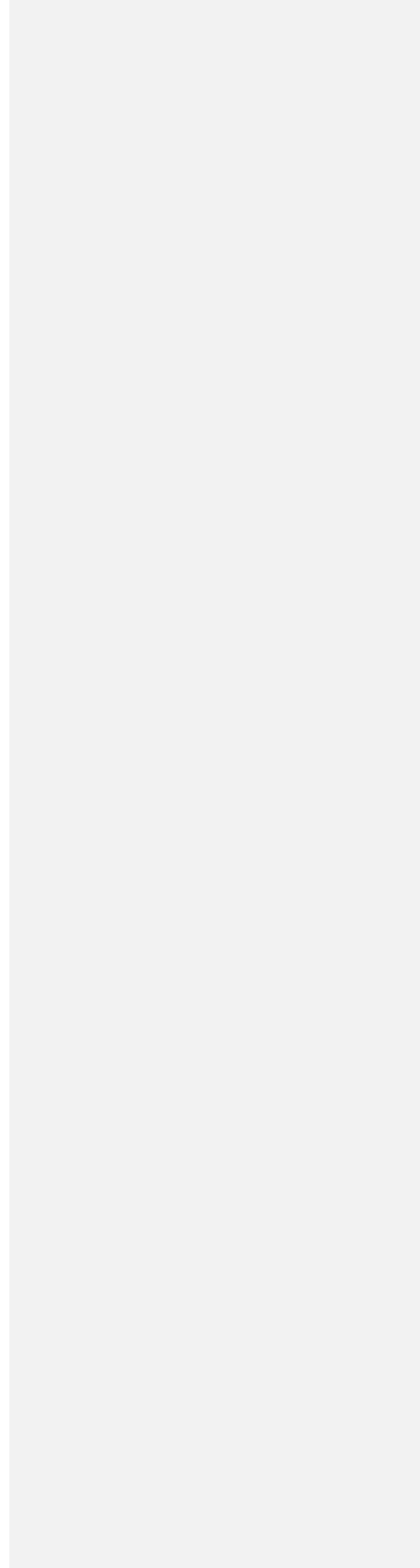


**Appendix F**  
**Quality Assurance and Project Plan**

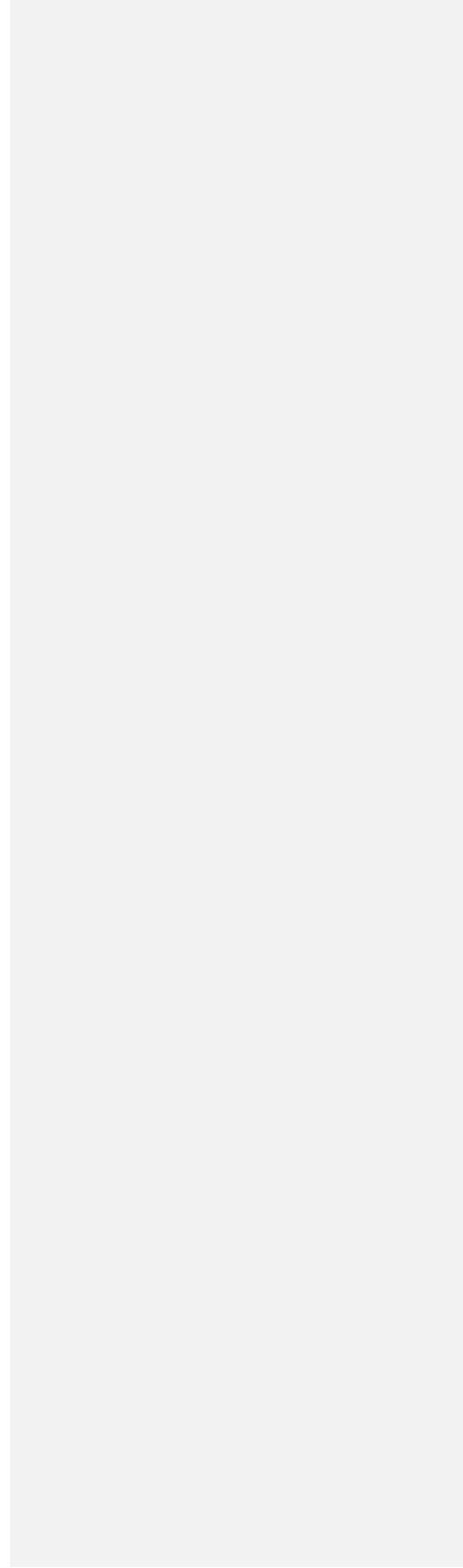




**Appendix G**  
**Daily and Weekly Inspection Checklists**



**Appendix H**  
**Equipment Data Sheets**





# **EQUIPMENT DATA SHEETS**

**RCF Treatment Facility  
City of Glendale Water and Power  
Glendale, CA**



## LIST OF EQUIPMENT

1. Progressive Cavity Pump
2. Aeration Tank Supply Blower
3. Aeration Tank Exhaust Blower
4. Filter Vessel Backwash Blower
5. Blower Air Filter Silencer
6. 7400 Gallon Backwash Settling Tank
7. 1700 Gallon Mix Tank
8. 710 Gallon Aeration Tank
9. 685 Gallon Rapid Mix Tank
10. Carbon Filter Drum
11. Polymer Dosing Pump – Rapid Mix Tank
12. Polymer Dosing Pump – Backwash
13. Polymer Tank
14. Polymer Mixer
15. Polymer Scale
16. Polymer Static Mixer (Backwash)
17. Ferrous Sulfate Dosing Pump
18. Ferrous Sulfate Scale
19. Ferrous Sulfate Static Mixer
20. SludgeMate
21. Sludge Treatment Filtrate Transfer Sump and Analyzer Drain  
Transfer Sump
22. Filter Drawdown Transfer Pump
23. Decant Pump
24. Flow Meters – Water
25. Flow Meter Air
26. Air/Vacuum Relief Valve
27. Pressure Relief Valve – Filter Vessels
28. Pressure Relief Valve – Progressive Cavity Pump
29. Butterfly Valves
30. Actuated Ball Valves
31. Solenoid Valves
32. Air Flow Control Valve
33. Differential Pressure Indicator/Transmitter
34. Level Transmitter – Backwash Tank
35. Level Transmitter – Rapid Mix Tank
36. Level Switch
37. Media Trap - Effluent
38. Cone Strainer – Backwash Line
39. Turbidimeter – Decant and Effluent
40. Turbidimeter – Backwash
41. ORP Meter

## **1. Progressive Cavity Pump**

## Range BN



## Range BN

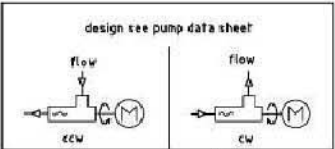
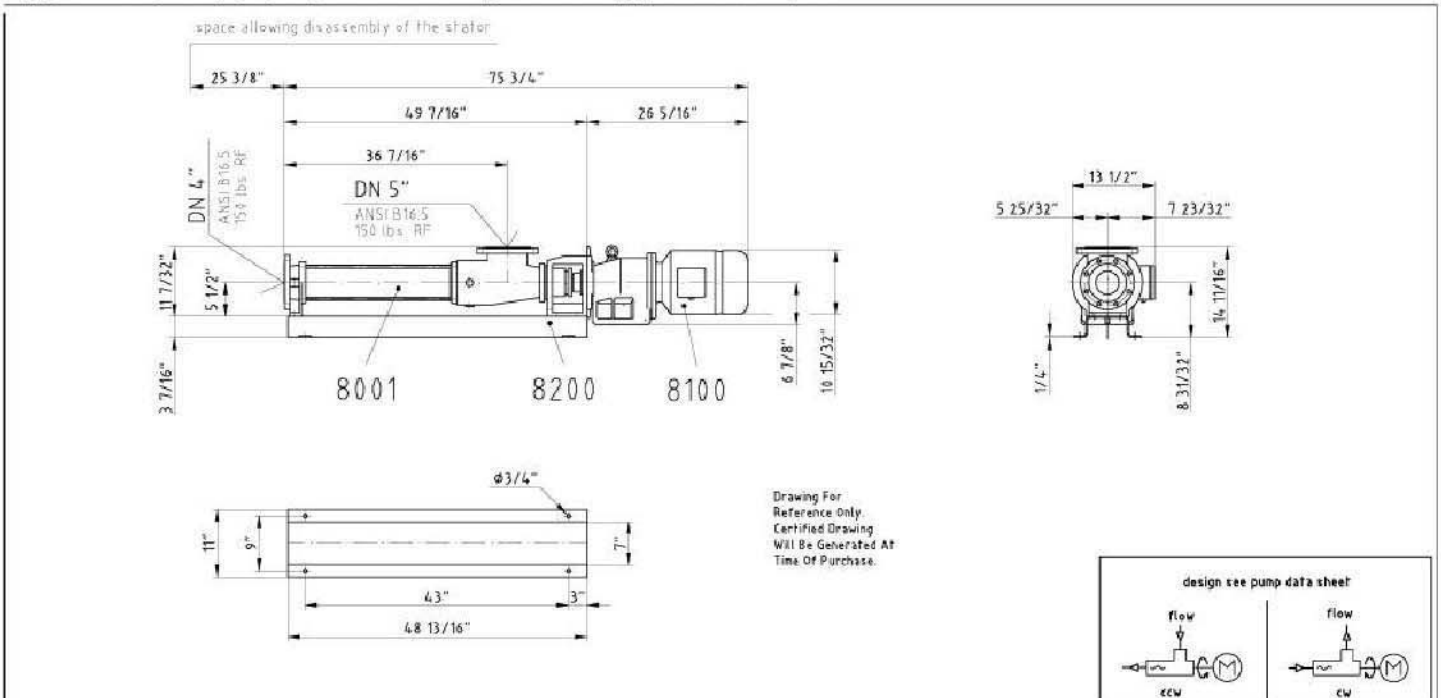
Short, compact design with directly flange-mounted drive (block design)

- Cost-efficient, since drive casing, elastic coupling and common baseplate are omitted
- Service-friendly due to plug-in connections between rotating unit and drive
- Conveying capacities: 30 l/h - 500 m<sup>3</sup>/h | 0.132 USGPM - 2,200 USGPM
- Pressures: up to 48 bar | 720 PSI

With seepex pumps of the **BN** range, the drive is flange-mounted directly on the pump. The combination possibilities were expanded and enhanced in dialog with well-known drive manufacturers. The design was adapted with respect to axial load, shaft dimensions and flange dimensions so that today, seepex pumps are available in block design in all sizes and pressure stages. Thus a separate pump bearing is not necessary. This compact, cost-efficient and service-friendly design is state of the art.



Copyright: This drawing is our property and patented for us according to the law of copyright and associated rights !



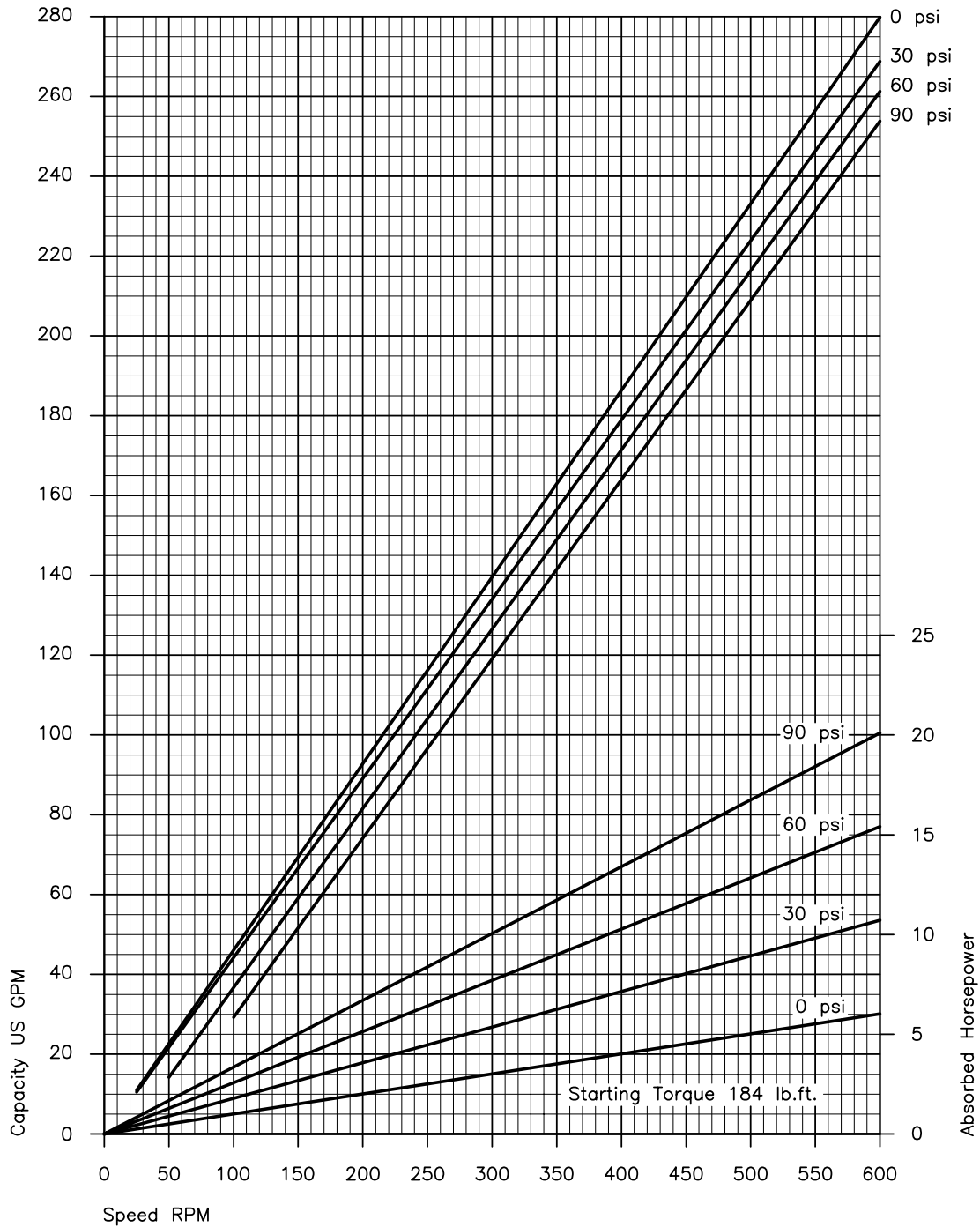
1	baseplate:	8200	St	Var.: 801-200/0170-C-100	28
1	drive: Nord Sk42F-1325	8100			87
1	pump: BN 17-12 / 35-6L / 55-6LT / 30-12T	8001	GG / VA		110
Quant.	Denomination	Item	Material	Note	Weight / kg
		2002	Name	Scale	Denomination
		Drawn	goe	17.05.1	1:20
		Checked		EDP-No.	Weight
				L:\LFDZCHNG.495\49564	225 kg
				Drawing-no.	Denomination
				262-C18/0170-C-135A4	dimensional drawing
					Form
					8/97

seepex. Inc.



changes of dimensions reserved

Characteristic Curves  
Size  
35-6L



Values based upon water 68°F ; For notes on drive selection refer to PER

## **2. Aeration Tank Supply Blower**

# ROTRON® Regenerative Blowers

## DR 513 & CP 513 Regenerative Blower

### FEATURES

- Manufactured in the USA – ISO 9001 compliant
- CE compliant – Declaration of Conformity on file
- Maximum flow: 78 SCFM
- Maximum pressure: 88 IWG
- Maximum vacuum: 5.5" Hg (74.8 IWG)
- Standard motor: 1.5 HP, TEFC
- Cast aluminum blower housing, impeller & cover; cast iron flanges (threaded)
- UL & CSA approved motor with permanently sealed ball bearings
- Inlet & outlet internal muffling
- Quiet operation within OSHA standards

### MOTOR OPTIONS

- International voltage & frequency (Hz)
- Chemical duty, high efficiency, inverter duty or industry-specific designs
- Various horsepower for application-specific needs

### BLOWER OPTIONS

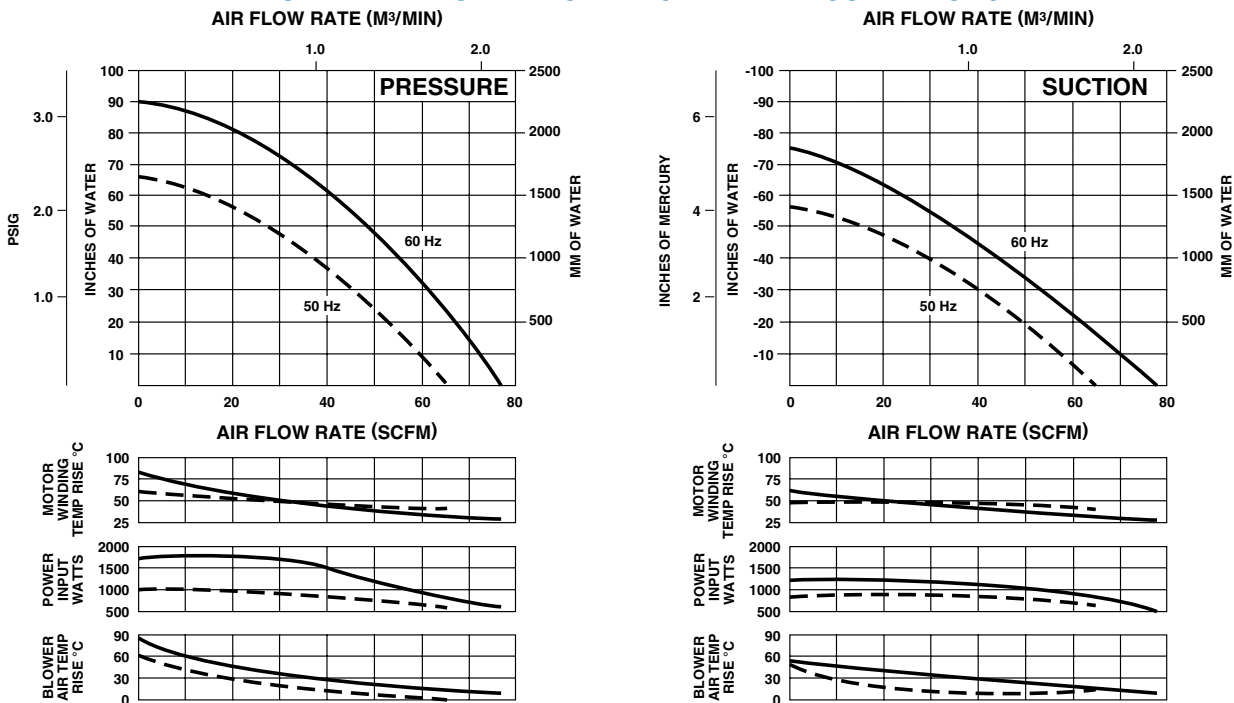
- Corrosion resistant surface treatments & sealing options
- Remote drive (motorless) models
- Slip-on or face flanges for application-specific needs

### ACCESSORIES (See Catalog Accessory Section)

- Flowmeters reading in SCFM
- Filters & moisture separators
- Pressure gauges, vacuum gauges & relief valves
- Switches – air flow, pressure, vacuum or temperature
- External mufflers for additional silencing
- Air knives (used on blow-off applications)
- Variable frequency drive package



### BLOWER PERFORMANCE AT STANDARD CONDITIONS

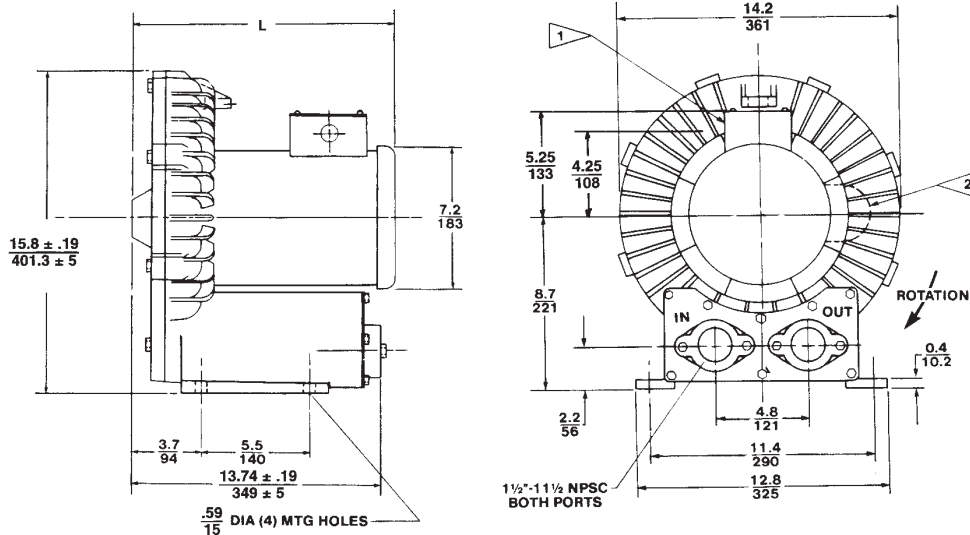


Rev. 2/04

# ROTRON® Regenerative Blowers

## DR 513 & CP 513 Regenerative Blower

Scale CAD drawing available upon request.



MODEL	L (IN)	L (MM)
DR513R58	14.7	373
DR513R72	13.7	348
DR513R86	13.7	348
CP513EZ2LR	13.7	348

DIMENSIONS:  $\frac{\text{IN}}{\text{MM}}$   
 TOLERANCES:  $.XX \pm \frac{.08}{2}$   
 (UNLESS OTHERWISE NOTED)

- 1 TERMINAL BOX CONNECTION .09 INCH DIAMETER ON TEFC MOTORS
- 2 LOCATION OF CAPACITOR ON SINGLE PHASE MOTORS AND TERMINAL BOX ON XP MOTORS

### SPECIFICATIONS

MODEL	DR513R72	DR513R58	DR513R86	CP513EZ2LR
Part No.	037217	037209	037773	038241
Motor Enclosure – Shaft Material	TEFC – CS	TEFC – CS	TEFC – CS	ChemTEFC – SS
Horsepower	1.5	1.5	1.5	Same as DR513R72 – 037217 except add Chemical Processing (CP) features from catalog inside front cover
Voltage <sup>1</sup>	230/460	115/230	575	
Phase – Frequency <sup>1</sup>	Three - 60 Hz	Single - 60 Hz	Three - 60 Hz	
Insulation Class <sup>2</sup>	F	F	F	
NEMA Rated Motor Amps	4.6/2.3	16.8/8.4	1.8	
Service Factor	1.15	1.15	1.5	
Locked Rotor Amps	43/21	120/60	13	
Max. Blower Amps <sup>3</sup>	4.8/2.4	18.2/9.1	1.85	
Recommended NEMA Starter Size	00/00	1/0	00	
Shipping Weight	86 lb (39 kg)	90 lb (41 kg)	86 lb (39 kg)	

<sup>1</sup> Rotron motors are designed to handle a broad range of world voltages and power supply variations. Our dual voltage 3 phase motors are factory tested and certified to operate on both: **208-230/415-460 VAC-3 ph-60 Hz** and **190-208/380-415 VAC-3 ph-50 Hz**. Our dual voltage 1 phase motors are factory tested and certified to operate on both: **104-115/208-230 VAC-1 ph-60 Hz** and **100-110/200-220 VAC-1 ph-50 Hz**. All voltages above can handle a ±10% voltage fluctuation. Special wound motors can be ordered for voltages outside our certified range.

<sup>2</sup> Maximum operating temperature: Motor winding temperature (winding rise plus ambient) should not exceed 140°C for Class F rated motors or 120°C for Class B rated motors. Blower outlet air temperature should not exceed 140°C (air temperature rise plus inlet temperature). Performance curve maximum pressure and suction points are based on a 40°C inlet and ambient temperature. Consult factory for inlet or ambient temperatures above 40°C.

<sup>3</sup> Maximum blower amps corresponds to the performance point at which the motor or blower temperature rise with a 40°C inlet and/or ambient temperature reaches the maximum operating temperature.

Specifications subject to change without notice. Please consult your Local Field Sales Engineer for specification updates.

Rev. 2/04



### **3. Aeration Tank Exhaust Blower**

# ROTRON® Regenerative Blowers

## DR 353M & CP 353M Regenerative Blower

### FEATURES

- Manufactured in the USA – ISO 9001 compliant
- CE compliant – Declaration of Conformity on file
- Maximum flow: 106 SCFM
- Maximum pressure: 46 IWG
- Maximum vacuum: 3.16" Hg (43 IWG)
- Standard motor: 3/4 HP, TEFC
- Cast aluminum blower housing, impeller & cover; cast iron flanges (threaded)
- UL & CSA approved motor with permanently sealed ball bearings
- Inlet & outlet internal muffling
- Quiet operation within OSHA standards

### MOTOR OPTIONS

- International voltage & frequency (Hz)
- Chemical duty, high efficiency, inverter duty or industry-specific designs
- Various horsepower for application-specific needs

### BLOWER OPTIONS

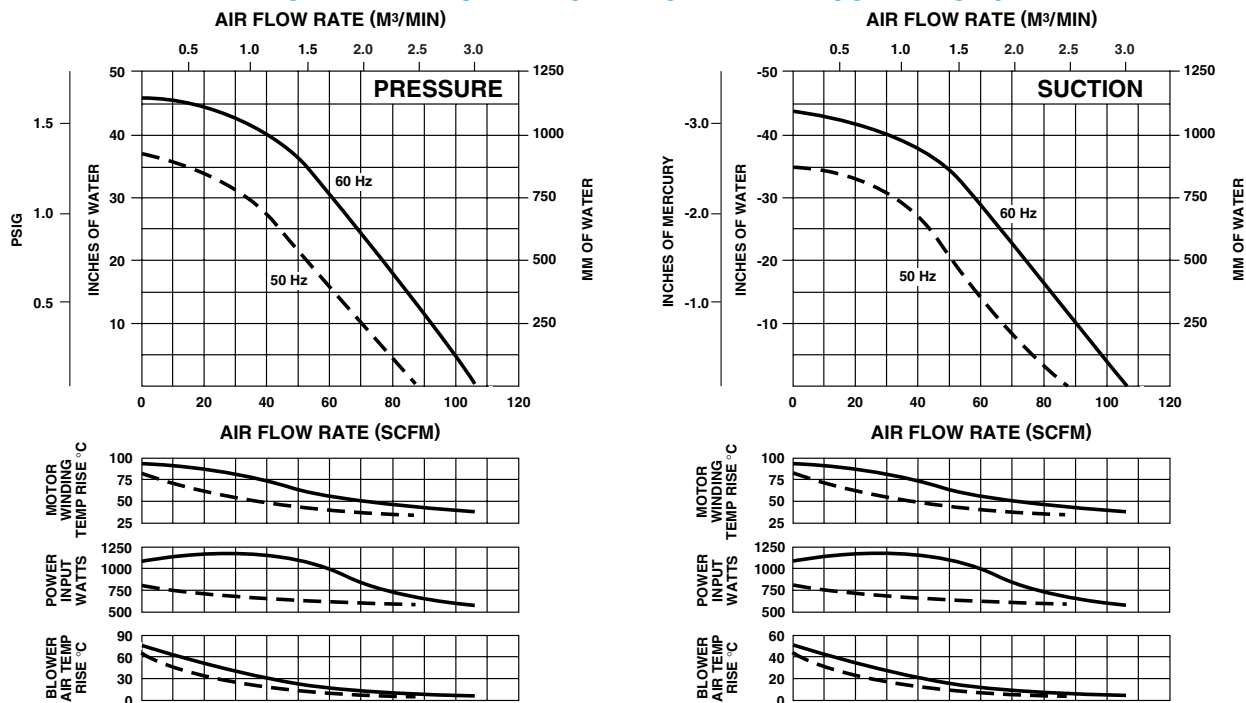
- Corrosion resistant surface treatments & sealing options
- Remote drive (motorless) models
- Slip-on or face flanges for application-specific needs

### ACCESSORIES (See Catalog Accessory Section)

- Flowmeters reading in SCFM
- Filters & moisture separators
- Pressure gauges, vacuum gauges & relief valves
- Switches – air flow, pressure, vacuum or temperature
- External mufflers for additional silencing
- Air knives (used on blow-off applications)
- Variable frequency drive package



### BLOWER PERFORMANCE AT STANDARD CONDITIONS

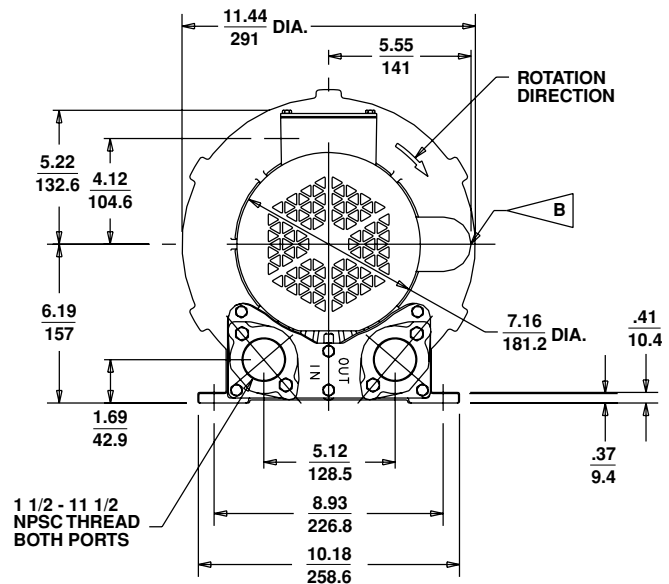
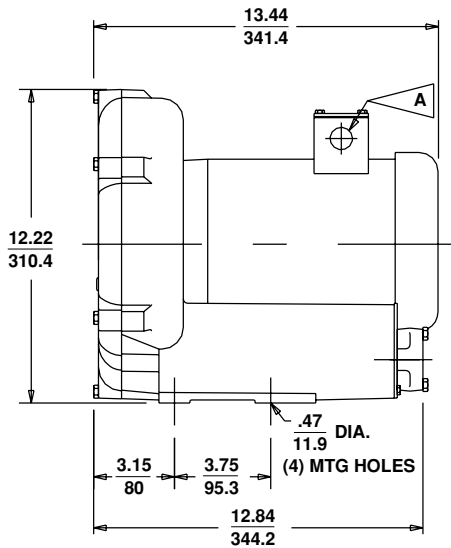


Rev. 2/04

# ROTRON® Regenerative Blowers

## DR 353M & CP 353M Regenerative Blower

Scale CAD drawing available upon request.



DIMENSIONS:  $\frac{IN}{MM}$   
TOLERANCES:  $.X \pm \frac{.08}{2}$   
(UNLESS OTHERWISE NOTED)

A TERMINAL BOX CONNECTOR HOLE .88 (22) DIA.

B LOCATION OF CAPACITOR ON SINGLE PHASE MOTORS

### SPECIFICATIONS

MODEL	DR353BR9M	DR353BR72M	DR353BR86M	CP353BR72MLR	CP353FD72MLR
Part No.	080554	080555	080556	—	—
Motor Enclosure – Shaft Material	TEFC – CS	TEFC – CS	TEFC – CS	ChemTEFC – CS	ChemTEFC – SS
Horsepower	0.75	0.75	0.75	Same as DR353BR72M 037148 except add Chemical Processing (CP) features from catalog inside front cover	Same as DR353BR72M 037148 except add Chemical Processing (CP) features from catalog inside front cover
Voltage <sup>1</sup>	115/230	230/460	575		
Phase – Frequency <sup>1</sup>	Single - 60 Hz	Three - 60 Hz	Three - 60 Hz		
Insulation Class <sup>2</sup>	F	F	F		
NEMA Rated Motor Amps	10.0/5.0	3.0/1.5	0.96		
Service Factor	1.15	1.25	1.25		
Locked Rotor Amps	59.6/29.8	15.2/7.6	6.1		
Max. Blower Amps <sup>3</sup>	7/3.5	3.6/1.8	1.0		
Recommended NEMA Starter Size	0/00	00/00	00		
Shipping Weight	54 lb (24.5 kg)	42 lb (19.1 kg)	42 lb (19.1 kg)		

<sup>1</sup> Rotron motors are designed to handle a broad range of world voltages and power supply variations. Our dual voltage 3 phase motors are factory tested and certified to operate on both: **208-230/415-460 VAC-3 ph-60 Hz** and **190-208/380-415 VAC-3 ph-50 Hz**. Our dual voltage 1 phase motors are factory tested and certified to operate on both: **104-115/208-230 VAC-1 ph-60 Hz** and **100-110/200-220 VAC-1 ph-50 Hz**. All voltages above can handle a ±10% voltage fluctuation. Special wound motors can be ordered for voltages outside our certified range.

<sup>2</sup> Maximum operating temperature: Motor winding temperature (winding rise plus ambient) should not exceed 140°C for Class F rated motors or 120°C for Class B rated motors. Blower outlet air temperature should not exceed 140°C (air temperature rise plus inlet temperature). Performance curve maximum pressure and suction points are based on a 40°C inlet and ambient temperature. Consult factory for inlet or ambient temperatures above 40°C.

<sup>3</sup> Maximum blower amps corresponds to the performance point at which the motor or blower temperature rise with a 40°C inlet and/or ambient temperature reaches the maximum operating temperature.

Specifications subject to change without notice. Please consult your Local Field Sales Engineer for specification updates.

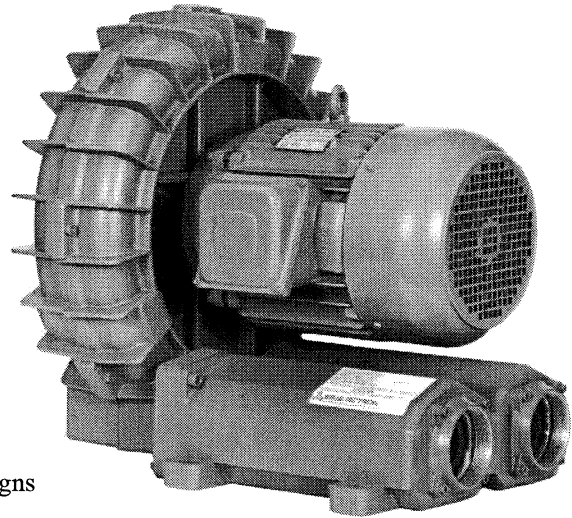
Rev. 2/04

#### **4. Filter Vessel Backwash Blower**

# DR633 & CP633 Regenerative Blower

## FEATURES

- Manufactured in the USA – ISO 9001 compliant
- CE Compliant – Declaration of conformity on file
- Maximum flow:120 SCFM
- Maximum pressure:9.53 PSIG (264 IWG)
- Maximum Vacuum 13.4 IHG (183 IWG)
- Standard Motor: 7.5 HP, TEFC
- Cast Aluminum blower housing, impeller & Cover
- Cast Iron flanges (threaded)
- UL & CSA approved motor with permanently sealed ball bearings
- Inlet & outlet internal muffling
- Quiet operation within OSHA Standards



## MOTOR OPTIONS

- International Voltage and Frequency (HZ)
- Chemical duty, High Efficiency, Inverter duty or industry Specific designs
- Various horsepower for application –specific needs

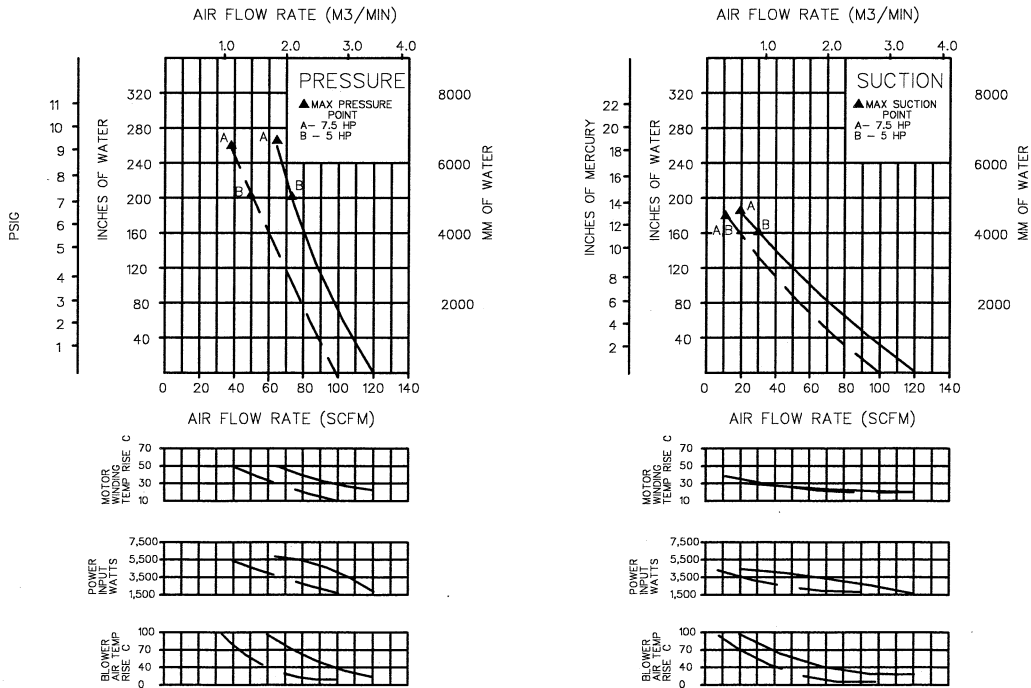
## BLOWER OPTIONS

- Corrosion resistant surface treatments & sealing options
- Remote drive (motorless) models
- Slip-on or face flanges for application-specific needs

## ACCESSORIES (See catalog accessory section)

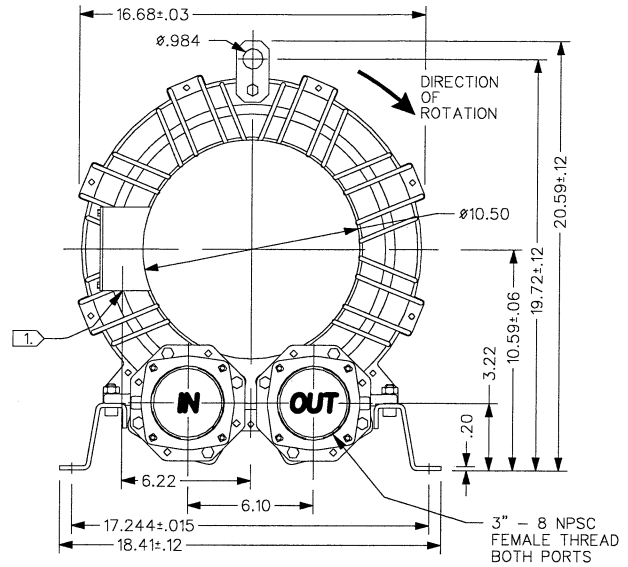
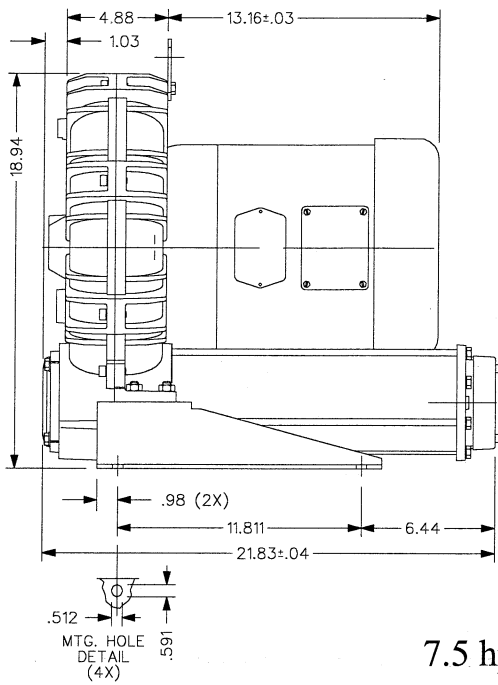
- Flowmeters reading in SCFM
- Filters and moisture separators
- Pressure gages, Vacuum gages and relief valves
- External mufflers for additional silencing
- Air knives (used on blow-off applications)
- Variable frequency drive package

### BLOWER PERFORMANCE AT STANDARD CONDITIONS



# DR633 & CP633 Regenerative Blower

**AMETEK**®  
Rotron® Industrial Products



7.5 hp MODEL SHOWN

Filter 515255 included

Model	DR633AY72	DR633AY86	DR633D89	CP633FG72LR
Part #	081268	081270	081267	081272
Motor Enclosure- Shaft Material	TEFC-CS	TEFC-CS	TEFC-CS	CHEM TEFC-SS
Horsepower	7.5	7.5	5	Same as DR633AY72- 081268 Except add Chemical Processing (CP) Features from catalog inside front cover
Voltage	208-230/ 460	575	208-230/ 460	
Phase-Frequency	Three - 60 Hz	Three - 60 Hz	Three - 60 Hz	
Insulation Class	F	F	F	
NEMA Rated Motor amps	23-21/10.5	8.4	16.9-15.3/7.65	
Service Factor	1.15	1.15	1.15	
Locked Rotor amps	170/85	55	165-155/76	
Max blower amps	19.8-18/9	7.9	15-13.6/6.8	
Recommended NEMA Starter Size	2/1	1	1-1/0	
Shipping Weight	180 lb (82 kg)	180 lb (82 kg)	180 lb (82 kg)	

## **5. Blower Air Filter Silencer**



®

## SMALL COMPACT FILTER SILENCERS WITH STANDARD FILTER DESIGN "FS" Series 1/2" - 3" MPT

### APPLICATIONS

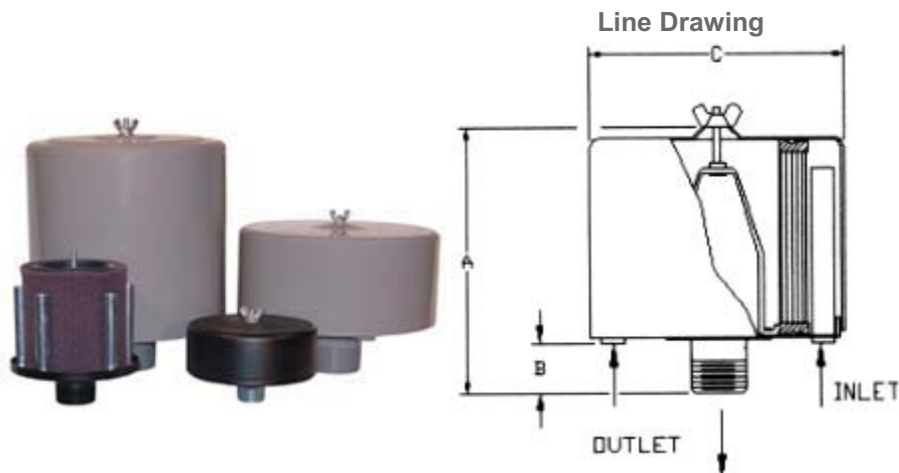
- Blowers-PD Type
- Blowers-Side Channel
- Compressor-Screw
- Construction\Contractor Industry
- Engines
- Hydraulic Breathers - fine filtration
- Medical
- Pneumatic Conveying Systems
- Waste Water Aeration
- Workshop
- Compressor-Piston
- Dental
- Industrial & Severe Duty
- Sparging

### FEATURES & SPECIFICATIONS

- :99%+ removal efficiency std: Paper=2 micron, Polyester=5 micron
- Durable carbon steel construction with powder coated finish or galvanized steel
- Filter change out differential: 10"-15" in. H<sub>2</sub>O above initial delta P
- Fully drawn weatherhood - no welds to rust or vibrate apart
- Interchangeable elements: Polyester, Paper, HEPA
- Low pressure drop center bracket and outlet pipe design
- Pressure drop graphs available upon request
- Temp (continuous): min -15° F ( -26° C) max 220° F (104° C)
- Tubular silencing design - tube is positioned to maximize attenuation and air flow while minimizing pressure drop
- Typical noise attenuation up to 15 dB's (due to the wide range of applications and machines these units are used on, a single graph is insufficient. Please inquire for your specific requirement)

### OPTIONS

- 1/8" tap holes for differential pressure gauges
- Available in *Stainless Steel*
- Epoxy coated housings
- Hot dipped galvanized housings
- Special connections, BSPT/Metric
- Various elements available



\*All measurements are shown in standards.

#### Typical Lead Times:

- 1 - 2 weeks
- 3 - 4 weeks



Normally in stock



5 - 7 weeks



8 + weeks

Add To Order	Model Number	Element Type	Outlet in. NPT or FLG	Connection Style	Dim A in.	Dim B in.	Dim C in.	Rated Flow Piston SCFM	Rated Flow Screw Blower Fan SCFM	Element Parent Flow SCFM	Tube Count	Approx. Weight lbs.	CAD
<span style="color: green;">■</span>	FS-15-050	Polyester	0.5	MPT	4	1.5	6	10	10	35	1	1.8	<span style="background-color: purple; color: white; padding: 2px;">CAD</span>
<span style="color: green;">■</span>	FS-15-075	Polyester	0.75	MPT	4	1.5	6	20	25	35	2	2	<span style="background-color: purple; color: white; padding: 2px;">CAD</span>
<span style="color: green;">■</span>	FS-15-100	Polyester	1	MPT	4	1.5	6	25	35	35	3	2.1	<span style="background-color: purple; color: white; padding: 2px;">CAD</span>
<span style="color: green;">■</span>	FS-19P-100	Polyester	1	MPT	6.63	1.5	6	35	55	100	3	3	<span style="background-color: purple; color: white; padding: 2px;">CAD</span>
<span style="color: green;">■</span>	FS-19P-125	Polyester	1.25	MPT	6.63	1.63	6.1	55	70	100	5	3.3	<span style="background-color: purple; color: white; padding: 2px;">CAD</span>
<span style="color: green;">■</span>	FS-19P-150	Polyester	1.5	MPT	6.63	1.5	6	70	85	100	5	3.5	<span style="background-color: purple; color: white; padding: 2px;">CAD</span>



■	FS-231P-200	Polyester	2	MPT	12.25	2.25	10	135	135	300	5	14	CAD
■	FS-31P-200	Polyester	2	MPT	7.25	2.25	10	85	135	195	5	7.8	CAD
■	FS-231P-250	Polyester	2.5	MPT	12.5	2.5	10	195	195	300	9	14.5	CAD
■	FS-31P-250	Polyester	2.5	MPT	7.5	2.5	10	100	195	195	5	8.2	CAD
■	FS-231P-300	Polyester	3	MPT	13	3	10	200	300	300	9	15	CAD
■	FS-14-050	Paper	0.5	MPT	4	1.5	6	10	10	35	1	1.8	CAD
■	FS-14-075	Paper	0.75	MPT	4	1.5	6	20	25	35	2	2	CAD
■	FS-14-100	Paper	1	MPT	4	1.5	6	25	35	35	3	2.1	CAD
■	FS-18P-100	Paper	1	MPT	6.63	1.5	6	35	55	100	3	3	CAD
■	FS-18P-125	Paper	1.25	MPT	6.63	1.63	6.1	55	70	100	5	3.3	CAD
■	FS-18P-150	Paper	1.5	MPT	6.63	1.5	6	70	85	100	5	3.5	CAD
■	FS-230P-200	Paper	2	MPT	12.25	2.25	10	135	135	300	5	14	CAD
■	FS-30P-200	Paper	2	MPT	7.25	2.25	10	85	135	195	5	8.2	CAD
■	FS-230P-250	Paper	2.5	MPT	12.5	2.5	10	195	195	300	9	14.5	CAD
■	FS-30P-250	Paper	2.5	MPT	7.5	2.5	10	100	195	195	5	8.2	CAD
■	FS-230P-300	Paper	3	MPT	13	3	10	200	300	300	9	15	CAD

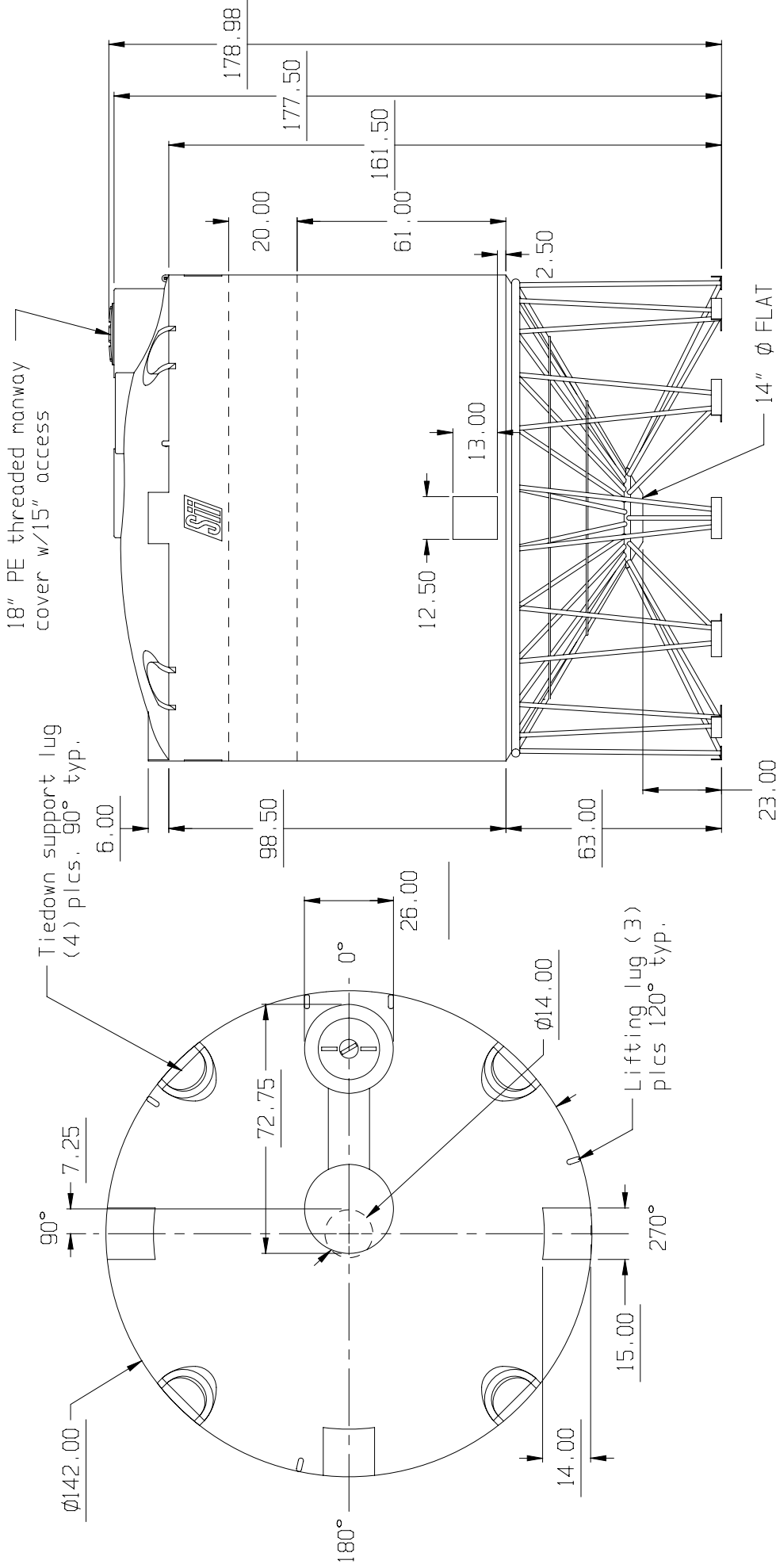
**Solberg Mfg.**

1151 W. Ardmore Ave. Itasca, IL 60143 (630)773-1363 Fax: (630)773-0727

SFS\_2-2

## **6. 7400 Gallon Backwash Settling Tank**

# 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](http://www.snydernet.com)

(all dimensions in inches)

PART #S TANK: 5320000N--L

7,400 GALLON 30° CONE BOTTOM TANK W/STAND

REF#: 00000 STAND: 79500000L

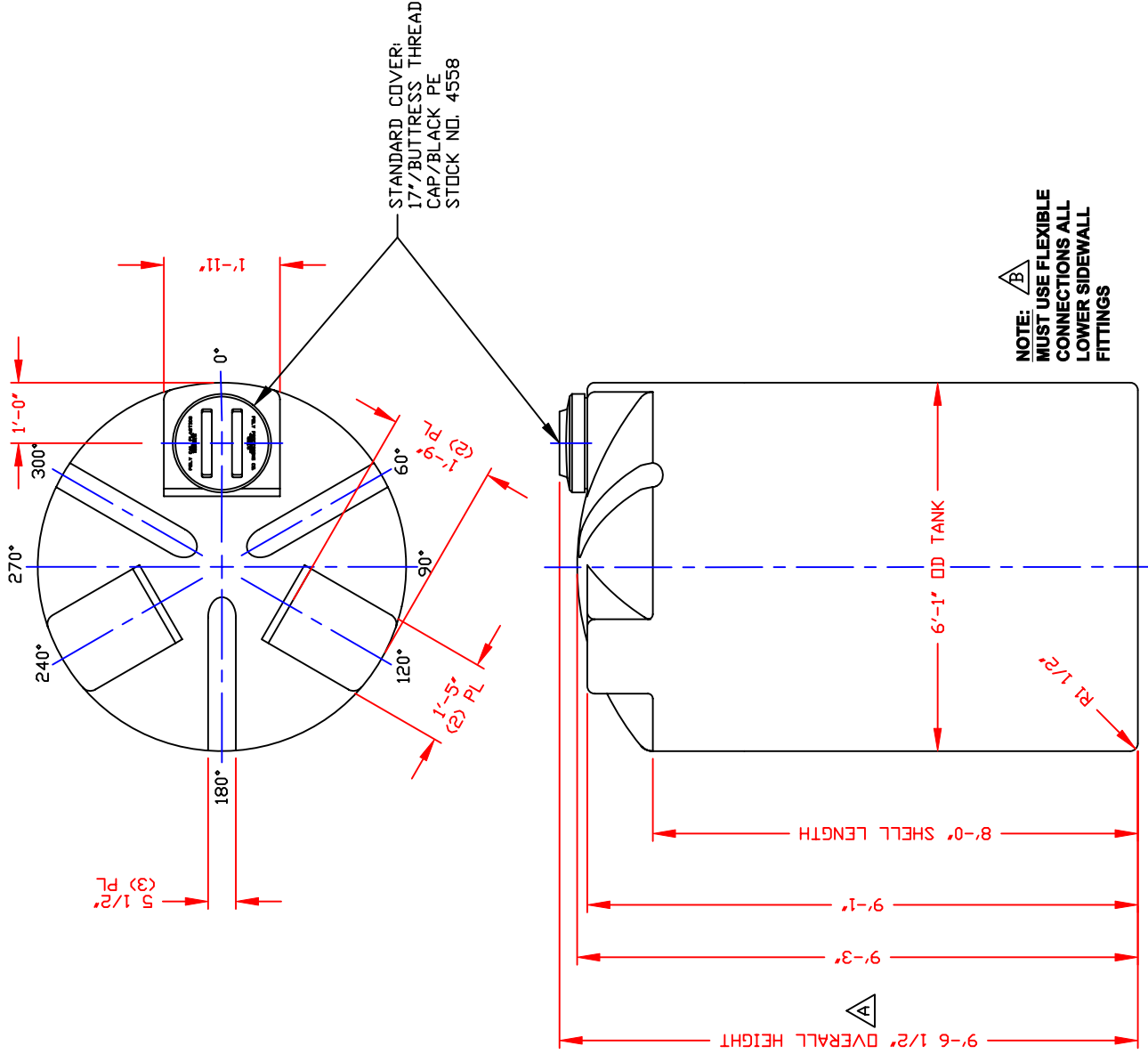
09/15/04

## **7. 1700 Gallon Mix Tank**

NON-CONTROLLED COPY  
 INFORMATION SUBJECT TO CHANGE WITHOUT NOTICE  
 COPY WILL NOT BE UPDATED

COPY ISSUED BY \_\_\_\_\_  
 COPY ISSUED ON \_\_\_\_\_

NOZZLE SCHEDULE & ACCESSORIES		FITTING		DEG ELEV	
SERVICE	MK	STOCK NO	SIZE	FITTING	DEG ELEV



**NOTES:**  
 1. THIS IS A COMPUTER GENERATED DWG. DO NOT REVISE BY HAND.  
 2. DIMENSIONS WILL VARY ±3% DUE TO VARIATIONS IN MULTIPLE MOLDS & CONDITIONS PREVALENT DURING MANUFACTURE & USAGE.  
 3. NO MOLDED IN GALLONAGE MARKERS THIS TANK

CALCULATED CAPACITIES/VOLUME IN U.S. GALLONS	
DESIGN CAP	DOME VOL/TOTAL VOL
1714	157 1871

CONFIDENTIAL PROPERTY OF  
 POLY PROCESSING COMPANY  
 NOT FOR REPRINT OR USE  
 WITHOUT PERMISSION

DWG TITLE  
 1700 GALLON UPRIGHT TANK

SCALE: 1/2"=1'-0"	Western Region		DPI:	MB WILKERSON
DATE: 2/29/00	PA: Box 88 1848 State St French Camp, CA 95821 FAX: (916) 368-4618		CK:	D. RECTOR
COMPANY		SHEET		COMPUTER FILE
POLY PROCESSING		1	DF 1	11001700
				REV
				B

REV 'B' ADDED FITTING NOTE BY:JB 3/19/03 CKIMBV  
 REV 'A' ADDED DIMENSION BY:JB 10/18/02 CKIMBV

## **8. 710 Gallon Aeration Tank**

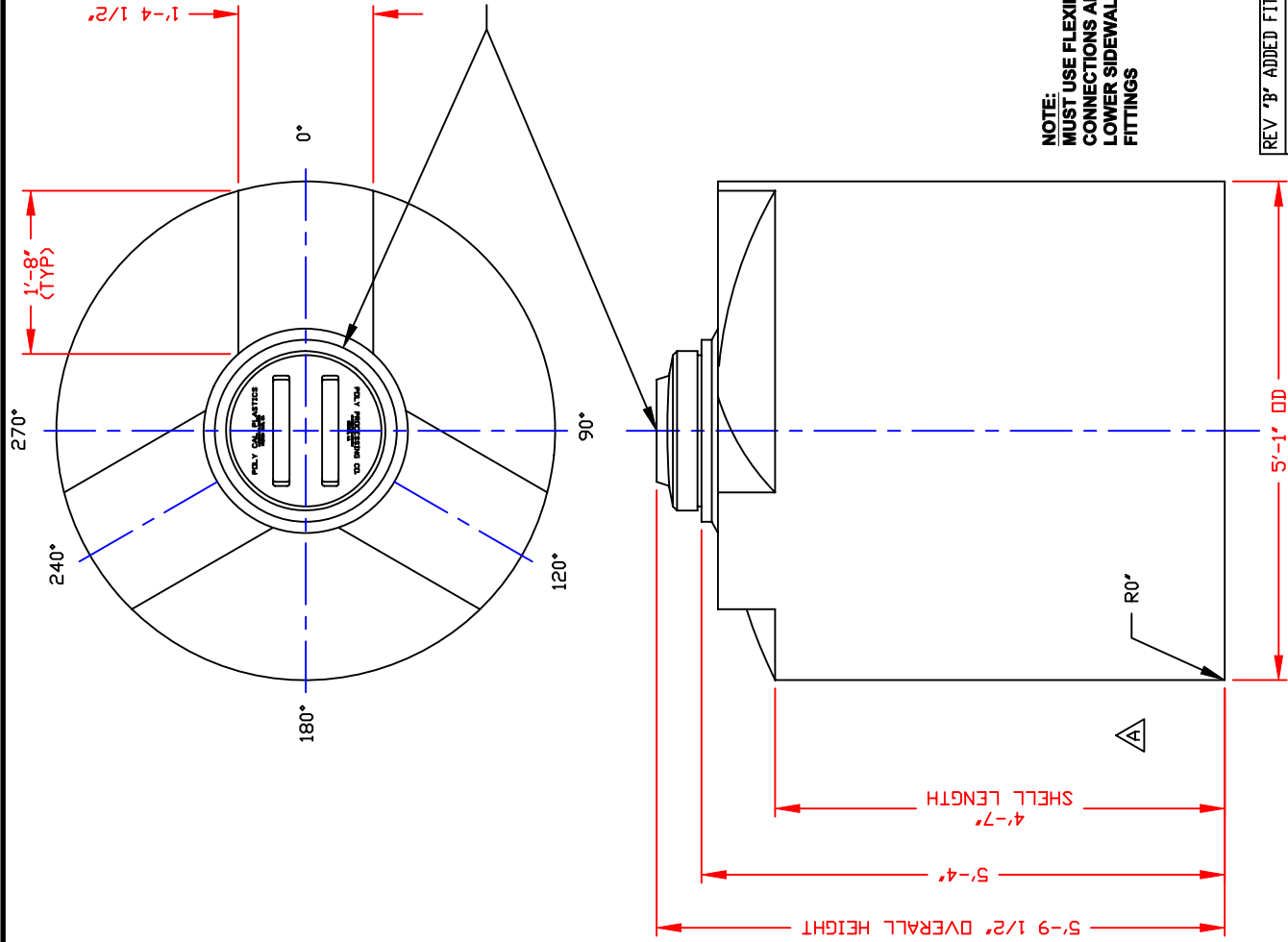


## **9. 685 Gallon Rapid Mix Tank**



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 INFORMATION SUBJECT TO CHANGE WITHOUT NOTICE  
 COPY WILL NOT BE UPDATED

COPY ISSUED BY \_\_\_\_\_  
 COPY ISSUED ON \_\_\_\_\_



NOZZLE SCHEDULE & ACCESSORIES			
SERVICE	MK	STOCK NO./SIZE	FITTING

STANDARD COVER:  
 17"/BUTTRESS THREAD CAP/  
 BLK PE  
 PPC STOCK NO. 4558

NOTES:  
 1. THIS IS A COMPUTER GENERATED DWG. DO NOT REVISE BY HAND.  
 2. DIMENSIONS WILL VARY ±3% DUE TO VARIATIONS IN MULTIPLE MOLDS & CONDITIONS PREVALENT DURING MANUFACTURE & USAGE.  
 3. MOLDED IN GALLONAGE MARKERS AT 0° IN 100 GAL INCREMENTS FROM 100 GAL TO 500 GAL.

CALCULATED CAPACITIES/ VOLUME IN U.S. GALLONS			
DESIGN CAP	DOME VOL	TOTAL VOL	REV
687	52	739	B

CONFIDENTIAL PROPERTY OF  
 POLY PROCESSING COMPANY  
 NOT FOR REPRINT OR USE  
 WITHOUT PERMISSION

DWG TITLE			
685 GALLON UPRIGHT TANK			
SCALE: 3/4"=1'-0"	DATE: 9/20/99	JR: MB WILKERSON	REV
POLY PROCESSING Company		CK: D. RECTOR	SHEET
Central Region		P.O. Box 4524 Cranston, RI 02909, U.S.A. Tel: (401) 944-2200 FAX: (401) 944-2208	COMPUTER FILE
1	DF 1	1000685	B

NOTE:  
 MUST USE FLEXIBLE CONNECTIONS ALL LOWER SIDEWALL FITTINGS

REV 'B' ADDED FITTING NOTE BYMBW 2/11/03 CK:JB  
 REV 'A' ADDED RADIUS BYMBW 2/22/00 CK:DR

## **10. Carbon Filter Drum**

# Westates™ brand Vent-Scrub™ Vapor Phase Adsorbers

# SIEMENS

## APPLICATIONS

The Westates™ brand Vent-Scrub™ adsorbers have been proven to be the simplest and most cost effective way to treat malodorous and VOC emission problems. Sturdy steel construction and specially formulated corrosion resistant internal coating ensures long service life and low maintenance. Applications for Vent-Scrub™ adsorbers include:

- API separator vents
- VOC control from soil vapor extraction (SVE) systems and airstrippers
- Wastewater and product storage tank vents
- Process vents
- Refinery and chemical plant wastewater sewer vents
- Laboratory hood exhausts

## INSTALLATION, STARTUP AND OPERATION

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 reactivation facilities, where the contaminants are thermally destroyed.

We 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

- Durable, carbon steel construction.
- Abrasion and corrosion resistant baked epoxy lining; urethane exterior finish (Vent-Scrub™ 1000, 2000, 3000, 8000 adsorbers).
- Ready-to-use systems: simple installation and operation.
- Applications to 3000 SCFM.
- The Vent-Scrub™ 1000, 2000, 3000 and 8000 adsorbers have forklift channels for easy handling.
- The Vent-Scrub™ 200, 400, 1000 and 2000 adsorbers are UN/DOT approved transportation containers for RCRA hazardous spent carbon.
- Hose kit and pipe manifold options are available to simplify installation and operation.

## PIPING MANIFOLD (OPTIONAL)

- 2"/13" sch 80 PVC piping and valves (optional carbon steel and stainless steel piping).
- Series or parallel operation.
- Sampling ports and pressure gauges.
- Flexible hoses with Kamlock fittings allow easy installation and removal during service exchange operations (Vent-Scrub™ 200, 400, 1000 and 2000 adsorbers).

## SPECIFICATIONS

Vent-Scrub™ Model No.	200	400	1000/2000	3000	8000
Dimensions, diameter x overall height	22" x 34"	30" x 43"	48" x 56"/48" x 8' 0"	60" x 9' 3"	96" x 11' 0"
Inlet Connection	2" FNPT	4" FNPT	4" FNPT	10" Flange	12" Flange
Outlet Connection	2" MPT	4" FNPT	4" FNPT	10" Flange	12" Flange
Manway	Top	Top	18" Top	16" Top	20" Top/Side
Internal Distribution <sup>(1)</sup>	PVC	PVC	PVC	FRP/PPL	FRP/PPL
Interior Coating	Epoxy	Epoxy	Epoxy	Epoxy	Epoxy
Exterior Coating	Enamel	Enamel	Epoxy/Urethane	Epoxy/Urethane	Epoxy/Urethane
Carbon Fill Volume (Cu.ft.)	6.8	14	34/68	107	273
Cross Sectional Area (sq.ft.)	2.8	4.9	12.3	19.6	50.2
Approx. Carbon Weight (lbs)	200	400	1000/2000	3000	8000
Empty Vessel Weight (lbs)	250	480	890/1190	2500	4500
Flow, CFM (max.)	100	300	500	1500	3750
Pressure, psig (max.)	3	3	14.9	5	5
Temperature, deg. F (max) <sup>(4)</sup>	140	140	140	140	140
Vacuum, in. Hg (max.)	N/A	N/A	12/12 <sup>(2)</sup>	6 <sup>(3)</sup>	12 <sup>(3)</sup>

<sup>1</sup>Carbon steel and stainless steel internals are also available.

<sup>2</sup>For vacuum greater than 12 in. Hg on Vent-Scrub™ 2000, contact your Siemens representative.

<sup>3</sup>For vacuum service on Vent-Scrub™ 3000 and Vent-Scrub™ 8000, contact your Siemens representative.

<sup>4</sup>For higher temperatures, stainless and carbon steel internals are available.

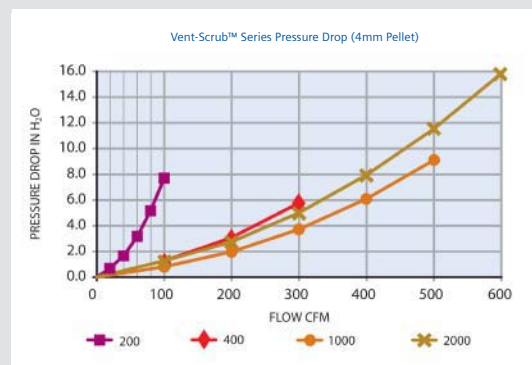
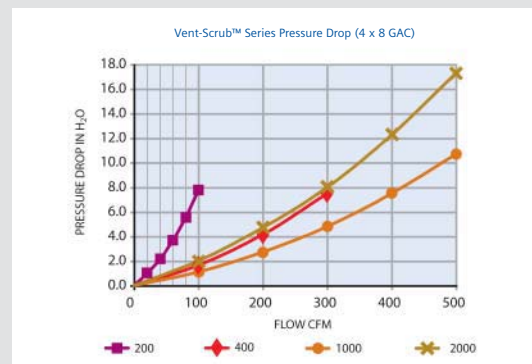
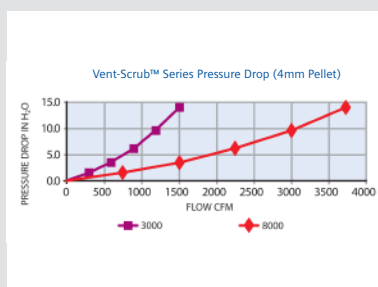
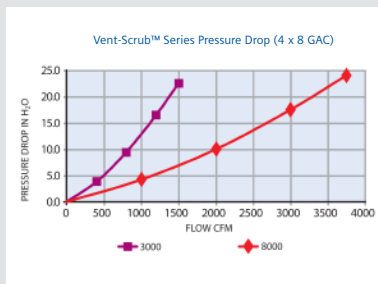
For detailed dimensional information or drawings, contact your local Siemens sales representative.

### VENT-SCRUB™ ADSORBERS SAFETY CONSIDERATIONS

The adsorption of organic contaminants on activated carbon is an exothermic process, i.e. involves the release of heat.

Certain chemical compounds such as ketones, aldehydes, organic acids and organic sulfur compounds may form reactive species on the carbon surface and under certain conditions may lead to a high temperature rise. If you are unaware or unsure of reactions that may occur, appropriate tests should be performed before installing the Vent-Scrub adsorbers.

At high VOC concentrations of organic compounds the heat of adsorption can lead to an increase in carbon bed temperature. The heat can be controlled by a number of techniques such as a dilution of the inlet flow, nitrogen blanketing of the carbon system or prewetting of the carbon bed.



The information provided in this literature contains merely general descriptions or characteristics of performance which in actual case of use do not always apply as described or which may change as a result of further development of the products. An obligation to provide the respective characteristics shall only exist if expressly agreed in the terms of the contract.

Wastates and Vent-Scrub are trademarks of Siemens, its subsidiaries or affiliates

**Siemens  
Water Technologies**

Environmental Services  
2430 Rose Place  
Roseville, MN 55113  
800.525.0658 phone

information.water@siemens.com  
WS-VSC-DS-0207  
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Subject to change without prior notice.

## **11. Polymer Dosing Pump – Rapid Mix Tank**

#### Configuration Data

Model AA **9** **4** **1** - 358HI

##### Control Code

- 1 --- **Manual Control:** Speed (stroking frequency) and stroke length manually adjustable.
- 7 --- **Instrument Responsive/Manual Control:** Manual adjustment features of Control Code 1 plus switch conversion to external control for automatic systems.
- 9 --- **Microprocessor/Instrument Responsive:** External 4-20mA or pulse or x direct; manual stroke length control.

##### Output/Size Code

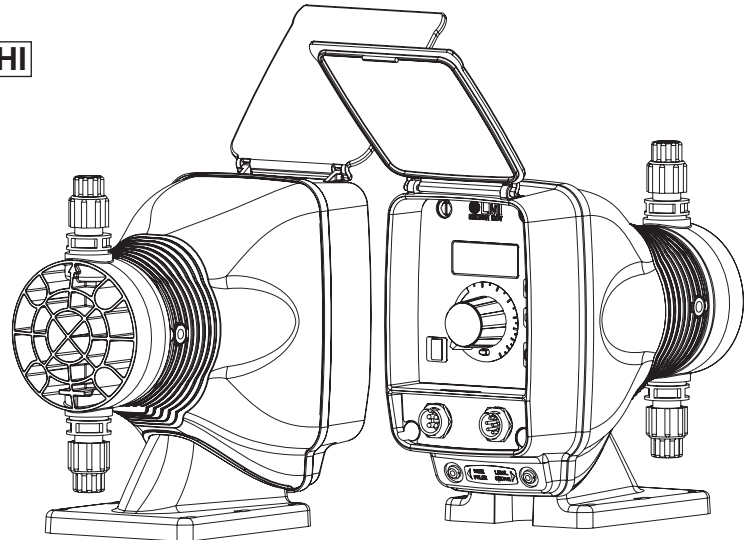
- 4 --- 0.58 GPH (2.2 l/h) --- 250 psi (17.3 Bar)
- 5 --- 1.00 GPH (3.8 l/h) --- 110 psi (7.6 Bar)
- 6 --- 2.00 GPH (7.6 l/h) --- 50 psi (3.5 Bar)
- 7 --- 0.42 GPH (1.6 l/h) --- 140 psi (9.7 Bar)
- 8 --- 0.75 GPH (2.8 l/h) --- 80 psi (5.5 Bar)

##### Voltage Code

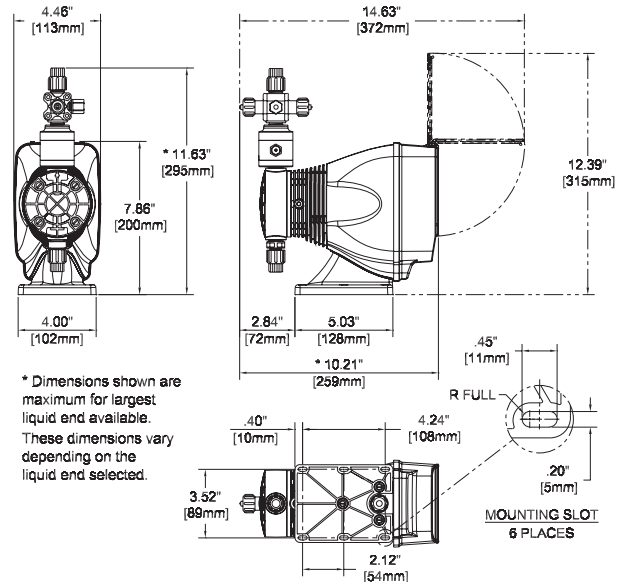
- 1 --- 120 VAC, US Plug
- 2 --- 240 VAC, US Plug
- 3 --- 220-240 VAC, DIN Plug
- 5 --- 240-250 VAC, UK Plug
- 6 --- 240-250 VAC, Aust./NZ Plug
- 7 --- 220-240 VAC, Swiss Plug

##### Liquid End

See next page for complete liquid end specifications and selection.



#### Dimensions



#### Specifications

Series	Strokes Per Minute (Adjustable)		Stroke Length (Adjustable) Recommended Minimum	Average Input Power @ Max Speed	Shipping Weight
	Min	Max			
AA14, AA74, AA94* AA15, AA75, AA95* AA16, AA76, AA96*	1	100	20%	22 watts	10 lbs (4.55 kg)
AA17, AA77, AA97* AA18, AA78	1	100	30%		

\*Series 9 pumps may be programmed for strokes per hour for lower outputs.



201 Ivyland Road  
Ivyland, PA 18974 USA  
TEL: (215) 293-0401  
FAX: (800) 327-7563  
<http://www.lmipumps.com>

## Configuration Data & Materials of Construction

Drive Assembly	Liquid End No.	Size Code	Materials of Construction				Accessory	Tubing & Connections	
			Head & Fittings	Balls	Liquifram™	Check Valve		Discharge	Suction
AA97	458HI	0.5	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .250" O.D.	
	450FI	0.5	Acrylic / PVC	PTFE	Fluorofilm™	PVDF / Polyprel™	4FV	PE .250" O.D.	
AA94	450HI	0.5	Acrylic / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .250" O.D.	
AA77	358HI	0.5	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .250" O.D.	
AA74	353HI	0.5	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / PTFE	4FV + AV	PE .250" O.D.	
AA17	352HI	0.5	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .250" O.D.	
AA14	155HV	0.5	Polypropylene	316 S.S.	Fluorofilm™	PTFE		PE .5" O.D. Vinyl .938" O.D.	
	155S**	0.5	Polypropylene	Ceramic	Fluorofilm™	PTFE	4FV	PE .250" O.D.	
	156HV	0.5	Acrylic/PP	316 S.S.	Fluorofilm™	Hypalon™		PE .5" O.D. Vinyl .938" O.D.	
	257	0.5	316 S.S.	316 S.S.	Fluorofilm™	316 S.S.		Pipe 1/4" NPT M	

AA95	498HI	0.9	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .375" O.D.	
	490HI	0.9	Acrylic / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .375" O.D.	
AA78	490FI	0.9	Acrylic / PVC	PTFE	Fluorofilm™	PVDF / Polyprel™	4FV	PE .375" O.D.	
AA75	398HI	0.9	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .375" O.D.	
AA18	392HI	0.9	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .375" O.D.	
AA15	393HI	0.9	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / PTFE	4FV + AV	PE .375" O.D.	
	85HV	0.9	Polypropylene	316 S.S.	Fluorofilm™	PTFE		PE .5" O.D. Vinyl .938" O.D.	
	86HV	0.9	Acrylic / PP	316 S.S.	Fluorofilm™	Hypalon™		PE .5" O.D. Vinyl .938" O.D.	
	89	0.9	UHMW PE	Ceramic	Hypalon™	Hypalon™		PE .5" O.D. Vinyl .5" O.D.	
	95S**	0.9	Polypropylene	Ceramic	Fluorofilm™	PTFE	4FV	PE .375" O.D.	
	297	0.9	316 S.S.	316 S.S.	Fluorofilm™	316 S.S.		Pipe 1/4" NPT M	

AA96	468HI	1.8	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .375" O.D.	
	460HI	1.8	Acrylic / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .375" O.D.	
AA76	460FI	1.8	Acrylic / PVC	PTFE	Fluorofilm™	PVDF / Polyprel™	4FV	PE .375" O.D.	
	368HI	1.8	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .375" O.D.	
AA16	362HI	1.8	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .375" O.D.	
	363HI	1.8	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / PTFE	4FV + AV	PE .375" O.D.	
	65S**	1.8	Polypropylene	Ceramic	Fluorofilm™	PTFE	4FV	PE .375" O.D.	
	75HV	1.8	Polypropylene	316 S.S.	Fluorofilm™	PTFE		PE .5" O.D. Vinyl .938" O.D.	
	76HV	1.8	Acrylic / PP	316 S.S.	Fluorofilm™	Hypalon™		PE .5" O.D. Vinyl .938" O.D.	
	79	1.8	UHMW PE	Ceramic	Hypalon™	Hypalon™		PE .5" O.D. Vinyl .5" O.D.	
	277	1.8	316 S.S.	316 S.S.	Fluorofilm™	316 S.S.		Pipe 1/4" NPT M	

■ See front page for voltage code specifications.

\*\* These Liquid Ends are available without a 4FV, by removing the S from the liquid end code.

To specify 1/4 NPT male, change 'I' to 'P'.  
 To specify black, UV resistant tubing, change 'I' to 'U'.  
 To specify Bleed 4FV, change 'H' to 'B'.  
 To specify 3FV, change 'H' to 'T'.  
 To specify 4FV only, change 'H' to 'S'.  
 To specify Auto Prime Valve only, change 'H' to 'A'.

**3FV** indicates that the pump is equipped with an LMI Three Function Valve (pressure relief, priming aid, line drain).

**4FV** indicates that the pump is equipped with an LMI Four Function Valve. This diaphragm type, anti-syphon/pressure relief valve is installed on the pump head. It provides anti-syphon protection and aids priming, even under pressure.

**AV** indicates that the pump is equipped with an LMI Auto Prime Valve. This valve allows for the constant removal of vapors and gases present in applications such as sodium hypochlorite and hydrogen peroxide.

Fluorofilm™ is a copolymer of PTFE and PFA. Polyprel™ is an elastomeric PTFE copolymer.

Polyprel is a registered trademark of Liquid Metronics Incorporated. Fluorofilm and Liquifram are trademarks of Liquid Metronics Incorporated. Hypalon is a registered trademark of E. I. du Pont de Nemours & Co., Inc.

## Output Information

Series	Gallons per Hour		Liters per Hour		mL/cc per Minute		mL/cc per Stroke		Maximum Injection Pressure
	Min	Max	Min	Max	Min	Max	Min	Max	
AA94*, AA74*, AA14	0.001	0.58	0.004	2.2	0.07	37	0.07	0.37	250 psi (17.3 Bar)
AA95*, AA75*, AA15	0.002	1.00	0.008	3.8	0.13	63	0.13	0.63	110 psi (7.6 Bar)
AA96*, AA76*, AA16	0.004	2.00	0.015	7.6	0.25	126	0.25	1.26	50 psi (3.5 Bar)
AA97*, AA77*, AA17	0.001	0.42	0.005	1.6	0.08	26	0.08	0.26	140 psi (9.7 Bar)
AA78*, AA18	0.002	0.75	0.009	2.8	0.14	47	0.14	0.47	80 psi (5.5 Bar)

\* Minimum output is based on one stroke per minute. Minimum output can be reduced further in external mode. Series AA9 pumps may be programmed for strokes per hour for lower outputs.

## **12. Polymer Dosing Pump – Backwash**



#### Configuration Data

Model AA **9** **4** **1** - 358HI

##### Control Code

- 1 --- **Manual Control:** Speed (stroking frequency) and stroke length manually adjustable.
- 7 --- **Instrument Responsive/Manual Control:** Manual adjustment features of Control Code 1 plus switch conversion to external control for automatic systems.
- 9 --- **Microprocessor/Instrument Responsive:** External 4-20mA or pulse or x direct; manual stroke length control.

##### Output/Size Code

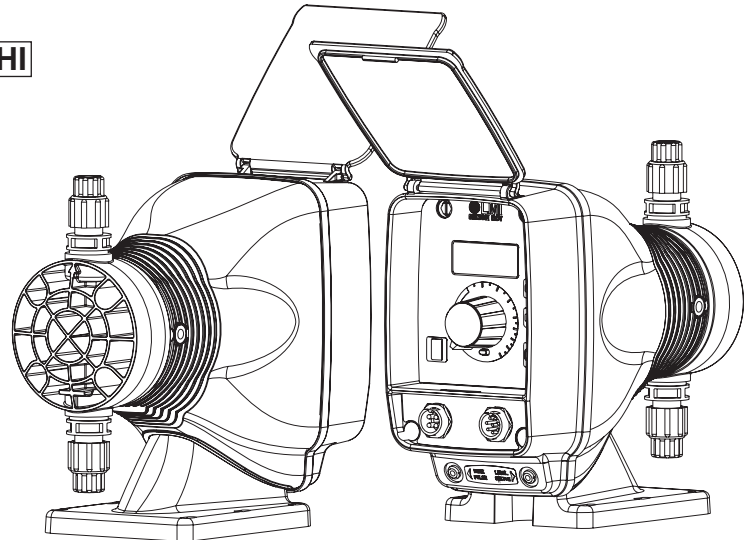
- 4 --- 0.58 GPH (2.2 l/h) --- 250 psi (17.3 Bar)
- 5 --- 1.00 GPH (3.8 l/h) --- 110 psi (7.6 Bar)
- 6 --- 2.00 GPH (7.6 l/h) --- 50 psi (3.5 Bar)
- 7 --- 0.42 GPH (1.6 l/h) --- 140 psi (9.7 Bar)
- 8 --- 0.75 GPH (2.8 l/h) --- 80 psi (5.5 Bar)

##### Voltage Code

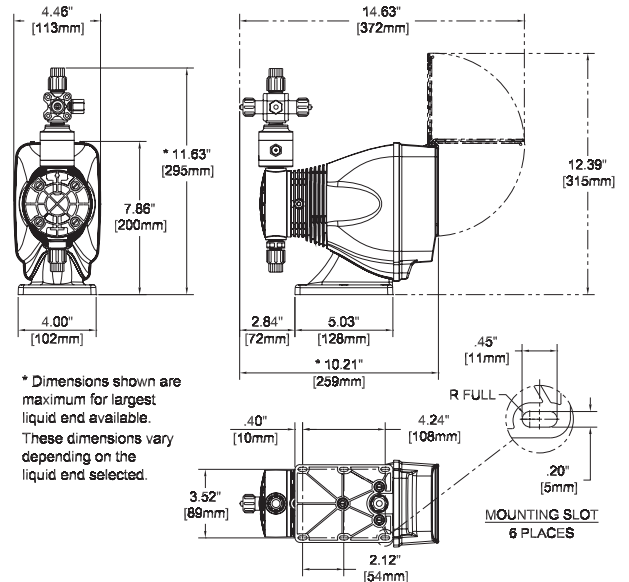
- 1 --- 120 VAC, US Plug
- 2 --- 240 VAC, US Plug
- 3 --- 220-240 VAC, DIN Plug
- 5 --- 240-250 VAC, UK Plug
- 6 --- 240-250 VAC, Aust./NZ Plug
- 7 --- 220-240 VAC, Swiss Plug

##### Liquid End

See next page for complete liquid end specifications and selection.



#### Dimensions



#### Specifications

Series	Strokes Per Minute (Adjustable)		Stroke Length (Adjustable) Recommended Minimum	Average Input Power @ Max Speed	Shipping Weight
	Min	Max			
AA14, AA74, AA94* AA15, AA75, AA95* AA16, AA76, AA96*	1	100	20%	22 watts	10 lbs (4.55 kg)
AA17, AA77, AA97* AA18, AA78	1	100	30%		

\*Series 9 pumps may be programmed for strokes per hour for lower outputs.



201 Ivyland Road  
Ivyland, PA 18974 USA  
TEL: (215) 293-0401  
FAX: (800) 327-7563  
<http://www.lmipumps.com>

## Configuration Data & Materials of Construction

Drive Assembly	Liquid End No.	Size Code	Materials of Construction				Accessory	Tubing & Connections	
			Head & Fittings	Balls	Liquifram™	Check Valve		Discharge	Suction
AA97	458HI	0.5	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .250" O.D.	
	450FI	0.5	Acrylic / PVC	PTFE	Fluorofilm™	PVDF / Polyprel™	4FV	PE .250" O.D.	
AA94	450HI	0.5	Acrylic / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .250" O.D.	
AA77	358HI	0.5	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .250" O.D.	
AA74	353HI	0.5	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / PTFE	4FV + AV	PE .250" O.D.	
AA17	352HI	0.5	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .250" O.D.	
AA14	155HV	0.5	Polypropylene	316 S.S.	Fluorofilm™	PTFE		PE .5" O.D. Vinyl .938" O.D.	
	155S**	0.5	Polypropylene	Ceramic	Fluorofilm™	PTFE	4FV	PE .250" O.D.	
	156HV	0.5	Acrylic/PP	316 S.S.	Fluorofilm™	Hypalon™		PE .5" O.D. Vinyl .938" O.D.	
	257	0.5	316 S.S.	316 S.S.	Fluorofilm™	316 S.S.		Pipe 1/4" NPT M	

AA95	498HI	0.9	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .375" O.D.	
	490HI	0.9	Acrylic / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .375" O.D.	
AA78	490FI	0.9	Acrylic / PVC	PTFE	Fluorofilm™	PVDF / Polyprel™	4FV	PE .375" O.D.	
AA75	398HI	0.9	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .375" O.D.	
AA18	392HI	0.9	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .375" O.D.	
AA15	393HI	0.9	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / PTFE	4FV + AV	PE .375" O.D.	
	85HV	0.9	Polypropylene	316 S.S.	Fluorofilm™	PTFE		PE .5" O.D. Vinyl .938" O.D.	
	86HV	0.9	Acrylic / PP	316 S.S.	Fluorofilm™	Hypalon™		PE .5" O.D. Vinyl .938" O.D.	
	89	0.9	UHMW PE	Ceramic	Hypalon™	Hypalon™		PE .5" O.D. Vinyl .5" O.D.	
	95S**	0.9	Polypropylene	Ceramic	Fluorofilm™	PTFE	4FV	PE .375" O.D.	
	297	0.9	316 S.S.	316 S.S.	Fluorofilm™	316 S.S.		Pipe 1/4" NPT M	

AA96	468HI	1.8	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .375" O.D.	
	460HI	1.8	Acrylic / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .375" O.D.	
AA76	460FI	1.8	Acrylic / PVC	PTFE	Fluorofilm™	PVDF / Polyprel™	4FV	PE .375" O.D.	
	368HI	1.8	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .375" O.D.	
AA16	362HI	1.8	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / Polyprel™	4FV + AV	PE .375" O.D.	
	363HI	1.8	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / PTFE	4FV + AV	PE .375" O.D.	
	65S**	1.8	Polypropylene	Ceramic	Fluorofilm™	PTFE	4FV	PE .375" O.D.	
	75HV	1.8	Polypropylene	316 S.S.	Fluorofilm™	PTFE		PE .5" O.D. Vinyl .938" O.D.	
	76HV	1.8	Acrylic / PP	316 S.S.	Fluorofilm™	Hypalon™		PE .5" O.D. Vinyl .938" O.D.	
	79	1.8	UHMW PE	Ceramic	Hypalon™	Hypalon™		PE .5" O.D. Vinyl .5" O.D.	
	277	1.8	316 S.S.	316 S.S.	Fluorofilm™	316 S.S.		Pipe 1/4" NPT M	

■ See front page for voltage code specifications.

\*\* These Liquid Ends are available without a 4FV, by removing the S from the liquid end code.

To specify 1/4 NPT male, change 'I' to 'P'.  
 To specify black, UV resistant tubing, change 'I' to 'U'.  
 To specify Bleed 4FV, change 'H' to 'B'.  
 To specify 3FV, change 'H' to 'T'.  
 To specify 4FV only, change 'H' to 'S'.  
 To specify Auto Prime Valve only, change 'H' to 'A'.

**3FV** indicates that the pump is equipped with an LMI Three Function Valve (pressure relief, priming aid, line drain).

**4FV** indicates that the pump is equipped with an LMI Four Function Valve. This diaphragm type, anti-syphon/pressure relief valve is installed on the pump head. It provides anti-syphon protection and aids priming, even under pressure.

**AV** indicates that the pump is equipped with an LMI Auto Prime Valve. This valve allows for the constant removal of vapors and gases present in applications such as sodium hypochlorite and hydrogen peroxide.

Fluorofilm™ is a copolymer of PTFE and PFA. Polyprel™ is an elastomeric PTFE copolymer.

Polyprel is a registered trademark of Liquid Metronics Incorporated. Fluorofilm and Liquifram are trademarks of Liquid Metronics Incorporated. Hypalon is a registered trademark of E. I. du Pont de Nemours & Co., Inc.

## Output Information

Series	Gallons per Hour		Liters per Hour		mL/cc per Minute		mL/cc per Stroke		Maximum Injection Pressure
	Min	Max	Min	Max	Min	Max	Min	Max	
AA94*, AA74*, AA14	0.001	0.58	0.004	2.2	0.07	37	0.07	0.37	250 psi (17.3 Bar)
AA95*, AA75*, AA15	0.002	1.00	0.008	3.8	0.13	63	0.13	0.63	110 psi (7.6 Bar)
AA96*, AA76*, AA16	0.004	2.00	0.015	7.6	0.25	126	0.25	1.26	50 psi (3.5 Bar)
AA97*, AA77*, AA17	0.001	0.42	0.005	1.6	0.08	26	0.08	0.26	140 psi (9.7 Bar)
AA78*, AA18	0.002	0.75	0.009	2.8	0.14	47	0.14	0.47	80 psi (5.5 Bar)

\* Minimum output is based on one stroke per minute. Minimum output can be reduced further in external mode. Series AA9 pumps may be programmed for strokes per hour for lower outputs.

### **13. Polymer Tank**

**American Tank Company's** cylindrical open top polyethylene (poly) tanks are most frequently used for safe, reliable storage and dispensing of fertilizers, chemicals, food products, potable water, gray water and a wide variety of other uses. These tanks and lids have exceptional chemical & impact resistance, and can be UV stabilized for use in harsh outdoor environments.

**American Tank Company's** cylindrical open top poly tanks and lids are one piece and are molded from tough linear polyethylene for maximum strength with no joints or seams to leak or cause problems. The tank lip is designed with a flange to accept a "shoebox" type lid. Linear poly tanks and lids are molded from 100% FDA approved materials for safe storage of food products and polyethylene will not impart any taste or residue.

These tanks and lids are designed for sustained temperatures up to 120° F, and peak temperatures up to 140°F. Steel tank stands, with or without agitator mounts, are designed for durability and easy content dispensing.

**American Tank Company** supports the manufacturer's 1-year limited warranty dependant on the chemical compatibility of the intended contents with the tank, lid, and tank fitting materials.

### **PRODUCT SPECIFICATIONS:**

**Color:**  
**White**  
**Capacity:**  
**30 gallons**  
**Diameter:**  
**18 inches**  
**Height:**  
**28.5 inches**  
**Weight:**  
**20 pounds**



## **14. Polymer Mixer**

# Cool Stir® Large Volume Stirrer



S5641

This magnetic stirring machine effectively agitates volumes of liquid as great as 190 liters (50 gallons). It features two speed ranges (0 to 200 and 0 to 400 rpm) with a stepless speed control. The large platform is made from chemical resistant, white polypropylene. A baked on epoxy finish protects the steel housing and four rubber feet prevent "walking". The driving magnet is a rare earth type. Use Giant Polygon Spinbar® magnetic stirring bars F37118 series with this stirrer. DC motor, 50 Watts, 50/60 Hz, 3-wire grounded cord, 1.8m (6 ft) long. 48cm x 48cm x 20cm ( 19" x 19" x 8"). Shipping weight: 18.2kg (40 lbs). Bel-Art. (CGLMTJ)

**Product Keywords:** [Magnetic Stirrers](#), [Large Volume](#)

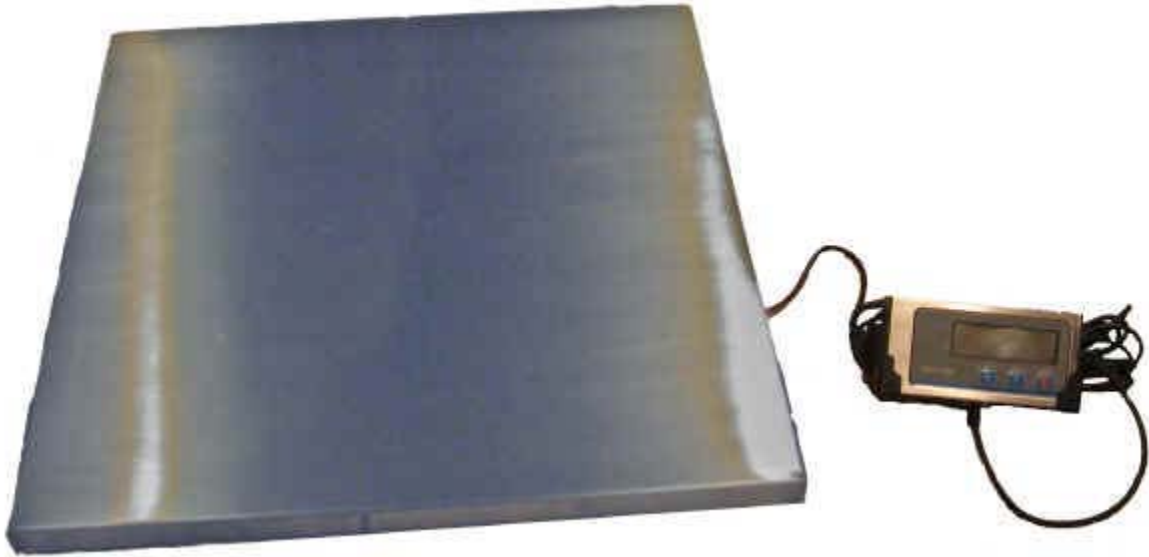
<b>Cat. No.</b>	<b>Mfg. No.</b>	<b>Description</b>
<b>S5641</b>	H370280000	Cool Stir® Large Volume Stirrer

## **15. Polymer Scale**

## LPB-1000 Drum Scale

1000 lb x 0.5 lb

Price: \$695



- \* 24" x 24" - 1000 lb capacity platform
- \* Stainless Steel cover, painted steel substructure
- \* Digital Display is battery / Electric powered
  - \* Low profile scale platform
  - \* Easy to read LCD display
- \* Digital Display comes standard with wall mounting bracket
  - \* 15 ft cable from platform to display



## **16. Polymer Static Mixer (Backwash)**



Westfall Manufacturing Company  
Bristol, Rhode Island, 02809-0007 • USA

*Quality - Safety - Service - Price - Vision*

<a href="#">Home</a>	<a href="#">Gas Diffusers</a>	<a href="#">Diatomaceous Earth Filter</a>	<a href="#">Venturi Flowmeters 2300</a>	<a href="#">Venturi Flowmeters 2350</a>	<a href="#">2900 Variable Flow Static Mixers</a>
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[2800 Static Mixer Brochure](#)

(The above link is a pdf file which will open in a new browser)

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**Model 2800 Wafer Type Static Mixer**

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Model 2800 Patent No. 5,839,828

- **Description:**  
The Westfall Static Mixer is a full pipe motionless static mixer in which fluids are injected and rapidly mixed by a combination of alternate vortex shedding and intense shear zone turbulence.
- **Applications:**  
Typical applications for the Westfall Static Mixers are:



- Water treatment
- Chemical blending
- Dissolving gases
- Polymer blending
- Flocculent blending
- Ph control
- Potable water
- Waste water
- Chlorination
- De-Chlorination

## **17. Ferrous Sulfate Dosing Pump**

#### Configuration Data

Model AA **9** **4** **1** - **358HI**

##### Control Code

- 1 --- **Manual Control:** Speed (stroking frequency) and stroke length manually adjustable.
- 7 --- **Instrument Responsive/Manual Control:** Manual adjustment features of Control Code 1 plus switch conversion to external control for automatic systems.
- 9 --- **Microprocessor/Instrument Responsive:** External 4-20mA or pulse or x direct; manual stroke length control.

##### Output/Size Code

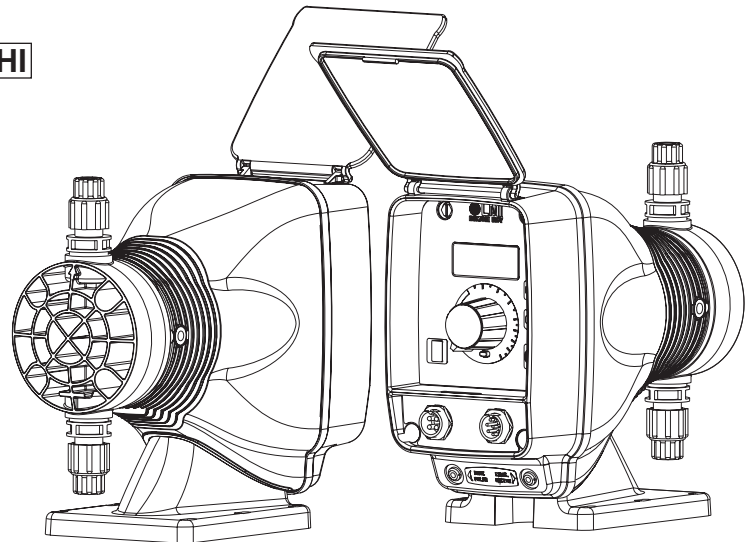
- 4 --- 0.58 GPH (2.2 l/h) --- 250 psi (17.3 Bar)
- 5 --- 1.00 GPH (3.8 l/h) --- 110 psi (7.6 Bar)
- 6 --- 2.00 GPH (7.6 l/h) --- 50 psi (3.5 Bar)
- 7 --- 0.42 GPH (1.6 l/h) --- 140 psi (9.7 Bar)
- 8 --- 0.75 GPH (2.8 l/h) --- 80 psi (5.5 Bar)

##### Voltage Code

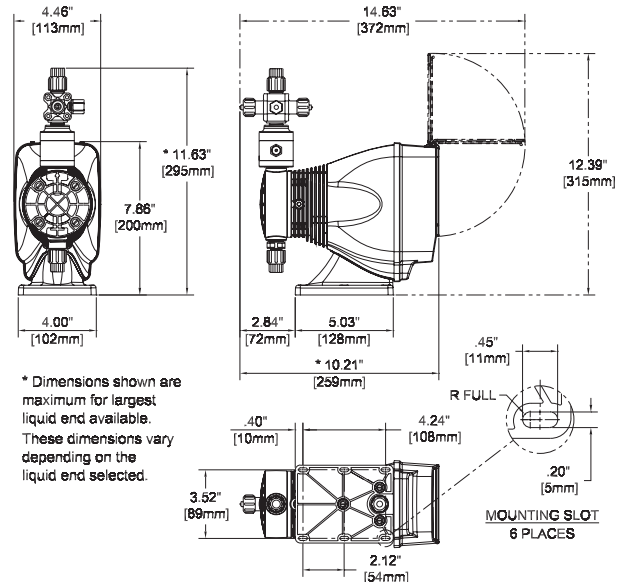
- 1 --- 120 VAC, US Plug
- 2 --- 240 VAC, US Plug
- 3 --- 220-240 VAC, DIN Plug
- 5 --- 240-250 VAC, UK Plug
- 6 --- 240-250 VAC, Aust./NZ Plug
- 7 --- 220-240 VAC, Swiss Plug

##### Liquid End

See next page for complete liquid end specifications and selection.



#### Dimensions



#### Specifications

Series	Strokes Per Minute (Adjustable)		Stroke Length (Adjustable) Recommended Minimum	Average Input Power @ Max Speed	Shipping Weight
	Min	Max			
AA14, AA74, AA94* AA15, AA75, AA95* AA16, AA76, AA96*	1	100	20%	22 watts	10 lbs (4.55 kg)
AA17, AA77, AA97* AA18, AA78	1	100	30%		

\*Series 9 pumps may be programmed for strokes per hour for lower outputs.



201 Ivyland Road  
Ivyland, PA 18974 USA  
TEL: (215) 293-0401  
FAX: (800) 327-7563  
<http://www.lmipumps.com>

# Configuration Data & Materials of Construction

Drive Assembly	Liquid End No.	Size Code	Materials of Construction				Accessory	Tubing & Connections	
			Head & Fittings	Balls	Liquifram™	Check Valve		Discharge	Suction
AA97 ■ AA94 ■ AA77 ■ AA74 ■ AA17 ■ AA14 ■	458HI	0.5	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel <sup>®</sup>	4FV + AV	PE .250" O.D.	
	450FI	0.5	Acrylic / PVC	PTFE	Fluorofilm™	PVDF / Polyprel <sup>®</sup>	4FV	PE .250" O.D.	
	450HI	0.5	Acrylic / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel <sup>®</sup>	4FV + AV	PE .250" O.D.	
	358HI	0.5	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel <sup>®</sup>	4FV + AV	PE .250" O.D.	
	353HI	0.5	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / PTFE	4FV + AV	PE .250" O.D.	
	352HI	0.5	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / Polyprel <sup>®</sup>	4FV + AV	PE .250" O.D.	
	155HV	0.5	Polypropylene	316 S.S.	Fluorofilm™	PTFE		PE .5" O.D. Vinyl .938" O.D.	
	155S**	0.5	Polypropylene	Ceramic	Fluorofilm™	PTFE	4FV	PE .250" O.D.	
156HV	0.5	Acrylic/PP	316 S.S.	Fluorofilm™	Hypalon <sup>®</sup>		PE .5" O.D. Vinyl .938" O.D.		
257	0.5	316 S.S.	316 S.S.	Fluorofilm™	316 S.S.		Pipe 1/4" NPT M		

AA95 ■ AA78 ■ AA75 ■ AA18 ■ AA15 ■	498HI	0.9	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel <sup>®</sup>	4FV + AV	PE .375" O.D.
	490HI	0.9	Acrylic / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel <sup>®</sup>	4FV + AV	PE .375" O.D.
	490FI	0.9	Acrylic / PVC	PTFE	Fluorofilm™	PVDF / Polyprel <sup>®</sup>	4FV	PE .375" O.D.
	398HI	0.9	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel <sup>®</sup>	4FV + AV	PE .375" O.D.
	392HI	0.9	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / Polyprel <sup>®</sup>	4FV + AV	PE .375" O.D.
	393HI	0.9	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / PTFE	4FV + AV	PE .375" O.D.
	85HV	0.9	Polypropylene	316 S.S.	Fluorofilm™	PTFE		PE .5" O.D. Vinyl .938" O.D.
	86HV	0.9	Acrylic / PP	316 S.S.	Fluorofilm™	Hypalon <sup>®</sup>		PE .5" O.D. Vinyl .938" O.D.
	89	0.9	UHMW PE	Ceramic	Hypalon <sup>®</sup>	Hypalon <sup>®</sup>		PE .5" O.D. Vinyl .5" O.D.
	95S**	0.9	Polypropylene	Ceramic	Fluorofilm™	PTFE	4FV	PE .375" O.D.
	297	0.9	316 S.S.	316 S.S.	Fluorofilm™	316 S.S.		Pipe 1/4" NPT M

AA96 ■ AA76 ■ AA16 ■	468HI	1.8	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel <sup>®</sup>	4FV + AV	PE .375" O.D.
	460HI	1.8	Acrylic / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel <sup>®</sup>	4FV + AV	PE .375" O.D.
	460FI	1.8	Acrylic / PVC	PTFE	Fluorofilm™	PVDF / Polyprel <sup>®</sup>	4FV	PE .375" O.D.
	368HI	1.8	PVC / PVC	Ceramic	Fluorofilm™	PVDF / Polyprel <sup>®</sup>	4FV + AV	PE .375" O.D.
	362HI	1.8	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / Polyprel <sup>®</sup>	4FV + AV	PE .375" O.D.
	363HI	1.8	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / PTFE	4FV + AV	PE .375" O.D.
	65S**	1.8	Polypropylene	Ceramic	Fluorofilm™	PTFE	4FV	PE .375" O.D.
	75HV	1.8	Polypropylene	316 S.S.	Fluorofilm™	PTFE		PE .5" O.D. Vinyl .938" O.D.
	76HV	1.8	Acrylic / PP	316 S.S.	Fluorofilm™	Hypalon <sup>®</sup>		PE .5" O.D. Vinyl .938" O.D.
	79	1.8	UHMW PE	Ceramic	Hypalon <sup>®</sup>	Hypalon <sup>®</sup>		PE .5" O.D. Vinyl .5" O.D.
	277	1.8	316 S.S.	316 S.S.	Fluorofilm™	316 S.S.		Pipe 1/4" NPT M

■ See front page for voltage code specifications.

\*\* These Liquid Ends are available without a 4FV, by removing the S from the liquid end code.

To specify 1/4 NPT male, change 'I' to 'P'.

To specify black, UV resistant tubing, change 'I' to 'U'.

To specify Bleed 4FV, change 'H' to 'B'.

To specify 3FV, change 'H' to 'T'.

To specify 4FV only, change 'H' to 'S'.

To specify Auto Prime Valve only, change 'H' to 'A'.

**3FV** indicates that the pump is equipped with an LMI Three Function Valve (pressure relief, priming aid, line drain).

**4FV** indicates that the pump is equipped with an LMI Four Function Valve. This diaphragm type, anti-syphon/pressure relief valve is installed on the pump head. It provides anti-syphon protection and aids priming, even under pressure.

**AV** indicates that the pump is equipped with an LMI Auto Prime Valve. This valve allows for the constant removal of vapors and gases present in applications such as sodium hypochlorite and hydrogen peroxide.

Fluorofilm™ is a copolymer of PTFE and PFA. Polyprel<sup>®</sup> is an elastomeric PTFE copolymer.

Polyprel is a registered trademark of Liquid Metronics Incorporated. Fluorofilm and Liquifram are trademarks of Liquid Metronics Incorporated. Hypalon is a registered trademark of E. I. du Pont de Nemours & Co., Inc.

## Output Information

Series	Gallons per Hour		Liters per Hour		mL/cc per Minute		mL/cc per Stroke		Maximum Injection Pressure
	Min	Max	Min	Max	Min	Max	Min	Max	
AA94*, AA74*, AA14	0.001	0.58	0.004	2.2	0.07	37	0.07	0.37	250 psi (17.3 Bar)
AA95*, AA75*, AA15	0.002	1.00	0.008	3.8	0.13	63	0.13	0.63	110 psi (7.6 Bar)
AA96*, AA76*, AA16	0.004	2.00	0.015	7.6	0.25	126	0.25	1.26	50 psi (3.5 Bar)
AA97*, AA77*, AA17	0.001	0.42	0.005	1.6	0.08	26	0.08	0.26	140 psi (9.7 Bar)
AA78*, AA18	0.002	0.75	0.009	2.8	0.14	47	0.14	0.47	80 psi (5.5 Bar)

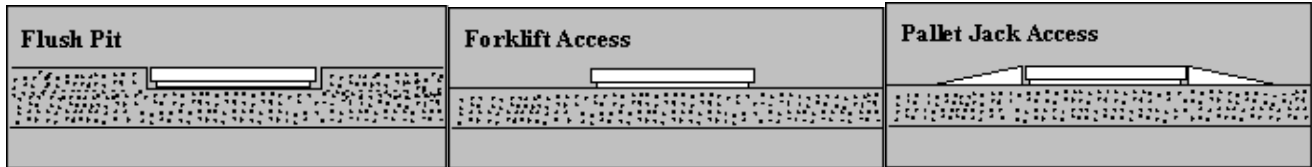
\* Minimum output is based on one stroke per minute. Minimum output can be reduced further in external mode. Series AA9 pumps may be programmed for strokes per hour for lower outputs.

## **18. Ferrous Sulfate Scale**

# HEAVY DUTY FLOOR SCALE

## Includes:

- Painted steel Base
- Choice of three different Indicators
- 15' of Indicator cable
- Factory Pre-Calibrated



## OPTIONS

Stainless Steel ~ Customer specific modifications ~ Swivel Leveling Feet ~ Top access for leveling ~ Top access J-Box ~ Ramps ~ Digital Indicator ~ Pit Frames ~ Anchor Plates

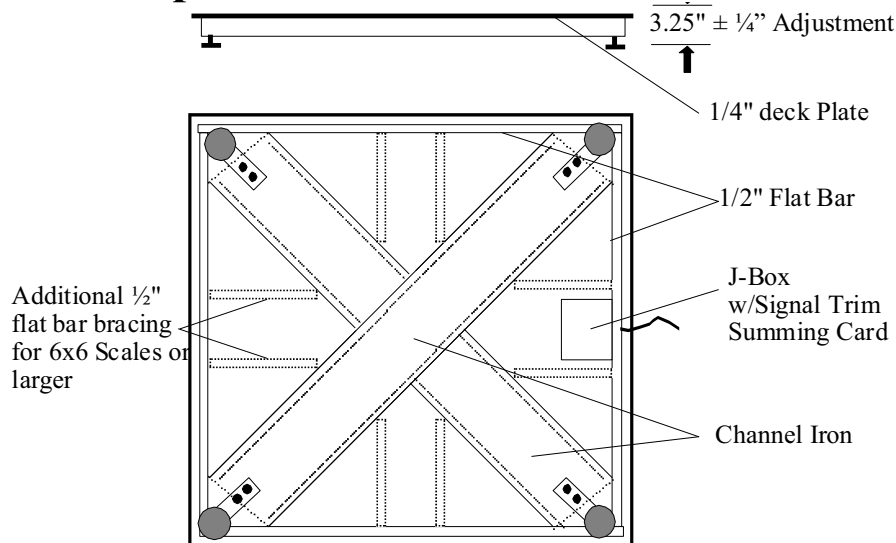
## STRUCTURE

100% Mig welded ~ Safe Overload 200% ~ Safe Side Load 100%

## WARRANTY

3 Year Warranty On Floor Scale, 1 Year Warranty On Weight Indicator

## Floor Scale Specifications



A and A Scales LLC  
78 North 12<sup>th</sup> Street, Prospect Park NJ 07508  
Toll Free: (800) 481-4114, 973-956-1600 Fax: (509) 355-3498  
www.scaleline.com

## **19. Ferrous Sulfate Static Mixer**





Westfall Manufacturing Company  
Bristol, Rhode Island, 02809-0007 • USA

*Quality - Safety - Service - Price - Vision*

<a href="#">Home</a>	<a href="#">Gas Diffusers</a>	<a href="#">Diatomaceous Earth Filter</a>	<a href="#">Venturi Flowmeters 2300</a>	<a href="#">Venturi Flowmeters 2350</a>	<a href="#">2900 Variable Flow Static Mixers</a>
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[2800 Static Mixer Brochure](#)

(The above link is a pdf file which will open in a new browser)

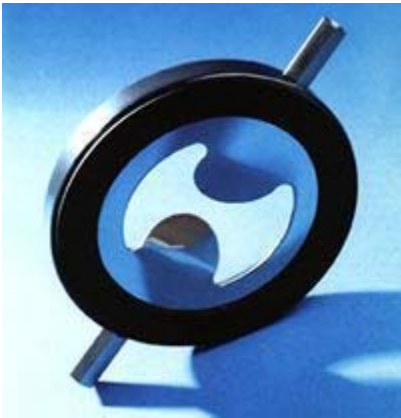
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**Model 2800 Wafer Type Static Mixer**

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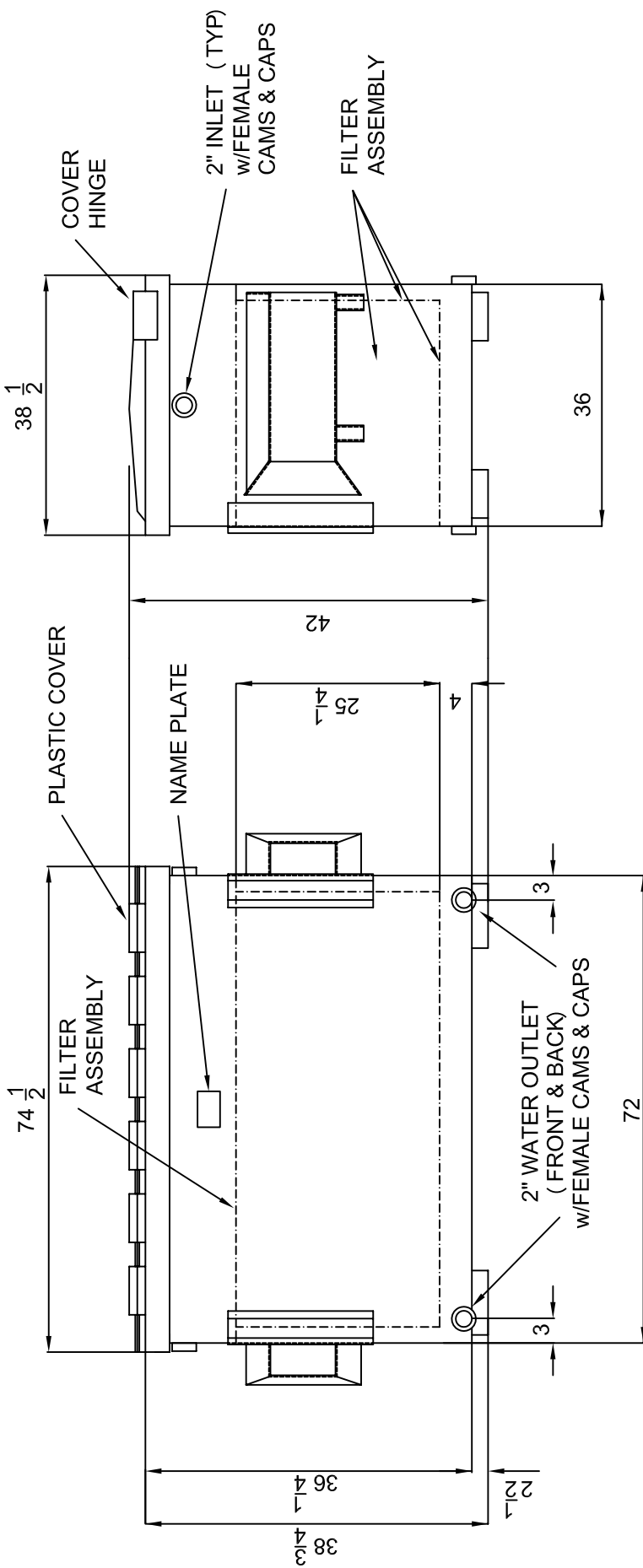
Model 2800 Patent No. 5,839,828

- **Description:**  
The Westfall Static Mixer is a full pipe motionless static mixer in which fluids are injected and rapidly mixed by a combination of alternate vortex shedding and intense shear zone turbulence.
- **Applications:**  
Typical applications for the Westfall Static Mixers are:



- Water treatment
- Chemical blending
- Dissolving gases
- Polymer blending
- Flocculent blending
- Ph control
- Potable water
- Waste water
- Chlorination
- De-Chlorination

## **20. SludgeMate**



**END ELEVATION**

**SIDE ELEVATION**

		HOUSTON, TEXAS 77018 DRAWN BY: JM
SCALE: NONE	APPROVED BY: JM	REVISION:
DATE: 01-23-09	DESCRIPTION: GENERAL ARRANGEMENT	
TITLE: FRONT END LOADER CONTAINER FILTER (2 YD CAPACITY)	DRAWING NUMBER: 09Q1000-001	

THESE DRAWINGS CONTAIN CONFIDENTIAL PROPRIETARY INFORMATION. THEY ARE NOT TO BE COPIED, REPRODUCED OR USED IN ANY MANNER THAT WOULD COMPROMISE THE CONFIDENTIALITY OF THE INFORMATION CONTAINED HEREIN. THESE DRAWINGS ARE NOT TO BE USED FOR ANY OTHER PROJECT WITHOUT THE WRITTEN PERMISSION OF FLO TREND SYSTEMS, INC. A SPECIFIC CONFIDENTIALITY AGREEMENT OR LICENSE AGREEMENT HAVE FIRST BEEN ENTERED INTO WITH FLO TREND SYSTEMS, INC. OF HOUSTON, TEXAS. FAILURE TO OBSERVE THE CONDITION OF THIS NOTICE WILL RESULT IN PROSECUTION AS ALLOWED UNDER THE LAWS OF THE STATE OF TEXAS, U.S.A. OR THOSE OF ANY OTHER APPROPRIATE JURISDICTION AS FLO TREND SYSTEMS, INC.

APPROVED BY: \_\_\_\_\_  
 APPROVED AS NOTED: \_\_\_\_\_  
 DISAPPROVED BY: \_\_\_\_\_  
 DATE: \_\_\_\_\_

**21. Sludge Treatment Filtrate Transfer Sump and Analyzer Drain  
Transfer Sump**

# Sump Pumps for Sewage Water

For information about pumps and pump performance, see page 296.

## Sump Pumps with Basin

These all-in-one pumps include their own thermoplastic basin and will work in a dug-out pit or at ground level. All have a continuous duty, single-phase motor with thermal overload protection and a power cord with three-prong plug.

**For Water**—Basin is polypropylene. Maximum solid diameter is 1/4". Pump housing is epoxy-coated cast iron. Powered by a pressure-diaphragm switch with an 8-ft. power cord. Intake and discharge connections are 1 1/2" NPT female; basin also has a 2" NPT female vent. Temperature range is 32° to 125° F.

**For Sewage Water**—Basin is polyethylene. Maximum solid diameter is 2". Pump housing is cast iron and has a heavy, structural foam cover. Powered by a tethered float switch. This "piggyback" switch is not wired to the pump; it has its own 10-ft. power cord so it's easy to replace and ideal for troubleshooting. Intake is a 4" OD unthreaded hole; discharge connection is 2" NPT female. Temperature range is 33° to 104° F.



For Water



For Water, Cutaway

Basin Capacity	Max. Flow, gpm				Max. ft. of Head	Turn-On Level	Turn-Off Level	hp	VAC @ 60 Hz	Amps	Overall Size, Ht. x Wd. x Dp.	Each	
	@ 5 ft. of Head	@ 10 ft. of Head	@ 15 ft. of Head	@ 20 ft. of Head									
<b>For Water</b>													
3.5 gal.	45	29	12	—	18	7"	3"	1/3	115	9	10 1/2" x 14 1/2" x 14 1/2"	99685K53	\$251.25
5 gal.	45	29	12	—	18	10"	4"	1/3	115	9	15 9/16" x 14 1/2" x 14 1/2"	99685K55	251.25
<b>For Sewage Water</b>													
41 gal.	125	95	51	—	19	11 1/2"	4 1/2"	4/10	115	12	24" x 28 1/4" x 24 3/8"	2921K51	428.52
41 gal.	138	112	71	41	25	11 1/2"	4 1/2"	1/2	115	12	24" x 28 1/4" x 24 3/8"	2921K52	478.28
41 gal.	145	120	90	61	28	11 1/2"	4 1/2"	3/4	115	12	24" x 28 1/4" x 24 3/8"	2921K53	692.17

## Sump Pumps for Sewage Water

With a rugged impeller, large intake, and 2" NPT female discharge connection (unless noted), these pumps are capable of handling large sewage waste up to 2" diameter, except 5143K45, which can handle solids up to 2 1/2" diameter.

**Standard** pumps have an epoxy-coated cast iron housing. They have a continuous duty, single-phase motor with thermal overload protection and power cord with three-prong plug. They require a minimum 18" Dia. x 24" Dp. sump. Temperature range is 32° to 120° F.

**High-flow** pumps have a cast iron housing and an intermittent duty, single-phase motor—limited to 20 starts per hour with a minimum 15 seconds between starts. Motor has thermal overload protection and a power cord without a plug, unless noted. All require a minimum 24" Dia. x 30" Dp. sump, unless noted. Temperature range is 33° to 104° F, unless noted. CSA certified.

**Plug-In Controlled**—Pumps do not have a switch; simply plug in to turn on. They must be submerged in water at all times. Do not run dry.

**Tethered Float-Switch Controlled**—"Piggyback" switch is not wired to the pump; it has its own power cord. Switch is easy to replace so it's ideal for troubleshooting.

**Integrated Float-Switch Controlled**—Float switch is a part of the pump for a smaller footprint than tethered float-switch pumps.

**Direct-Wire Tethered Float-Switch Controlled**—Float switch is directly wired to the pump.

Max. of Head	Max. Flow, gpm			Max. Head	Turn-On Level	Turn-Off Level	hp	VAC @ 60 Hz	Amps	Cord Lg.	Overall Size, Ht. x Wd. x Dp.	Each	
	@ 5 ft. of Head	@ 10 ft. of Head	@ 15 ft. of Head										
<b>Standard</b>													
<b>Plug-In Controlled</b>													
80	50	16	18	—	—	—	—	4/10	115	13	15 ft. 11 5/8" x 10 5/16" x 6 3/4"	42935K14	\$243.69
110	85	45	20	—	—	—	—	1/2	115	12	15 ft. 12 1/16" x 10 5/16" x 8 1/4"	42935K15	336.39
110	85	45	20	—	—	—	—	1/2	208/230	5.8/6.6	15 ft. 12 1/16" x 10 5/16" x 8 1/4"	42935K16	344.34
<b>Tethered Float-Switch Controlled</b>													
80	50	16	18	14"	6"	—	—	4/10	115	13	15 ft. 11 5/8" x 10 5/16" x 6 3/4"	42935K24	264.22
110	85	45	20	14"	6"	—	—	1/2	115	12	15 ft. 12 1/16" x 10 5/16" x 8 1/4"	42935K25	366.85
<b>Integrated Float-Switch Controlled</b>													
110	85	45	20	14"	8"	—	—	1/2	115	9.2	10 ft. 15" x 10 5/16" x 9 1/16"	42935K31	363.56
110	85	45	20	14"	8"	—	—	1/2	115	9.2	25 ft. 15" x 10 5/16" x 9 1/16"	42935K32	375.46
110	85	45	20	14"	8"	—	—	1/2	230	4.6	25 ft. 15" x 10 5/16" x 9 1/16"	42935K33	405.93
<b>High Flow</b>													
<b>Plug-In Controlled</b>													
165	140	98	25	—	—	—	—	1/2	120	11.6	15 ft. 18 5/8" x 9 3/4" x 12 5/8"	5143K57	491.05
165	140	98	25	—	—	—	—	1/2	240	5.9	15 ft. 18 5/8" x 9 3/4" x 12 5/8"	5143K58	524.43
220	195	165	36	—	—	—	—	1	200/240	8.8/8.3	15 ft. 18 5/8" x 9 3/4" x 13 1/16"	5143K35	619.80
405	375	335	46	—	—	—	—	2	230	19	25 ft. 21 1/4" x 12 5/8" x 16 3/4"	5143K45	1394.15
<b>Tethered Float-Switch Controlled</b>													
115	95	68	26	13"	6"	—	—	4/10	115	12	15 ft. 16 3/4" x 7 3/4" x 10 3/4"	5143K37	368.97
165	140	98	25	13"	6"	—	—	1/2	120	11.6	15 ft. 18 5/8" x 9 3/4" x 12 5/8"	5143K28	474.68
<b>Direct-Wire Tethered Float-Switch Controlled</b>													
165	140	98	25	20"	13"	—	—	1/2	120	11.6	15 ft. 18 5/8" x 9 3/4" x 12 5/8"	5143K72	474.68
165	140	98	25	20"	13"	—	—	1/2	240	5.9	15 ft. 18 5/8" x 9 3/4" x 12 5/8"	5143K73	487.13

■ Power cord has a three-prong plug. ♣ Discharge connection is 3" NPT female.

♥ Pump requires an 18" Dia. x 30" Dp. sump. Temperature range is 33° to 77° F. ★ Temperature range is 33° to 77° F.



Standard, Integrated Float Switch



High Flow, Plug In

## Grinder-Style Sump Pumps for Sewage Water

Type 440C stainless steel blades process sewage and stringy materials into an easy-to-transfer slurry to reduce clogging. Do not use with metal particles or any debris that could damage cutting blades. Powered by a tethered float switch. Switch is not wired to the pump; it has its own power cord so it's easy to replace and ideal for troubleshooting. Housing is epoxy-coated cast iron. Motor has thermal overload protection and a power cord with no plug. Discharge connection is 1 1/4" NPT female. It requires a minimum 24" Dia. x 36" Dp. sump. UL listed and CSA certified. 2758K24 has an intermittent duty (2 hours max. on; 1 hour min. off) motor and a temperature range of 32° to 140° F. 2758K25, K26, and K27 has an intermittent duty (duty cycle not rated) motor and a maximum temperature of 130° F. Minimum temperature is not rated.

Max. of Head	Max. Flow, gpm			Max. Head	Turn-On Level	Turn-Off Level	hp	VAC @ 60 Hz (phase)	Amps	Cord Lg.	Overall Size, Ht. x Wd. x Dp.	Each	
	@ 20 ft. of Head	@ 60 ft. of Head	@ 100 ft. of Head										
32	30	20	130	24"	10"	—	—	230 (1)	13.9	20 ft.	21 9/16" x 11 1/16" x 9 5/8"	2758K24	\$1132.76
74	30	2.5	104	24"	12"	—	—	230 (1)	17.2	20 ft.	24 1/4" x 11 1/16" x 8 1/8"	2758K25	1857.51
74	30	2.5	104	24"	12"	—	—	200/208 (1)	20	20 ft.	24 1/4" x 11 1/16" x 8 1/8"	2758K26	1890.10
74	30	2.5	104	24"	12"	—	—	230 (3)	10.8	20 ft.	24 1/4" x 11 1/16" x 8 1/8"	2758K27	2263.12



## **22. Filter Drawdown Transfer Pump**



Position	Count	Description	Unit price
	1	<p><b>CRI 10-2 A-FGJ-I-E HQQE</b></p>  <p>Product photo could vary from the actual product</p> <p>Product No.: 96523020                      Vertical, non-self-priming, multistage, in-line, centrifugal pump for installation in pipe systems and mounting on a foundation.</p> <p><b>The pump has the following characteristics:</b></p> <ul style="list-style-type: none"> <li>- Impellers, intermediate chambers and outer sleeve are made of Stainless steel DIN W.-Nr. DIN W.-Nr. 1.4301.</li> <li>- Pump head cover and base are made of Stainless steel DIN W.-Nr. DIN W.-Nr. 1.4408.</li> <li>- The shaft seal has assembly length according to DIN 24960.</li> <li>- Power transmission is via cast iron split coupling.</li> <li>- Pipework connection is via ANSI flanges/couplings.</li> </ul> <p>The motor is a 3-phase AC motor.</p> <p><b>Liquid:</b></p> <p>Liquid temperature range: 24.8 .. 248 °F                      Liquid temp: 68 °F                      Density: 62.29 lb/ft³</p> <p><b>Technical:</b></p> <p>Speed for pump data: 3466 rpm                      Rated flow: 53.28 US gpm                      Rated head: 72.5 ft                      Shaft seal: HQQE                      Approvals on nameplate: ANSI/NSF61                      Curve tolerance: ISO 9906 Annex A</p> <p><b>Materials:</b></p> <p>Pump housing: Stainless steel                      DIN W.-Nr. 1.4408                      ASTM A 351 CF 8M</p>	On request



Company name: -  
Created by: -  
Phone: -  
Fax: -  
Date: -

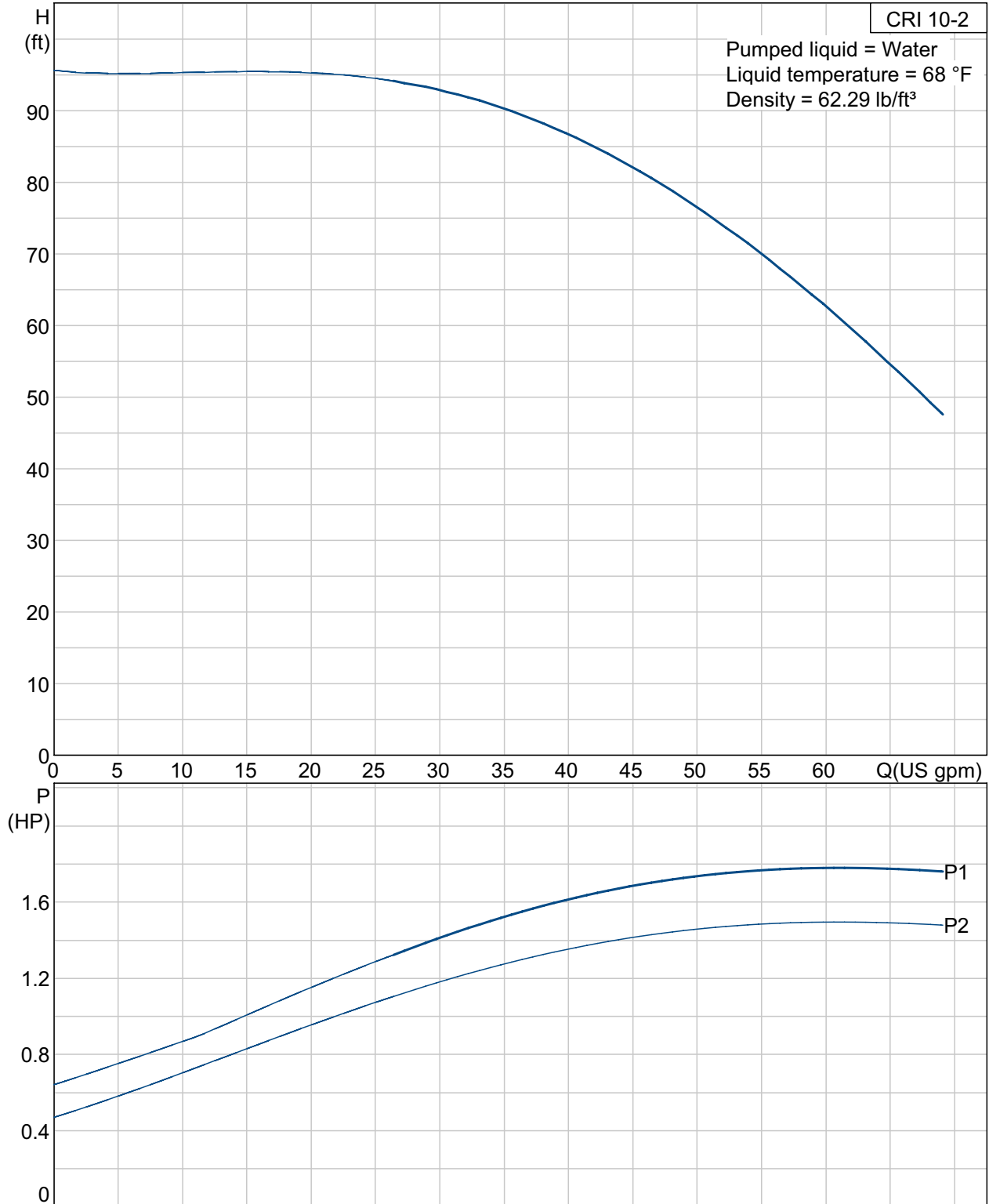
Position	Count	Description	Unit price
		<p>Impeller: Stainless steel DIN W.-Nr. 1.4301 AISI 304</p> <p><b>Installation:</b> Maximum ambient temperature: 104 °F Max pressure at stated temperature: 232 psi / 250 °F 232 psi / -4 °F</p> <p>Flange standard: ANSI Pipe connection: 2" Pressure stage: CLASS 300 Flange size for motor: 56C</p> <p><b>Electrical data:</b> Motor type: GRUNDFOS Efficiency class: H Number of poles: 2 Rated power - P2: 1.5 HP Power (P2) required by pump: 1.5 HP Main frequency: 60 Hz Rated voltage: 3 x 208-230 / 460 V Rated current: 4,70-4,60 / 2.3 A Starting current: 720-800 % Cos phi - power factor: 0.84-0.75 Rated speed: 3450-3480 rpm Motor efficiency at full load: 84.0 % Motor efficiency at 3/4 load: 83.5 % Motor efficiency at 1/2 load: 82.0-81.0 % Enclosure class (IEC 34-5): 55 Insulation class (IEC 85): F</p> <p><b>Others:</b> Net weight: 180 lb Shipping volume: 3.18 ft³</p>	



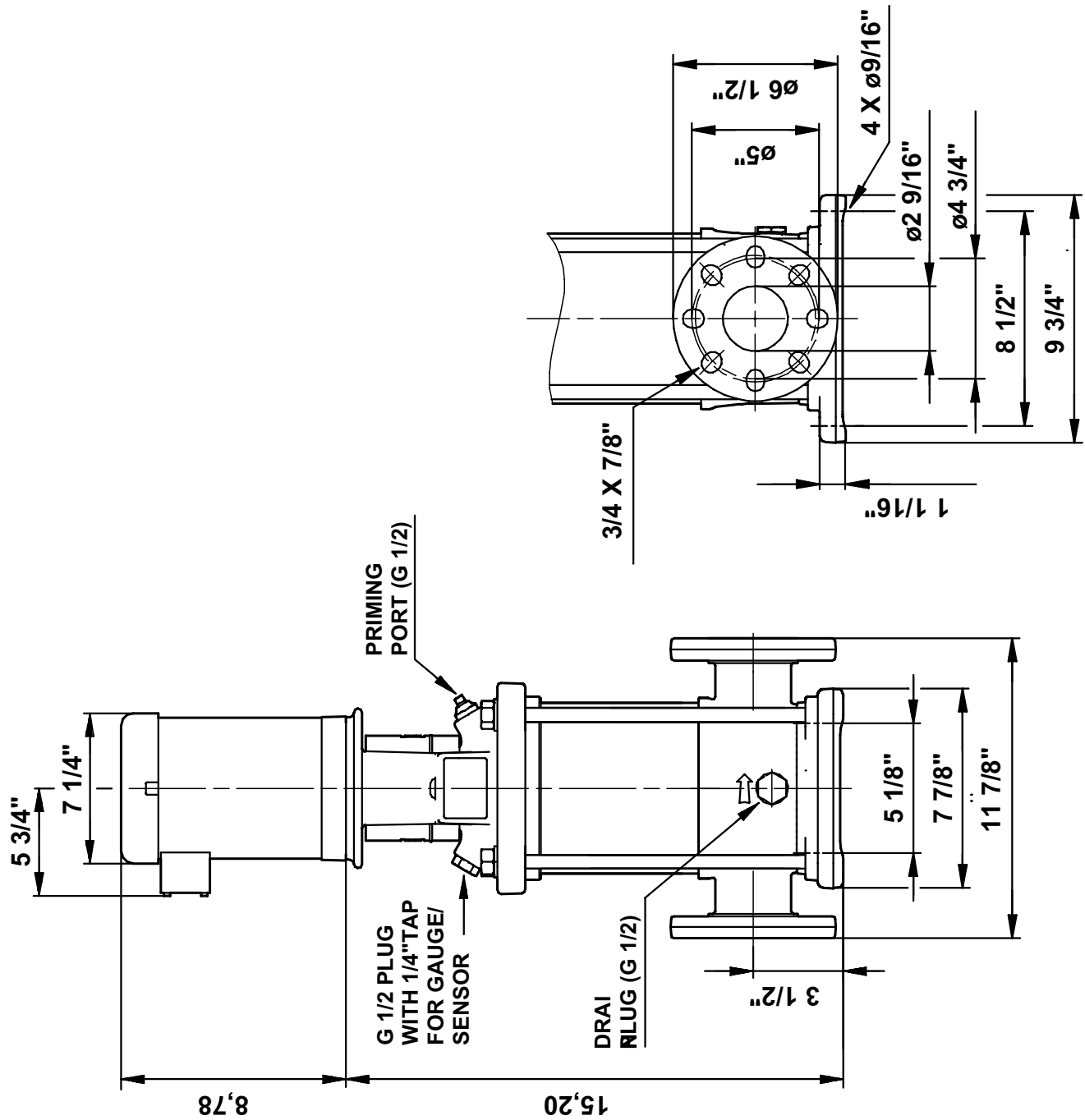


Company name: -  
Created by: -  
Phone: -  
Fax: -  
Date: -

### 96523020 CRI 10-2 60 Hz



96523020 CRI 10-2 60 Hz



Note! All units are in [mm] unless others are stated.  
 Disclaimer: This simplified dimensional drawing does not show all details.

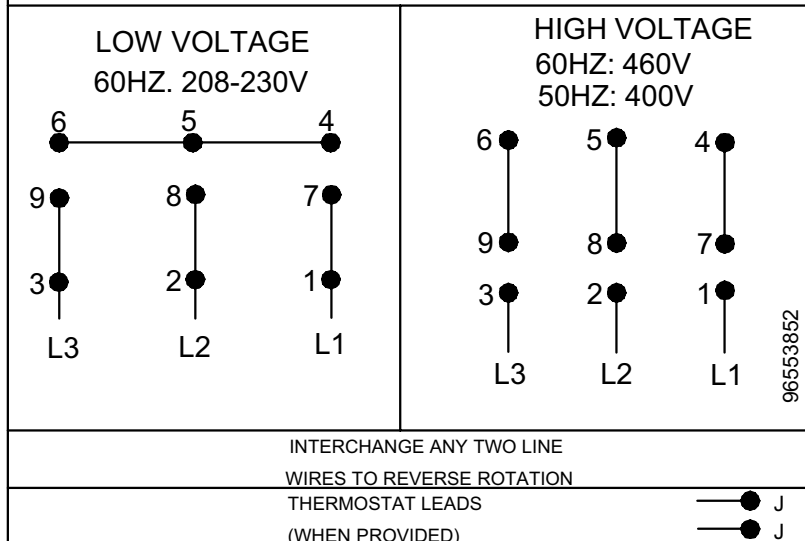
96523020 CRI 10-2 60 Hz



**WARNING**

MOTOR MUST BE GROUNDED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND LOCAL CODES BY TRAINED PERSONNEL TO PREVENT SERIOUS ELECTRICAL SHOCKS.

TO SERVICE MOTOR, DISCONNECT POWER SOURCE FROM MOTOR AND ANY ACCESSORY DEVICES AND ALLOW MOTOR TO COME TO A COMPLETE STAND STILL.



96553852

All units are [mm] unless otherwise presented.

## **23. Decant Pump**



Position	Count	Description	Unit price
	1	<p><b>CRI 1S-2 A-FGJ-I-E HQQE</b></p>  <p>Product photo could vary from the actual product</p> <p>Product No.: 96081401            Vertical, non-self-priming, multistage, in-line, centrifugal pump for installation in pipe systems and mounting on a foundation.</p> <p><b>The pump has the following characteristics:</b></p> <ul style="list-style-type: none"> <li>- Impellers, intermediate chambers and outer sleeve are made of Stainless steel DIN W.-Nr. DIN W.-Nr. 1.4301.</li> <li>- Pump head cover and base are made of Stainless steel DIN W.-Nr. DIN W.-Nr. 1.4408.</li> <li>- The shaft seal has assembly length according to DIN 24960.</li> <li>- Power transmission is via cast iron split coupling.</li> <li>- Pipework connection is via ANSI flanges/couplings.</li> </ul> <p>The motor is a 3-phase AC motor.</p> <p><b>Liquid:</b>            Liquid temperature range: -4 .. 248 °F            Liquid temp: 68 °F            Density: 62.29 lb/ft³</p> <p><b>Technical:</b>            Speed for pump data: 3425 rpm            Rated flow: 4.403 US gpm            Rated head: 40 ft            Shaft seal: HQQE            Approvals on nameplate: ANSI/NSF61            Curve tolerance: ISO 9906 Annex A</p> <p><b>Materials:</b>            Pump housing: Stainless steel            DIN W.-Nr. 1.4408            ASTM A 351 CF 8M</p>	On request



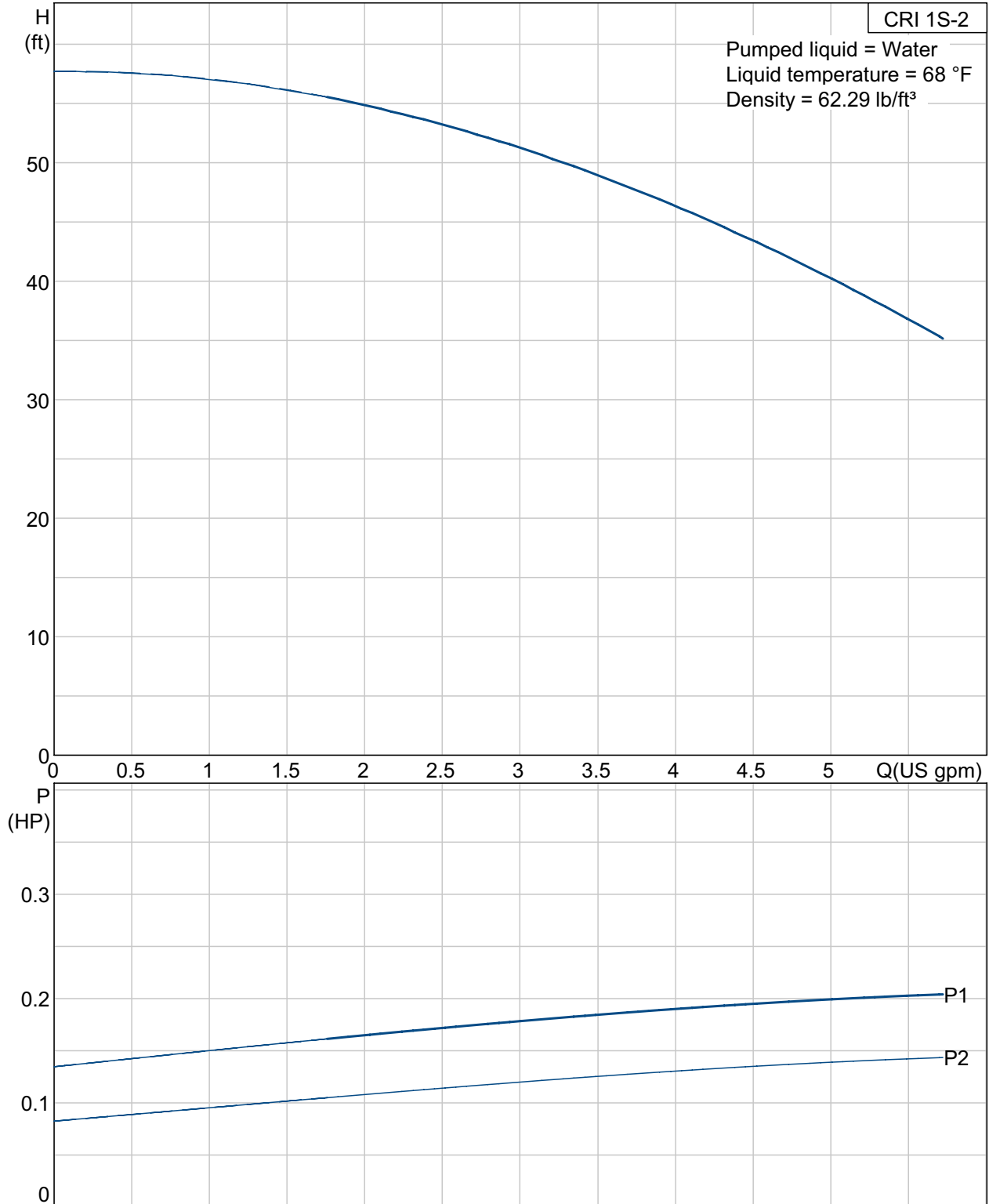
Company name: -  
 Created by: -  
 Phone: -  
 Fax: -  
 Date: -

Position	Count	Description	Unit price
		<p>Impeller: Stainless steel            DIN W.-Nr. 1.4301            AISI 304</p> <p><b>Installation:</b>            Maximum ambient temperature: 104 °F            Max pressure at stated temperature: 363 psi / 250 °F              363 psi / -4 °F</p> <p>Flange standard: ANSI            Pipe connection: 1 1/4"            Pressure stage: CLASS 300            Flange size for motor: 56C</p> <p><b>Electrical data:</b>            Motor type: GRUNDFOS            Number of poles: 2            Rated power - P2: 0.33 HP            Power (P2) required by pump: 0.33 HP            Main frequency: 60 Hz            Rated voltage: 3 x 208-230 / 460 V            Rated current: 1.12-1.10 / 0.55 A            Starting current: 630-700 %            Cos phi - power factor: 0.81-0.75            Rated speed: 3450-3480 rpm            Motor efficiency at full load: 78.5 %            Motor efficiency at 3/4 load: 77.5-78.0 %            Motor efficiency at 1/2 load: 72.5-73.5 %            Enclosure class (IEC 34-5): 55            Insulation class (IEC 85): F</p> <p><b>Others:</b>            Net weight: 49.4 lb            Gross weight: 54.9 lb            Shipping volume: 1.77 ft³</p>	



Company name: -  
Created by: -  
Phone: -  
Fax: -  
Date: -

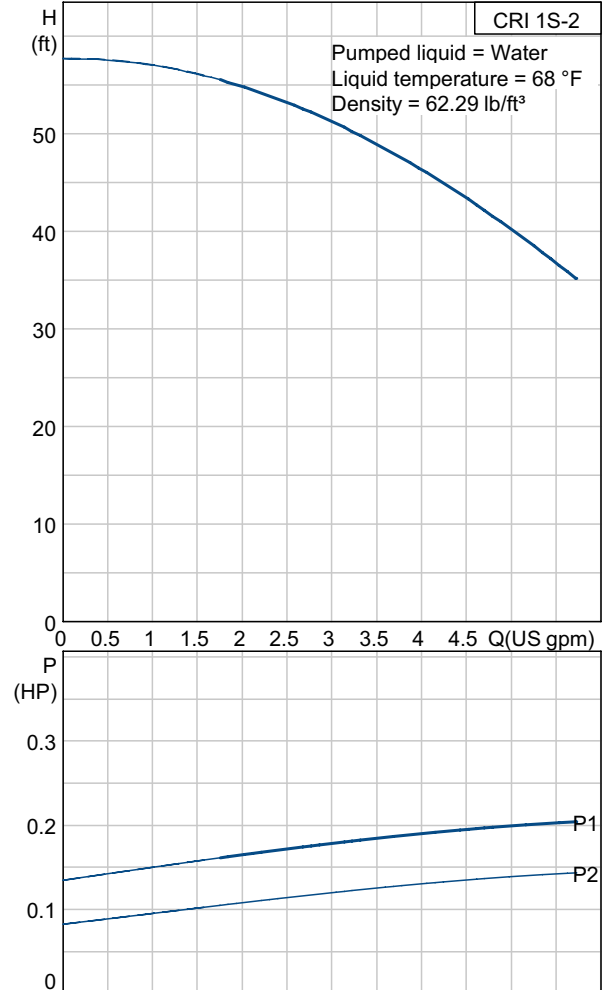
### 96081401 CRI 1S-2 60 Hz





Company name: -  
 Created by: -  
 Phone: -  
 Fax: -  
 Date: -

Description	Value
Product name:	CRI 1S-2 A-FGJ-I-E HQQE
Product No.:	96081401
EAN:	5700395157802
<b>Technical:</b>	
Speed for pump data:	3425 rpm
Rated flow:	4.403 US gpm
Rated head:	40 ft
Impellers:	2
Shaft seal:	HQQE
Approvals on nameplate:	ANSI/NSF61
Curve tolerance:	ISO 9906 Annex A
Stages:	3
Pump version:	A
Model:	A
Cooling:	TEFC
<b>Materials:</b>	
Pump housing:	Stainless steel DIN W.-Nr. 1.4408 ASTM A 351 CF 8M
Impeller:	Stainless steel DIN W.-Nr. 1.4301 AISI 304
Material code:	I
Code for rubber:	E
<b>Installation:</b>	
Maximum ambient temperature:	104 °F
Max pressure at stated temperature:	363 psi / 250 °F 363 psi / -4 °F
Flange standard:	ANSI
Connect code:	FGJ
Pipe connection:	1 1/4"
Pressure stage:	CLASS 300
Flange size for motor:	56C
<b>Liquid:</b>	
Liquid temperature range:	-4 .. 248 °F
Liquid temp:	68 °F
Density:	62.29 lb/ft <sup>3</sup>
<b>Electrical data:</b>	
Motor type:	GRUNDFOS
Number of poles:	2
Rated power - P2:	0.33 HP
Power (P2) required by pump:	0.33 HP
Main frequency:	60 Hz
Rated voltage:	3 x 208-230 / 460 V
Rated current:	1.12-1.10 / 0.55 A
Starting current:	630-700 %
Cos phi - power factor:	0.81-0.75
Rated speed:	3450-3480 rpm
Motor efficiency at full load:	78.5 %
Motor efficiency at 3/4 load:	77.5-78.0 %
Motor efficiency at 1/2 load:	72.5-73.5 %
Enclosure class (IEC 34-5):	55
Insulation class (IEC 85):	F
Motor protection:	NONE
Motor Number:	85900700



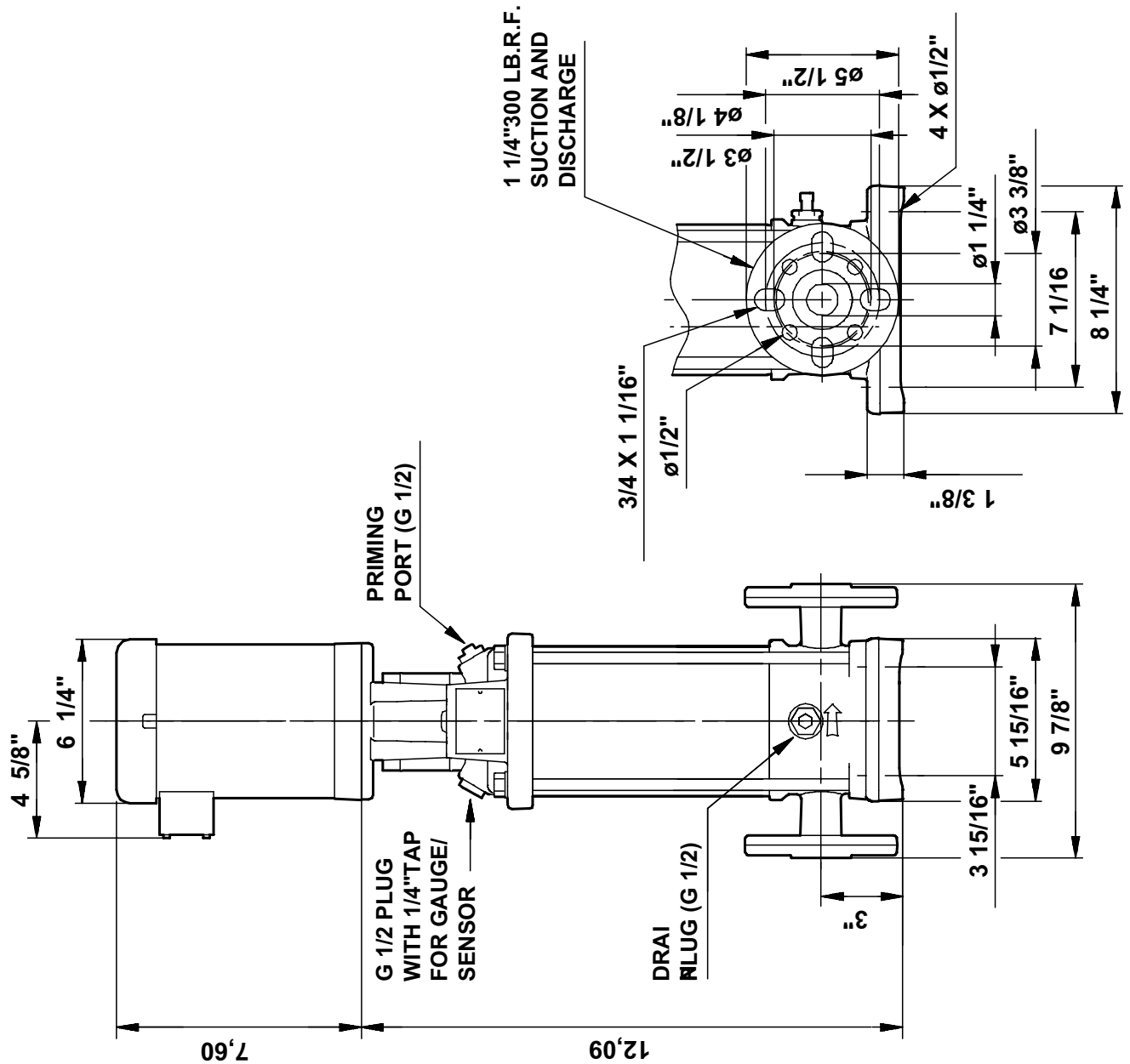




Company name: -  
Created by: -  
Phone: -  
Fax: -  
Date: -

Description	Value
Others:	
Net weight:	49.4 lb
Gross weight:	54.9 lb
Shipping volume:	1.77 ft <sup>3</sup>

## 96081401 CRI 1S-2 60 Hz



Note! All units are in [mm] unless others are stated.  
 Disclaimer: This simplified dimensional drawing does not show all details.

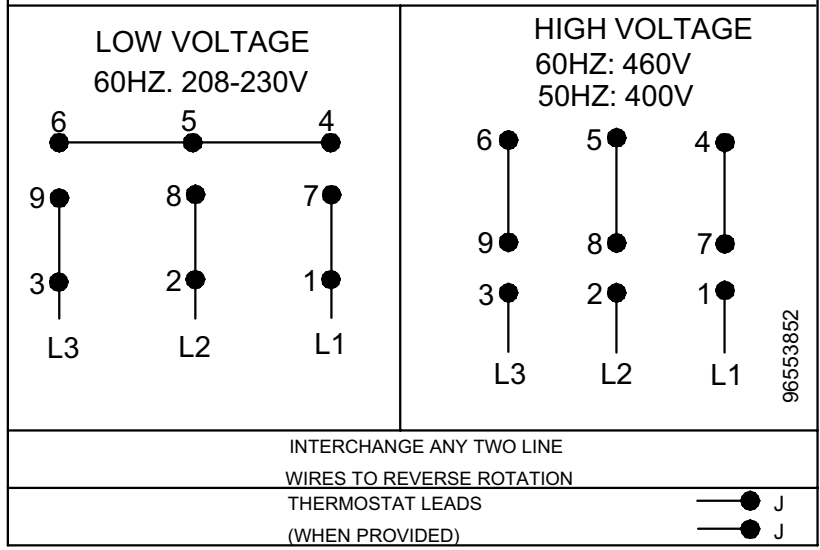
96081401 CRI 1S-2 60 Hz



**WARNING**

MOTOR MUST BE GROUNDED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND LOCAL CODES BY TRAINED PERSONNEL TO PREVENT SERIOUS ELECTRICAL SHOCKS.

TO SERVICE MOTOR, DISCONNECT POWER SOURCE FROM MOTOR AND ANY ACCESSORY DEVICES AND ALLOW MOTOR TO COME TO A COMPLETE STAND STILL.



All units are [mm] unless otherwise presented.

## **24. Flow Meters – Water**

## IFS 4000 KC (ENVIROMAG) Electromagnetic flowmeters ... for water and wastewater measurements

- short inlet and outlet runs
- unaffected by contamination, solids, fibers, slurries
- no maintenance, no zero point calibration, no precalibration, no periodic recalibration
- consistent results independent of age of meter
- wet-calibration on accredited (EN 17025) calibration rigs in factory and supplied with test certificate
  - suitable for potable water, chlorinated, fluorinated water, etc.
  - continuous self-diagnosis



### Electromagnetic flowmeters

Variable area flowmeters

Mass flowmeters

Ultrasonic flowmeters

Vortex flowmeters

Flow controllers

Level measuring instruments

Pressure and temperature

Heat metering

Communications technology

Switches, counters, displays and recorders

Engineering systems & solutions

# ENVIROMAG 4000

## The modular system with the ENVIROMAG 4000 Hardrubber or Polyurethane flow sensor

This modular system has the right electromagnetic flowmeter for your specific application - right from both the flowmetering and the economic viewpoint.



**Quality**  
Flowmeters are manufactured ISO 9000 - certified quality assurance standard.

## ENVIROMAG 4000 Hardrubber or Polyurethane

### Economic Benefits

- **Low investment and operating costs**
- **Meter size 1" - 60" flange connections to ANSI and AWWA**
- **Flow sensor:**  
Hardrubber: 1" - 60"  
Polyurethane: 1" - 40"
- **Easy, quick, low-cost installation**
- **Short delivery times, allowing just-in-time purchasing**
- **Absolutely maintenance-free, reliable, no mechanically moving parts**

The ENVIROMAG 4000 flow is compatible with all KROHNE signal converters:

Combinations available:

ENVIROMAG 4010 C Compact version with 010 converter

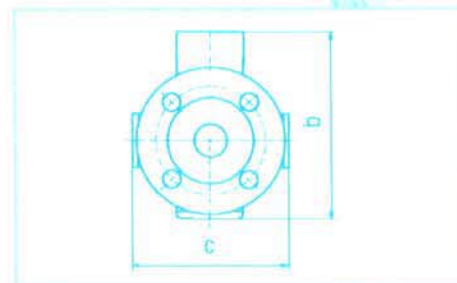
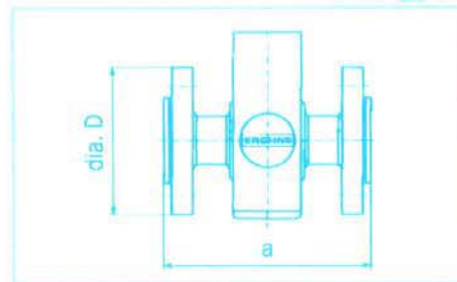
ENVIROMAG 4090 C Compact version with 090 converter

ENVIROMAG 4010 F Field version with separate 010 converter

ENVIROMAG 4090 F Field version with separate 090 converter

### Wide scope of application

- Suitable for water and wastewater
- For process temperature up to 176°F
- For pressure up to 580 psig
- IP 67 protection equivalent to NEMA 6, suitable for short-time submersion
- **Its favourable price/ performance payoff and low operating costs** means that the flowmeter will quickly pay for itself even in applications where it was previously not possible to carry out measurements at all or only using other methods.





## ENVIROMAG 4000

### ENVIROMAG 4000 Hardrubber and Polyurethane

#### Compact Systems



ENVIROMAG 4010 C



ENVIROMAG 4090 C

#### Flow sensor



ENVIROMAG 4000

#### Separate systems



IFC 010



IFC 090

## ENVIROMAG 4000

### Hardrubber

<b>Meter sizes</b>	1" – 60"				
<b>Pipe flanges</b>	1" – 24" / Class 150 lb / RF				
to ANSI B 16.5	28" – 60" / Class D / RF				
to AWWA					
<b>Electrical conductivity</b>	≥ 5 µS/cm				
<b>Temperatures</b>	Ambient temperature	Process temperature			
ENVIROMAG 4000 Compact systems	-13 to + 140°F	-13 to +140°F			
<b>ENVIROMAG 4000 F (separate)</b>					
Hardrubber (ANSI 4" - 60")	-13 to + 140°F	-13 to +176°F			
In storage	-13 to + 140°F				
<b>Vacuum load</b>					
<b>Liner</b>	<b>Meter size</b>	<b>Max. Allowed vacuum load in psig at product temperature of ...</b>			
		<b>&lt; 68°F</b>	<b>&lt; 104°F</b>	<b>&lt; 140°F</b>	<b>&lt; 176°F</b>
Hardrubber	1" - 60"	3.6	3.6	5.8	5.8
<b>Insulation class of field coils</b>	E				
<b>Electrodes design</b>	1"-60"	replaceable electrodes			
<b>Protection category</b>	IP 67 and IP 68				
<b>Materials</b>					
Measuring tube	Stainless steel 1.4301 (AISI 304 )				
Electrodes	AISI 316 L ( option HC, Titanium )				
Housing	Steel SAE 1008, paint finish				
Grounding rings	Stainless steel 1.4435 ( AISI 316 ) / 1.4301 ( AISI 304 )				
Terminal box	Die-cast aluminium				

Liner	Flange standard	Nominal diameter	Pressure rating class	Max. operating pressure in psi					
				at a process temperature of					
				<68°F	<104°F	<140°F	<176°F	<194°F	
Hardrubber	ANSI B 16.5	1" - 6"	150 lb	286	284	276	271	—	
			300 lb			on request			
		8"	150 lb	286	284	276	271	—	
			300 lb	343	343	339	326	—	
		10"	150 lb	286	284	276	271	—	
			300 lb	466	466	466	466	—	
		12"	150 / 300 lb	286	284	276	265	—	
		14"	150 / 300 lb	258	258	255	245	—	
		16"	150 / 300 lb	226	226	223	215	—	
		18"	150 / 300 lb	200	200	199	190	—	
		20"	150 / 300 lb	180	180	178	171	—	
		24"	150 / 300 lb	206	206	205	197	—	
		AWWA	28" – 60"	D	145	145	145	145	—



**Polyurethane**

<b>Pipe flanges</b>		
to ANSI B 16.5	1" – 24" / Class 150 lb / RF	
to AWWA	28" – 40" / Class D / RF	
<b>Electrical conductivity</b>	≥ 5 μS/cm	
<b>Temperatures</b>	Ambient temperature	Process temperature
ENVIROMAG 4000 C (compact)	-13 to + 140°F	-13 to +140°F
ENVIROMAG 4000 F (separate)		
Polyurethane 1" – 40"	-13 to + 140°F	-13 to + 140°F
In storage	-13 to + 140°F	
<b>Vacuum load</b>	max. allowed vacuum load 7.2 psig (<104°F)	
<b>Insulation class of field coils</b>	E	
<b>Electrodes design 1" - 60"</b>	<b>Replaceable</b> electrodes	
<b>Protection category</b>	IP 67 and IP 68	
<b>Materials</b>		
Measuring tube	Stainless steel 1.4301 ( AISI 304)	
Electrodes	AISI 316 L ( option HC, Titanium )	
Housing	Steel SAE 1008, paint finish	
Grounding rings	Stainless steel 1.4435 ( AISI 316 ) / 14301 ( AISI 304 )	
Terminal box	Die-cast aluminium	

Liner	Flange standard	Nominal diameter	Pressure rating class	Max. Operating pressure in psi					
				at a process temperature of ...					
				<68°F	<104°F	<140°F	<176°F	<194°F	
Polyurethane	ANSI B 16.5	1" – 3"	150 lb	286	284	276	—	—	
			300 lb			on request			
	ANSI B 16.5	4" – 6"	150 lb	286	284	276	—	—	
			300 lb			on request			
		8"	150 lb	286	284	276	—	—	
			300 lb	343	343	339	—	—	
		10"	150 lb	286	284	276	—	—	
			300 lb	466	466	466	—	—	
		12"	150 / 300 lb	286	284	276	—	—	
		14"	150 / 300 lb	258	258	255	—	—	
		16"	150 / 300 lb	226	226	223	—	—	
		18"	150 / 300 lb	200	200	199	—	—	
		20"	150 / 300 lb	180	180	178	—	—	
		24"	150 / 300 lb	206	206	205	—	—	
		AWWA	28" – 40"	D	145	145	145	—	—

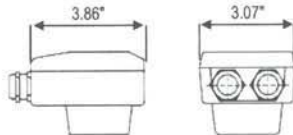
**Dimensions and weights**

ENVIROMAG 4000 Hardrubber and Polyurethane

The total dimension for the height is obtained from dimension B (see table) plus the height of the terminal box or the signal converter, see drawings.  
The total weight is made up of the weight of the flow sensor (see table) plus the weight of the terminal box or signal converter, see below.

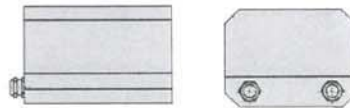
**Terminal Box**

Weight approx. 1.1 lb



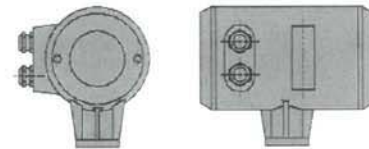
**IFC 010 K and IFC 020 K**

Signal converters  
Weight approx. 3.6 lb



**IFC 090 K**

Signal converter  
Weight approx. 5.1 lb



Flange connections to			Dimensions in inch
ANSI B 16.5	1" – 24"	150 lb / RF	see table
		≥ 300 lb / RF	information supplied on request
AWWA	28"	Class B, D / RF	information supplied on request

Dimension "A":

With grounding rings

Gaskets not included with flowmeter

Dimension A + 2x thickness of the gasket + 2x 0.12" (thickness of grounding rings)

Nominal Diameter ANSI Inch	Dimensions in inch								Weight approx. lb
	A		B		C		D		
	DIN ISO	ANSI	DIN. ISO	ANSI	DIN. ISO	ANSI	DIN. ISO	ANSI	
1"	5.91	5.91	9.21	9.21	5.12	5.12	4.53	4.25	6.90
1 1/2"	5.91	5.91	9.21	9.21	5.12	5.12	5.91	5.00	13.20
2"	7.87	7.87	7.52	7.28	6.50	6.00	6.50	6.00	17.60
3"	7.87	7.87	8.23	8.03	7.87	7.50	7.87	7.50	37.50
4"	9.84	9.84	10.04	10.24	8.66	8.98	8.66	8.98	41.90
5"	9.84	9.84	11.03	11.10	9.84	10.00	9.84	10.00	48.50
6"	11.81	11.81	11.81	11.69	11.22	10.98	11.22	10.98	57.30
8"	13.78	13.78	14.06	14.17	13.39	13.50	13.39	13.50	110.20
10"	15.75	15.75	16.97	17.20	15.55	16.00	15.55	16.00	161.00
12"	19.69	19.69	19.02	19.76	17.52	19.02	17.52	19.02	218.30
14"	19.69	19.69	21.30	21.85	19.88	21.00	19.88	21.00	251.30
16"	23.62	23.62	24.92	24.92	22.24	23.50	22.24	23.50	337.30
18"	23.62	23.62	26.22	26.54	24.21	25.00	24.21	25.00	374.80
20"	23.62	23.62	28.11	28.62	26.38	26.38	26.38	27.50	418.90
24"	23.62	23.62	33.07	33.66	30.71	32.00	30.71	32.00	551.10
28"	27.56	27.56	36.61	37.68	35.24	36.50	35.24	36.50	661.40
30"	31.50	31.50	-	42.91	-	38.75	-	38.75	793.70
32"	31.50	31.50	41.34	42.24	39.96	41.75	39.96	41.75	1,003.00
36"	35.43	35.43	45.91	47.09	43.90	46.00	43.90	46.00	1,212.50
40"	39.37	39.37	50.16	50.91	48.43	50.75	48.43	50.75	1,385.00
42"	51.18	51.18	-	55.40	-	53.00	-	53.00	1,541.00
48"	51.18	51.18	59.91	62.13	57.28	59.50	57.28	59.50	1,995.00
54"	62.99	62.99	-	68.11	-	66.25	-	66.25	2,275.00
60"	66.93	66.93	-	73.82	-	73.00	-	73.00	3,858.00

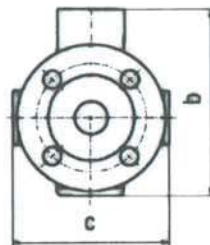
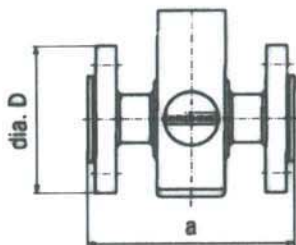
1" to 24" - weight with ANSI flanges

28" to 40" - weight with AWWA Class D flanges

42" to 60" - weight with AWWA Class B flanges

Dimensions

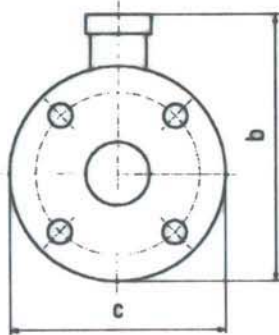
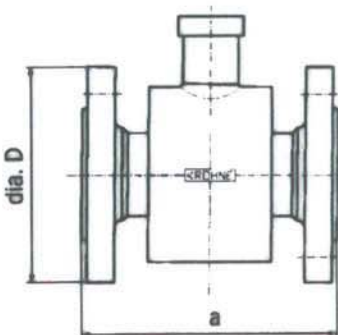
1" - 1 1/2"



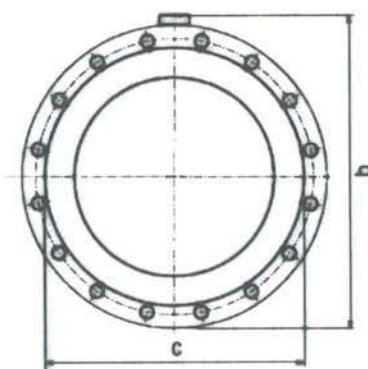
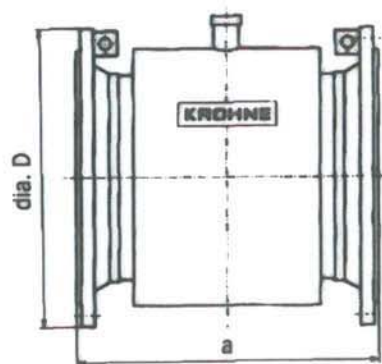
Tolerance details for fitting length dimensions "A"

ANSI B 16.5  
 $\leq 12"$  :  $\pm 0.5\%$ , min.  $\pm 0.04"$   
 $\geq 14"$  :  $\pm 0.5\%$

2" - 12"



14" - 60"





### Selection of meter size

The optimum flow velocity should be 6 - 9 ft/s. For products with solids contents between 9 and 15 ft/s. The exact flow velocity can be determined from the columns in the tables.

v = 40 ft/s as shown in the following example:

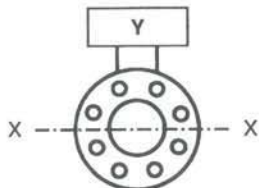
- Meter size: 3"
- Desired measuring range:  
200 US Gal/min  
From the table obtain for  
v = 40 ft/s the flow rate of 955.9 US Gal/min at 3" meter size  
v = 200 US Gal/min x 40 ft/s : 955.9 US Gal/min  
v = 8.37 ft/s

Meter size inch	Q <sub>100%</sub> in US Gal/min	
	v = 1 ft/s (minimum)	v = 40 ft/s (maximum)
1	2.334	93.34
1 1/2	5.979	239.0
2	9.339	373.5
3	23.90	955.6
4	37.35	1.493
5	58.38	2.334
6	84.05	3.361
8	149.43	5.975
10	233.4	9.334
12	336.2	13.442
14	464.8	18.593
16	597.9	23.899
20	933.9	37.345
24	1.345	53.781
28	1.919	76.76
30	2.203	88.133
32	2.507	100.272
36	3.173	126.904
40	3.917	156.672
42	4.121	164.693
48	5.464	218.56
54	6.807	272.255
60	8.405	336.114

### Recommendations for installation

Location and position as required, but electrode axis

x - - - - x must be approximately horizontal in a horizontal pipe run.



Y terminal box or converter housing

- Measuring tube must be completely filled at all times.
- **Direction of flow is arbitrary.**
- **Stud bolts and nuts:** to fit, make sure there is sufficient room next to the pipe flanges.
- **Vibration:** support the pipeline on both sides of the compact flowmeter.
- **Do not expose to direct sunlight,** fit a sunshade if necessary, not included with flowmeter, to be provided by customer.
- **Large meter sizes (= 8"):** use adapter pipes to allow axial shifting of the counter flanges and to facilitate installation.
- **Strong electromagnetic fields,** avoid in vicinity of flowmeter.
- **Straight inlet run minimum of 5 x DN and outlet run minimum of 2 x DN,** (DN = meter size), measured from the electrode axis.
- **Vortex and corkscrew flow:** increase length of inlet and outlet runs or install flow conditioners.
- **Mixing different process liquids:** install flowmeter upstream of mixing point or at an adequate distance downstream (minimum of 30 x DN), otherwise display may be unsteady.
- **Plastic pipes and internally coated metal pipelines:** grounding rings required.
- **Insulated pipeline:** do not insulate flowmeter.
- **Zero setting not necessary:** To check, it should be possible to set "zero" flow velocity in the completely filled measuring tube. Shutoff valves should therefore, be provided either downstream of the flowmeter or upstream and downstream of the flowmeter.

### Grounding rings

For process flow measurement reasons the product must be grounded. Such as grounding system is lacking in pipes upstream and downstream of the flow sensors which features a corrosion-resistant internal coating or liner, or are made entirely of plastic material. In such cases, grounding rings must be fitted on both sides of the flow sensor.

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## **25. Flow Meter Air**



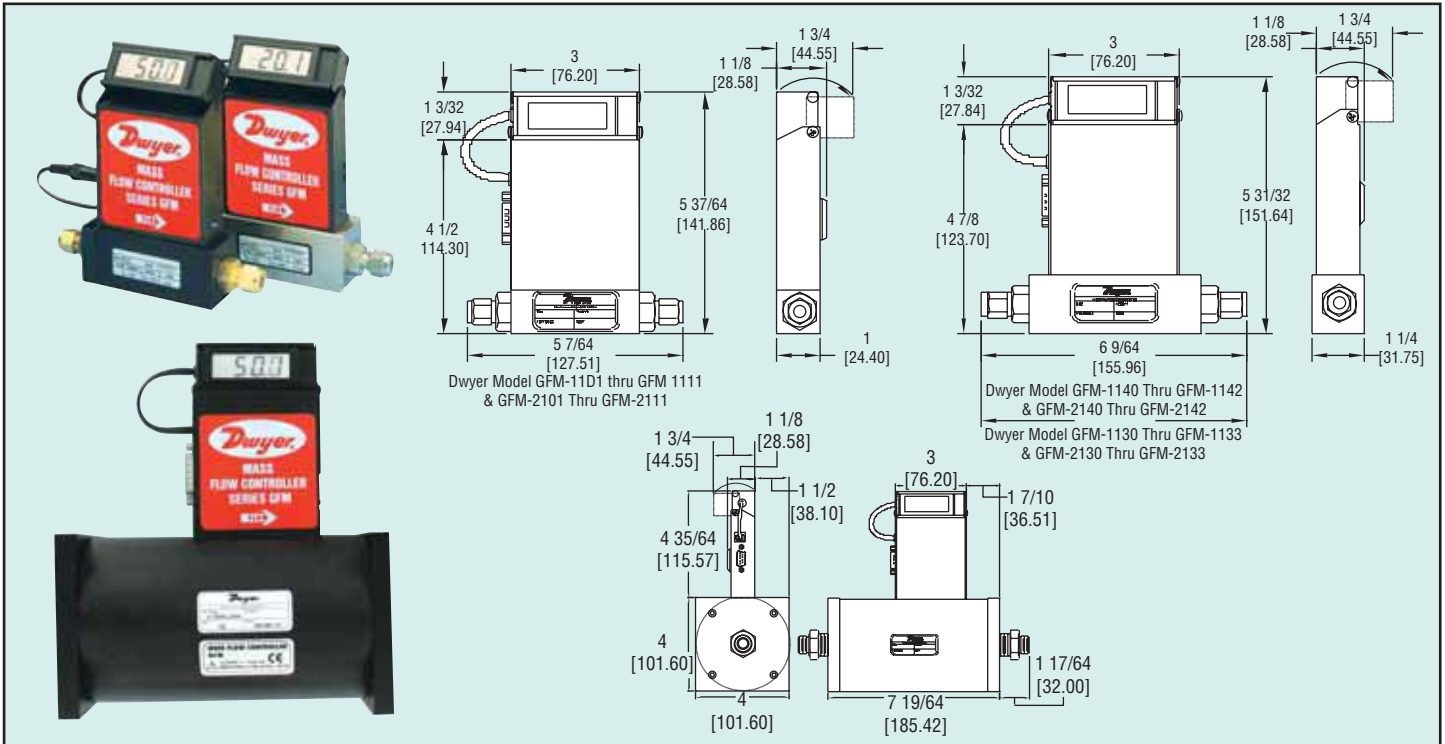
Series  
GFM

# Gas Mass Flow Meters

Flow Range Up to 1000 L/min, Pressures Up to 500 psi, NIST Traceable



Flow



Series GFM Gas Mass Flow Meters combine a straight tube sensor with a restrictor flow element to provide high accuracy and repeatability. Flow rates are virtually unaffected by temperature and pressure variations. Actual gas flow is displayed in engineering units on a 3-digit, 90° tiltable LCD readout. Units can be used with Series GFT Flow Totalizer for applications requiring totalization. Series GFM includes a NIST traceable certificate.

Flow Range	Meters		Process Connector Compression Fitting
	Aluminum	SS	
0-10 sccm	GFM-1101*	GFM-2101*	1/4"
0-20 sccm	GFM-1102*	GFM-2102*	1/4"
0-50 sccm	GFM-1103*	GFM-2103*	1/4"
0-100 sccm	GFM-1104*	GFM-2104*	1/4"
0-200 sccm	GFM-1105*	GFM-2105*	1/4"
0-500 sccm	GFM-1106*	GFM-2106*	1/4"
0-1 L/min	GFM-1107*	GFM-2107*	1/4"
0-2 L/min	GFM-1108*	GFM-2108*	1/4"
0-5 L/min	GFM-1109*	GFM-2109*	1/4"
0-15 L/min	GFM-1111*	GFM-2111*	1/4"
0-30 L/min	GFM-1131*	GFM-2131*	1/4"
0-50 L/min	GFM-1133*	GFM-2133*	1/4"
0-100 L/min	GFM-1142*	GFM-2142*	3/8"
0-200 L/min	GFM-1143*	GFM-2143*	3/8"
0-500 L/min	GFM-1144*	GFM-2144*	1/2"
0-1000 L/min	GFM-1145*	GFM-2145*	3/4"

\*Specified flow ranges are for an equivalent flow of nitrogen at 70°F (21°C) @ 760 mm Hg.

## SPECIFICATIONS

**Service:** Clean gases compatible with wetted parts.

**Wetted Materials:** GFM-1XXX: Anodized Aluminum, Brass, 316 SS and Fluoroelastomer O-rings; GFM-2XXX: 316 SS and Fluoroelastomer O-rings.

**Accuracy:** ±1.5% FS including linearity over 59 to 77°F (5 to 25°C) and 5 to 60 psia (0.35 to 4 bar).

**Repeatability:** ±0.5% of full scale.

**Response Time:** 2 seconds to within ±2% of actual flow.

**Output:** Linear 0-5 VDC and 4-20 mA.

**Max. Particulate Size:** 5 microns.

**Temperature Limits:** 32 to 122°F (0 to 50°C).

**Power Supply:** ±12 VDC.

**Process Connections:** 1/4" compression fitting for flow rates ≤50 L/m; 3/8" for 100 and 200 L/m; 1/2" for 500 L/min; 3/4" for 1000 L/min.

**Pressure Limits:** 500 psig (34.5 bar).

**Leak Integrity:** 1 x 10<sup>-7</sup> sccs of Helium.

**Display:** 90° tiltable, 3-1/2 digit.

**Agency Approvals:** CE.

## ACCESSORIES

**For Series GFM Gas Mass Flowmeters**

**Model GFM-110P,** 110V Power Supply

**Model GFM-220PE,** 220V Power Supply

**Model GFM-CBL4,** 3 ft cable for 4-20mA output

**Model GFM-CBL5,** 3 ft cable for 0-5 VDC output

**Model IO-1,** 0-5 VDC to RS232 Input to Output

**Signal Conditioner**

**GFT-10,** Flow Totalizer with 5-10 VDC input for direct connection to GFM and GFC (replaces GFM/GFC LCD Process display)

**GFT-10C,** Connection Cable for utilizing GFT-10 totalizer in conjunction with GFM/GFC LCD process display

## **26. Air/Vacuum Relief Valve**

# KINETIC COMPACT COMBINATION AIR VALVE

1/2" thru 1" NPT Inlet and Outlet



FIG. 945

## COMBINETIC

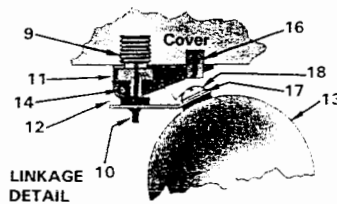
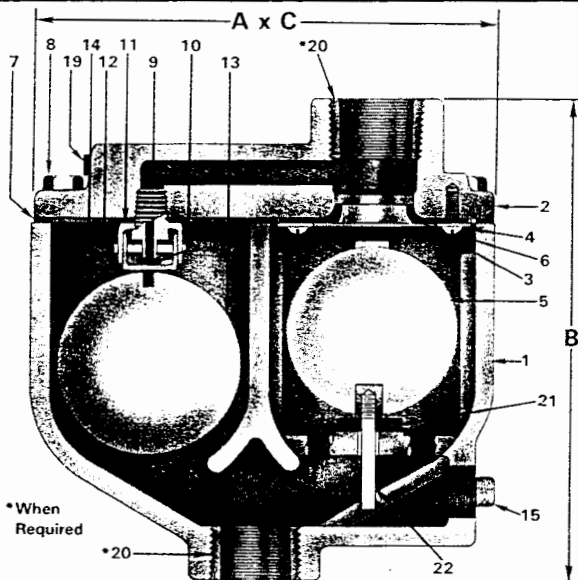


FIG. 945

## GENERAL DIMENSIONS

VALVE SIZE	A (LENGTH)	B (HEIGHT)	C (WIDTH)	WEIGHT (LBS.)
1/2" NPT	6 1/2"	7 1/4"	3 7/8"	16
3/4" NPT	6 1/4"	7 1/4"	3 7/8"	16
1" NPT	6 1/4"	7 1/4"	3 7/8"	16

## ENGINEERING SPECIFICATION

The Combination Air Valve shall consist of a KINETIC Air & Vacuum Valve and an Air Release Valve contained in a single body housing. The valve shall be designed to exhaust large amounts of air during filling, to release small amounts of accumulated air during operation and to admit large amounts of air upon impending vacuum during draining.

The inlet shall be the nominal size of the valve and the outlet shall be the same size as the inlet. Body and cover shall be of cast iron conforming ASTM A126, Class B. The Air & Vacuum portion of the valve shall be designed to exhaust air at up to sonic velocity without blowing shut. The floats shall be spherical and shall be capable of withstanding a test pressure of 1000 psi. The Air Release portion shall have a stainless steel leverage mechanism and float. The small orifice shall be stainless steel and have a rubber seat.

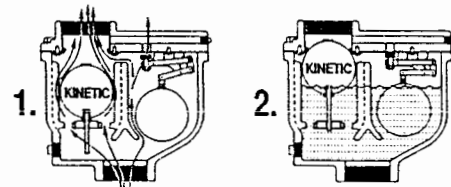
Kinetic Compact Combination Air Valves shall be as manufactured by GA Industries, Inc., Mars, PA, their Figure 945.

## PARTS LIST

1. BODY - Cast Iron, A126 Class B
2. COVER - Cast Iron, A126 Class B
3. SEAT (Air Vacuum) - Buna-N
4. SUPPORT RING - 304 Stainless Steel
5. FLOAT BALL (Air Vacuum) - 304 Stainless Steel
6. SEAT SCREWS - 18-8 Stainless Steel
7. COVER GASKET - Composition
8. COVER BOLTS - Steel Grade 2
9. ORIFICE - 303 Stainless Steel
10. ORIFICE BUTTON - Buna-N
11. LEVERAGE BRACKET - 302/304 Stainless Steel
12. FLOAT ARM - 302/304 Stainless Steel
13. FLOAT BALL (Air Release) - 304 Stainless Steel
14. COILED SPRING PIN - 302 Stainless Steel
15. PIPE PLUG - Steel (Commercial)
16. SLOTTED SPRING PIN - 410/420 Stainless Steel
17. LOCKWASHER - 18-8 Stainless Steel
18. FLOAT SCREW - 18-8 Stainless Steel
19. COUNTERSUNK PLUG - Steel (Commercial)
20. REDUCING BUSHING - Steel (Commercial)
21. CUSHION - Buna-N
22. BALL GUIDE - UHMW-PE

## ENGINEERING DATA

### Kinetic Operating Principle of the Combinetic Valve:



1. During the exhausting sequence, the air flowing around the large orifice Buoy ball produces a resultant downward force which maintains the ball in the open position.
2. The buoyant force of the balls will seal both orifices when water reaches the balls.

### Pressure Rating:

NPT Inlet Body rated to 300 psi WOG; tested to 450 psi.

Floats tested to 1000 psi.

### Working Pressure:

10-150 psi with 3/32" orifice (Standard-Fig. 945)  
10-300 psi with 1/16" orifice (Optional-Fig. 945H)  
Consult factory if operating pressure is less than 10 psi.

### Small Orifice (Air Release) Maximum Venting Rate: Fig.945

@ 150 psi with 3/32" orifice = 14.7 SCFM Fig.945-H

@ 300 psi with 1/16" orifice = 8.5 SCFM

For Sizing and Locating see pages 16-17,36-37.

### Connections:

Inlet - NPT, Standard  
Outlet - NPT, Standard

### Options:

For Optional Outlet Cowl specify 945-C.

For Optional Throttling Device specify 945-D, see pages 41 and 35.



## **27. Pressure Relief Valve – Filter Vessels**



Section VIII  
Pressure Vessels

## 500 Series Multi-Purpose Safety Relief Valves

Versatile safety relief valve available in bronze, carbon steel or all stainless steel construction, suitable for a wide range of steam, air, gas and liquid applications. High capacity full nozzle design is available with metal to metal, PCTFE or elastomer O-ring seating. Short tuned blowdown and backpressure tight body minimizes fugitive emissions and product losses in the event of valve operation.

ASME Section VIII Air, Steam, and Liquid service  
 Sizes 1/2" through 2" NPT  
 Set pressure range 5-900 psig @ 800°F max.  
 (See press. / temp. limit chart below for specific ratings for each model).



### Applications:

- Pressure Vessels and Pressure Piping Systems
- Pumps, Tanks and Hydraulic Systems
- Thermal Relief of Liquid Filled Vessels
- Chemical, Process and other Industrial Plants.
- Power Plant Auxiliary Systems
- Cryogenic and Industrial Gases
- Air and Gas Compressors and Dryers
- Vacuum Relief

### Features

- Wide Range of Materials and Options
- One Trim Design is Suitable for Steam, Air / Gas and Liquid Service
- High Capacity Full Nozzle Design
- Stainless Steel Springs
- Integral Lift Stop
- Self - Aligning Pivoting Disc
- API 527 Seat Tightness, standard for all models
- Tuned Blowdown - Short and Adjustable, reduces product losses.
- Backpressure Tight Design Minimizes Fugitive Emissions
- CSA B51 CRN OG8547.5C

### Options

- Screwed Cap (standard), Packed Lift Lever
- Test gags
- Elastomer or PCTFE Soft Seat for Exceptional Seat Tightness
- High Temperature Alloy Springs for 422°F - 800°F Service
- Special Cleaning Available
- Cryogenic Preparation (Consult factory)

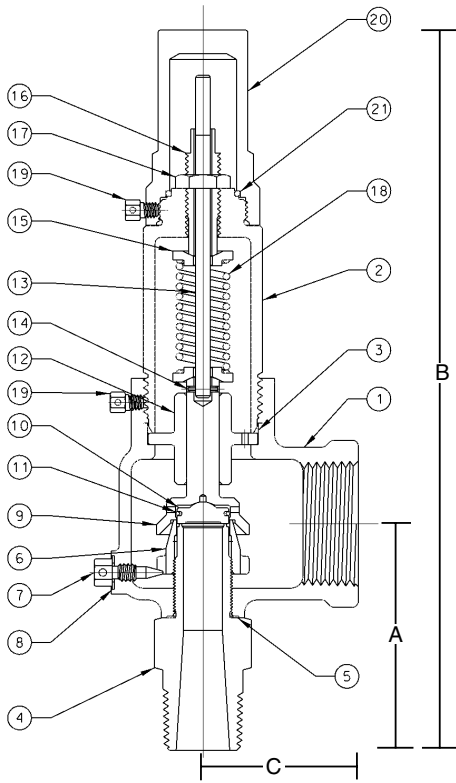
## 500 Series Model Numbering System

52	3	J	H	B	K	M	AA	0425
Series Body/Trim Mat'l	Cap	Orifice Letter	Inlet Size	Connection	Service	Seat	Special Options	Set Pressure
51=Bronze/Brass	1=Screwed Cap	D	C=1/2	B=MNPT X FNPT	J=Sec VIII Liquid	M=Metal	Factory Issued	Set pressure
52=Bronze/ Stainless	2=Screwed + Gag	E	D=3/4		K=Sec VIII Air/Gas	B=BUNA-N	Letters / Numbers	psig (4 Digits)
53=Carbon/ Stainless	3=Packed Lever	F	E=1	D=3/4 Outlet	L=SEC VIII Steam	E=EPR	For Special Options	
54=All Stainless	4=Packed + Gag	G	F=1-1/4	(Model 510 & 520 D Orifice Only)	M=Non Code Liquid	K=PCTFE	Or Features	Vacuum
		H	G=1-1/2		N=Non Code Air / Gas	N=Neoprene	"AA"=Default Standard	"HG" Prefix
		J	H=2		P=NON CODE Steam	S=Silicone	"HT" High Temp Spring	+ 2 Digits
					Q=Vacuum	V=Viton	"OX"=Cleaned For Oxygen	

### Notes:

1. The ASME Code Section VIII requires a lift lever for the following services: air, steam, or hot water over 140°F
2. Maximum back pressure is 50 psig.
3. High temperature stainless steel alloy spring is required above 422°F / 217°C. Specify option "HT"

## 500 Series Multi-Purpose Safety Relief Valves



**500 Assembly w/Screwed Cap**

### Materials

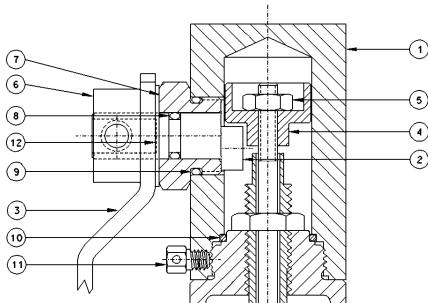
Item	Component	Material 510 Series	Material 520 Series	Material 530 Series	Material 540 series
1	BODY	BRONZE B-584-C844	BRONZE B-584-C844	STEEL SA-216 WCB	SS SA-351-CF8M
2	BONNET	BRASS*	BRASS*	STEEL**	SS TYPE 316***
3	BONNET SEAL	PTFE	PTFE	PTFE	PTFE
4	NOZZLE	BRASS B-16	SS TYPE 316	SS TYPE 316	SS TYPE 316
5	NOZZLE SEAL	PTFE	PTFE	PTFE	PTFE
6	NOZZLE RING	SS TYPE 316	SS TYPE 316	SS TYPE 316	SS TYPE 316
7	SET SCREW	BRASS	BRASS	SS TYPE 316	SS TYPE 316
8	SET SCREW SEAL	PTFE	PTFE	PTFE	PTFE
9	DISC HOLDER	BRASS	SS TYPE 316	SS TYPE 316	SS TYPE 316
10	DISC	SS TYPE 316	SS TYPE 316	SS TYPE 316	SS TYPE 316
11	RETAINING RING	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL
12	DISC GUIDE	BRASS	BRASS	SS TYPE 316	SS TYPE 316
13	STEM	BRASS	BRASS	SS TYPE 316	SS TYPE 316
14	SPRING PIN	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL
15	SPRING WASHER	BRASS	BRASS	SS TYPE 316	SS TYPE 316
16	ADJUSTING BOLT	BRASS	BRASS	SS TYPE 316	SS TYPE 316
17	LOCK NUT	BRASS	BRASS	SS TYPE 316	SS TYPE 316
18	SPRING	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL
	SPRING, HIGH TEMP.	INCONEL	INCONEL	INCONEL	INCONEL
19	LOCK SCREW	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL
20	CAP, SCREWED	BRASS	BRASS	STEEL	SS TYPE 316
	SEAL, CAP	VITON	VITON	VITON	VITON
-	NAMEPLATE	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL
-	DRIVE SCREW	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL
-	SEAL & WIRE	LEAD/SS	LEAD/SS	LEAD/SS	LEAD/SS

Notes:

\* Sizes G, H and J are Cast Bronze

\*\* Sizes H and J are Cast Steel

\*\*\* Sizes H and J are Cast Stainless Steel Type 316



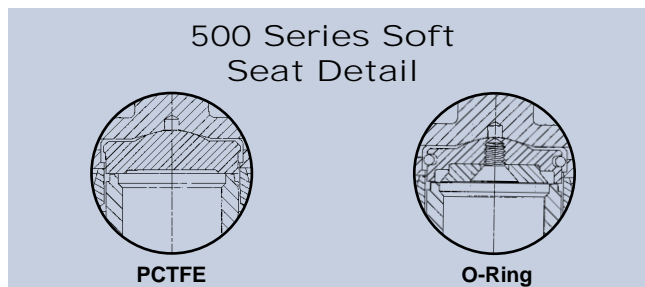
**Packed Lever Detail**

### Materials of Construction, Lift Lever Option

Item	Component	Material 513, 523 Series	Material 533 Series	Material 543 Series
1	CAP, PACKED LEVER	BRASS	STEEL	SS TYPE 316
2	CAM BUSHING	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL
3	LEVER	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL
4	LIFT WASHER	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL
5	LOCKNUT	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL
6	COLLAR	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL
7	CAM BUSHING	BRASS	STAINLESS STEEL	STAINLESS STEEL
8	CAM O-RING	VITON	VITON	VITON
9	BUSHING O-RING	VITON	VITON	VITON
10	SEAL, CAP	VITON	VITON	VITON
11	SET SCREW	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL
12	WASHER	PTFE	PTFE	PTFE



**Test Gag Detail**



## **28. Pressure Relief Valve – Progressive Cavity Pump**

# Adjustable Relief Valves

For information about relief valves, see page 455. For pipe size information, see pages 2-3.

## Brass and Bronze Extended-Life Adjustable Relief Valves

Made from a rugged bronze casting (unless noted) for long life in heavy duty applications. All are factory set at the midpoint of the pressure range.

**High-accuracy valves** have fine screw threads for more accurate adjustment and greater flow rates. For use with water and oil. Body is brass for 1/2" and 3/4" sizes; body is bronze for 1" and larger sizes. Seal is metal to metal and spring is Type 302 stainless steel. Temperature range is -60° to +406° F.

**Connections:** NPT male bottom inlet; NPT female side outlet.

**To Order:** Please specify pressure range: 0-14, 15-25, 26-40, 41-75, 76-110, 111-130, 131-150, 151-200, or 201-400 psi.

**Pressure-maintaining valves** are ideal for back-pressure relief in hydraulic systems and for hydraulic pumping units where a discharge pressure must be maintained. Use with water, liquids, and light fuel oils. They have a metal-to-metal seal and Type 302 stainless steel spring. Temperature range is -40° to +450° F.

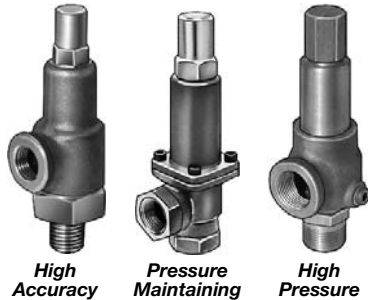
**Connections:** NPT female bottom inlet and side outlet.

**To Order:** Please specify pressure range: 15-75, 50-150 (50-140 psi for 1/4" and 3/8" sizes), 100-300, or 200-600.

**High-pressure valves** are for use with liquids only. They handle higher pressures than high-accuracy and pressure-maintaining valves. Choose a Type 316 stainless steel or Viton soft seal. Spring is Type 316 stainless steel. Temperature range is -10° to +406° F.

**Connections:** NPT male bottom inlet and NPT female side outlet.

**To Order:** Please specify pressure range in psi: 15-75, 50-150, 100-300, 200-600, or 600-900. Note: 1 1/2" pipe size is not available in 600-900 psi pressure range.



High Accuracy Pressure Maintaining High Pressure

High Accuracy		
Pipe Size	Ht.	Each
1/2".....3/4"	4703K54	\$110.39
3/4".....3/8"	4703K55	112.69
1".....4 7/8"	4703K56	130.63
1 1/4".....5 1/4"	4703K57	171.41
1 1/2".....6 1/4"	4703K58	205.78
2".....7 1/8"	4703K59	305.08
3".....8 3/8"	4703K62	774.11

Pressure Maintaining		
Pipe Size	Ht.	Each
1/4".....4 1/4"	4662K46	\$165.56
3/8".....4 1/4"	4662K48	170.90
1/2".....5 5/8"	4662K32	257.83
3/4".....5 5/8"	4662K34	266.15
1".....7 7/8"	4662K36	485.94
1 1/4".....7 7/8"	4662K38	504.99

High Pressure		
Pipe Size	Ht.	Each
<b>Type 316 Stainless Steel Seal</b>		
1/2".....4 7/8"	4460K81	\$297.41
3/4".....4 7/8"	4460K82	306.73
1".....4 7/8"	4460K83	339.28
1 1/4".....5"	4460K84	393.34
1 1/2".....5 7/8"	4460K85	476.02

Viton Soft Seal		
Pipe Size	Ht.	Each
1/2".....4 7/8"	4460K91	\$330.31
3/4".....4 7/8"	4460K92	347.58
1".....4 7/8"	4460K93	380.13
1 1/4".....5"	4460K94	438.81
1 1/2".....5 7/8"	4460K95	521.51

## Cast Iron Adjustable Pressure-Maintaining Relief Valves

Also known as back-pressure relief valves and back-pressure regulators, these cast iron valves can be used with oil and corrosive and viscous liquids. They maintain your adjusted set pressure at the inlet regardless of the outlet pressure. If the set pressure is exceeded, the excess is vented through the bottom relief port. Use in centrifugal, reciprocating, and rotary pump bypass applications. Not for use with steam. Pressure is factory set at mid-range, but is adjustable to any pressure within the range. All have a Monel diaphragm with series 300 stainless steel seal. Temperature range is -40° to +200° F.

**Connections:** NPT female side inlet and outlet and vented bottom relief port.

**To Order:** Please specify pressure range from those listed in the table.

Pipe Size	Ht.	Available Pressure Ranges, psi	Each
1/2".....6 3/4"	0-25, 5-50, 30-100, 75-175, 150-400	4675K21	\$531.14
3/4".....8"	10-50, 20-110, 30-200, 100-250, 150-400	4675K22	604.92
1 1/4".....10 1/16"	20-85, 40-125, 50-230, 175-380, 300-400	4675K25	941.28
1 1/2".....10 3/4"	10-55, 30-100, 40-200, 125-300, 200-400	4675K26	1088.80
2".....11"	10-55, 30-100, 40-200, 125-300, 200-400	4675K27	1204.06



## Bronze EZ-Adjustable Relief Valves

Change pressures without gauges or guesswork. These valves are small in size and can be used with cold water for overpressure relief, thermal expansion protection, and low-capacity pump relief. They have a bronze body, silicone rubber seal, and Type 302 stainless steel spring. **Connections:** NPT male bottom inlet and NPT female side outlet.

**Adjustable valves** adjust between 50 and 175 psi in 25 psi increments. Factory set at 100 psi. Temperature range is 32° to 200° F. **Precision-adjustable valves** adjust to any pressure between 25 and 175 psi. Valves have graduation marks every 25 psi and are factory set at 125 psi. Temperature range is 33° to 210° F.

Pipe Size, Inlet x Outlet	Height	Each
<b>Adjustable</b>		
1/2" x 1/2"	2 1/8"	4612K16 \$22.64
3/4" x 1/2"	2 1/8"	4612K18 24.46
<b>Precision Adjustable</b>		
1/2" x 1/2"	2 5/8"	8088K14 21.76
3/4" x 3/4"	2 5/8"	8088K16 23.46



Precision Adjustable

## Steel Tamper-Resistant Adjustable Relief Valves

Pressure setting is changed with an internal 3/8" hex nut that can't be adjusted while the valve is installed. Furnished with the pressure set at mid-range. For use with oils, synthetic hydraulic fluids, and other oil-based liquids. Body is zinc-plated steel and seal is PTFE. Springs for 50-400 psi valves are stainless steel; springs for other ranges are music wire. Temp. range is -40° to +300° F. **Connections:** NPT bottom inlet (see table) and side or top outlet. Valves include a plug to cap the unused outlet. **To Order:** Please specify pressure range: 50-400, 300-1000, or 900-2000 psi.

Pipe Size	Ht.	Each	Pipe Size	Ht.	Each
<b>Male Inlet x Female Outlet</b>			<b>Female Inlet x Female Outlet</b>		
1/4" x 1/4".....4 5/8"	5026K51	\$61.85	1/2" x 1/4".....3 3/4"	5026K61	\$61.85
3/8" x 1/4".....4 5/8"	5026K52	61.85	3/8" x 1/4".....3 3/4"	5026K73	61.85
1/2" x 1/4".....4 1/2"	5026K53	61.85	1/2" x 1/4".....3 7/8"	5026K72	61.85



Male x Female

## Cast Iron High-Temperature Adjustable Relief Valves

Rugged cast iron valves are ideal for viscous liquids at high temperatures. Use with oil and liquids in hydraulic or lubrication systems. Furnished with pressure set at mid-range. Valves have a Type 416 stainless steel piston for a metal-to-metal seal. Cap seal is Viton. Springs are 18-8 stainless steel for pressure ranges 3-15, 7-35, and 30-100 psi; springs are 17-7 PH stainless steel for all other pressure ranges, unless noted. Temp. range is -31° to +400° F.

**Connections:** NPT female bottom inlet and side outlet. **To Order:** Please specify pressure range: 3-15, 7-35, 30-100, 60-175, 150-350, or 300-500 psi.

Pipe Size	Ht.	Each	Pipe Size	Ht.	Each
3/8".....4"	4704K32*	\$91.59	1 1/4".....7"	4704K14	\$183.48
1/2".....4 1/2"	4704K11	98.28	1 1/2".....8 3/8"	4704K25	237.48
3/4".....5"	4704K12	117.48	2".....10"	4704K26	376.76
1".....5 1/8"	4704K13	148.68			

\* Spring is 18-8 stainless steel for 60-175 psi valve.



## Aluminum Adjustable Pressure-Maintaining Relief Valves

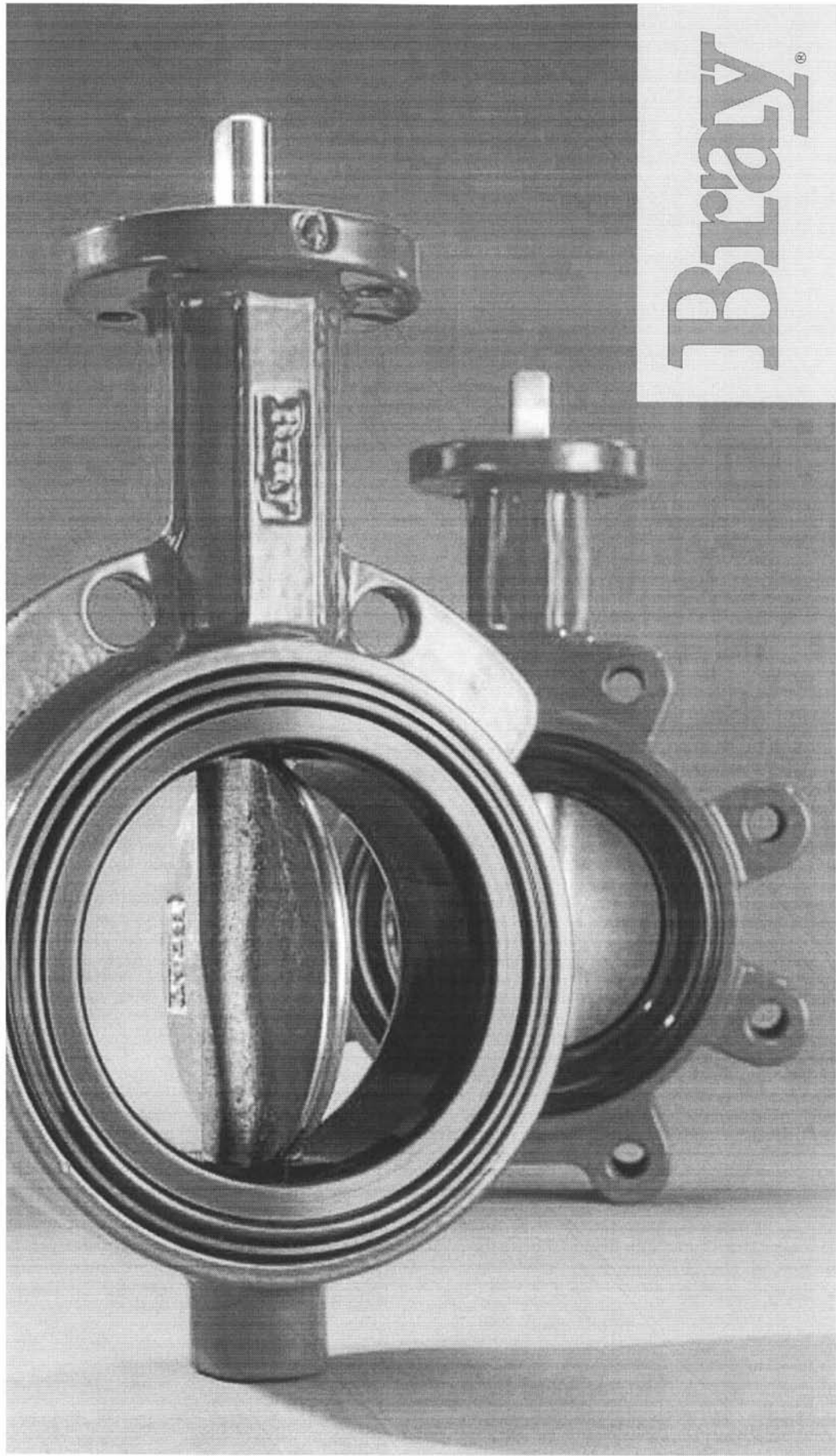
For use with compressed air, these cast aluminum valves maintain your adjusted set pressure at the inlet regardless of the outlet pressure. If the set pressure is exceeded, the valve quickly vents the excess through the unthreaded side port. Also known as back-pressure relief valves and back-pressure regulators. Commonly used to control air pressure instruments in a system supplied by a compressor.

They have a Buna-N seal; a Buna-N-coated, polyester fabric diaphragm; a phenolic adjustment knob; and a 1/4" NPT female gauge port. They are not factory set to a specific pressure. Max. pressure is 250 psi. Temp. range is -20° to +160° F. **Connections:** NPT female side inlet and outlet and vented side relief port. **To Order:** Please specify pressure range: 0-2, 0-10, 0-30, 0-60, or 0-150 psi.

Pipe Size	Ht.	Each
1/4".....5 7/16"	4783K51	\$103.25
3/8".....5 7/16"	4783K53	112.93
1/2".....5 7/16"	4783K55	125.80



## **29. Butterfly Valves**



**Bray**<sup>®</sup>

**SERIES 30/31** Wafer/Lug  
2" - 20" (50mm-500mm)

**BUTTERFLY VALVES**  
RESILIENT SEATED



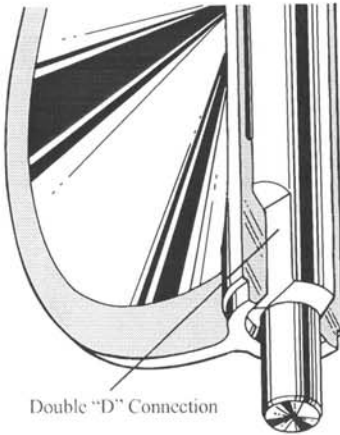
# SERIES 30

## 2"-20" (50mm-500mm)

Bray® Controls is proud to offer a high quality line of butterfly valves to meet the requirements of today's market. Combining years of field application experience, research and development, Bray has designed many unique features in the Series 30/31 not previously available. The results are longer service life, greater reliability, ease of parts replacement and interchangeability of components.

### DISC AND STEM CONNECTION

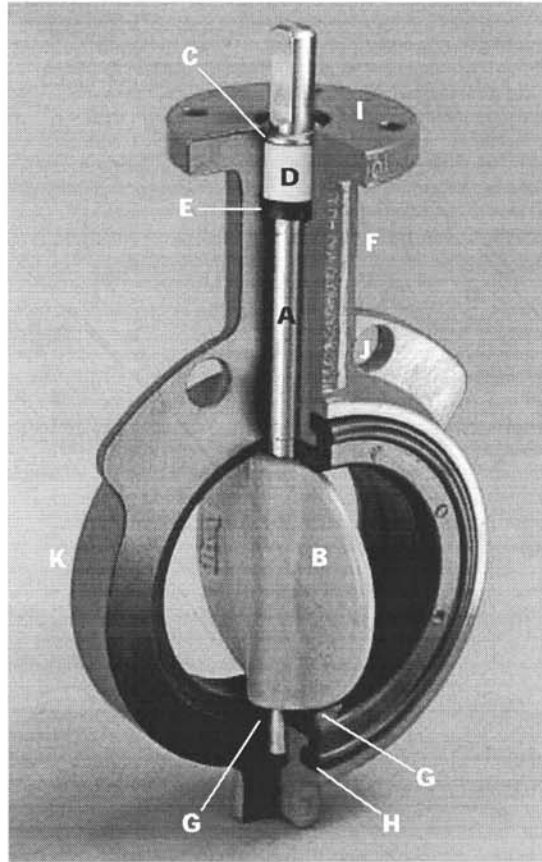
**(A)** Features a high-strength through stem design. The close tolerance, double "D" connection that drives the valve disc is an exclusive feature of the Bray valve. It eliminates stem retention components being exposed to the line media, such as disc screws and taper pins, which commonly result in leak paths, corrosion, and vibration failures. Disc screws or taper pins, due to wear and corrosion, often



Double "D" Connection

require difficult machining for disassembly. Disassembly of the Bray stem is just a matter of pulling the stem out of the disc. Without fasteners obstructing the line flow, the Series 30/31  $C_v$  values are higher than many other valves, turbulence is reduced, and pressure recovery is increased. The stem ends and top mounting flange are standardized for interchangeability with Bray actuators.

**DISC (B)** Casting is spherically machined and hand polished to provide a bubble-tight shut off, minimum torque, and longer seat life. The disc O.D. clearance is designed to work with all standard piping.



### STEM BUSHING (D)

Non-corrosive, heavy duty acetal bushing absorbs actuator side thrusts.

### STEM SEAL (E)

Double "U" cup seal design is self-adjusting and gives positive sealing in both directions. Prevents external substances from entering the stem bore.

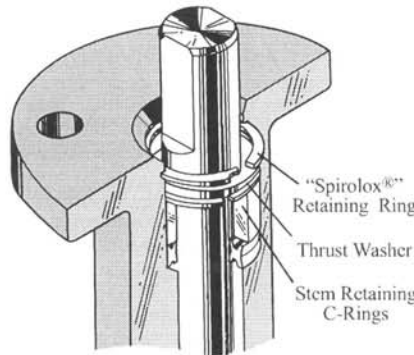
**NECK (F)** Extended neck length allows for 2" of piping insulation and is easily accessible for mounting actuators.

### PRIMARY AND SECONDARY SEALS (G)

The Primary Seal is achieved by an interference fit of the molded seat flat with the disc hub. The Secondary Seal is created because the stem diameter is greater than the diameter of the seat stem hole. These seals prevent line media from coming in contact with the stem or body.

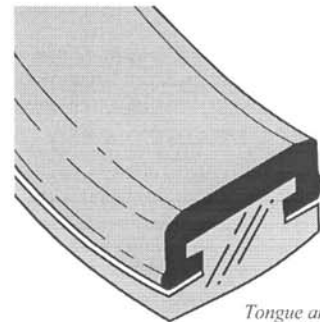
### STEM RETAINING ASSEMBLY (C)

The stem is retained in the body by means of a unique Stainless Steel "Spirolox®" retaining ring, a thrust washer and two C-rings, manufactured from brass as standard, stainless steel upon request. The retaining ring may be easily removed with a standard hand tool. The stem retaining assembly prevents unintentional removal of the stem during field service.



### BRAY UNIQUE SEAT DESIGN (H)

One of the valve's key elements is Bray's unique *tongue and groove* seat design. This resilient seat features lower torque than many valves on the market today and provides complete isolation of flowing media from the body. The tongue-and-groove seat to body retention method is superior to traditional designs, making field replacement simple and fast. The seat is specifically designed to seal with slip-on or weld-neck flanges. The seat features a molded O-ring which eliminates the use of flange gaskets. An important maintenance feature is



Tongue and Groove Design

\*"Spirolox®" designation is a registered trademark of Kaydon Ring and Seal, Inc.



that all resilient seats for Bray butterfly valves Series 20, 21, 30, 31 and 34 are completely interchangeable.

**ACTUATOR MOUNTING FLANGE AND STEM CONNECTION (I)**

Universally designed to ISO 5211 for direct mounting of Bray® power actuators and manual operators.

**FLANGE LOCATING HOLES (J)**

Provide quick and proper alignment during installation.

**BODY (K)**

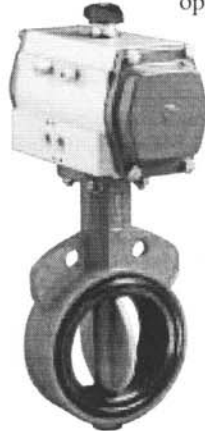
One-piece wafer or lug style. Polyester coating for excellent corrosion resistance. Bray valve bodies meet ANSI 150 pressure ratings for hydrostatic shell test requirements.

**DESIGN FEATURES**

Bray's Series 30 valve is a wafer version with flange locating holes, and the Series 31 is the companion lug version for dead-end service and other flange requirements. All Bray valves are tested to 110% of full pressure rating before shipment.

A major design advantage of Bray valve product lines is international compatibility. The same valve is compatible with most world flange standards – ANSI Class 125/150, BS 10 Tables D and E, BS 4504 NP 10/16, DIN ND 10/16, AS 2129 and JIS10. In addition the valves are designed to comply with ISO 5752 face-to-face and ISO 5211 actuator mounting flanges. Therefore, one valve design can be used in many different world markets.

Due to a modular concept of design, all Bray® handles, manual gear operators and pneumatic and electric actuators mount directly to Bray valves. No brackets or adapters are required.



Bray interchangeability and compatibility offers you the best in uniformity of product line and low-cost performance in the industry today.

**POLYESTER COATING CORROSION PROTECTION**

Bray's standard product offers valve bodies with a polyester coating, providing excellent corrosion and wear resistance to the valve's surface. The Bray polyester coating is a hard, gloss red finish.

Chemical Resistance – resists a broad range of chemicals including: dilute aqueous acids and alkalis, petroleum solvents, alcohols, greases and oils. Offers outstanding resistance to humidity and water.

Weatherability – outdoor tested resistant to ultra-violet radiation.

Abrasion Resistance – excellent resistance to abrasion.

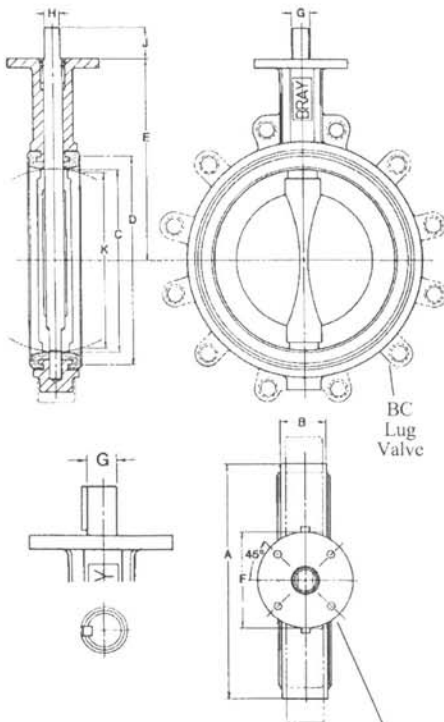
Impact Resistance – withstands impact without chipping or cracking.

**NYLON 11 COATING**

Optionally available for valve bodies where outstanding protection and performance is needed. A thermoplastic produced from a vegetable base, this coating is inert to fungus growth and molds. Nylon 11 is *USDA Approved*, as well as certified to ANSI/NSF 61 for water service.

Corrosion Resistance – superior resistance to a broad range of chemical environments. Salt spray tested in excess of 2,000 hours and seawater immersion tested for over 10 years without corrosion to metal substrates.

Nylon 11 features a very low coefficient of friction and excellent resistance to impact and ultra-violet radiation.



**DIMENSIONS SERIES 30 Wafer**

Valve Size		A	B	C	D	E	F	Mounting Flange Drig.			G	H	J	K
ins	mm							BC	No. Holes	Hole Dia.				
2	50	3.69	1.62	2.00	2.84	5.50	3.54	2.76	4	.39	.55	.39	1.25	1.32
2 1/2	65	4.19	1.75	2.50	3.34	6.00	3.54	2.76	4	.39	.55	.39	1.25	1.91
3	80	4.88	1.75	3.00	4.03	6.25	3.54	2.76	4	.39	.55	.39	1.25	2.55
4	100	6.06	2.00	4.00	5.16	7.00	3.54	2.76	4	.39	.63	.43	1.25	3.57
5	125	7.06	2.12	5.00	6.16	7.50	3.54	2.76	4	.39	.75	.51	1.25	4.63
6	150	8.12	2.12	5.75	7.02	8.00	3.54	2.76	4	.39	.75	.51	1.25	5.45
8	200	10.50	2.50	7.75	9.47	9.50	5.91	4.92	4	.57	.87	.63	1.25	7.45
10	250	12.75	2.50	9.75	11.47	10.75	5.91	4.92	4	.57	1.18	.87	2.00	9.53
12	300	14.88	3.00	11.75	13.47	12.25	5.91	4.92	4	.57	1.18	.87	2.00	11.47

**SERIES 31 Lug**

Lug Bolting Data		
BC	No. Holes	Threads UNC-2B
4.75	4	5/8-11
5.50	4	5/8-11
6.00	4	5/8-11
7.50	8	5/8-11
8.50	8	3/4-10
9.50	8	3/4-10
11.75	8	3/4-10
14.25	12	7/8-9
17.00	12	7/8-9

Valve Size		A	B	C	D	E	F	Mounting Flange Drig.			G	J	KEY SIZE	K
ins	mm							BC	No. Holes	Hole Dia.				
14	350	17.05	3.00	13.25	15.28	13.62	5.91	4.92	4	.57	1.38	2.00	39x.39	13.04
16	400	19.21	4.00	15.25	17.41	14.75	5.91	4.92	4	.57	1.38	2.00	39x.39	14.85
18	450	21.12	4.25	17.25	19.47	16.00	8.27	6.50	4	.81	1.97	2.50	39x.47	16.85
20	500	23.25	5.00	19.25	21.59	17.25	8.27	6.50	4	.81	1.97	2.50	39x.47	18.73

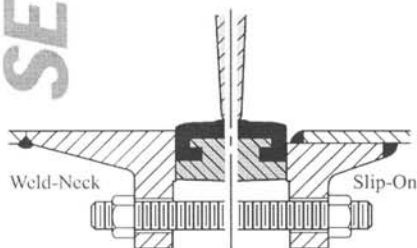
Lug Bolting Data		
BC	No. Holes	Threads UNC-2B
18.75	12	1-8
21.25	16	1-8
22.75	16	1 1/8-7
25.00	20	1 1/8-7

See chart for Actuator Mounting Flange Drilling.

# SELECTION DATA

## FLANGE REQUIREMENTS

Bray valves are designed for installation between ANSI Class 125/150 lb. weld-neck or slip-on flanges, BS 10 Tables D & E, BS 4504 NP 10/16, DIN ND 10/16, AS 2129 and JIS 10, either flat faced or raised faced. While weld-neck flanges are recommended, Bray has specifically designed its valve seat to work with slip-on flanges, thus eliminating common failures of other butterfly valve designs. When using raised face flanges be sure to properly align valve and flange. Type C stub-end flanges are not recommended.



## PRESSURE RATINGS\*

For bi-directional bubble-tight shut off, disc in closed position:

Inches	mm	psig	bar
2-12	50-300	175	12
14-20	350-500	150	10

## For Dead-end Service Applications:

With *downstream flanges installed* or with *vulcanized seats*, the dead-end pressure ratings are equal to valve bi-directional ratings as stated above. With no downstream flanges or with seats that are not vulcanized, the dead-end pressure rating for 2"-12" valves is 75 psi (5 bar) for 14"-20" valves, 50 psi (3.5 bar).

\*Pressure Ratings are based on standard disc diameters. For low pressure application, Bray offers a standard reduced disc diameter to decrease seating torques and to extend seat life, thus increasing the valve's performance and reducing actuator costs for the customer.

## VELOCITY LIMITS

For On/Off Services:

Fluids – 30 ft/sec (9m/s)  
Gases – 175 ft/sec (54m/s)

## C<sub>v</sub> VALUES – VALVE SIZING COEFFICIENT

Valve Size		Disc Position (degrees)								
ins	mm	90°	80°	70°	60°	50°	40°	30°	20°	10°
2	50	144	114	84	61	43	27	16	7	1
2 1/2	65	282	223	163	107	67	43	24	11	1.5
3	80	461	364	267	154	96	61	35	15	2
4	100	841	701	496	274	171	109	62	27	3
5	125	1376	1146	775	428	268	170	98	43	5
6	150	1850	1542	1025	567	354	225	129	56	6
8	200	3316	2842	1862	1081	680	421	241	102	12
10	250	5430	4525	2948	1710	1076	667	382	162	19
12	300	8077	6731	4393	2563	1594	1005	555	235	27
14	350	10538	8874	5939	3384	2149	1320	756	299	34
16	400	13966	11761	7867	4483	2847	1749	1001	397	45
18	450	17214	14496	10065	5736	3643	2237	1281	507	58
20	500	22339	18812	12535	7144	4536	2786	1595	632	72

C<sub>v</sub> is defined as the volume of water in U.S.G.P.M. that will flow through a given restriction or valve opening with a pressure drop of one (1) p.s.i. at room temperature. Recommended control angles are between 25°–70° open. Preferred angle for control valve sizing is 60°–65° open.

## EXPECTED SEATING/UNSEATING TORQUES (Lb.-Ins.)

Valve Size		Full-Rated Pressure Valves				Reduced Disc Diameter
		Δ P (PSI)				Δ P (PSI)
ins	mm	50	100	150	175	50
2	50	125	130	135	140	125
2 1/2	65	195	205	215	220	195
3	80	260	275	290	297	260
4	100	400	425	450	462	267
5	125	615	670	725	755	410
6	150	783	871	953	1003	537
8	200	1475	1650	1825	1915	983
10	250	2240	2520	2800	2940	1493
12	300	3420	3870	4320	4545	2280
14	350	4950	5700	6450	—	3300
16	400	6400	7700	9000	—	4267
18	450	7850	9850	11850	—	5267
20	500	10300	12900	15500	—	6867

Valve Torque Rating – Bray has classified valve torque ratings according to 3 types: non-corrosive lubricating service, general service, and severe service. Torques listed above are for general services. Consult Bray for torque information corresponding to specific applications.

## TO USE TORQUE CHART, NOTE THE FOLLOWING:

- 1) For Bray valves, Series 20, 21, 30, 31 and 34.
- 2) Review Technical Bulletin No. 1001, Expected Seating/Unseating Torques, for explanation of the 3 service classes and their related seating/unseating torque values for given pressure differentials of Full-Rated and Reduced Disc Diameter valves.
- 3) Dynamic Torque values are not considered. See

Technical Bulletin No. 1002 for evaluation of Dynamic Torque values vs. Seating/Unseating Torque values.

- 4) Do not apply a safety factor to above torque values when determining actuator output torque requirement.
- 5) For 3 way assemblies where one valve is opening and other is closing, multiply torque by 1.5 factor.

### **30. Actuated Ball Valves**

# EloFlow™ 2-way equal percentage ball valve, Spring-Return Fail-Safe actuator

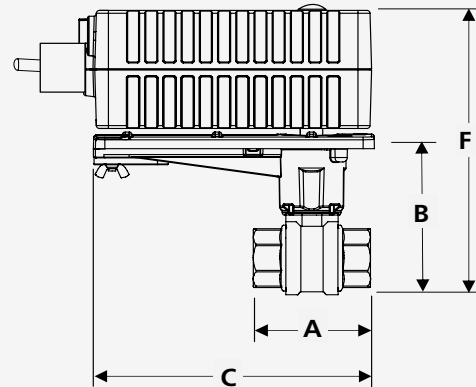


Perfection is Our Drive

Valve Specifications	
Static Pressure/Temp:	360 PSI / 250°F (600 WOG)
Service:	Chilled water, hot water, up to 50% Glycol
Flow Optimizer:	Glass Filled Polymer
Body Material:	Forged Brass ASTM B283
End Connections:	NPT/SWT
Stem:	Brass (standard). Stainless Steel (optional)
Stem Seals:	EPDM O-Rings
Ball:	Nickel-Plated Brass (standard). Stainless Steel (optional)
Ball Seals:	Teflon Seals with EPDM O-Rings
Angle of Rotation:	0–90°



## Dimensions (nominal) (measured in inches unless noted)



Size	C <sub>v</sub>	A:Length		B:Height	C:Length		D:Depth (not shown)	F:Height
		NPT	SWT		NPT	SWT		
1/2"	0.38, 0.68, 1.3, 2.6, 4.7, 11.7	2.37	2.28	3.3	5.4	5.5	2.6	5.8
	8.0	2.64	3.03	3.6	5.3	5.5		6.1
3/4"	0.31, 0.63, 1.2, 2.5, 4.3, 14.7	2.37	2.70	3.3	5.2	5.3	2.6	5.8
	10.1, 28.6	2.64	2.90	3.6	5.3	5.5		6.1
1"	9.0, 28.4	3.73	3.94	3.6	5.9	5.5	2.6	6.1
	4.4, 15.3, 54.2	3.05	3.43	3.8	5.5	5.9		6.3
	26.1, 43.9	4.40	4.43	4.3	6.2	6.2		6.8
1-1/4"	4.4, 8.3, 14.9, 41.1	3.01	3.43	3.8	5.5	5.9	2.6	6.3
	36.5, 102.3	3.60	3.85	4.3	5.8	5.9		6.8
1-1/2"	22.8, 73.9	3.43	4.92	3.8	5.7	6.5	2.6	6.3
	41.3, 171.7	3.70	4.53	5.1	5.9	6.3	2.8	7.6
2"	41.7, 108.0	3.98	5.04	5.1	6.0	6.5	2.8	7.6
	57.0, 71.1, 100.0, 210, 266	4.41	5.59	5.7	6.2	6.8	3.0	8.2
2-1/2"	45.0, 55.0, 72.3, 101, 162, 202	4.70	N/A	5.7	6.4	N/A	3.0	8.2
3"	49.0, 63.0, 82.0, 124, 145	5.02	N/A	5.8	6.0	N/A	3.6	8.3

## **31. Solenoid Valves**



## NPD Series Solenoid Valves

### True Union



#### Overview

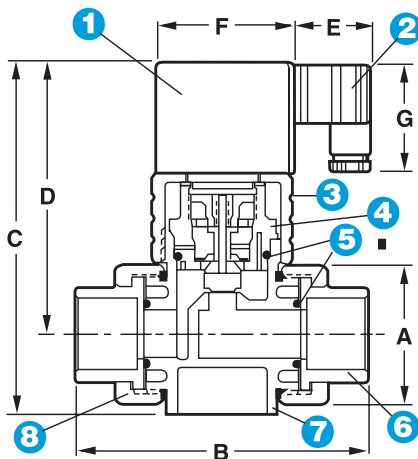
Heavy-duty solenoid valves feature true union end connections and are designed so No Pressure Differential is required for reliable operation. Problems such as sticking and “chattering” are eliminated and downstream restrictions caused by nozzles, flowmeters, and other equipment will not affect performance. The valve’s unique coil design results in lower coil operating temperatures and a 100% continuous duty rating. A molded polyester housing protects the coil assembly and electronics from harsh corrosive environments, and an easy to replace one-piece seal cartridge and plunger assembly allow the valve to quickly be put back in service.

#### Features

- Continuous 100% Duty Cycle
- Multi-Position Electric Connections
- Polyester Coil Housing
- 115 VAC Standard
- Corrosion Resistant
- Built-In 1/2” Conduit or S-J Type Cord Electric Connections
- FPM or EPDM Seals
- NPD Design
- 1/4 - 1” PVC, Corzan® CPVC

#### Options

- Voltage Options:  
12 VAC/VDC, 24 VAC/VDC, 220 VAC



#### Parts List

##### True Union Solenoid Valves

- 1 Solenoid Coil
- 2 Electrical Connector
- 3 Bonnet Nut – CPVC
- 4 Seal Cartridge – CPVC, PVC
- 5 O-Rings
- 6 End Connector – PVC/CPVC
- 7 Body – PVC/CPVC
- 8 Union Nut – PVC/CPVC

#### Operating Parameters

For optimum valve performance, inlet pressure must not exceed 120 PSI. Flow rate should not exceed 5 feet per second.

#### Pressure Loss Calculation Formula

$$\Delta P = \left[ \frac{Q}{Cv} \right]^2$$

$\Delta P$  = Pressure Drop  
 $Q$  = Flow in GPM  
 $Cv$  = Flow Coefficient

#### Cv Factors

Size	Factor	Size	Factor
1/4"	1.3	3/4"	3.2
1/2"	2.3	1"	3.8

#### Dimensions-Inches

Size	A	B	C	D	E	F	G	Weight (lb/kg)
1/4"	2.25	5.30	6.30	4.60	1.60	2.60	2.00	2.79/1.3
1/2" /20*	2.25	5.30	6.30	4.60	1.60	2.60	2.00	2.81/1.3
3/4" /25*	2.63	5.50	6.60	5.10	1.60	2.60	2.00	3.01/1.4
1" /32*	2.63	5.50	6.60	5.10	1.60	2.60	2.00	3.03/1.4

\* Metric End Connections Available in: BSP – Straight Thread, BSP TR – Tapered Thread and Metric Socket

Corzan® is a registered trademark of Noveon, Inc.



## Technical Information

### Part Numbers

PVC/FPM Seals			CPVC/FPM Seals		
Size	End Conn.	Part Number	Size	End Conn.	Part Number
1/2"	Socket/Threaded	SV10050STV	1/4"	Socket/Threaded	SV20025STV
3/4"	Socket/Threaded	SV10075STV	1/2"	Socket/Threaded	SV20050STV
1"	Socket/Threaded	SV10100STV	3/4"	Socket/Threaded	SV20075STV
			1"	Socket/Threaded	SV20100STV

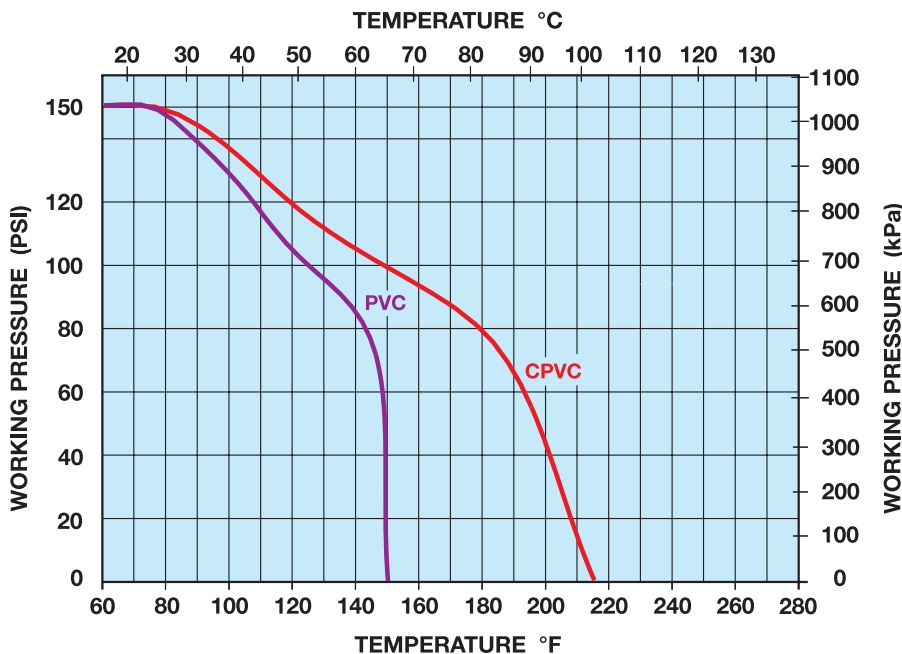
PVC/EPDM Seals			CPVC/EPDM Seals		
Size	End Conn.	Part Number	Size	End Conn.	Part Number
1/2"	Socket/Threaded	SV10050STE	1/4"	Socket/Threaded	SV20025STE
3/4"	Socket/Threaded	SV10075STE	1/2"	Socket/Threaded	SV20050STE
1"	Socket/Threaded	SV10100STE	3/4"	Socket/Threaded	SV20075STE
			1"	Socket/Threaded	SV20100STE

### Solenoid Valve Selection Chart

Size	Material	End Conn.	Liner & Seals	Pressure Rating	Coil Rating
1/4", 1/2" 3/4", 1"	PVC*, CPVC	Socket, Threaded, or Flanged	FPM, EPDM	150 PSI @ 70°F Non-Shock 120 PSI Max Inlet Pressure	1.6 Amp @ 120 VAC

\*1/4" not available in PVC

### Operating Temperatures/Pressure



## **32. Air Flow Control Valve**





## ProFile2™ Proportional Control All-Plastic Ball Valves

1" to 6" - PVC, Corzan® CPVC



### Features

- All-Plastic Construction
- Precise Flow Control
- True Union Design
- Integrally Molded Stem Support and Mounting Platform for Proper Alignment and Actuator Mounting
- Fully Serviceable Internals can be Inspected and Serviced

### Options

- Positioners for Automated Modulating Service Applications
- EPDM Seals
- Manual Handle

### Two Proportional Flow Control Rates with One Valve

Hayward ProFile2 corrosion resistant, proportional control ball valves provide two linear flow curves – one for fast opening, one for slow opening. The percentage of flow through the valves with either flow curve is equal to the degree of opening. As the valves are opened or closed, the flow varies in direct proportion to the valve opening. This permits predictable, accurate control of the downstream flow rate with a 1/4-turn valve.

### Unique-Design “Characterized” Ball

These valves utilize a unique, patented ball with a special “characterized” opening that results in the linear flow rate change. Valves are shipped with the ball installed so that the smaller opening enters the flow first, creating the slow open rate. To switch to the fast opening rate, simply reverse the ball in the valve. Then the larger opening will enter the flow first – creating a large opening with slower changes.

### Perfect with Positioners

Hayward ProFile2 Proportional Control True Union Ball Valves can be supplied with optional electric or pneumatic actuators with positioners for automated modulating service applications.

### Never a Problem with Corrosion

Because of their all-plastic construction, Hayward ProFile2 ball valves will never rust or corrode – and they can survive corrosive environments and harsh weather conditions without the need for painting or expensive epoxy coating.

### Applications

- Methane Gas Recovery
- Fill Station Lines
- Lateral Take Off Line Flow Control
- Flow Reduction in Systems with Oversize Pumps
- Control Flow from Tanks

ProFile2™ is a trademark of Hayward Industrial Products, Inc.  
Corzan® is a registered trademark of Noveon, Inc.

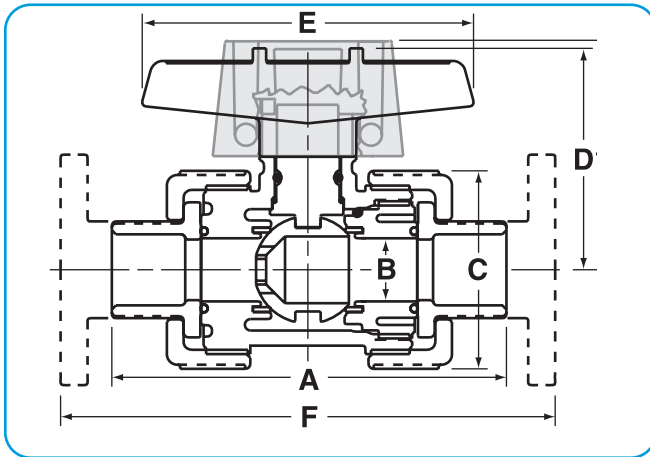


## Technical Information

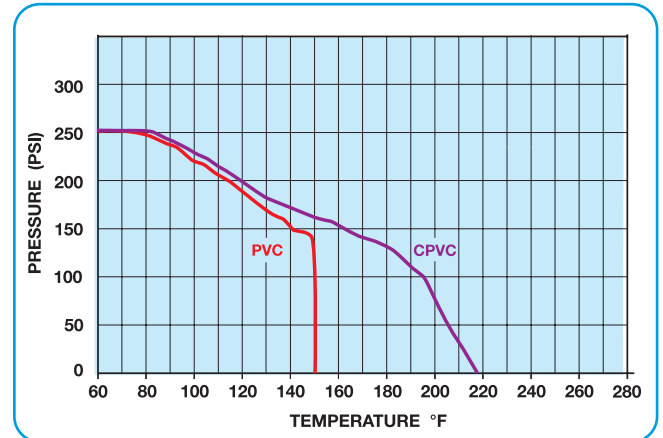
### Selection Chart

Size	Material	End Conn.	Seals	Pressure Rating
1, 2, 3, 4"	PVC or CPVC	Socket, Threaded or Flanged	FPM or EPDM	250 PSI @ 70°F
6"*	PVC or CPVC	Flanged		Non-Shock

### Dimensions



### Temperature/Pressure Chart



### Dimensions

Size	A	B	C	D1	D2	E	F
1"	5.25	1.00	3.00	3.32	3.05	4.00	8.00
2"	8.00	1.83	4.75	4.43	4.00	5.00	11.38
3"	10.56	3.00	6.40	5.50	5.50	10.50	14.44
4"	12.94	3.75	8.56	6.50	6.50	10.50	17.13

### Pressure Loss Determination

The charts below are used to determine the flow coefficients for ProFile2 Proportional Control Ball valves. The flow coefficient can be used to calculate the pressure loss across the valve at any angular degree of opening using the formula: **Pressure Loss = (Flow in GPM / Flow Coefficient)<sup>2</sup>**. For example a 1" valve with a "slow open" configuration that is 60° open has a flow coefficient of 8. If the valve were to be installed in a system with a flow rate of 16 gpm, the **Pressure Loss** would be **(16 / 8)<sup>2</sup> = 4**. The flow coefficients for standard, full flow valves are shown for comparison.

Angular Deg of Opening	Slow Open	Fast Open	Full Port Valve
15°	0.5	1.0	1.2
30°	1.9	3.4	3.5
45°	3.7	7.0	7.5
60°	8.0	13.0	15.3
75°	14.7	18.8	27.8
90°	21.0	21.0	29.0

Angular Deg of Opening	Slow Open	Fast Open	Full Port Valve
15°	1	2.5	10
30°	4	11	16
45°	11	25	35
60°	21	44	72
75°	37	54	117
90°	56	56	150

#### Pressure Loss Calculation Formula

$$\Delta P = \left[ \frac{Q}{C_v} \right]^2$$

$\Delta P$  = Pressure drop

$Q$  = Flow in GPM

$C_v$  = Flow coefficient

Angular Deg of Opening	Slow Open	Fast Open	Full Port Valve
15°	3	10	10
30°	12	26	26
45°	30	50	55
60°	60	79	110
75°	89	112	212
90°	128	128	490

Angular Deg of Opening	Slow Open	Fast Open	Full Port Valve
15°	5	18	38
30°	30	55	90
45°	65	114	165
60°	120	183	250
75°	185	200	458
90°	215	215	600

### **33. Differential Pressure Indicator/Transmitter**

**PERFORMANCE SPECIFICATIONS**
**Reference Condition:** 23°C ±2° (73°F)

**Accuracy:** ±0.50% FS (URL)

(Accuracy includes the effects of linearity, hysteresis, and repeatability)

**Stability:** ±0.25% FS/year

**Response Time:** 100msec (user adjustable)

**Output Resolution:** 0.1% FS (URL)

**Standard Ranges (Bi-Directional, Inches W.C.):**  
±4, ±8, ±20, ±40, ±80, ±200

**Standard Ranges (Uni-Directional, Inches W.C.):**  
0-4, 8, 20, 40, 80, 200, 400

**ENVIRONMENTAL SPECIFICATIONS**
**Temperature Limits:**
**Storage:** -15 to 65°C (5 to 150°F)

**Operating:** -10 to 60°C (14 to 140°F)

**Compensated:** -10 to 60°C (14 to 140°F)

**Temperature Effects (-10 to 60°C):**

±0.03% FS/°C (from reference, 23°C (73°F))

**FUNCTIONAL SPECIFICATIONS**
**Static (Line) Pressure:**

Pressure Range	Proof	Burst
All	300 psi	1000 psi

**Static (Line) Pressure Effects:**

Pressure Range	Effect
≥20" W.C., ±8" W.C.	±0.3% FS/100psi
8" W.C., ±4" W.C.	±0.7% FS/100psi
4" W.C.	±1.5% FS/100psi

**Single Side (Differential) Limits:**

Pressure Range	Proof	Burst
≤8" W.C., ±4" W.C.	30 psid	130 psid
≥20" W.C., ±8" W.C.	100 psid	130 psid

**Vibration:** 5g's 150Hz

**Shock:** 10g's 16ms

**ELECTRICAL SPECIFICATIONS**
**Output Signal:** 4-20mA (2 Wire)

**Supply Voltage:** 12-32Vdc

**Rangeability / Adjustment\*:**

Zero -10% to +110% FS

Span -10% to +110% FS

**\*Note:** Accuracy and output resolution based upon full scale (URL) value

**Insulation Resistance:** 50Vdc (>100Mohms)

**CE Compliance:** EN 613261 1997, A1/1998,  
A2/2001 (Heavy Industrial)

**Features**

- Up to 8 times smaller than a conventional process transmitter
- Robust NEMA 4X (IP65) aluminum die cast housing
- Bright backlit LCD display
- 2 Wire 4-20mA
- Internal "Push Button" configurability allows quick range changes
- Scaling function allows display to indicate arbitrary physical units
- Easily rotatable display, 90° increments

**Applications**

The GC52 utilizes Ashcrofts' proven Si-Glas™ silicon variable capacitance sensor technology in a wet-wet package ideal for applications where reliable, low differential pressure measurement is required with line (static) pressure to 300 psi.

Applications include:

- Pressurized & non-pressurized tank levels
- Flow (liquid/gas) measurement


**MECHANICAL SPECIFICATIONS**
**Pressure Connection:** 1/4" Female NPT

**Enclosure:** Aluminum

**Rating:** IP65 / NEMA 4X

**Electrical Connection:**
**External Options:**

- 1/2" Female NPT Conduit

- Cable Gland (Cable Diameters 0.35" to 0.47")

**Weight:** Approx. 1.0 lb

**Mounting:** Mounting Bracket included

**Media:** Fluids and gases compatible with 316SS, Viton and Alumina Ceramic

**TO ORDER THE GC52 PRESSURE TRANSMITTER:**

<b>GC52</b>	<b>7</b>					<b>X</b>
Type Configuration (GC52)	Accuracy (7) ±0.25% FS	Pressure Fitting (F02) 1/4" FNPT	Output Signal (42) 4-20mA	Electrical Connection (CG) = Cable Guard (CD) = 1/4" FNPT Conduit	Pressure Ranges (Compound/Bidirectional) 4IWL = ±4" W.C. 8IWL = ±8" W.C. 20IWL = ±20" W.C. 40IWL = ±40" W.C. 80IWL = ±80" W.C. 200IWL = ±200" W.C.	Optional X-Variations XRH 9 pt. NIST traceable calibration certificate
					Pressure Range (Differential Gauge) 4IW = 0-4" W.C. 8IW = 0-8" W.C. 20IW = 0-20" W.C. 40IW = 0-40" W.C. 80IW = 0-80" W.C. 200IW = 0-200" W.C. 400IW = 0-400" W.C.	

### **34. Level Transmitter – Backwash Tank**

# Rosemount 2051 Pressure Transmitter

- Reference Accuracy of 0.075%
- Rangeability of 100:1
- Protocols available include 4-20 mA HART®, FOUNDATION fieldbus®, 1-5 Vdc HART Low Power
- Coplanar™ platform enables integration of primary elements, manifolds, and diaphragm seal solutions
- Complete pressure transmitter family to meet your pressure, level, and flow needs



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Product Certifications . . . . .	page 12
Dimensional Drawings . . . . .	page 18
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## Meeting Your Pressure Measurement Needs

### Confidence in your measurement

The 2051 capabilities are designed to meet a wide range of applications. Combining 0.075% reference accuracy, 100:1 rangedown, and extended two-year stability provides confidence in your pressure measurements.

### Output protocols enable easy integration

The 2051 is available in 4-20mA HART, Low Power HART, or FOUNDATION fieldbus output protocols. Easily integrate the 2051 into existing or new installations.

### Coplanar platform enables integrated solutions

The versatile Coplanar platform design enables the best process connection for pressure, flow, and level applications. The final 2051 assembly arrives factory calibrated, pressure-tested, and ready to install. The flexible design reduces engineering and inventory costs.

### Complete pressure offering

The 2051 family of pressure transmitters offers differential, gage, and absolute pressure measurements. The complete offering ensures the 2051 meets your measurement needs.

## Rosemount Pressure Solutions

### Rosemount 3051S Series of Instrumentation

Highest performing scalable pressure, flow and level measurement solutions drive better plant efficiency and more productivity. Innovative features include wireless, advanced diagnostics, and multivariable technologies.

### Rosemount 3095 Mass Flow Transmitter

Accurately measures differential pressure, static pressure and process temperature to dynamically calculate fully compensated mass flow.

### Rosemount 3051 Pressure Transmitter Family

Proven industry standard performance and reliability to increase plant profitability. Includes the most comprehensive offering to meet all application needs.

### Rosemount 305, 306 and 304 Manifolds

Factory-assembled, calibrated and seal-tested transmitter-to-manifold assemblies reduce installation costs.

### Rosemount 1199 Diaphragm Seals

Provides reliable, remote measurements of process pressure and protects the transmitter from hot, corrosive, or viscous fluids.

### Orifice Plate Primary Element Systems: Rosemount 1495 and 1595 Orifice Plates, 1496 Flange Unions and 1497 Meter Sections

A comprehensive offering of orifice plates, flange unions and meter sections that are easy to specify and order. The 1595 Conditioning Orifice provides superior performance in tight fit applications.

### Annubar® Flowmeter Series: Rosemount 3051SFA ProBar®, 3095MFA Mass ProBar, and 485

The state-of-the-art, fifth generation Rosemount 485 Annubar combined with the 3051S or 3095 MultiVariable transmitter creates an accurate, repeatable and dependable insertion-type flowmeter.

### Compact Orifice Flowmeter Series: Rosemount 3051SFC, 3095MFC, and 405

Compact Orifice Flowmeters can be installed between existing flanges, up to a Class 600 (PN100) rating. In tight fit applications, a conditioning orifice plate version is available, requiring only two diameters of straight run upstream and two downstream.

### ProPlate® Flowmeter Series: Rosemount 3051SFP ProPlate, 3095MFP Mass ProPlate, and 1195

These integral orifice flowmeters eliminate the inaccuracies that become more pronounced in small orifice line installations. The completely assembled, ready to install flowmeters reduce cost and simplify installation.

## Product Offering

### Rosemount 2051C Differential and Gage

See ordering information on page 26.

- Performance of 0.075% accuracy, optional 0.065%
- Two-year stability of 0.10%, optional five-year stability
- *Coplanar* platform enables integrated manifold, primary element and diaphragm seal solutions
- Calibrated spans/ranges from 0.5 inH<sub>2</sub>O to 2000 psi (1,2 mbar to 276 bar)
- 316L SST and Alloy C-276 process wetted parts



### Rosemount 2051T Gage and Absolute

See ordering information on page 30.

- Performance of 0.075% accuracy, optional 0.065%
- Two-year stability of 0.10%, optional five-year stability
- Calibrated spans/ranges from 0.3 to 10000 psi (10,3 mbar to 689 bar)
- Multiple process connections available
- 316L SST and Alloy C-276 process wetted parts

### Rosemount 2051L Liquid Level

See ordering information on page 33.

- Performance of 0.075% accuracy
- Welded fill fluid system provides best-in-class system reliability
- Flush and extended diaphragms
- Multiple fill fluids and process wetted materials available





### **35. Level Transmitter – Rapid Mix Tank**

## OPTISOUND 3010 C-3030 C Ultrasonic Level Gauge

for liquids

- Level measurement during processing and storage of liquids
- Sumps, water and wastewater basins
- Noncontact flow measurement and detection in open channels



Electromagnetic flowmeters

Variable area flowmeters

Mass flowmeters

Ultrasonic flowmeters

Vortex flowmeters

Flow controllers

**Level measuring instruments**

Pressure and temperature

Heat metering

Communications technology

Switches, counters, displays and recorders

Engineering systems & solutions

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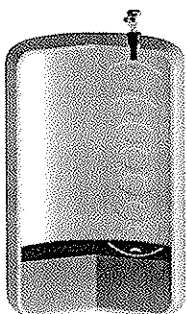
Take note of safety  
instructions for Ex  
application



Please note the Ex specific safety information which you will find on our homepage [www.krohne-mar.com](http://www.krohne-mar.com) and which come with the appropriate instrument. In hazardous areas you should take note of the appropriate regulations, conformity and type approval certificates of the sensors and power supply units. The sensors must only be operated on intrinsically safe circuits. The permissible electrical values are stated in the certificate.

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## 1 Description of the measuring principle



### Measuring principle

Short ultrasonic pulses in the range of 35 kHz to 70 kHz are emitted by the transducer to the product surface, reflected there and received by the transducer. The pulses travel at the speed of sound - the elapsed time from emission to reception of the signals depends on the level in the vessel.

The latest microcomputer technology and the proven processing software select the level echo from among any number of false echoes and calculate the exact distance to the product surface. An integrated temperature sensor detects the temperature in the vessel and compensates the influence of temperature on the signal running time.

By simply entering the vessel dimensions, a level-proportional signal is generated from the distance. It is not necessary to fill the vessel for adjustment.

### Wide application range

OPTISOUND 3010 C, 3020 C and 3030 C ultrasonic sensors are especially suitable for level measurement of liquids, but are also good for solids. The instruments differ in the measuring range, the transducer version and the process fitting. Through different, adapted emitting frequencies, levels in a measuring range of 5 ... 15 m (16.4 ... 49.2 ft) can be measured. Resistant materials for transducers and process fittings also allow applications in corrosive products (depending on the model). A practical mounting strap (option) enables easy orientation of OPTISOUND 3030 C.

### Unaffected by product properties

Fluctuations in product composition or even complete product changes do not influence the measuring result. A fresh adjustment is not necessary.

### Service and maintenance friendly

Thanks to the non-contact measuring principle, OPTISOUND sensors are particularly easy to service and maintain.

## 1.1 Application examples

### Open basins

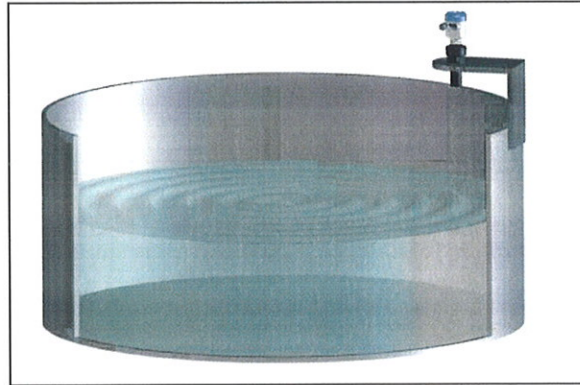


Fig. 1: Level measurement in an open basin with OPTISOUND 3010 C

A typical application for OPTISOUND 3010 C sensors is level measurement on open basins. Products such as rain water or sewage water, i.e. with impurities. Here is where the advantages of non-contact measurement with OPTISOUND come into their own: simple and maintenance-free. The degree of pollution of the water or an accumulation of mud in the basin is not important, because OPTISOUND measures the surface.

### Sludge container

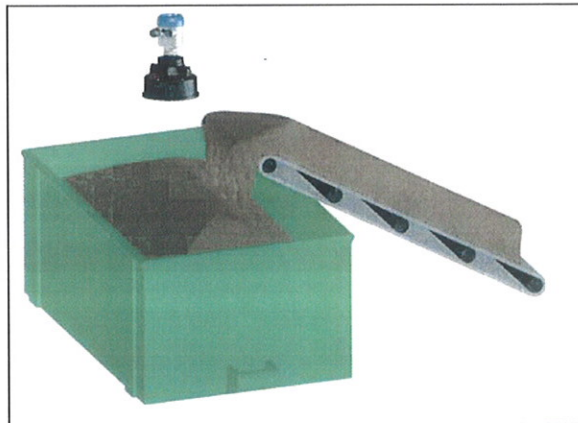


Fig. 2: Level measurement in a container with OPTISOUND 3030 C

In sewage treatment plants, the accumulated sludge is dewatered and transported via conveyor belts to containers. The OPTISOUND 3030 C sensor measures the filling of the container. An empty container can thus be readied in good time before the max. level is reached. Thanks to the metal transducer diaphragm, measurement functionality is also ensured even under conditions of fluctuating temperatures and steam generation.

## 2 Type overview

OPTISOUND 3010 C



OPTISOUND 3020 C



Applications:	liquids and solids in virtually all industries, particularly in water and waste water management	as OPTISOUND 3010 C
Measuring range:	Liquids: 0.25 ... 5 m (0.8 ... 16.4 ft) Solids: 0.25 ... 2 m (0.8 ... 6.6 ft)	Liquids: 0.4 ... 8 m (1.3 ... 26.2 ft) Solids: 0.4 ... 3.5 m (1.3 ... 11.5 ft)
Process fitting:	G1½A of PVDF	G2A of PVDF
Process temperature:	-40 ... 80°C (-40 ... +176°F)	-40 ... 80°C (-40 ... +176°F)
Process pressure:	-0.2 ... 2 bar (-20 ... 200 kPa) (-2.9 ... 29 psi)	-0.2 ... 2 bar (-20 ... 200 kPa) (-2.9 ... 29 psi)
Signal output	two-wire/four-wire 4 ... 20 mA/HART	two-wire/four-wire 4 ... 20 mA/HART

OPTISOUND 3030 C



## OPTISOUND 3030 C



Applications:	liquids and solids in virtually all industries
Measuring range:	liquids: 0.6 ... 15 m (2 ... 49.2 ft) solids: 0.6 ... 7 m (2 ... 23 ft)
Process fitting:	compression flange DN 100 or mounting strap
Process temperature:	-40 ... 80°C (-40 ... +176°F)
Process pressure:	-0.2 ... 1.0 bar (-20 ... 100 kPa) (-2.9 ... 14.5 psi)
Signal output	two-wire/four-wire 4 ... 20 mA/HART

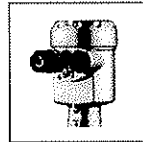
**Indicating and adjustment module**



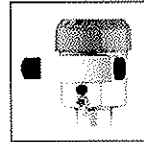
**Housing**



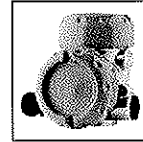
Plastic



Stainless steel



Aluminium

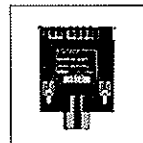


Aluminium  
(double chamber)

**Electronics**

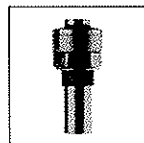


4 ... 20 mA/  
HART

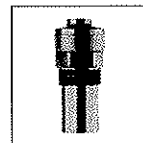


4 ... 20 mA/  
HART – four-  
wire

**Sensors**



Transducer  
1½"

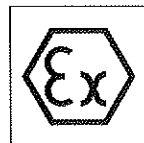


Transducer 2"



Transducer 4"

**Approvals**



Gas explosion  
protection

30600-EN-050816



### 3 Mounting information

#### Measuring range

The reference plane for the measurement is the lower edge of the transducer. All statements concerning the measuring range as well as the internal signal processing refer to this.

With all instruments, a min. distance from the lower edge of the flange - the so-called dead zone, in which measurement is not possible - must be maintained. The exact value of the dead zone, depending on the instrument version, is stated in the Technical data.

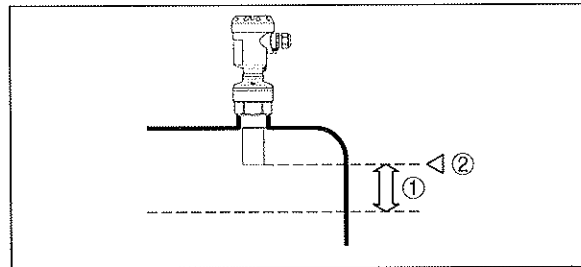


Fig. 3: Min. distance to the max. level

- 1 Dead zone
- 2 Reference plane for the measurement



#### Note:

If the product reaches the transducer, buildup can form on it over a period of time and later cause measurement errors.

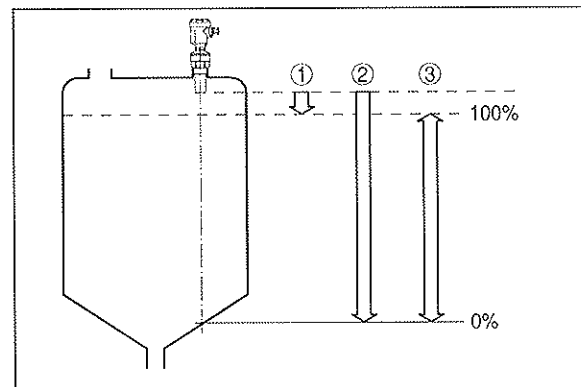


Fig. 4: Measuring range and max. measuring distance

- 1 full
- 2 empty (max. measuring distance)
- 3 max. measuring range

#### Pressure/Vacuum

Gauge pressure in the vessel does not influence OPTISOUND. Low pressure or vacuum, however damp the ultrasonic pulses. This influences the measuring result, particularly if the level is very low. With pressures under -0,2 bar (-20 kPa) use a different measuring principle, e.g. radar or guided radar (TDR).

#### Installation position

When mounting OPTISOUND, keep a distance of at least 200 mm to the vessel wall. If the sensor is installed in the center of dished or spherical vessel tops, multiple echoes can arise. These can, however, be faded out by an appropriate adjustment.

If you cannot keep this distance, a false echo storage should be carried out during setup. This applies particularly if buildup on the vessel wall is expected. In this case, we recommend repeating the false echo storage later on with existing buildup.

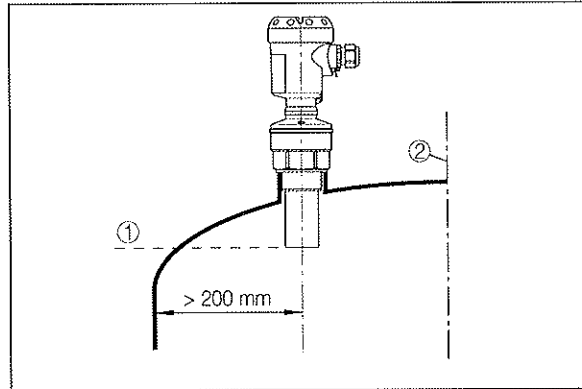


Fig. 5: Mounting on dished vessel tops

- 1 Reference plane
- 2 Vessel center or symmetry axis

In vessels with conical bottom it can be advantageous to mount the sensor in the center of the vessel, as measurement is then possible down to the lowest point of the vessel bottom.

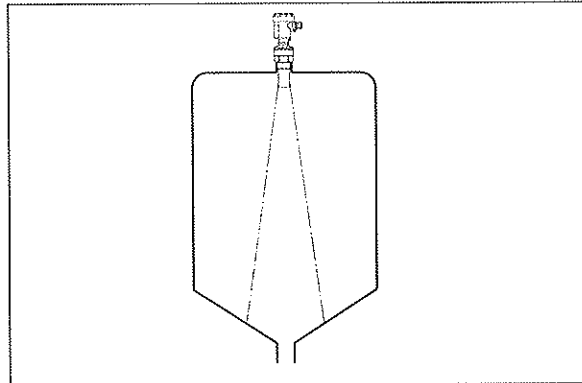


Fig. 6: Vessel with conical bottom

**Socket**

The mounting socket should preferably be dimensioned to allow the lower edge of the transducer to protrude at least 10 mm out of the socket.

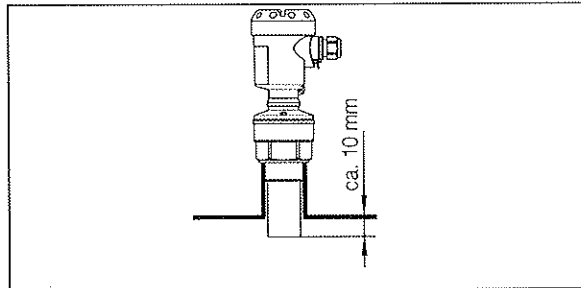


Fig. 7: Recommended socket mounting

If the reflective properties of the medium are good, you can mount OPTISOUND on sockets longer than the transducer. You will find recommended values of the socket heights in the following illustrations. The socket end should be smooth and burr-free, if possible also rounded. A false echo storage is recommended.

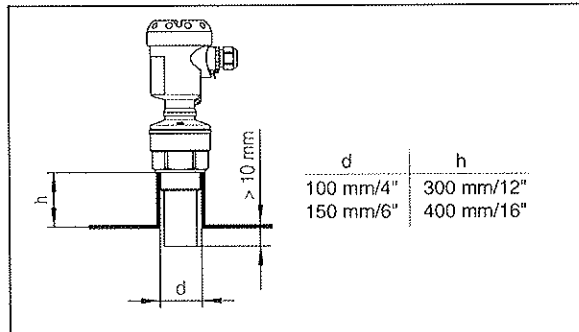


Fig. 8: Deviating socket dimensions with OPTISOUND 3010 C

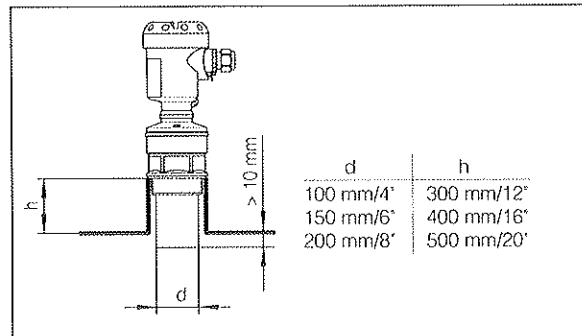


Fig. 9: Deviating socket dimensions with OPTISOUND 3020 C

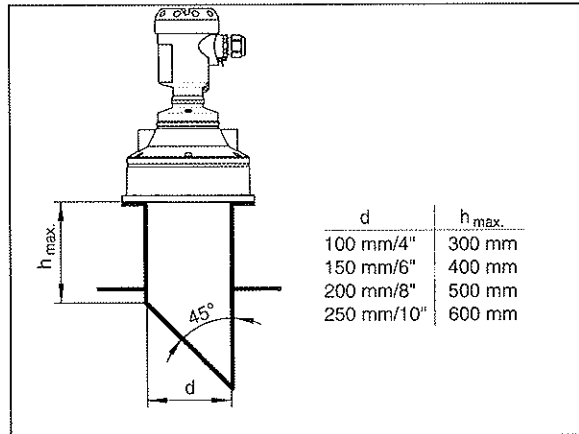


Fig. 10: Deviating socket dimensions with OPTISOUND 3030 C

**Sensor orientation**

With liquids, align the sensor as close to vertical as possible to achieve optimum measuring results.

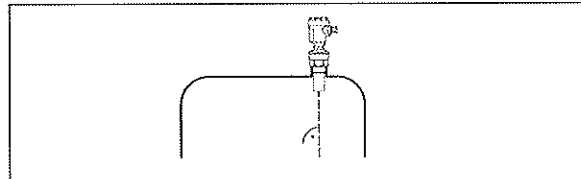


Fig. 11: Orientation in liquids

To reduce the min. distance to the medium, you can also mount OPTISOUND with a beam deflector of corrosion-resistant material. By doing this, it is possible to fill the vessel nearly to maximum. Such an arrangement is suitable primarily for open vessels such as e.g. overflow basins.

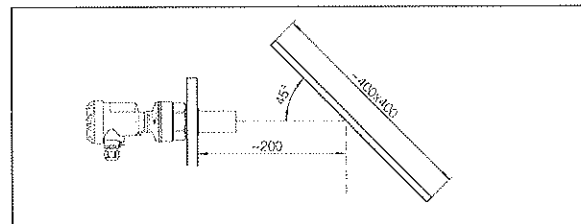


Fig. 12: Beam deflector

**Vessel installations**

The ultrasonic sensor should be installed at a location where no installations cross the ultrasonic beam.

Vessel installations such as, for example, ladders, limit switches, heating spirals, struts, etc. can cause false echoes superimposed on the wanted echo. Make sure when planning your measuring location that the ultrasonic signals have "free access" to the measured product.

If there are existing vessel installations, a false echo storage should be carried out during setup.

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If large vessel installations such as struts or supports cause false echoes, these can be attenuated through supplementary measures. Small, inclined sheet metal or plastic baffles above the installations scatter the ultrasonic signals and avoid direct false echoes.

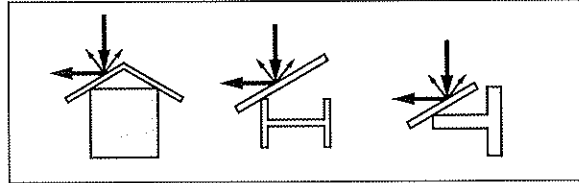


Fig. 13: Cover smooth profiles with deflectors

### Inflowing material

The instruments must not be mounted in or above the filling stream. Make sure that the product surface and not the inflowing material is detected.

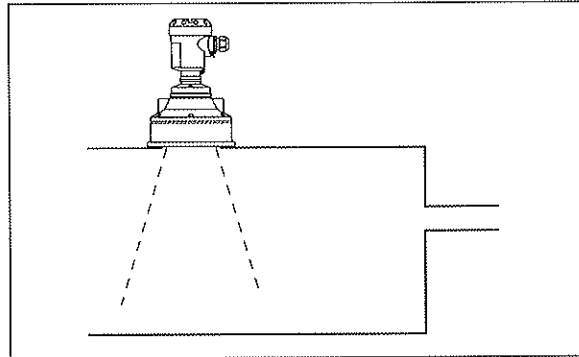


Fig. 14: Inflowing liquid

### Foam

Through the action of filling, stirring and other processes in the vessel, dense foams which considerably damp the emitted signals may form on the product surface.

If foams are causing measurement errors, the sensor should be used in a standpipe or, alternatively, the more suitable sensors with guided radar (TDR) should be used.

Guided radar is not influenced by foam generation and is particularly suitable for such applications.

### Air flow

If there are strong air currents in the vessel, e.g. due to strong winds in outdoor installations, or because of air turbulence, you should mount OPTISOUND in a standpipe or use a different measuring principle, e.g. radar or guided radar (TDR).

### Standpipe measurement

By using a standpipe (surge or bypass tube), the influence of vessel installations, foam generation and turbulence is excluded.

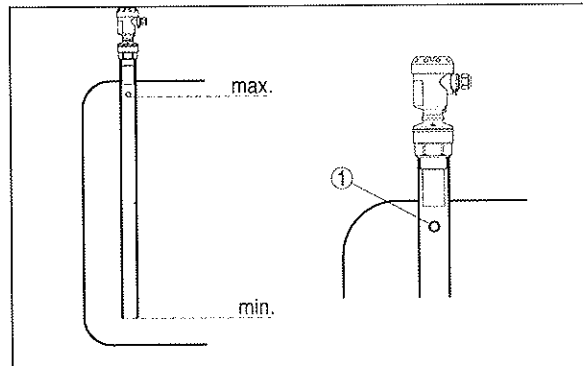


Fig. 15: Standpipe in a tank

1 Vent hole  $\varnothing$  5 ... 10 mm

A standpipe measurement with OPTISOUND is possible with the following tube diameters:

- OPTISOUND 3010 C from 40 mm
- OPTISOUND 3020 C from 50 mm
- OPTISOUND 3030 C from 100 mm.

Avoid large gaps and thick welding joints when connecting the tubes. A false echo storage should always be carried out.

Measurement in a standpipe is not recommended for very adhesive products.

## 4 Electrical connection

### 4.1 General requirements

The power supply range can differ depending on the instrument version. The exact range is stated in the Technical data.

Take note of country-specific installation standards (e.g. the VDE regulations in Germany) as well as prevailing safety regulations and accident prevention rules.



In hazardous areas you should take note of the appropriate regulations, conformity and type approval certificates of the sensors and power supply units.

### 4.2 Supply voltage

#### 4 ... 20 mA/HART two-wire

Power supply and current signal are carried over the same two-wire connection cable. The requirements on the power supply are stated in the Technical data of this Product Information manual.

#### 4 ... 20 mA/HART four-wire

Power supply and current output are carried on two separate connection cables.

The standard version can be operated with an earth-connected current output, the Exd version must be operated with a floating output.

The instrument is designed in protection class I. To maintain this protection class, it is absolutely necessary that the ground conductor be connected to the internal ground conductor terminal.

### 4.3 Connection cable and installation

The sensors are connected with standard cable without screen. An outer cable diameter of 5 ... 9 mm ensures the seal effect of the cable entry.

As an option, OPTISOUND are also available with standard plug connectors (see Technical data).

If strong electromagnetic interference is expected, screened cable should be used for the signal lines.



In Ex applications, the corresponding installation regulations must be noted for the connection cable.

### 4.4 Cable screening and grounding

If screened cable is required, the cable screen must be connected on both ends to ground potential. If potential equalisation currents are expected, the connection on the evaluation side must be made via a ceramic capacitor (e.g. 1 nF, 1500 V).

### 4.5 Wiring plans

#### Single chamber housing

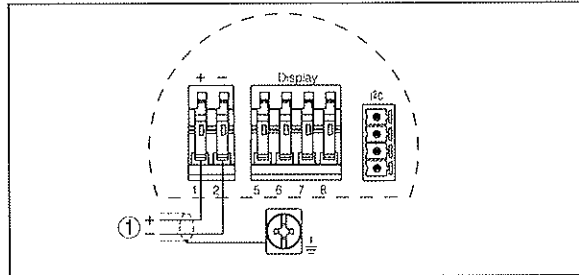


Fig. 16: Connection HART two-wire

1 Power supply and signal output

#### Double chamber housing – two-wire

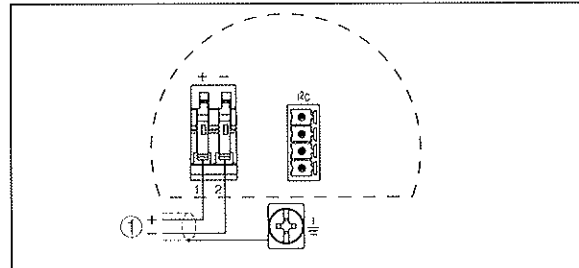


Fig. 17: Connection HART two-wire

1 Power supply and signal output

#### Double chamber housing – 4 ... 20 mA/HART four-wire

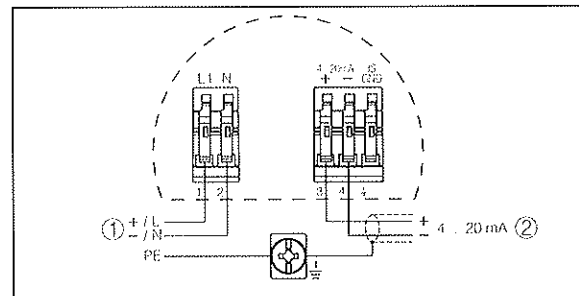


Fig. 18: Connection 4 ... 20 mA/HART four-wire

1 Supply voltage  
2 Signal output



## 5 Adjustment

### 5.1 Adjustment, general

OPTISOUND can be adjusted with the following adjustment media:

- the indicating and adjustment module
- a HART handheld (4 ... 20 mA/HART)

The entered parameters are generally saved in OPTISOUND, optionally also in the indicating/adjustment module.

### 5.2 Compatibility acc. to NAMUR NE 53

OPTISOUND meet NAMUR recommendation NE 53.

The parameter adjustment of the basic sensor functions is independent of the software version. The range of available functions depends on the respective software version of the individual components.

### 5.3 Adjustment with the indicating/adjustment module

#### Setup and indication

The indication and adjustment module can be plugged into OPTISOUND sensors. It can be placed in four different positions on the instrument (each displaced by 90°). Indication and adjustment are made via four keys and a clear, graphic-capable dot matrix indication. The adjustment menu with language selection is clearly structured and enables easy setup. After setup, the indicating/adjustment module serves as indicating instrument: through the screwed cover with glass insert, measured values can be read directly in the requested unit and presentation.

#### Adjustment

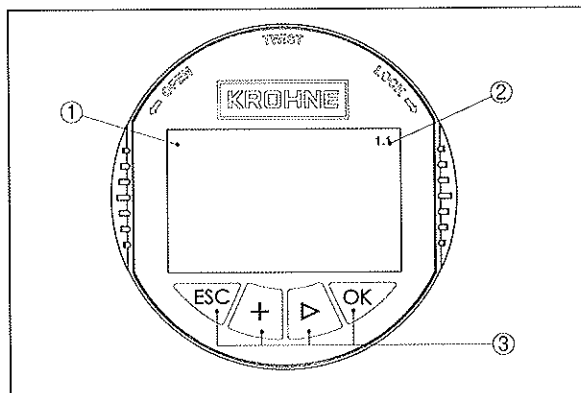


Fig. 19: Indicating and adjustment elements

- 1 LC display
- 2 Indication of the menu item number
- 3 Adjustment keys

#### Key functions

- **[OK]** key:
  - move to the menu overview
  - confirm selected menu
  - edit parameter
  - save value
- **[→]** key to select:
  - menu change
  - list entry
  - editing position
- **[+]** key:
  - modify value of a parameter
- **[ESC]** key:
  - interrupt input
  - jump to the next higher menu

## 6 Technical data

### General data

OPTISOUND 3010 C and 3020 C	Materials, wetted parts	
	– Process fitting	PVDF
	– Transducer	PVDF
	– Seal transducer/process fitting	EPDM
OPTISOUND 3030 C	Materials, wetted parts	
	– Mounting strap	1.4301
	– Process fitting	UP
	– transducer diaphragm	1.4571
	– Seal transducer/process fitting	EPDM
	Materials, non-wetted parts	
	– Compression flange (OPTISOUND 3010 C)	PPH, 1.4435
	– Housing	plastic PBT (Polyester), Alu-die casting powder-coated, 316L (stainless steel 1.4435)
	– Seal ring between housing and housing cover	NBR (stainless steel housing), silicone (Alu/plastic housing)
	– Inspection window in housing cover for indicating/adjustment module	Polycarbonate
	– Ground terminal	stainless steel 1.4571/1.4435
	Weight	
	– OPTISOUND 3010 C and 3020 C	1.8 ... 4.0 kg (4.0 ... 8.8 lbs), depending on process fitting and housing
– OPTISOUND 3030 C	2.7 ... 5.7 kg (6 ... 12.6 lbs), depending on process fitting and housing	

### Output variable

Output signal	4 ... 20 mA/HART
Resolution	1.6 $\mu$ A
Fault signal	current output unchanged; 20.5 mA; 22 mA; <3.6 mA (adjustable)
Current limitation	22 mA
Load	see load diagram in Power supply
Integration time (63 % of the input variable)	0 ... 999 s, adjustable
Rise time	500 ms (ti: 0 s, 0 ... 100 %)
Fulfilled NAMUR recommendation	NE 43
Integration time (63 % of the input variable)	0 ... 999 s, adjustable
Rise time	500 ms (ti: 0 s, 0 ... 100 %)

### Input variable

Parameter	distance between lower edge of the transducer and product surface
-----------	---

Dead zone	
– OPTISOUND 3010 C	0.25 m (0.8 ft)
– OPTISOUND 3020 C	0.4 m (1.3 ft)
– OPTISOUND 3030 C	0.6 m (2 ft)
Measuring range	
– OPTISOUND 3010 C	up to 5 m (16.4 ft) liquid/up to 2 m (6.6 ft) solid
– OPTISOUND 3020 C	up to 8 m (26.2 ft) liquid/up to 3.5 m (11.5 ft) solid
– OPTISOUND 3030 C	up to 15 m (49.2 ft) liquid/up to 7 m (23 ft) solid

**Accuracy (similar to DIN EN 60770-1)**

Reference conditions acc. to  
DIN EN 61298-1

– Temperature	18 ... 30°C (64 ... 86°F)
– Relative humidity	45 ... 75 %
– Atmospheric pressure	860 ... 1060 mbar (86 ... 106 kPa/ 12.5 ... 15.4 psi)

**Characteristic curve deviation and measurement characteristics<sup>1)</sup>**

Average temperature coefficient of the zero signal (temperature error)	0.06 %/10 K
Resolution, general	max. 1 mm
Ultrasonic frequency	
– OPTISOUND 3010 C	70 kHz
– OPTISOUND 3020 C	54 kHz
– OPTISOUND 3030 C	35 kHz
Interval	>2 s (dependent on the parameter adjustment)
Beam angle	
– OPTISOUND 3010 C and 3020 C	5.5°
– OPTISOUND 3030 C	3°
Adjustment time <sup>2)</sup>	>3 s (dependent on the parameter adjustment)

OPTISOUND 3010 C

Accuracy	better than 0.2 % or ±4 mm (see diagram)
----------	--

<sup>1)</sup> Relating to the nominal range, incl. hysteresis and repeatability, determined acc. to the limit point method.

<sup>2)</sup> Time to output the correct level (with max. 10 % deviation) after a sudden level change.

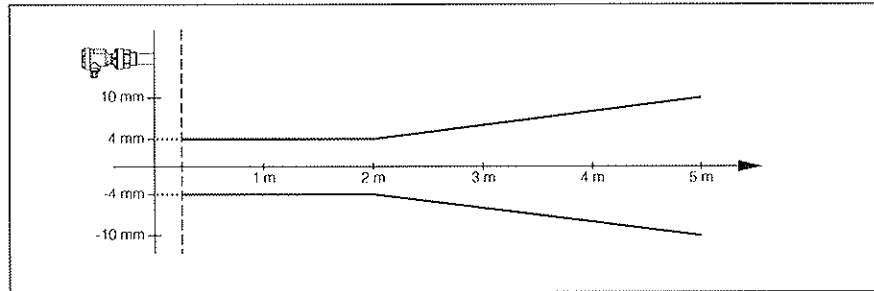


Fig. 20: Accuracy diagram OPTISOUND 3010 C

OPTISOUND 3020 C

Accuracy

better than 0.2 % or ±4 mm (see diagram)

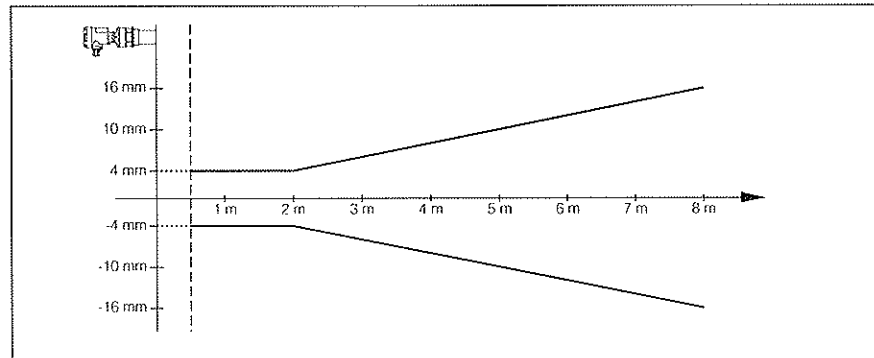


Fig. 21: Accuracy diagram OPTISOUND 3020 C

OPTISOUND 3030 C

Accuracy

better than 0.2 % or ±6 mm (see diagram)

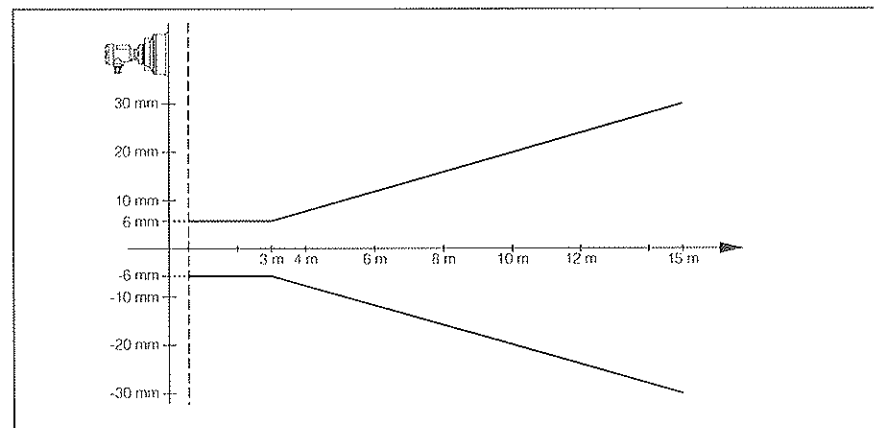


Fig. 22: Accuracy diagram OPTISOUND 3030 C

**Ambient conditions**

Ambient, storage and transport temperature

- without indicating and adjustment module -40 ... +80°C (-40 ... +176°F)
- the indicating and adjustment module -20 ... +70°C (-4 ... +158°F)
- Version IP 66/IP 68 1 bar with connection cable PE -20 ... +60°C (-4 ... +140°F)

**Process conditions**

Vessel pressure

- OPTISOUND 3010 C and 3020 C -20 ... 200 kPa (-0.2 ... 2 bar)
- OPTISOUND 3030 C with compression flange -20 ... 100 kPa (-0.2 ... 1 bar)
- OPTISOUND 3030 C with mounting strap 0 kPa (0 bar), because no sealing possibility

Process temperature (transducer temperature)

-40 ... +80°C (-40 ... +176°F)

Vibration resistance

mechanical vibrations with 4 g and 5 ... 100 Hz<sup>3)</sup>

**Electromechanical data**

Cable entry/

- Single chamber housing
  - 1x cable entry M20x1.5 (cable-ø 5 ... 9 mm), 1x blind stopper M20x1.5

or:

- 1x closing cap ½ NPT, 1x blind stopper ½ NPT

- Double chamber housing

- 1x cable entry M20x1.5 (cable-ø 5 ... 9 mm), 1x blind stopper M20x1.5

or:

- 1x closing cap ½ NPT, 1x blind stopper ½ NPT

or:

Spring-loaded terminals

for wire cross sections up to 2.5 mm<sup>2</sup>

<sup>3)</sup> Tested acc. to the regulations of German Lloyd, GL directive 2

### Indicating and adjustment module

Power supply and data transmission	through sensor via gold-plated sliding contacts (I <sup>2</sup> C bus)
Indication	LC display in full dot matrix
Adjustment elements	4 keys
Protection	
– unassembled	IP 20
– mounted into the sensor without cover	IP 40
Materials	
– Housing	ABS
– Inspection window	Polyester foil

### Supply voltage

Power supply – two-wire instrument	
– non-Ex instrument	14 ... 36 V DC
– EEx ia instrument	14 ... 30 V DC
Permissible residual ripple	
– < 100 Hz	U <sub>ss</sub> < 1 V
– 100 Hz ... 10 kHz	U <sub>ss</sub> < 10 mV
Load	see diagram

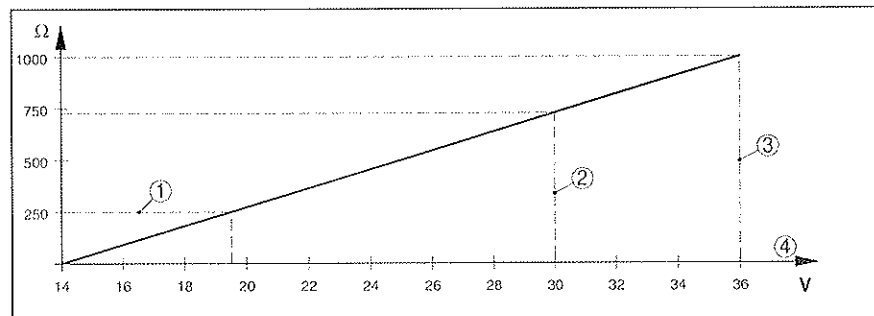


Fig. 23: Voltage diagram

- 1 HART load
- 2 Voltage limit EEx ia instrument
- 3 Voltage limit non-Ex instrument
- 4 Supply voltage

Supply voltage – four-wire instrument	20 ... 72 V DC, 20 ... 253 V AC, 50/60 Hz
Power consumption – four-wire instrument	max. 4 VA; max. 2.1 W

**Electrical protective measures**

Protection	IP 66/IP 68 (0.2 bar)
Overvoltage category	III
Protection class	
– Two-wire	II
– four-wire	I

**Approvals OPTISOUND 3010 C and 3020 C<sup>4)5)</sup>**

ATEX	ATEX II 1G, 1/2G, 2G EEx ia IIC T6
------	------------------------------------

**CE conformity**

EMC (89/336/EWG)	Emission EN 61326: 1997 (class A), susceptibility EN 61326: 1997/A1: 1998
LVD (73/23/EWG)	EN 61010-1: 2001

<sup>4)</sup> Deviating data with Ex applications: see separate safety instructions.  
<sup>5)</sup> Depending on order specification.



## 7 Dimensions

### Housing

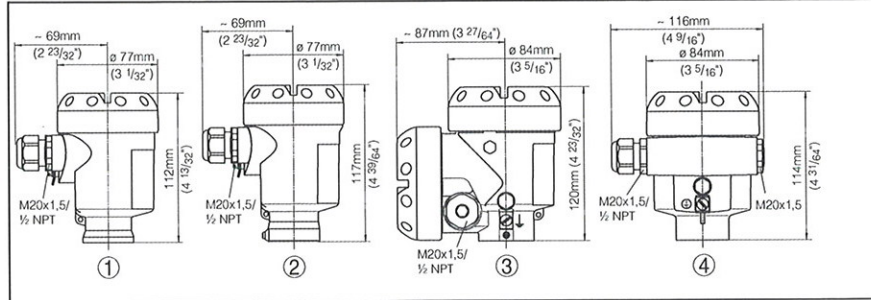


Fig. 24: Housing versions (with integrated indicating/adjustment module the housing height or width is increased by 9 mm/0.35 in)

- 1 Plastic housing
- 2 Stainless steel housing
- 3 Aluminium double chamber housing
- 4 Aluminium housing

### OPTISOUND 3010 C

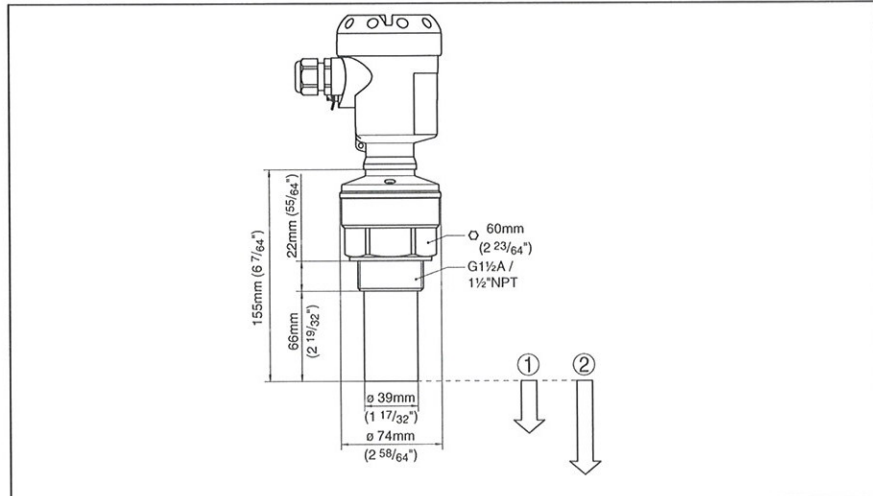


Fig. 25: OPTISOUND 3010 C

- 1 Dead band: 0.25 m (0.8 ft)
- 2 Meas. range: in liquids up to 5 m (16.4 ft), in solids up to 2 m (6.6 ft)

**OPTISOUND 3020 C**

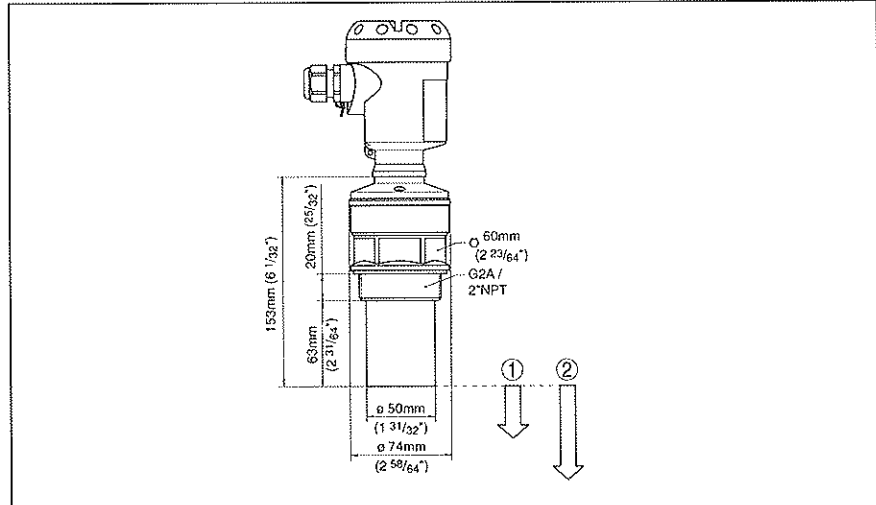


Fig. 26: OPTISOUND 3020 C

- 1 Dead zone: 0.4 m (1.3 ft)
- 2 Meas. range: in liquids up to 8 m (26.2 ft), in solids up to 3,5 m (11.5 ft)

**OPTISOUND 3030 C**

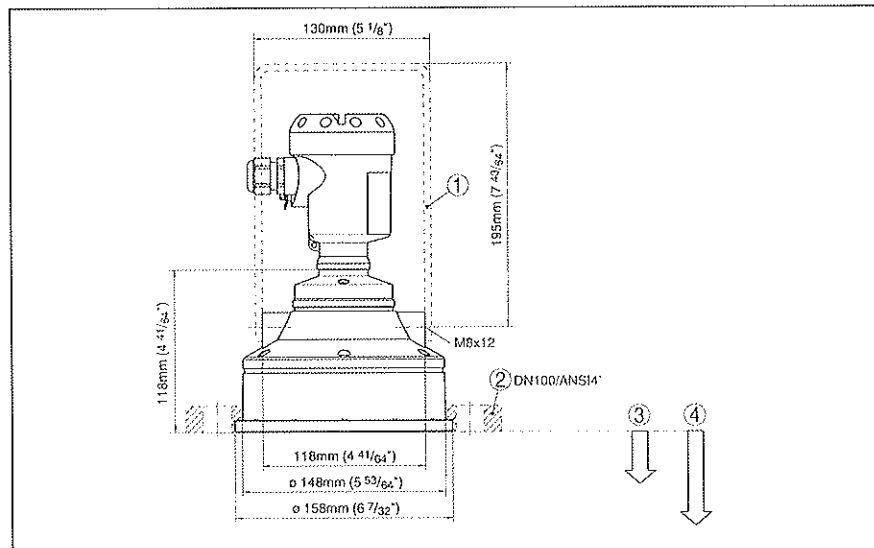


Fig. 27: OPTISOUND 3030 C

- 1 Mounting strap
- 2 Compression flange
- 3 Dead zone: 0.6 m (2 ft)
- 4 Meas. range: in liquids up to 15 m (49.2 ft), in solids up to 7 m (23 ft)

## **36. Level Switch**



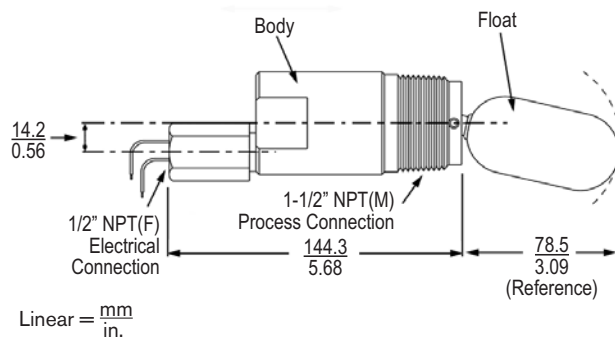
# Type 1510 Electric Level Switch

Form 498

**Type 1510** is a horizontally mounted, float-operated level switch suitable for plant and OEM applications where open or closed contacts are required to signal presence or absence of liquid at a discrete level. The float extension arm moves a magnet which actuates (deactuates) a hermetically sealed reed switch. Actuation (deactuation) can be reversed by rotating the unit 180 degrees.



## Dimensions



Linear =  $\frac{\text{mm}}{\text{in.}}$

## Product Specifications

<b>Mounting (Half coupling only)</b>	
Orientation	Horizontal mount only
Connection Size	1-1/2" NPT(M) Standard
<b>For</b>	<b>Change</b> <b>To</b>
2" NPT(M)	G5A G2A
Flanged Mounting	G5A *
*See flange table on page 2 for option designator (316SS construction only)	
Maximum Process Pressure	1500 psi (100 bar)
<b>Electrical</b>	
Switch Type	Hermetically sealed reed switch with 18" 20 AWG wire leads
Switch Rating (resistive)	1 amp at 110 VAC 3 amps at 28 VDC
Housing	Class I, Groups A, B, C & D; Divisions 1 & 2
Relay Housing	Class I, Groups C & D; Divisions 1 & 2
Connection Size	1/2" NPT(F)
Contact Form	SPST (For SPDT change W9 to W1 in the model number.)
Minimum Specific Gravity	0.45
Design Code	ANSI B31.3
Shipping Weight	Approximately 6 lbs. (3 kg)
Agency Listing	CSA Certified (optional). See Page 2.

*Design and specifications are subject to change without notice. For latest revision, see [www.sorinc.com](http://www.sorinc.com).*

## How to Order

Select model number from table below. Accessory designator(s) may be added after ES if required. See page 2.

Body Material	Float Material	Process Rating		Model Number
303SS* Standard	316SS (Standard)	1500 psi - 40 to 400°F	100 bar	1510B - G5A - C - W9 - ES
	Monel	900 psi - 40 to 400°F	62 bar	1510B - G5A - M - W9 - ES
	Polypropylene	5000 psi - 40 to 150°F	345 bar	1510B - G5A - S - W9 - ES
316SS	316SS	1500 psi - 40 to 400°F	100 bar	1510C - G5A - C - W9 - ES
	Monel	900 psi - 40 to 400°F	62 bar	1510C - G5A - M - W9 - ES
	Polypropylene	5000 psi - 40 to 150°F	345 bar	1510C - G5A - S - W9 - ES

\*Also known as ASME SA 320 Grade B8F.

# Type 1510 Electronic Level Switch

Optional Flanges

## Optional Flanges (316SS) construction only

Designator	Raised Face Flange		Designator	Raised Face Flange	
G7C	2-1/2"	150#	G4C	4"	150#
G7D		300#	G4D		300#
G7E		600#	G6C	6"	150#
G3C	3"	150#	G6D		300#
G3D		300#			
G3E		600#			

On flanged units, the float will be detached from the unit during shipping.

## Optional Accessories Add option designator(s) to end of model number.

Description	Designator
Wetted parts are cleaned for industrial oxygen service.	BB
ATEX and IECEX approved.	CL
3/4" NPT(F) conduit connection.	CR
CSA Certified. Class I, Group A, B, C, D; Divisions 1 & 2. For relay option; Class I, Group C & D, Divisions 1 & 2.	CS*
Canadian Registration Number (CRN). Maximum allowable pressure rating is 1500 psi. Consult the factory for details.	CV
Manual check accessory (uses Viton GLT o-rings).	MC**
NACE construction - MR-01-75. Available only with 316SS materials of construction.	NC
Tag, fiber. Attached with plastic wire to housing. Stamped with customer-specified tagging information.	PP
24 VDC powered DPDT relay in explosion proof terminal box. Contact rating: 10 amps @ 115 VAC. Class I, Group C, D; Divisions 1 & 2.	RB
120 VAC powered DPDT relay in explosion proof terminal box. Contact rating: 10 amps @ 115 VAC. Class I, Group C, D; Divisions 1 & 2.	RC
Tag, stainless steel. Attached with stainless steel wire to housing. Stamped with customer-specified tagging information.	RR
Stainless steel nameplate permanently attached to housing. Stamped with customer specified tagging information.	TT
Fungicidal varnish. Covers exterior except working parts.	VV
Powder coat epoxy coating. No coating on 316SS parts or plated screws. (500 hours)	PY
Epoxy coating. Exterior only. Polyamide epoxy with 316SS pigment. (200 hours)	YY
ANSI B31.3 certificate of conformance.	CZ

\*CS option is required on all flange mounted units. \*\*Manufacturer limits on Viton GLT are -40 to 400°F.

## Replacement Parts

Part Number	Description
3130-091	SPST Hermetically Sealed Reed Switch Capsule
3130-242	SPDT Hermetically Sealed Reed Switch Capsule
3130-106	SPST Hermetically Sealed Reed Switch Capsule for CSA Certified units
3130-243	SPDT Hermetically Sealed Reed Switch Capsule for CSA Certified units
3130-052	316SS Float Assembly

## Limited Warranty

SOR® agrees to repair or replace any switch found to be defective in material or workmanship within five years from date of shipment. The limited warranty is valid only if the switch was installed in accordance with published factory installation instructions, operated within the design limitations stated on the nameplate, and returned to the factory for inspection, freight prepaid, within the warranty period. Contact the factory for return authorization. No claim for labor or consequential damages will be allowed.



Form 498 (0407) © 2007 SOR Inc.

### **37. Media Trap - Effluent**

# BASKET STRAINERS



## SMALL DIAMETER BASKET STRAINERS 2", 3" AND 4" SIZES

### FEATURES

- The non-jamming quick removal cover eases cleaning. No tools are needed.
- Has high performance/low cost due to the heavy-duty welded construction and simplicity of design.
- The sturdy perforated baskets are designed for ease of servicing and long life.
- Contains a large basket capacity for less frequent cleaning.
- Has a high-flow capability with a 100 PSI pressure rating.
- The optional gauge guard connections are perfect for measuring the pressure drop between the clean and debris-filled sides of the basket.

**ORDER: 5358.(Size No.) PVC BASKET STRAINER, Viton Seals**

Size No.	Pipe Size	Basket Diameter	Price Each
120	2" Socket	3-1/4	\$313.30
220	2" Flanged	3-1/4	391.70
020	2" Threaded	3-1/4	334.70
130	3" Socket	3-1/4	534.10
230	3" Flanged	3-1/4	704.90
030	3" Threaded	3-1/4	598.10
140	4" Socket	5-3/8	989.70
240	4" Flanged	5-3/8	1,203.30
040	4" Threaded	—	—

340.180.120

CPVC also available, operating temperatures to 180°F. Contact Ryan Herco for details.

1/8" holes standard on basket strainers. 1/16" and 1/32" holes optional (PVC only).



Fluor-O-Shield strainers are well-suited for use in removing suspended or waste solids from extremely corrosive or high-purity fluid streams.

## PTFE AND PVDF BASKET STRAINERS

### FEATURES

- High capacity FLUOR-O-SHIELD™ PTFE and PVDF Basket Strainers.
- Maximize up-time by stretching the time between clean-outs.
- Teflon-encapsulated o-ring.
- Slant-head PTFE cartridge minimizes head-loss.
- Easily removable cartridge can be serviced in a matter of minutes.
- Drain plug standard.
- Both PTFE and PVDF units are available in pipe sizes up to 3".
- Standard connections in PTFE include NPT and flanges.
- PVDF units are also available with socket-weld connections in both metric and IPS sizes.
- Other connections such as Tri-Clamp are available.
- Screw-on top with handles.
- Standard Tefzel ETFE screens.
- Mesh sizes ranging from 160 to 11 mesh (70 to 1,800 microns). (Other mesh sizes and types available).

### APPLICATIONS

- High-purity liquids.
- Extremely corrosive fluids.
- Protect sensitive down stream process components.
- Increase life of expensive filters.

### **38. Cone Strainer – Backwash Line**



# Models: 22, 23, 24

- 22 Basket Type
- 23 Conical Type
- 24 Plate Type



## Basket, Conical and Plate Temporary Strainers Sizes: 1 1/2" - 24" (40 - 600mm)

### Typical Service

- Mueller Steam Specialty fabricated strainers are designed to remove foreign particles from pipelines.
- These provide effective and economical protection of pumps, valves, and similar more costly equipment, particularly during start up.
- Temporary strainers are not manufactured to be used instead of permanent strainers.
- Temporary strainers must be removed from pipeline after initial start up.

### Features

- Available with special lengths providing straining ratios of many times the pipe area
- Available to fit up to 2500 lb. flanges

### Construction

- Standard Class 150 and Class 300 units available
- Available in carbon steel, stainless steel and other materials

### Installation

- These units are installed between flanges.
- Ideal for applications where space restrictions are a factor

### Screens

- Standard material is 304SS.
- Specify other alloy material is required.
- Specify perforation and mesh size for proper particle retention.
- Consider maximum allowable pressure drop when specifying.

MODEL	SIZES	STANDARD (WATER)		STEAM, GAS, AIR	
		MATERIAL	OPENING	MATERIAL	OPENING
22, 23, 24	1/2" - 2"	304SS	.062 perf	304SS	.033 perf
22, 23, 24	2 1/2" - Up	304SS	.125 perf	mesh lined	

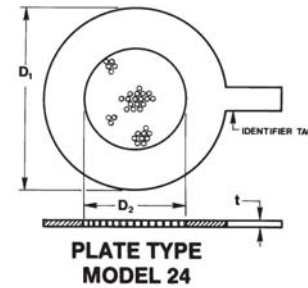
### Pressure Drop

Temporary strainer's pressure drop is normally lower than Y Strainer. Consult factory.

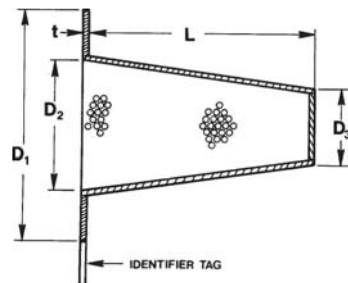
# Dimensions and Weights

## Models 24 (Plain Type)

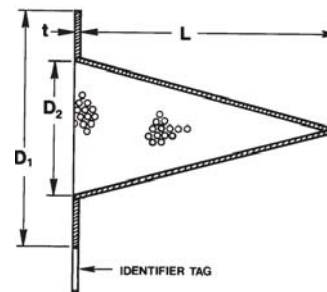
SIZE		DIMENSIONS									
		OD (D1)								ID (D2)	
		150 #		300 #		600 #					
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
1½	40	3¼	83	3⅝	92	3⅝	92	1¾	44		
2	50	4	100	4¼	108	4¼	108	2¼	57		
2½	65	4¾	121	5	125	5	125	2⅝	67		
3	80	5¼	83	5¾	146	5¾	146	3¼	83		
4	100	6¾	171	7	178	7½	191	4¼	108		
6	150	8⅝	219	9¾	248	10⅜	364	6¼	159		
8	200	10⅞	276	12	300	12½	318	8¼	210		
10	250	13¼	337	14⅞	359	15⅝	397	10¼	260		
12	300	16	400	16½	419	17⅞	454	12¼	311		
14	350	17⅞	448	19	483	19¼	489	14	350		
16	400	20⅞	511	21⅞	537	22⅞	562	16	400		
18	450	21½	546	23⅜	594	24	600	18	450		
20	500	23¾	603	25⅝	651	26¾	679	20	500		
24	600	28⅞	714	30⅝	772	31	787	24	600		



Basket Type Model 22



Conical Type Model 23



## Models 22 & 23 (Basket and Conical)

SIZE		DIMENSIONS											
		D1				D2				D3		T	
		Class 150/300		Class 600		Class 150/300		Class 600		All		All	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm		
1½	40	3¼	83	3⅝	92	1⅞	40	1⅜	35	1	25	14 GA.	
2	50	4	102	4¼	108	2	51	1¾	44	1⅝	35		
2½	65	4¾	121	5	127	2⅞	62	2⅞	54	1⅞	41		
3	80	5¼	133	5¾	146	3	76	2¾	70	2	51		
4	100	6¾	171	7½	191	3⅝	100	3⅞	92	2¾	70		
6	150	8⅝	219	10⅜	263	6	152	5⅞	144	4	100		
8	200	10⅞	276	12½	318	7⅞	200	7⅞	192	5½	140		
10	250	13¼	337	15⅝	397	9⅝	252	9⅝	244	7	178		
12	300	16	406	17⅞	454	11⅞	302	11½	292	8½	216		
14	350	17⅞	448	19¼	489	13	330	—	—	10	250		
16	400	20⅞	511	22⅞	562	14⅞	378	—	—	11½	292		
18	450	21½	546	24	610	16¾	425	—	—	13	330		
20	500	23¾	592	26¾	679	18¾	476	—	—	14½	368		
24	600	28⅞	714	31	787	22½	572	—	—	17	432		

% Open area with perforated ⅛" Dia. Holes on 3/16" centers (Compared to cross section schedule 40 Pipe.)

## Dimensions and Weights

### Length Dimensions (L) for Temporary Basket Type

SIZE		DIMENSIONS							
Model # 22 - Basket									
		100%		150%		200%		300%	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
1½	40	1¾	44	2¼	57	3	76	4½	114
2	50	2	50	2¾	70	3¾	95	5¾	146
2½	65	2¼	57	3¼	83	4½	114	6½	165
3	80	2½	64	3¾	95	5	127	7¾	197
4	100	3¼	83	5	127	6½	165	10	254
6	150	4½	114	6¾	171	9¼	235	14¼	362
8	200	5¾	146	8½	216	11½	292	17¾	451
10	250	7	178	10½	267	14¼	362	22	559
12	300	8	203	12¼	311	17	432	26	660
14	350	8¾	210	13	330	18	457	27½	699
16	400	9¼	235	14½	368	20¼	514	31	787
18	450	10½	267	16½	419	22½	572	35	889
20	500	11½	292	19	483	25½	648	39	991
24	600	13¾	349	22	559	30½	775	47	1194

### Length Dimensions (L) for Temporary Conical Type

SIZE		DIMENSIONS							
Model # 23 - Conical									
		100%		150%		200%		300%	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
1½	40	3	76	4	100	5¾	146	8¼	210
2	50	3¾	95	5	120	7¼	184	10½	267
2½	65	4¼	108	5¾	146	8	203	11¾	298
3	80	5	127	6¾	171	9½	241	14	356
4	100	6	152	8½	216	11¾	298	17¼	438
6	150	8¾	222	12½	318	17½	445	26	660
8	200	11	279	16	406	22	559	32¾	832
10	250	13½	343	20	508	27	686	40½	1029
12	300	15¾	400	23½	597	32	813	48	1219
14	350	17¼	438	26	660	35	889	52½	1333
16	400	19½	495	29	737	40	1016	60	1524
18	450	21½	546	32½	826	44	1118	66½	1689
20	500	23½	597	36	914	48½	1232	73½	1867
24	600	28¼	718	43	1092	58½	1486	—	—

Larger sizes and higher pressure classes available.  
Consult Factory

### **39. Turbidimeter – Decant and Effluent**



**1720E Low Range Process Turbidimeter (Turbidity) and sc100 Controller**

# Specifications

## 1720E Process Turbidimeter: Specifications

**Range:** 0 to 100 nephelometric turbidity units (NTU)

**Accuracy:** (Defined According to ISO 15389)

$\pm 2\%$  of reading or  $\pm 0.015$  NTU  
(whichever is greater) from 0 to 40 NTU;

$\pm 5\%$  of reading from 40 to 100 NTU

$\pm 5\%$  of reading from 40 to 100 NTU

**Displayed Resolution:** 0.0001 NTU up to 9.9999 NTU;

0.001 NTU from 10.000 to 99.999 NTU

**Repeatability:** (Defined According to ISO 15389)

Better than  $\pm 1.0\%$  of reading or  
 $\pm 0.002$  NTU, whichever is greater

**Response Time:** Initial response in 1 minute, 15 seconds for a full scale step change

**Signal Average Time:** User selectable from 6, 30, 60, 90 seconds; default 30 seconds

**Sample Flow Required:** 200 to 750 mL/minute  
(3.1 to 11.9 gal/hour)

**Storage Temperature:** -20 to 60° C  
(-4 to 140° F)

**Operating Temperature:** 0 to 50° C for Single Sensor System  
(32 to 122° F)

0 to 40° C for Two Sensor System  
(32 to 104° F)

**Operating Humidity:** 5 to 95% non-condensing

**Sample Temperature:** 0 to 50° C  
(32 to 122° F)

**Recorder Outputs:** Two selectable for 0-20 mA or 4-20 mA;  
output span programmable over any portion of the 0 to 100 NTU range; built into the sc100 Controller

**Alarms:** Two set-point alarms, each equipped with an SPDT relay with unpowered contacts rated for 5A resistive load at 230 Vac; built into the sc100 Controller

**Power Requirements:** 100-230 Vac, 50/60 Hz, auto selecting; 40 VA

**Sample Inlet Fitting:** 1/4" NPT female, 1/4" compression fitting (provided)

**Drain Fitting:** 1/2" NPT female, 1/2" hose barb (provided)

**Digital Communication:** Network Card compatible;  
MODBUS RS/485, MODBUS/RS232, LonWorks protocol (optional)

IR Port on the sc100 Controller to download into a handheld Personal Digital Assistant (PDA), or laptop computer via MODBUS

**Wireless Communication:**

**Dimensions:** Turbidimeter Body and Cap:  
25.4 x 30.5 x 40.6 cm (10 x 12 x 16")  
sc100 Controller:  
14.4 x 14.4 x 15.0 cm (5.67 x 5.67 x 5.91")

**Mounting:** Turbidimeter Body and Head Assembly:  
wall and floor stand

sc100 Controller:  
wall, pole, panel, and floor stand

**Enclosures:** NEMA-4X (indoor) /IP66 Controller

**Compliance:** Standard Methods 2130B, USEPA 180.1, Hach Method 8195

**Certification** Listed by ETL to UL 61010A-1: Certified by ETL to CSA C22.2 No. 1010.1: CE certified by Hach Company to EN 61010-1

**Safety:** Certified by ETL to CSA C22.2 No. 1010.1

**Immunity:** CE Certified by Hach Company to EN61326 (industrial levels)

**Emissions:** Class A: EN 61326, CISPR 11, FCC Part 15, Canadian Interference-Causing Equipment Regulation ICES-003

Specifications subject to change.



#### **40. Turbidimeter – Backwash**



Catalog Number DOC023.54.03232

# **SOLITAX sc**

USER MANUAL

October 2005, Edition 3

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# Section 1 Specifications

Specifications are subject to change without notice.

<b>Measuring Technique</b>	Infrared Duo scattered light technique for color-independent turbidity measurement Turbidity in accordance with DIN EN 27027 / TS equivalent DIN 38414
<b>Measuring Range</b>	t-line turbidity: 0.000–4000 FNU/NTU ts-line, inline turbidity: 0.001–4000 FNU/NTU; TSS content: 0.001–50 g/l hs-line, highline turbidity: 0.001–4000 FNU/NTU; TSS content: 0.001–150 g/l TSS
<b>Reproducibility</b>	Turbidity <1%, Total Suspended Solids (TSS) <3 %
<b>Measuring Accuracy</b>	Turbidity: Less than 1% of reading or ±0.001 NTU, whichever is greater Suspended Solids: Less than 5% of reading (depends on homogeneity of municipal activated sludge)
<b>Response Time</b>	1 s ≤ T90 ≤ 300 s (adjustable)
<b>Calibration</b>	Turbidity Formazin or StablCal® Standard (at 800 NTU). Requires a calibration kit. Suspended Solids Sample specific, based on gravimetric analysis with a correction factor procedure
<b>Cable Length</b>	10 m (33 ft) standard. Optional extension cables available in 25 ft, 50 ft, 100 ft Maximum total length: 100 m (328 ft).
<b>Ambient Temperature</b>	>0 to +40 °C (32–104 °F)
<b>Pressure Range</b>	≤ 6 bar (87 psi)
<b>Flow Velocity</b>	Max. 3 m/s (9.8 ft/s)
<b>Materials</b>	Optics carrier and sleeve: stainless steel 1.4571 or PVC black
	Wiper shaft: stainless steel 1.4104
	Wiper arm: stainless steel 1.4581
	Wiper rubber: silicone rubber (standard) Optional: Viton (LZX578)
	Windows and light guide: quartz glass (Suprasil)
	O-rings (optics carrier, wiper, windows): NBR (acrylonitrile butadiene rubber)
	Housing seals: NBR 70
	Sensor connecting cable (hard-wired): 1 cable pair AWG 22 / 12 V DC twisted, 1 cable pair AWG 24 / data twisted, common cable screen, Semoflex (PUR)
	Sensor connection plug (hard-wired): type M12 enclosure rating IP 67
Threaded cable fitting: stainless steel 1.4305 or PVC white	
<b>Dimensions</b>	Display unit: W x H x D 306 x 286 x 93 mm (12 x 11.3 x 3.7 in.)
	Immersion sensors (T-line, TS-Line and HS-line): D x L 60 x 200 mm (2 x 8 in.)
	Insertion sensor (Inline or Highline): D x L 60 x 315 mm (2 x 12.4 in.)
	Pipe installation fitting for insertion sensors: DN 65 / PN 16 DIN 2633; ≤5 bar; for pipes from DN 80 Distance sensor–wall (floor): TSS >10 cm, turbidity >50 cm
<b>Weight</b>	Display unit: approx. 3.5 kg (7.7 lb)
	Immersion sensors (T-line, TS-Line and HS-line): approx. 1.8 kg (4 lb) (t-line: approx. 0.6 kg (1 lb))
	Insertion sensor (Inline or Highline): approx. 2.4 kg (5.3 lb)
	Pipe installation fitting: approx. 2.7 kg (6 lb) (without probe) Pipe installation safety fitting: approx. 18 kg (40 lb) (without probe)
<b>User Maintenance</b>	1 h / month, typical
<b>Certifications</b>	CE, UL/CSA Safety Standards (cETLus )

# Section 2 General Information

---

## 2.1 Safety Information

Please read this entire manual before unpacking, setting up, or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

To ensure that the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that specified in this manual.

### 2.1.1 Use of Hazard Information

**DANGER**

*Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.*

**CAUTION**







*Indicates a potentially hazardous situation that may result in minor or moderate injury.*

**Important Note:** *Information that requires special emphasis.*

**Note:** *Information that supplements points in the main text.*

### 2.1.2 Precautionary Labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed

	This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.
	This symbol, when noted on a product enclosure or barrier, indicates that a risk of electrical shock and/or electrocution exists.
	This symbol, if noted on the product, indicates the need for protective eye wear.
	This symbol, when noted on the product, identifies the location of the connection for Protective Earth (ground).
	This symbol, when noted on the product, identifies the location of a fuse or current limiting device.
	This symbol, when noted on the product, indicated the presence of devices sensitive to Electro-static Discharge (ESD) and indicated that care must be taken to prevent damage with the equipment.

### 2.2 Sensor Overview

*Note: All sensors are also available without wipers for special applications.*

**t-line: 0.001–4000 FNU/NTU**

High-resolution turbidity probe made of plastic for the outlets of sewage treatment plants and bodies of water.

**ts-line: 0.001–4000 FNU/NTU; 0.001–50.0 g/L**

High-precision turbidity and solids probe made of stainless steel or plastic for color-independent measurement of fine turbidities and sludges.

**hs-line: 0.001–4000 FNU/NTU; 0.001–150.0 g/L**

High-precision turbidity and solids probe made of stainless steel or plastic for color-independent measurement of highly concentrated sludges.

**inline: 0.001–4000 FNU/NTU; 0.001–50.0 g/L**

High-precision pipe installation probe for turbidity and solids made of stainless steel for color-independent measurement of fine turbidities and sludges.

**highline: 0.001–4000 FNU/NTU; 0.001–150.0 g/L**

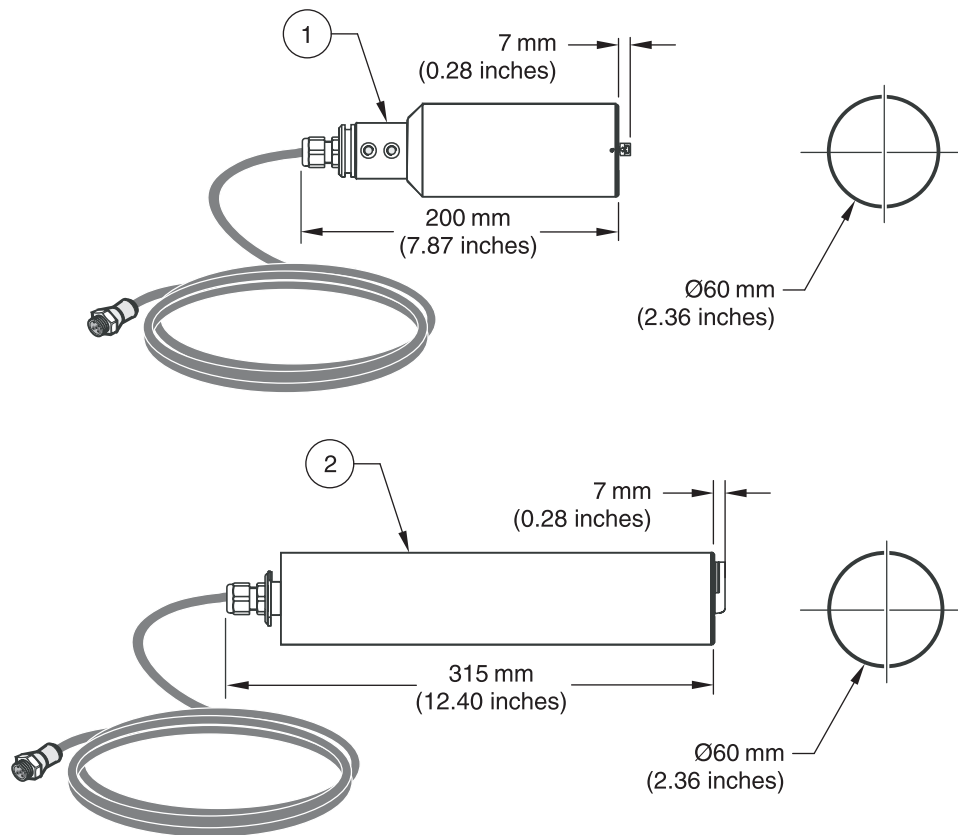
High-precision pipe installation probe for turbidity and suspended solids made of stainless steel for color-independent measurement of highly concentrated sludges.

---

**Figure 1 Solitax sc Sensors**



Figure 2 Sensor Dimensions



- |   |
|---|
| 1. SOLITAX sc models t-line, ts-line, and hs-line for immersion in open tanks |
| 2. SOLITAX sc models inline and highline sensors for insertion in pipes       |

## 2.3 Measuring Principle

The measuring principle is based on a combined infrared absorption scattered light technique that measures the lowest turbidity values in accordance with DIN EN 27027 just as precisely and continuously as high sludge content.

The instrument is available as a turbidity-only analyzer, and as an analyzer that can measure both turbidity and suspended solids using an additional sensor photoreceptor. An LED (light-emitting diode) light source in the analyzer's sensor transmits a beam of infrared light into the sample stream at an angle of 45° to the sensor face. A pair of photoreceptors in the sensor face detect light scattered at 90° to the transmitted beam. In models that measure suspended solids, a back-scatter photoreceptor positioned at 140° to the transmitted beam detects light scattered in high-solids sample streams.

## 2.4 Handling

The sensor contains high-quality optical and electronic assemblies. Make sure the sensor is not subjected to any hard mechanical knocks. There are no customer-serviceable items inside the sensor and the display unit.



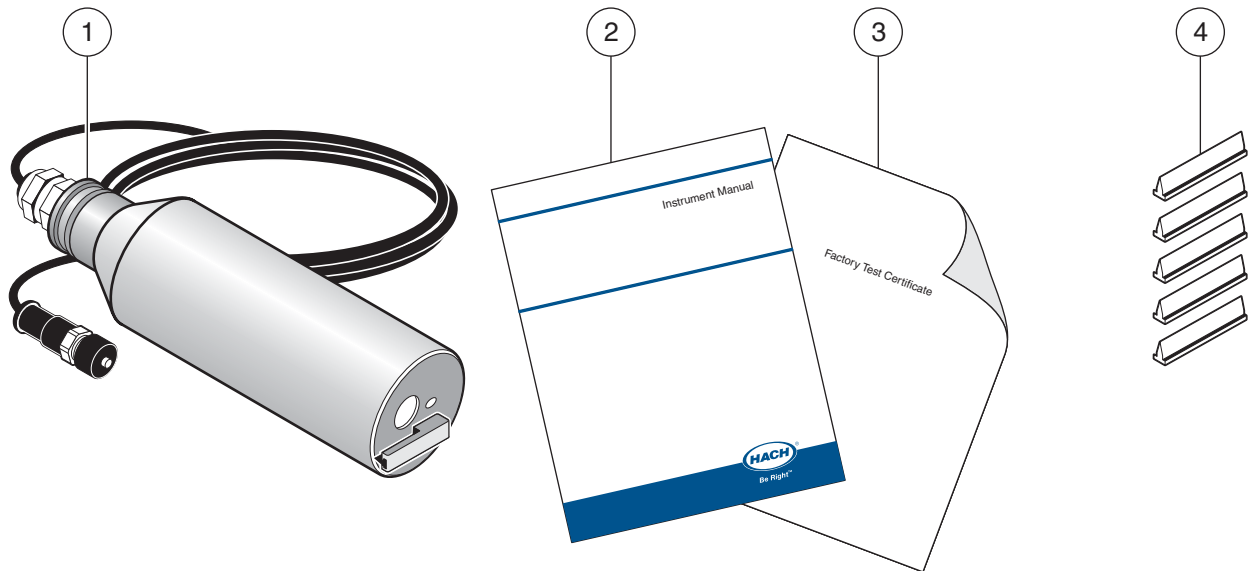
## Section 3 Installation

### **DANGER**

*Only qualified personnel should conduct the tasks described in this section of the manual.*

### 3.1 Unpacking the Instrument

Figure 3 Items Supplied with Sensor



1. SOLITAX sc Sensor	3. Factory Test Certificate
2. User Manual	4. Wiper Set (for 5 changes) LZX050

#### 3.1.1 Function Check

After unpacking, both components should be checked for any transport damage and a short function check performed prior to installation.

To perform a function check, connect the sensor to the display unit and power the unit. Shortly after the unit is plugged in, the display is activated and the instrument switches to the measurement display. Measured values taken in air is meaningless.

If no messages appear in the lower part of the display, the function check is then complete.

## 3.2 Connecting/Wiring the Sensor to the sc100 Controller

**DANGER**

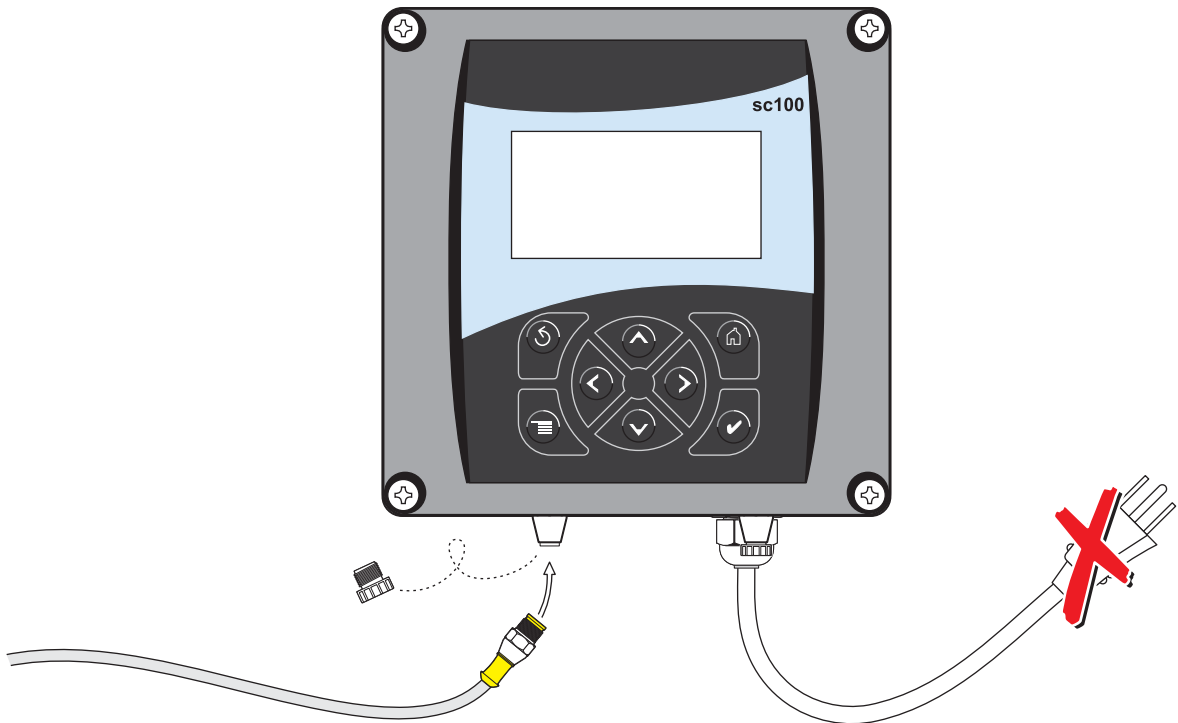
*Although the sc100 controller is certified for Class 1, Division 2 Hazardous Locations, it is only certified when installed with sensors listed in Control Drawings 5860078. The sc100 controller and this sensor are NOT suitable for use in Class 1, Division 2 Hazardous Locations.*

### 3.2.1 Attaching a sc Sensor with a Quick-connect Fitting

The sensor cable is supplied with a keyed quick-connect fitting for easy attachment to the controller (Figure 4). Retain the connector cap to seal the connector opening in case the sensor must be removed. Optional extension cables may be purchased to extend the sensor cable length. If the total cable length exceeds 100 m (300 ft), a termination box must be installed.

---

**Figure 4** Attaching the Sensor Using the Quick-connect Fitting



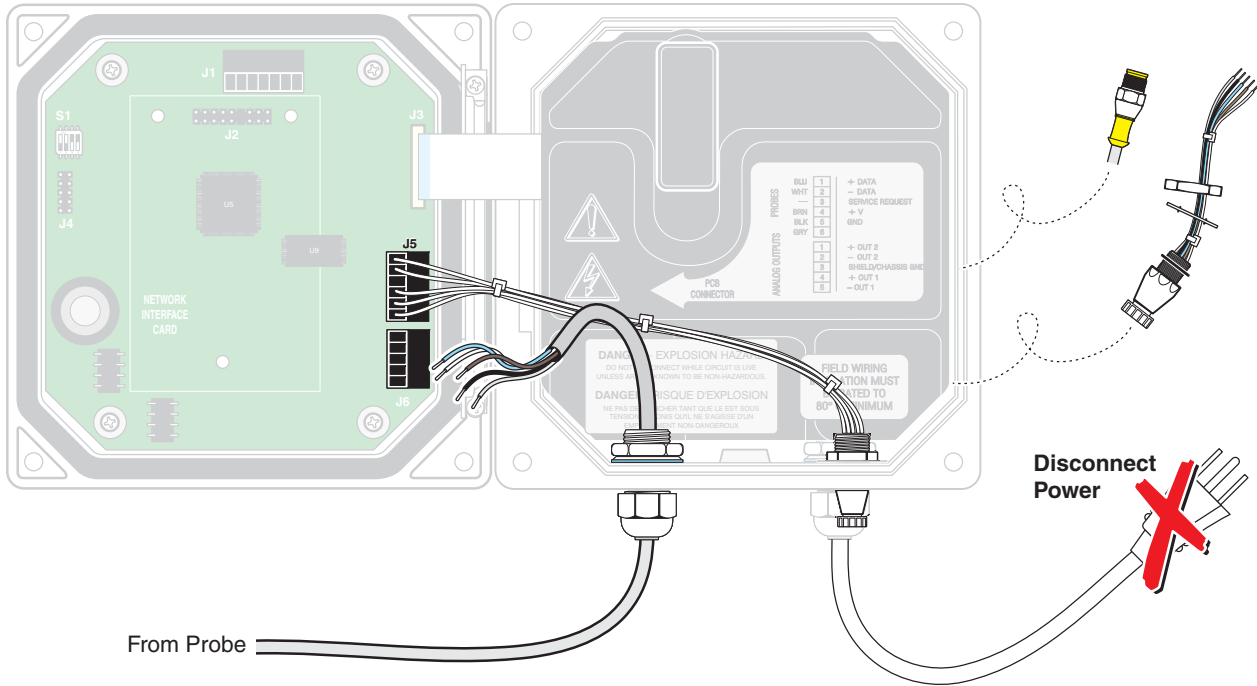
### 3.2.2 Hard-wiring a sc Sensor to the Controller

1. Disconnect power to the controller.
2. Open the controller cover.
3. Disconnect and remove the existing wires between the quick-connect and terminal strip J5, see [Figure 5 on page 14](#).
4. Remove the quick-connect fitting and wires and install the threaded plug on the opening to maintain the environmental rating.
5. Cut the connector from the sensor cable.
6. Strip the insulation on the cable back 1-inch. Strip ¼-inch of each individual wire end.
7. Pass the cable through conduit and a conduit hub or a strain relief fitting (Cat. No. 16664) and an available access hole in the controller enclosure. Tighten the fitting. Use of strain relief fitting other than Cat. No. 16664 may result in a hazard. Use only the recommended strain relief fitting.
8. Reinstall the plug on the sensor access opening to maintain the environmental rating.
9. Wire as shown in [Table 1](#) and [Figure 5](#).
10. Close and secure the cover.

**Table 1 Wiring the Sensor at Terminal Block J5**

Terminal Number	Terminal Designation	Wire Color
1	Data (+)	Blue
2	Data (-)	White
3	Service Request	No Connection
4	+12 VDC	Brown
5	Circuit Common	Black
6	Shield	Shield (grey wire in existing quick-disconnect fitting)

**Figure 5** Hard-wiring the Sensor



## 3.3 Connecting the Sensor to the sc1000

### 3.3.1 Connecting the Sensor using the Quick-connect Fittings

1. Unscrew the connector cap from the controller. Retain the connector cap to seal the connector opening in case the sensor must be removed.
2. Push the connector into the socket.
3. Hand-tighten the union nut.

**Note:** Do not use the middle connection for the sensors as this is reserved for the display module.

---

## 3.4 Sensor Installation

### 3.4.1 Installation Overview

[Figure 6 on page 16](#) and [Figure 7 on page 17](#) illustrates the installation overview for Solitax sc Models t-line, ts-line, and hs-line for immersion in open tanks (Fixed Point Installation Kit, Cat. No. 57344-00). Refer to [Figure 8 on page 18](#) for a description of the Sensor Bracket Components.

The maximum distance from the mounting surface to the sensor without the use of an extension tube is 1.5 m (4.9 ft) as shown in [Figure 7 on page 17](#). When that distance exceeds 1.5 m (4.9 ft), one of the following extension tubes is required and can be ordered separately:

- Extension Tube, 35 cm (1.15 ft), Cat. No. BRO068
- Extension tube 1.0 m (3.28 ft), Cat. No. BRO061
- Extension tube 1.8 m (5.90 ft), Cat. No. BRO062

To ensure a suitable measuring position, install the probe to the following conditions:

- The probe optical window must have a ground clearance of at least 30 cm (11.8 in.).
- Install the probe with the optical window facing (downstream) in the direction of the flow to minimize the risk of fouling.
- Avoid installation sites where air bubbles are inconsistent. If this not possible, try moving the probe slightly or adjusting its alignment to minimize the bubble effect.
- Protect the probe against the oncoming flow of large objects, such as branches or ice and against flow surges.
- Avoid installing the probe with the optical window facing into direct light or facing a highly-reflective surface.

Figure 6 Sensor Installation Overview

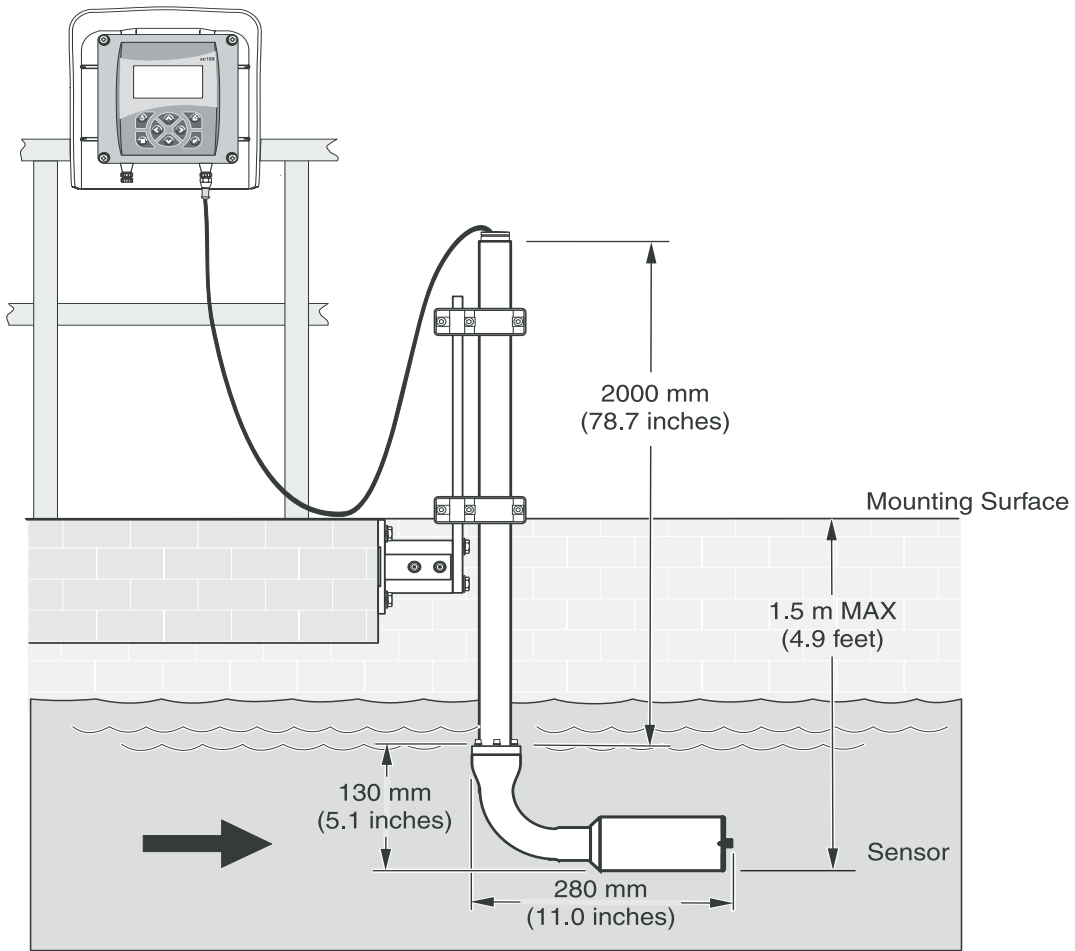
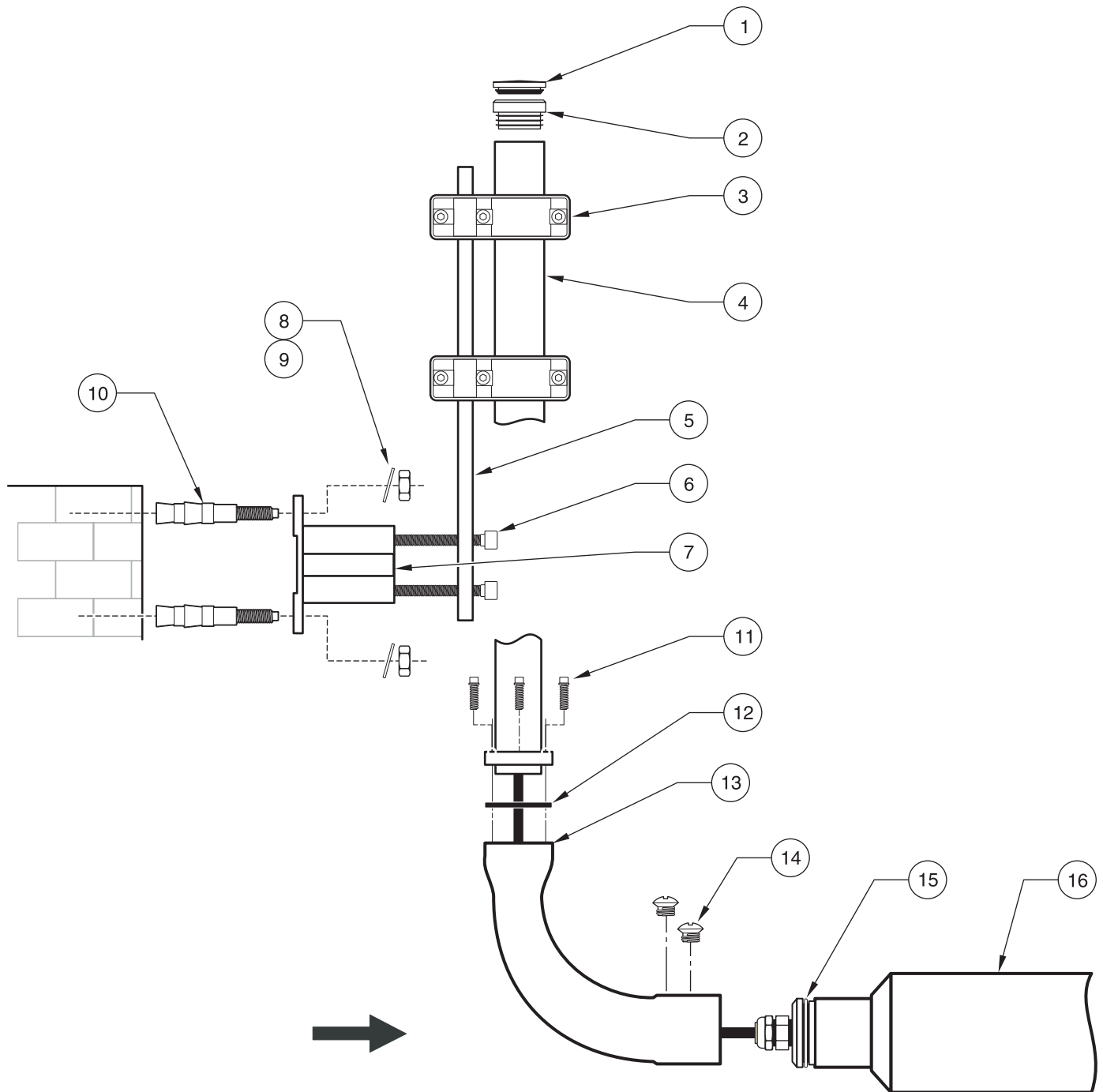
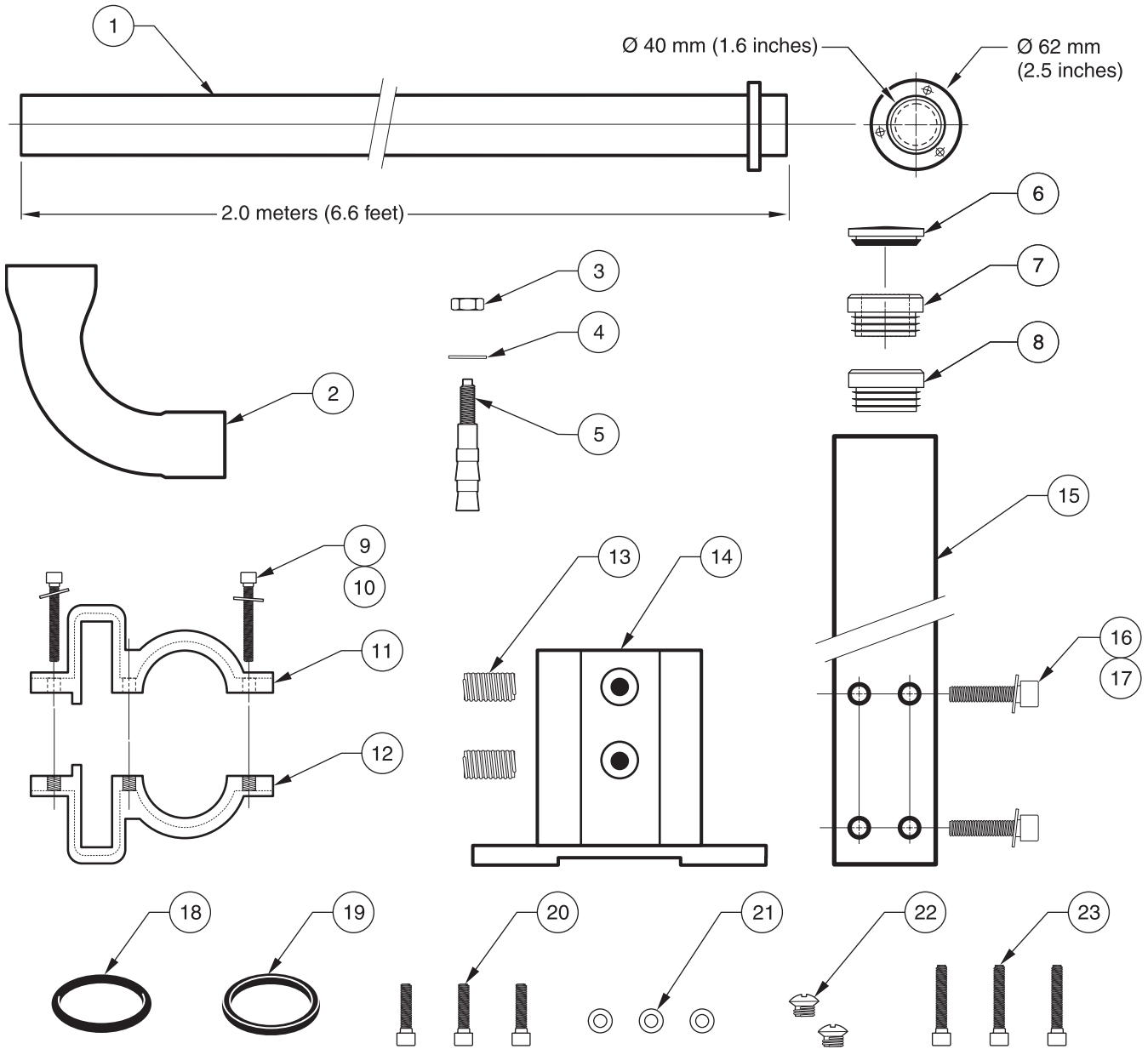


Figure 7 Fixed Point Installation Kit (57344-00) for Solitax models t-line, ts-line, and hs-line sensors



1. Sealing Plug	9. Flat Washer
2. Plug	10. Concrete Anchor
3. Retaining Clamp (2)	11. Bolt M3 x 10 (3)
4. Mounting Pipe (2.0 meters)	12. Flat seal
5. Fastening Lug	13. Adapter 90°
6. Bolt, M8 x 40 (4)	14. Countersunk head bolt M6 x 8 (2)
7. Base	15. O-ring EPDM
8. Hex Nut	16. Probe

Figure 8 Sensor Bracket Components



1. Mounting pipe 2.0 m	13. Set screws (2)
2. 90° adapter	14. Base
3. Hex Head Cap screws (4)	15. Fastening Lug
4. Flat Washers (4)	16. Bolt M8 x 40 (4)
5. Concrete Anchors (4)	17. Sealing plug (rubber)
6. Sealing Plug (LZX417)	18. O-ring, EPDM (LZX417)
7. Open Grommet	19. Flat Seal (LZX417)
8. Closed Grommet (LZX417)	20. Bolt M3 x 10 (3) (LZX417)
9. Socket Head Cap Screws (6)	21. Flat washers (3) (LZX417)
10. Flat Washers (6)	22. Countersunk head bolt M6 x 8 (2) (LZX417)
11. Bracket with thru holes (2)	23. Three extra socket head cap screws (M3 X 16) are included with the kit. These screws are not used with the Solitax.
12. Bracket with tapped holes (2)	

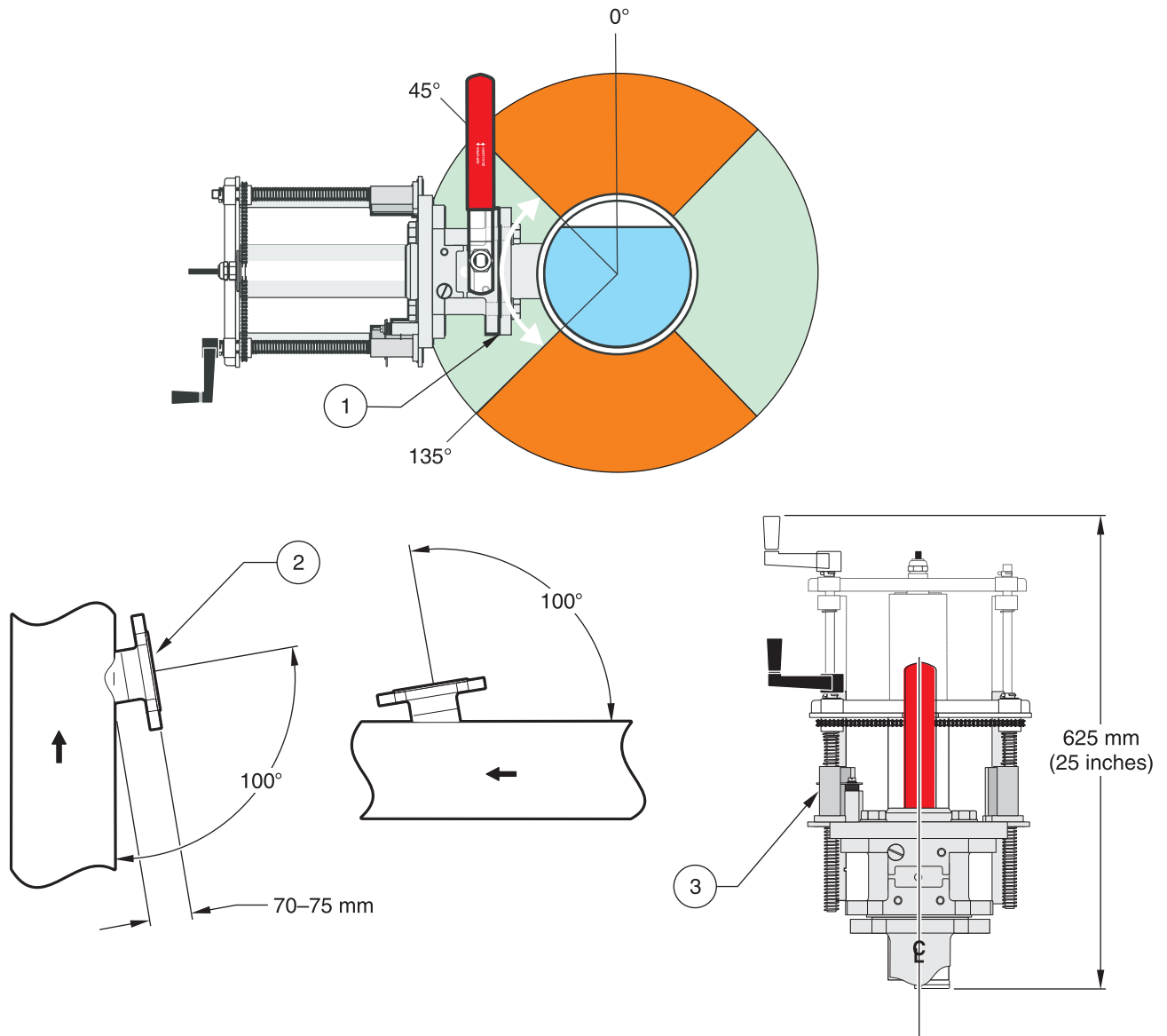


### 3.5 Pipe Installation

The Insertion Mounting Kit (Cat. No. 57384-00) for inline and highline insertion sensors includes a Carbon Steel flange (LZX703) and ball valve and extraction system (LZX337).

**Note:** It is recommended to coat the Carbon Steel flange with a protective coating to prohibit rust.

**Figure 9** Installation Preparation

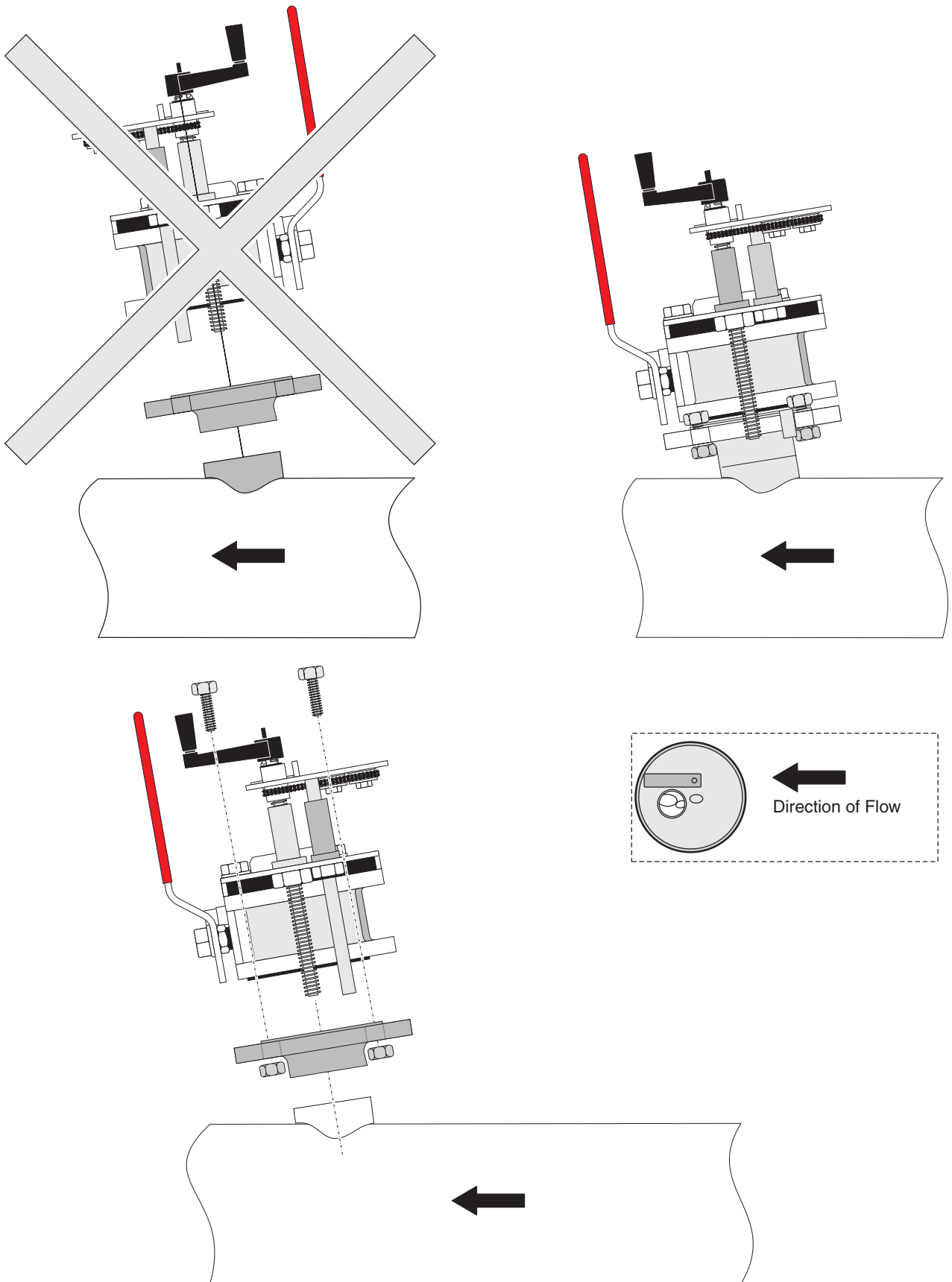


1.	Recommended installation angle 45°-135°
2.	Welded flange: Carbon Steel LZX703
3.	Pipe installation LZX 337

### 3.5.1 Pipe Installation Placement Guidelines

- Install the sensor in an up-flow pipe section for best results. Do not mount the sensor in a down-flow pipe section.
- Mounting in a horizontal pipe section is acceptable if the sensor is fully immersed at all times. Usually, mounting 90 degrees from the top of the pipe guarantees full immersion. Do not mount on the top or bottom of a horizontal pipe section.
- Install the sensor in a pipe that is equal to or greater than 4 inches in diameter.
- Install the sensor at least 1.5 m (5 ft.) or three times the pipe diameter (whichever is greater) downstream of pumps, valves, or pipe elbows.
- Install the sensor on the discharge side of a pump, if possible, with a dilution or flush valve installed on the suction side of the pump.
- If the sensor is to be used to measure sludge with significant amounts of debris, install it after a sludge grinding pump or after a pump with a grinding/comminuting unit in front of it.
- Install the sensor within 7.8 M of the controller with the standard probe cable. Optional cable extensions can be added for a maximum combined distance of 100 meters.
- If the flange cannot be welded to the pipe due to incompatibility of materials between the stud and the pipe, it is recommended that a stainless steel pipe section be fabricated. Weld the flange onto the stainless steel pipe section and attach the stainless steel section as a segment of the process pipe.

Figure 10 Proper Positioning for Insertion into Pipe

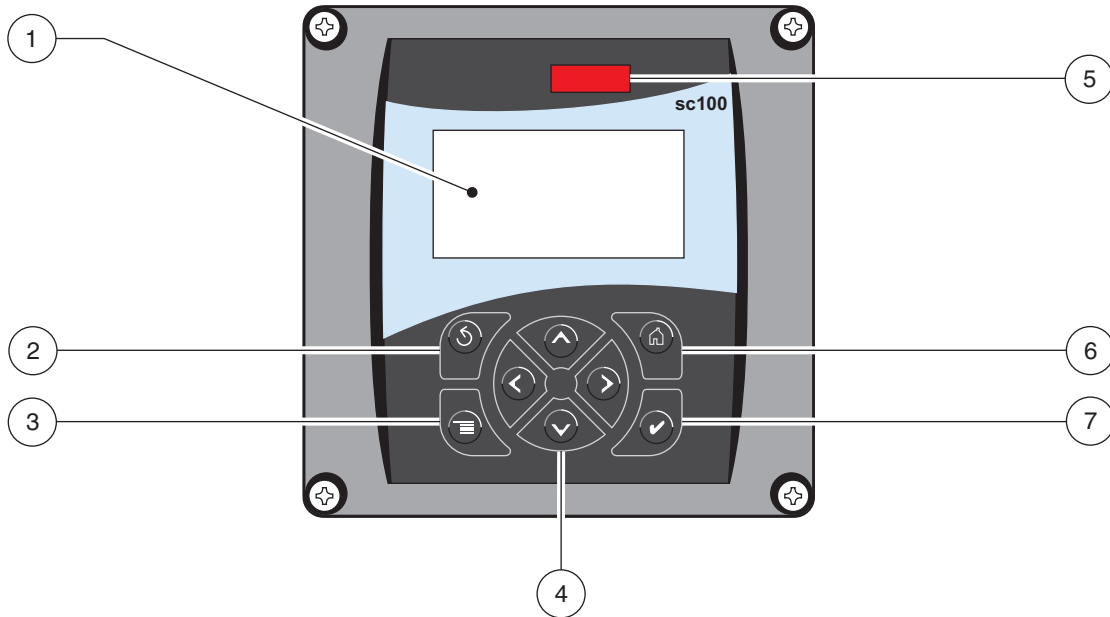


# Section 4 User Interface and Navigation

## 4.1 Using the sc100 Controller






The front of the controller is shown in [Figure 11](#). The keypad consists of the eight keys described in [Table 2](#).

**Figure 11 Front of the Controller**



1. Instrument display	5. IrDA window
2. <b>BACK</b> key	6. <b>HOME</b> key
3. <b>MENU</b> key	7. <b>ENTER</b> key
4. <b>RIGHT, LEFT, UP, and DOWN</b> keys	

**Table 2 Controller Key Functions/Features**

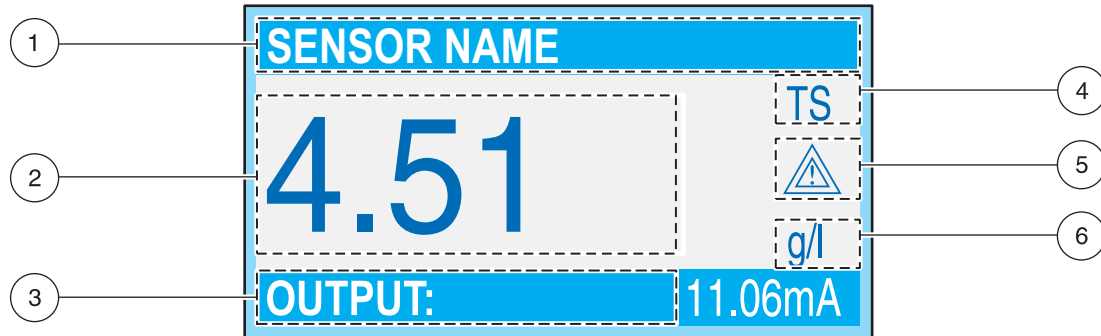
Number	Key	Function
2		Moves back one level in the menu structure.
3		Moves to the main menu from other menus. This key is not active in menus where a selection or other input must be made.
4		Navigates through the menus, changes settings, and increments and decrements digits.
5		Moves to the Main Measurement screen from any other screen. This key is not active in menus where a selection or other input must be made.
6		Accepts an input value, updates, or accepts displayed menu options.

## 4.1.1 sc100 Display Features

When a sensor is connected and the controller is in measurement mode, the controller display will show the current reading. On startup, when a sensor error has occurred and when a sensor is being calibrated, the display will flash.

An active system warning will cause the warning icon (a triangle with an exclamation point inside) to be displayed on the right side of the display.

## 4.1.2 Important Key Presses



1. Status line (indicates sensor names and the status of the relay contacts)	3. Current output 1 or 2	5. Area for the warning icon
2. Main measured value	4. Parameter	6. Unit of measure

- Press the **HOME** key then the **RIGHT** or **LEFT** key to display two readings when two sensors are connected. Continue to press the **RIGHT** or **LEFT** key to toggle through the available display options.
- Press the **UP** and **DOWN** keys to toggle the status bar at the bottom of the measurement display to display the secondary measurement (temperature) and output information.
- When in Menu mode, an arrow may appear on the right side of the display to indicate that more menus are available. Press the **UP** or **DOWN** key (corresponding to the arrow direction) to display additional menus.

## 4.2 Using the sc1000 Controller

The sc1000 is a touch screen application. Use your finger to touch keys and menu commands. In normal operation the touch screen displays the measured values for the sensors selected.








### 4.2.1 Display Features

#### 4.2.1.1 Using the Pop-up Toolbar

The pop-up toolbar provides access to the controller and sensor settings. The toolbar is normally hidden from view. To view the toolbar, touch the bottom-left of the screen.

**Figure 12 Pop-up Toolbar Functions**



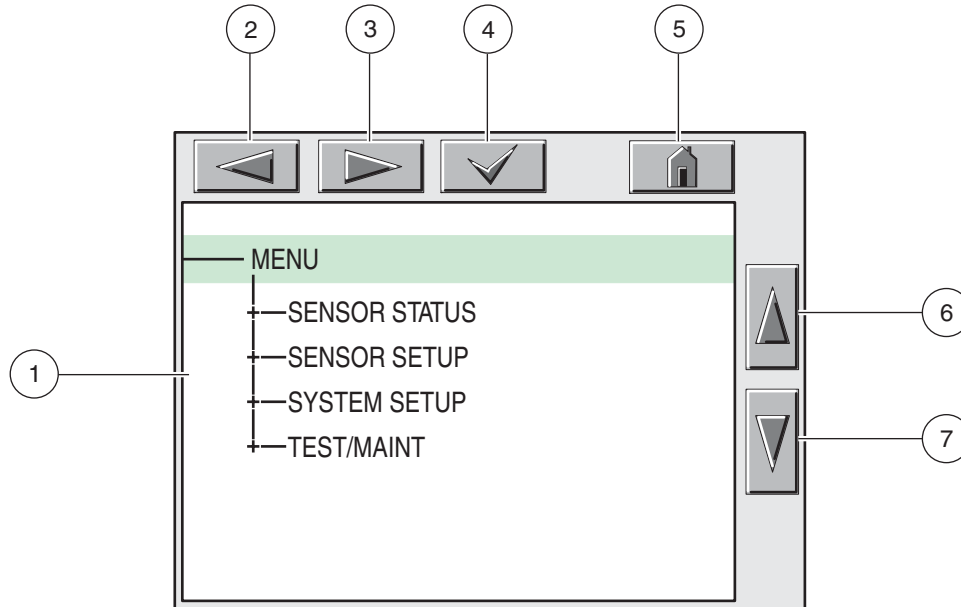
	<b>MAIN MENU</b> —displays the Main Menu Structure
	<b>UP Arrow</b> —scrolls up to the previous displayed value.
	Displays one value.
	Displays two values at the same time.
	Displays four values at the same time.
	<b>LIST</b> —displays the list of connected devices and sensors.
	<b>DOWN Arrow</b> —scrolls down to the next displayed value.

#### 4.2.1.2 Using the Menu Windows

If the Menu button (from the pop-up toolbar) is selected, the Main Menu screen is opened. The Main Menu screen allows the user to view the sensor status, configure the sensor setup, system setup, and perform diagnostics.

The menu structure may vary depending on the configuration of the system.

**Figure 13 Main Menu**



1.	Display Area
2.	<b>BACK</b>
3.	<b>FORWARD</b>
4.	<b>ENTER</b> —confirms the entry or selection.
5.	<b>HOME</b> —changes to the display of measured values. The pop-up toolbar cannot open from the menu window. To view the Main Menu from this display, touch the Home button and then the bottom of the screen.
6.	<b>UP</b> —scrolls up
7.	<b>DOWN</b> —scrolls down

### 4.2.1.3 Navigating the Menu Windows

To view a menu item, touch the menu item or use the **UP** and **DOWN** keys to highlight the item. The menu item remains highlighted for approximately 4 seconds after it is selected. To view the highlighted command, select the area to the left of the menu item or select the **ENTER** button.

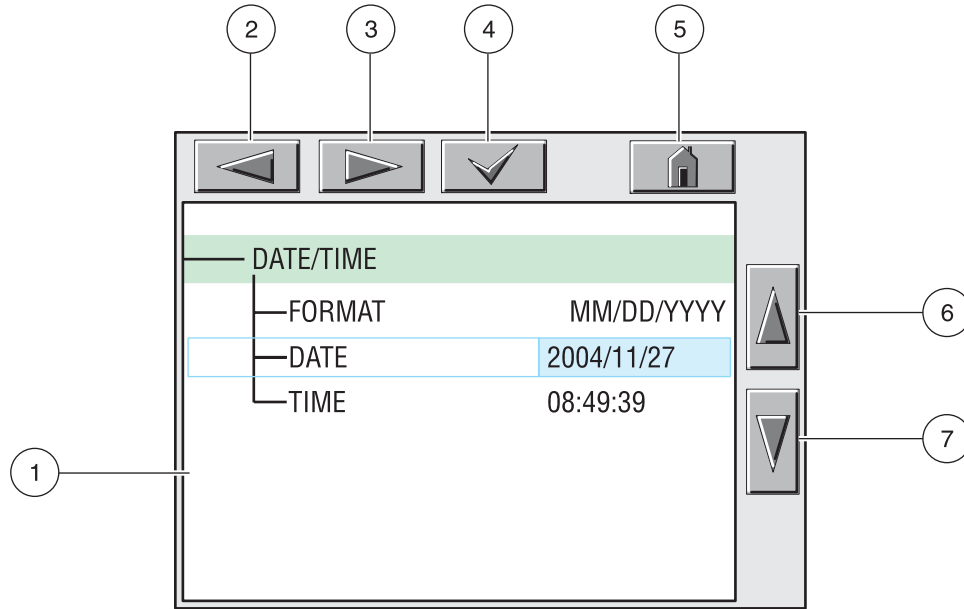
A “+” next to a menu command indicates there is a submenu. Touch the “+” to view the submenu. An “i” next to a menu command indicates it is information only.

If a menu item is editable, highlight the item and touch the far-left part of the menu item until it is highlighted and press **ENTER** or double-tap the highlighted item. A keypad will be displayed to change an entry ([Figure 15 on page 27](#)) or a list box will be displayed ([Figure 16 on page 28](#)).

Messages are displayed in the message window ([Figure 17 on page 28](#)).

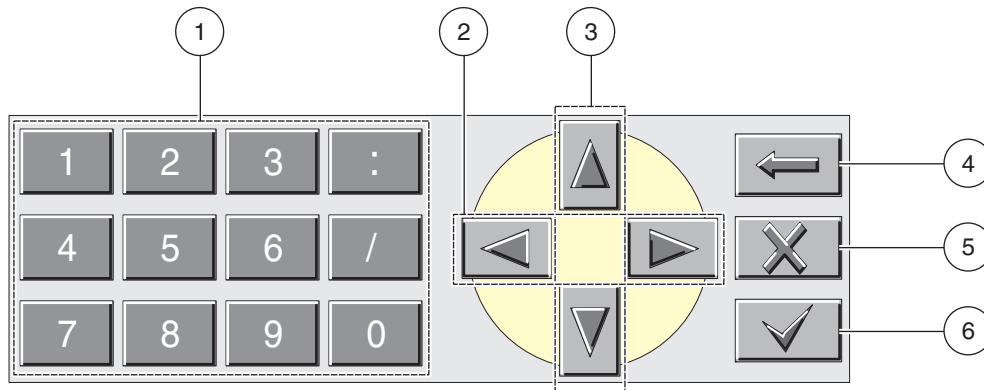
If an entry is incorrect, repeat the entry with the correct values. If the entry is outside the working range, a correction to the entry is made automatically.

Figure 14 Changing a Menu Item



1. Display Area	5. HOME—changes to the display of measured values.
2. BACK	6. UP—scrolls up
3. FORWARD	7. DOWN—scrolls down
4. ENTER—confirms the entry or selection.	

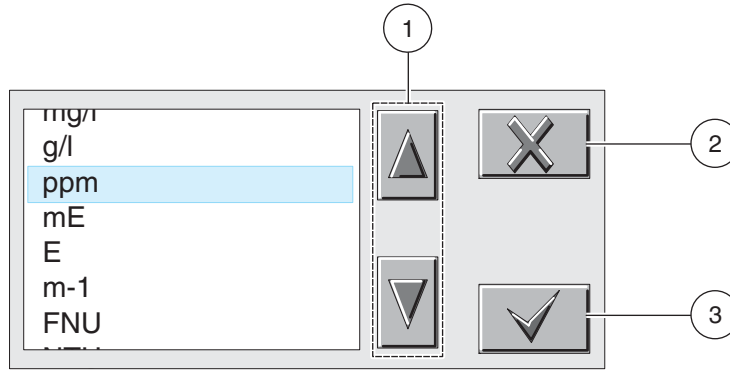
Figure 15 Keypad



1. Enters numbers or the character as shown on the button.
2. Moves the cursor one position to the left or to the right.
3. Increase/Decrease a number or letter at the cursor position. Keep the button pressed to change the numbers/characters continuously.
4. Deletes the character to the left of the cursor.
5. CANCEL—cancels the entry.
6. ENTER—confirms the entry or selection.

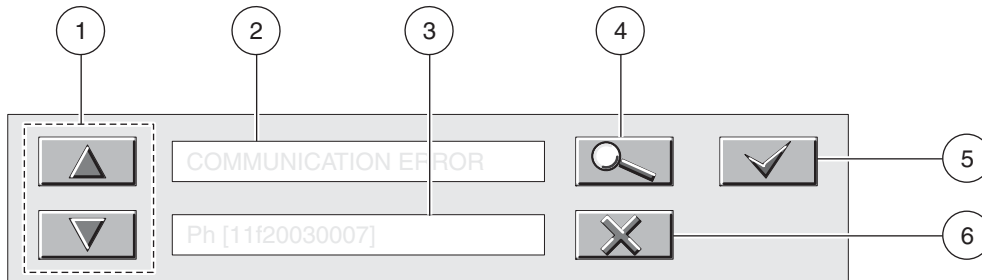


**Figure 16** List Box



- |  |
|--|
| 1. Scrolls up or down                  |
| 2. <b>CANCEL</b> —cancels and entry.   |
| 3. <b>ENTER</b> —confirms a selection. |

**Figure 17** Message window



- |  |
|--|
| 1. Scrolls up or down.                               |
| 2. Displays the messages or warnings.                |
| 3. Displays details on the selected entry.           |
| 4. This button changes back to the previous display. |
| 5. <b>ENTER</b> —confirms an entry.                  |
| 6. <b>CANCEL</b> —cancels an entry.                  |

# Section 5 Operations

## 5.1 Sensor Setup

When a sensor is initially installed, the serial number of the sensor will be displayed as the sensor name. To change the sensor name refer to the following instructions:

1. Select Main Menu.
2. From the Main Menu, select SENSOR SETUP and confirm.
3. Highlight the appropriate sensor if more than one sensor is attached and confirm.
4. Select CONFIGURE and confirm.
5. Select EDIT NAME and edit the name. Confirm or cancel to return to the Sensor Setup menu.

## 5.2 Sensor Data Logging

The sc100 controller provides three data logs (one for each sensor and one for calculated values) and three event logs (one for each sensor and one for the controller). The data logs store the measurement data at selected intervals. The event log stores a variety of events that occur on the devices such as configuration changes, alarms, and warning conditions. The data logs are stored in a packed binary format and the event logs are stored in a CSV format. The logs can be downloaded through the digital network port or the IrDA port.

## 5.3 Sensor Diagnostics Menu

**SELECT SENSOR (if more than one sensor is attached)**

STATUS	
ERROR LIST	See <a href="#">section 7.1 on page 37.</a>
WARNING LIST	See <a href="#">section 7.2 on page 37..</a>

## 5.4 Sensor Setup Menu

**SELECT SENSOR (if more than one sensor is attached)**

WIPE	
	Initiates a wiping action on the sensor window.
CALIBRATE	
SET OUTMODE	Select the behavior of the outputs during calibration for zero point setting (Hold, Active, Transfer, Selection). Hold maintains the last reading prior to going into the menu. Active transmits the current level readings, corrected with previous calibration data until new data is entered. Set Transfer transmits the value designated during the system setup
SENSOR MEASURE	Displays the current, uncorrected measured value.
CONFIGURE	Select the calibration type and follow the calibration steps for 2 point, 3 point, 4 point, and 5 point calibration.
FACTOR/2 POINTS/3 POINTS/4 POINTS/5 POINTS	Display depends on the selection in configuration.
SET CAL DEFAULT	Return the instrument to the default calibration settings.

## 5.4 Sensor Setup Menu (continued)

CONFIGURE	
EDIT NAME	Enter up to a 10-digit name in any combination of symbols and alpha or numeric characters.
SET PARAMETER	This setting configures the Solitax to measure turbidity or suspended solids. The Solitax cannot simultaneously measure both. Choose "TRB" for turbidity measurements, or "TS" for suspended solids measurement. This selection determines which units may be selected in the "Meas Units" menu.
MEAS UNITS	Choose from the displayed units. TRB (FNU, EBC, TE/F, NTU); TS (mg/L, g/L, ppm, %) Default: FNU If TRB was selected in set parameter, select "NTU" (commonly used in the U.S.), FNU, EBC, or TE/F. If TS was selected, choose mg/L, g/L, ppm, or %. Press enter to choose the selection. If the units selected result in a reading that exceeds 4 digits, the display will only show dashes. For example, if mg/L were selected, and the measurement was 10,500 mg/L, the display will show dashes until the reading drops to 9999 or lower.
CLEAN INTERVAL	Select the cleaning interval (1, 5, 15 or 30 minutes; 1, 4, or 12 hours; 1, 3, 7 days) Default: 12 hours This is the interval between wiper cleaning of the sensor window. It is recommended to start with a setting of 30 minutes. This time may be adjusted according to the application. If readings continue to be accurate, try a longer interval. If not, shorten the interval.
RESPONSE TIME	This is a damping function. While the Solitax takes readings continually, it will average them together over the period of the response time. Once the response time has elapsed, the displayed reading, 4-20 outputs, and alarm status are updated. (0 to 300 seconds) Default: 3 seconds
LOGGER INTERVAL	This is the datalog interval, with options from 1-15 minutes. Values logged are the average of the all readings during the previous logging interval. The controller will hold approximately 360 days of readings for one sensor at 15 minute intervals, or 24 days at 1 minute intervals (and proportional in between). Default: 10 minutes
SET DEFAULTS	Resets all user-editable options to the factory-defaults.
TEST/MAIN	
PROBE INFO	Displays the sensor type, entered name of the sensor (Default: sensor serial number), the sensor serial number, the software version number, and the sensor driver version number.
PROFILE	Select Profile Counter to display the number of wipes made (from 20000 backwards). Select Reset Config to manually reset the profile counter.
COUNTER	Shows the number of hours or cycles left for operating hours, test/maint, gasket, and the motor.
TEST/MAIN	WIPE—Initiates the wiping action of the wiper.
	SIGNALS—displays the signal outputs for the device.
	OUTPUT MODE—Select the behavior of the instrument outputs (Hold, Active, Transfer, Selection)
	DEFAULT SETUP—Resets all user-editable options to the factory defaults.

---

## 5.5 Calibration

There are two calibration techniques; depending on whether turbidity or suspended solid is required (refer to [section 5.5.2](#) or [section 5.5.3 on page 32](#)). Before calibration, determine the behavior of the 4–20 outputs and alarm relays while the user is in the CALIBRATE menu (refer to [section 5.5.1](#)).

### 5.5.1 Setting the Outmode

1. From the Main Menu, select SENSOR SETUP and press confirm.
2. Select the appropriate sensor if more than one is attached and confirm.
3. Select CALIBRATE and press confirm.
4. Select SET OUTMODE. Select the available Out Mode (Active, Hold, Transfer) and confirm.

### 5.5.2 Calibration for Turbidity

Turbidity calibration requires the use of 800 NTU Turbidity Standard Solutions and Calibration Kit (Cat. No. 57330-00). A zero-point calibration using deionized water is also recommended.

1. From the Main Menu, select SENSOR SETUP and press confirm.
2. Select the appropriate sensor if more than one is attached and confirm.
3. Select CALIBRATE and press confirm.
4. Select SENSOR MEASURE and confirm.
5. Place the sensor in the calibration cylinder with deionized water, mounting it with the supplied clamp. The tip of the probe should be approximately 1-inch below the surface of the water. Record the reading from the sensor measure display.
6. Select OFFSET. Multiply the reading obtained in step 5 and enter the value.
7. Select SENSOR MEASURE.
8. Rinse the outside of the StablCal® 800 NTU standard with water to remove any dust or debris adhering to the surface of the bottle. Gently invert both StablCal standard bottles a minimum of 50 times. Remove the lid and seal from each bottle. Slowly (to avoid creating bubbles) pour the contents of the bottles into the calibration cylinder. Immediately place the tip of the probe into the positioning bracket in the calibration cylinder. The tip of the probe should be approximately 1-inch below the surface standard. Allow the reading to become stable on the SENSOR MEASURE screen. Record the value (measured value). Calculate the factor. Refer to [section 5.5.2.1](#).
9. Select FACTOR to display the corrected measurement.

### 5.5.2.1 Calculating the Factor

$$\text{New Factor} = \frac{800 \text{ NTU Standard}}{\text{measured value}}$$

For example, if a sample measures 750 NTU using the sensor and the standard is 800 NTU, the new factor would be calculated as follows:

$$\text{New Factor} = \frac{800}{750} = 1.07$$

### 5.5.3 Calibration for Suspended Solids

Suspended solids calibration requires calibration to the actual sample. This optimizes the compensation for the particle size and shape typical at a measuring site. It is best performed by mounting the sensor as usual for normal measurement, and then grab samples collected and evaluated by laboratory methods. While a single point calibration is usually sufficient to provide accuracy, the SOLITAX does offer the ability to calibrate with up to 5 calibration points.

1. From the Main Menu, select SENSOR SETUP and press confirm.
2. Select the appropriate sensor if more than one is attached and confirm.
3. Select CALIBRATE and press confirm.
4. Select CONFIGURE and confirm.
5. Select the number of points desired for calibration (the unit will linearly interpolate values between calibration points). Select Factor for a single point calibration.
6. Mount the sensor as is during normal operation. Alternatively, place the sensor in the calibration cylinder (or a container with dark, non-reflective walls) 2 inches of clearance from the probe face with the probe face submerged by 1 inch or more.
7. Select SENSOR MEASURE and record the reading.
8. Immediately take a grab sample. Determine the total suspended solids using a gravimetric method such as Method 2540 D in *Standards Methods for the Examination of Water and Wastewater*.
9. Calculate the new factor. Refer to [section 5.5.3.1](#) for single point (Factor) calibration. Refer [section 5.5.3.2 on page 33](#) for multiple point calibrations.
10. Select FACTOR and press confirm. The corrected measurement should be displayed.

#### 5.5.3.1 For Single Point (Factor) Calibration

Calculate the new factor:

$$\text{New Factor} = \frac{\text{Determined gravimetric value}}{\text{measured value}}$$

For example, if a sample measures 23 mg/L using the SS sensor and the gravimetric value was 20 mg/L, the new factor would be calculated as follows:

$$\text{New Factor} = \frac{20}{23} = 0.86 \text{ mg/L}$$

### 5.5.3.2 Multi-point Calibration

1. Repeat steps 6–8 in [section 5.5.3 on page 32](#) at different times to obtain different measurements.
2. From the CONFIGURE menu, select the appropriate calibration point menu.
3. Enter the pairs of values for each reading, the target value being the laboratory determined value, and the actual value being the reading that the SOLITAX produced in step 5. The pairs should be entered in order from lowest values to highest.

## Section 6 Maintenance

---

### **DANGER**

**Only qualified personnel should conduct the tasks described in this section of the manual.**

Proper maintenance of the measuring windows in the sensor is critical for accurate measurements. The measuring windows should be checked monthly for soiling and the wiper checked for wear.

**Important Note:** *The seals must be replaced every 2 years by the Service Department. If the seals are not changed regularly, water may enter the probe head and seriously damage the instrument.*

### 6.1 Maintenance Schedule

Maintenance Task	Duration
Visual inspection	monthly
Check calibration	monthly <i>(depending on the ambient conditions)</i>
Inspection	six months (counter)
Seal change	every 2 years (counter)
Change wiper and reset counter	as per counter (20000 cycles)

### 6.2 Cleaning the Sensor Measuring Windows

#### **CAUTION**

**Always wear safety glasses and gloves when handling hydrochloric acid.**

The measuring windows are made of quartz glass. If necessary, they can be cleaned with a cleaning agent and a cloth.

For very stubborn deposits a 5 % solution of hydrochloric acid is recommended.

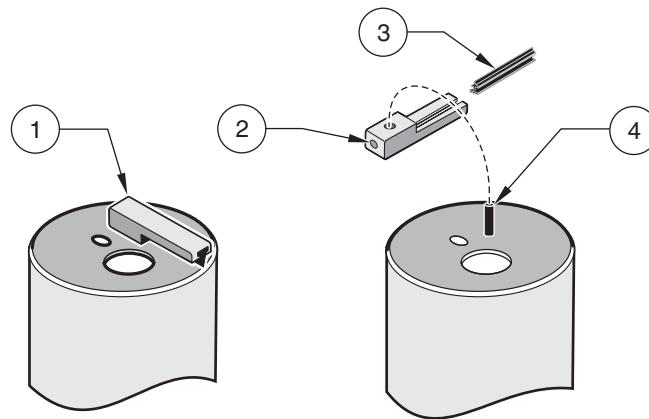
### 6.3 Replacing the Wiper

The life of the wiper is dependent on the number of cleaning actions performed and the type of deposits to be removed. The life of the wiper varies. The wipers supplied with the instrument should last for approximately one year.

1. From the Main Menu, select SENSOR SETUP and press confirm.
2. Select the appropriate sensor if more than one is attached and confirm.
3. Select TEST/MAINT and press confirm.
4. Select PROFILE and confirm. Change the wiper, see [section 6.3 on page 36](#).
5. Select RESET CONFIG and confirm.
6. Select MAN. RESET ARE YOU SURE? and confirm.

---

**Figure 18**      **Wiper Replacement**



1. Wiper arm	3. Wiper
2. M4 hex socket head bolt	4. Wiper axle



# Section 7 Troubleshooting

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## 7.1 Error Codes

In the case of an error, the indication of the measured value flashes on the display and all the contacts and current outputs allocated to this sensor are placed on hold. The following conditions will result in flashing measured values:

- Data transmission between controller and sensor interrupted

On the Main menu open the SENSOR DIAG menu using **ENTER** and determine the cause of the fault.

**Table 3 Error Messages**

Error Displayed	Cause	Solution
POS. UNKNOWN	Wiper position unknown	Open the TEST/MAINT menu and trigger the "WIPE" function, if the problem persists contact the manufacturer's customer service
LED FAULTY	Faulty LED	Contact customer service
MOIST	Moisture value > 10	Remove the sensor immediately and store in a dry place, contact customer service
CAL. DATA	Factory calibration data lost	Contact customer service

## 7.2 Warnings

A warning results in a flashing warning icon on the right of the display, all menus, contacts and outputs remain unaffected and continue to work normally. On the Main menu open the SENSOR DIAG menu using **ENTER** and determine the cause of the warning.

A warning may be used to trigger a relay and users can set warning levels to define the severity of the warning.

**Table 4 Warnings**

Warning Displayed	Cause	Solution
WARNING	Cause	Action
REPLACE WIPER	Counter elapsed	Replace wiper, reset counter
TEST/MAINT	Counter elapsed	Contact customer service
GASKET	Counter elapsed	Contact customer service

## Section 8 Replacement Parts and Accessories

### 8.1 Immersion Sensors<sup>1</sup>

Description	Catalog Number
Turbidity, t-line sc, PVC with wiper (0.001 to 4000 NTU)	LXV423.99.10000
Turbidity, t-line sc, PVC without wiper (0.001 to 4000 NTU)	LXV423.99.12000
Turbidity and Suspended Solids, ts-line sc, PVC with wiper (0.001 to 4000 NTU, 0.001 to 50 g/L)	LXV423.99.10100
Turbidity and Suspended Solids, ts-line sc, PVC without wiper (0.001 to 4000 NTU, 0.001 to 50 g/L)	LXV423.99.12100
Turbidity and Suspended Solids, ts-line sc, stainless steel with wiper (0.001 to 4000 NTU, 0.001 to 50 g/L)	LXV423.99.00100
Turbidity and Suspended Solids, ts-line sc, stainless steel without wiper (0.001 to 4000 NTU, 0.001 to 50 g/L)	LXV423.99.02100
Turbidity and Suspended Solids, hs-line sc, PVC with wiper (0.001 to 4000 NTU, 0.001 to 150 g/L)	LXV423.99.10200
Turbidity and Suspended Solids, hs-line sc, PVC without wiper (0.001 to 4000 NTU, 0.001 to 150 g/L)	LXV423.99.12200
Turbidity and Suspended Solids, hs-line sc, stainless steel with wiper (0.001 to 4000 NTU, 0.001 to 150 g/L)	LXV423.99.00200
Turbidity and Suspended Solids, hs-line sc, stainless steel without wiper (0.001 to 4000 NTU, 0.001 to 150 g/L)	LXV423.99.02200

<sup>1</sup> All sensors come with the sensor, replacement wipers, and manual.

### 8.2 Insertion Sensors<sup>1</sup>

Description	Catalog Number
Turbidity and Suspended Solids, inline sc, stainless steel with wiper (0.001 to 4000 NTU, 0.001 to 50 g/L)	LXV424.99.00100
Turbidity and Suspended Solids, inline sc, stainless steel without wiper (0.001 to 4000 NTU, 0.001 to 50 g/L)	LXV424.99.02100
Turbidity and Suspended Solids, highline sc, stainless steel with wiper (0.001 to 4000 NTU, 0.001 to 150 g/L)	LXV424.99.00200
Turbidity and Suspended Solids, highline sc, stainless steel without wiper (0.001 to 4000 NTU, 0.001 to 150 g/L)	LXV424.99.02200

<sup>1</sup> All sensors come with the sensor, replacement wipers, and manual.

### 8.3 Replacement Parts

Description	Catalog Number
Adapter, Sensor 90° elbow	AHA034
Ball valve for insertion probes without adapting flange	LZX337
Calibration kit, includes calibration cylinder, two 500-mL 800 NTU StablCal® and a sensor bracket	57330-00
Conduit strain relief	16664
Extension cable, 7.6 m (25 ft)	57960-00
Extension cable, 15.2 m (50 ft)	57961-00
Extension cable, 30.5 m (100 ft)	57962-00
Extension tube, 1.8 m	BRO062
Extension tube, 1.0 m	BRO061
Extension pipe, 0.35 m	BRO068
Handrail mounting kit (for sensor to be used with either AHA033NPT or AHA034NPT) includes 1.5 inch diameter by 7.5 ft long CPVC pipe and swivel/pivot/pipe clamp assembly	MH236B00
Insertion mounting kit for inline and highline insertion sensors (ball valve and extraction system)	57384-00
Installation kit, fixed-point (for t-line, ts-line, and hs-line immersion sensors)	LZX414.00.10000
Installation kit with straight adapter	LZX414.00.20000
Junction box (for extension cables)	58670-00
Kit, screws and seals for sensor adapters	LZX417
L-bracket	ATS011
Miscellaneous hardware for probe installation kit	LZX416
Second fastening point, includes: bracket, sensor pipe stand, sensor pipe stand bracket, screws, and grommet)	LZX456
Sensor adapter, straight 1½-FNPT	AHA033NPT
Sensor adapter, elbow 1½-FNPT	AHA034NPT
Sensor fixed-point mounting kit: Sensor pipe bracket	ATS010
Sensor pipe stand bracket	LZX200
Set of wipers (for 5 changes) made of silicone for normal applications	LZX050
Set wipers (for 5 changes) made of Viton for e. g. media containing oil	LZX578
SOLITAX sc Instrument Manual	DOC023.54.03232
StablCal®, 800 NTU, 500 mL bottle (2 bottles required for calibration or calibration verification)	26605-49
Welded flange made of C-steel for the pipe installation fitting	LZX703
Welded flange made of stainless steel for pipe installation safety fitting	LZX660

### U.S.A. Customers

**By Telephone:**

6:30 a.m. to 5:00 p.m. MST  
Monday through Friday  
(800) 227-HACH (800-227-4224)

**By Fax:**

(970) 669-2932

**By Mail:**

Hach Company  
P.O. Box 389  
Loveland, Colorado 80539-0389 U.S.A.

**Ordering information by e-mail:** [orders@hach.com](mailto:orders@hach.com)

### Information Required

- Hach account number (if available)
- Your name and phone number
- Purchase order number
- Brief description or model number
- Billing address
- Shipping address
- Catalog number
- Quantity

### International Customers

Hach maintains a worldwide network of dealers and distributors. To locate the representative nearest you, send an e-mail to: [intl@hach.com](mailto:intl@hach.com) or contact:

**Hach Company World Headquarters;** Loveland, Colorado, U.S.A.  
Telephone: (970) 669-3050; Fax: (970) 669-2932

### Technical and Customer Service (U.S.A. only)

Hach Technical and Customer Service Department personnel are eager to answer questions about our products and their use. Specialists in analytical methods, they are happy to put their talents to work for you.

Call 1-800-227-4224 or e-mail [techhelp@hach.com](mailto:techhelp@hach.com)

## Section 10 Repair Service

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**Authorization must be obtained from Hach Company before sending any items for repair. Please contact the Hach Service Center serving your location.**

**In the United States:**

Hach Company  
Ames Service  
100 Dayton Avenue  
Ames, Iowa 50010  
(800) 227-4224 (U.S.A. only)  
FAX: (515) 232-3835

**In Canada:**

Hach Sales & Service Canada Ltd.  
1313 Border Street, Unit 34  
Winnipeg, Manitoba  
R3H 0X4  
(800) 665-7635 (Canada only)  
Telephone: (204) 632-5598  
FAX: (204) 694-5134  
E-mail: [canada@hach.com](mailto:canada@hach.com)

**In Latin America, the Caribbean, the Far East,  
Indian Subcontinent, Africa, Europe, or the Middle East:**

Hach Company World Headquarters,  
P.O. Box 389  
Loveland, Colorado, 80539-0389 U.S.A.  
Telephone: (970) 669-3050  
FAX: (970) 669-2932  
E-mail: [intl@hach.com](mailto:intl@hach.com)

## Section 11 Limited Warranty

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Hach Company warrants its products to the original purchaser against any defects that are due to faulty material or workmanship for a period of one year from date of shipment unless otherwise noted in the product manual.

In the event that a defect is discovered during the warranty period, Hach Company agrees that, at its option, it will repair or replace the defective product or refund the purchase price excluding original shipping and handling charges. Any product repaired or replaced under this warranty will be warranted only for the remainder of the original product warranty period.

This warranty does not apply to consumable products such as chemical reagents; or consumable components of a product, such as, but not limited to, lamps and tubing.

Contact Hach Company or your distributor to initiate warranty support. Products may not be returned without authorization from Hach Company.

### Limitations

This warranty does not cover:

- Damage caused by acts of God, natural disaster, labor unrest, acts of war (declared or undeclared), terrorism, civil strife or acts of any governmental jurisdiction
- Damage caused by misuse, neglect, accident or improper application or installation
- Damage caused by any repair or attempted repair not authorized by Hach Company
- Any product not used in accordance with the instructions furnished by Hach Company
- Freight charges to return merchandise to Hach Company
- Freight charges on expedited or express shipment of warranted parts or product
- Travel fees associated with on-site warranty repair

This warranty contains the sole express warranty made by Hach Company in connection with its products. All implied warranties, including without limitation, the warranties of merchantability and fitness for a particular purpose, are expressly disclaimed.

Some states within the United States do not allow the disclaimer of implied warranties and if this is true in your state the above limitation may not apply to you. This warranty gives you specific rights, and you may also have other rights that vary from state to state.

This warranty constitutes the final, complete, and exclusive statement of warranty terms and no person is authorized to make any other warranties or representations on behalf of Hach Company.

### Limitation of Remedies

The remedies of repair, replacement or refund of purchase price as stated above are the exclusive remedies for the breach of this warranty. On the basis of strict liability or under any other legal theory, in no event shall Hach Company be liable for any incidental or consequential damages of any kind for breach of warranty or negligence.

## Section 12 Certification

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Hach Co. certifies this instrument was tested thoroughly, inspected and found to meet its published specifications when it was shipped from the factory.

The **Model sc100/sc1000 with the Solitax Sensor** has been tested and is certified as indicated to the following instrumentation standards:

### Product Safety

UL 61010A-1 (ETL Listing # 65454)  
CSA C22.2 No. 1010.1 (ETLc Certification # 65454)  
Certified by Hach Co. to EN 61010-1 Amds. 1 & 2 (IEC1010-1) per 73/23/EEC, supporting test records by Intertek Testing Services.

### Immunity

This equipment was tested for Industrial level EMC per:

**EN 61326** (EMC Requirements for Electrical Equipment for Measurement, Control and Laboratory Use) **per 89/336/EEC EMC**: Supporting test records by Hach Company, certified compliance by Hach Company.

#### Standards include:

IEC 1000-4-2:1995 (EN 61000-4-2:1995) Electro-Static Discharge Immunity (Criteria B)  
IEC 1000-4-3:1995 (EN 61000-4-3:1996) Radiated RF Electro-Magnetic Field Immunity (Criteria A)  
IEC 1000-4-4:1995 (EN 61000-4-4:1995) Electrical Fast Transients/Burst (Criteria B)  
IEC 1000-4-5:1995 (EN 61000-4-5:1995) Surge (Criteria B)  
IEC 1000-4-6:1996 (EN 61000-4-6:1996) Conducted Disturbances Induced by RF Fields (Criteria A)  
IEC 1000-4-11:1994 (EN 61000-4-11:1994) Voltage Dip/Short Interruptions (Criteria B)

#### Additional Immunity Standard/s include:

ENV 50204:1996 Radiated Electro-Magnetic Field from Digital Telephones (Criteria A)

### Emissions

This equipment was tested for Radio Frequency Emissions as follows:

Per 89/336/EEC EMC: **EN 61326:1998** (Electrical Equipment for measurement, control and laboratory use-EMC requirements) Class "A" emission limits. Supporting test records by Hewlett Packard, Fort Collins, Colorado Hardware Test Center (A2LA # 0905-01) and certified compliance by Hach Company.

#### Standards include:

EN 61000-3-2 Harmonic Disturbances Caused by Electrical Equipment  
EN 61000-3-3 Voltage Fluctuation (Flicker) Disturbances Caused by Electrical Equipment

#### Additional Emissions Standard/s include:

**EN 55011 (CISPR 11)**, Class "A" emission limits

### **Canadian Interference-causing Equipment Regulation, IECS-003, Class A**

Supporting test records by Hewlett Packard, Fort Collins, Colorado Hardware Test Center (A2LA # 0905-01) and certified compliance by Hach Company.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

### **FCC PART 15, Class "A" Limits**

Supporting test records by Hewlett Packard, Fort Collins, Colorado Hardware Test Center (A2LA # 0905-01) and certified compliance by Hach Company.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense. The following techniques of reducing the interference problems are applied easily.

1. Disconnect the Controller from its power source to verify that it is or is not the source of the interference.
2. If the Controller is connected into the same outlet as the device with which it is interfering, try another outlet.
3. Move the Controller away from the device receiving the interference.
4. Reposition the receiving antenna for the device receiving the interference.
5. Try combinations of the above.



# Appendix A Modbus Register Information

**Table 5 Sensor Modbus Registers**

Group Name	Tag Name	Register	Data Type#	Length	R/W	Description
Measurements	TurbidityFNU	40001	Float	2	R	Turbidity FNU
Measurements	TurbidityEBC	40003	Float	2	R	Turbidity EBC
Measurements	SolidsMGL	40005	Float	2	R	Solids mg/L
Measurements	SolidsGL	40007	Float	2	R	Solids g/L
Measurements	SolidsPR	40009	Float	2	R	Solids %
—	reserved	40011	Unsigned Integer	1	R	reserved
Base	Parameter	40012	Unsigned Integer	1	R/W	parameter
Base	UnitTRB	40013	Unsigned Integer	1	R/W	Unit Turbidity
Base	UnitTS	40014	Unsigned Integer	1	R/W	Units Solids
Calibration	OffsetTRB	40015	Float	2	R/W	Turbidity Offset
Calibration	FactorTRB	40017	Float	2	R/W	Turbidity Factor
Calibration	FactorTS	40019	Float	2	R/W	Solids Factor
Data	wiperstate	40021	Unsigned Integer	1	R/W	wiper register
Setup	ResponseInterval	40022	Unsigned Integer	1	R/W	response time
Setup	CleaningInterval	40023	Unsigned Integer	1	R/W	wiper interval
Setup	LogInterval	40024	Unsigned Integer	1	R/W	Logger interval
Setup	Outputmodekal	40025	Unsigned Integer	1	R/W	Output when calibrate
Setup	Outputmodesrv	40026	Unsigned Integer	1	R/W	Output when service
Setup	Location	40027	String	8	R/W	Edited name
Setup	ProfilCounter	40035	Unsigned Integer	1	R/W	Profi counter
Data	SerienNummer	40036	String	6	R	serial number
Calibration	DateUserCal	40042	Date	2	R	date of manufacturing calibration
Calibration	DateUserCalTURB	40044	Date	2	R	date of calibration turbidity
Calibration	DateUserCalSOLID	40046	Date	2	R	date of calibration solid
Data	VersionAppl	40048	Float	2	R	Version application
Data	VersionBoot	40050	Float	2	R	Version Bootlader
Data	VersionStruct	40052	Unsigned Integer	1	R	Version structure probedriver
Data	VersionContent	40053	Unsigned Integer	1	R	Version register probedriver
Data	VersionFirmware	40054	Unsigned Integer	1	R	Version firmware probedriver
Data	FormatMinFNU	40055	Float	2	R	minimum turbidity FNU
Data	FormatMaxFNU	40057	Float	2	R	maximum turbidity FNU
Data	FormatMinEBC	40059	Float	2	R	minimum turbidity EBC
Data	FormatMaxEBC	40061	Float	2	R	maximum turbidity EBC
Data	FormatMinGL	40063	Float	2	R	minimum solids g/L
Data	FormatMaxGL	40065	Float	2	R	maximum solids g/L
Data	FormatMinMGL	40067	Float	2	R	minimum solids mg/L
Data	FormatMaxMGL	40069	Float	2	R	maximum mg/L
Data	FormatMinPR	40071	Float	2	R	minimum solids %
Data	FormatMaxPR	40073	Float	2	R	maximum solids %
Data	SignalsLED	40075	Unsigned Integer	1	R	Signal LED
Data	SignalsMoist	40076	Unsigned Integer	1	R	Signal moist

## **41. ORP Meter**

# Differential pH and ORP Sensors

pH/ORP



Hach Digital pH/ORP sensors are available in convertible (PEEK® or Ryton®), insertion, and sanitary body styles. Three electrodes are used in these sensors to increase measurement accuracy and eliminate sensor ground loops.

## Features and Benefits

### Differential Electrode Measurement Technique

This field-proven technique uses three electrodes instead of the two normally used in conventional pH sensors. Process and reference electrodes measure the pH differentially with respect to a third ground electrode. The end result is unsurpassed measurement accuracy, reduced reference junction potential, and elimination of sensor ground loops. These sensors provide greater reliability, resulting in less downtime and maintenance.

### Patented Technology

The former GLI, now a Hach Company brand, invented the Differential Electrode Technique for pH measurement in 1970. The pH<sup>DM</sup> sensor series (U.S. Patent Number 6395158B1, dated May 28, 2002) takes this field-proven technology to a new level.

### Replaceable Salt Bridge/Protector

The unique, replaceable salt bridge holds an extraordinary volume of buffer to extend the working life of the sensor by protecting the reference electrode from harsh process conditions. The salt bridge simply threads onto the end of the sensor if replacement is needed.

### Built-in Encapsulated Preamp

Encapsulated construction protects the sensor's built-in preamp from moisture and humidity, ensuring reliable sensor operation. The preamp in the pH<sup>DM</sup> analog sensor produces a strong signal, enabling the sensor to be located up to 1000 m (3280 ft.) from the analyzer.

### Durable Body Materials

Both the digital and analog pH and ORP differential sensors feature a durable PEEK® body for chemical compatibility

with most process solutions. For less aggressive solutions, Hach offers a Ryton® sensor in a convertible style for pH and ORP measurement. A sensor with a stainless steel body is available for immersion applications.

### Digital Electronics Modules

Sensors are available with integral digital electronics or with a gateway module for high temperature (above 70°C) applications.

### Versatile Mounting Styles

Sensors are available in four mounting styles—convertible, insertion, immersion, and sanitary. Please turn to page 5 for more information.

### Full Featured “Plug and Play” sc100 Digital Controller

There's no complicated wiring or set up procedures with the Hach sc100 controller. Just plug in any Hach digital sensor and it's ready to use—it's “plug and play.”

**One or two sensors**—Use the sc100 Digital Controller to receive data from up to two Hach digital sensors in any combination.

**Communications**—Multiple alarm/control schemes are available using three relays and two PID control outputs. Communications use analog 4-20 mA and digital MODBUS®/RS485, MODBUS®/RS232 protocols. (Other digital protocols are available. Contact your Hach representative for details.) Every sc100 controller is equipped with wireless communication through an infrared port.

**Data logger**—A built-in data logger collects measurement data, calibration, verification points, and alarm history for up to 6 months.

DW = drinking water WW = wastewater municipal PW = pure water / power  
IW = industrial water E = environmental C = collections FB = food and beverage



Be Right™

DW

WW

PW

IW

## Specifications\*

### pH Sensors

Most pH applications fall in the 2.5 to 12.5 pH range. A Hach pHD sc Differential pH sensor with the wide-range glass process electrode performs exceptionally well in this range. Some industrial applications require accurate measurement and control below 2 or above 12 pH. In these special cases, please contact Hach Technical Support for further details.

#### Measuring Range

-2 to 14 pH

#### Sensitivity

± 0.01 pH

#### Stability

0.03 pH per 24 hours, non-cumulative

#### Operating Temperature

Digital Sensor: -5 to 70°C (23 to 158°F)

Analog Sensor with Digital Gateway: -5 to 105°C (23 to 221°F)

Immersion Sensor: 0 to 50°C (32 to 122°F)

#### Flow Rate

3 m (10 ft.) per second, maximum

#### Sensor Pressure/Temperature Limits

Digital: 6.9 bar at 70°C (100 psi at 158°F)

Analog: 6.9 bar at 105°C (100 psi at 221°F)

#### Built-in Temperature Element

NTC 300 ohm thermistor for automatic temperature compensation and analyzer temperature readout

#### Transmission Distance

100 m (328 ft.), maximum

1000 m (3280 ft.), maximum when used with a termination box

#### Sensor Cable (integral)

4 conductor cable with one shield and polyurethane jacket; rated to 105°C (221°F); 10 m (33 ft.) standard length

#### Wetted Materials

PEEK® or Ryton® (PVDF), salt bridge of matching material with Kynar® junction, glass process electrode, titanium ground electrode, and Viton® O-ring seals

(pH sensor with optional HF-resistant glass process electrode has 316 stainless steel ground electrode, and perfluoroelastomer wetted O-rings; consult factory for other available wetted O-ring materials)

### ORP (Redox) Sensors

For best ORP measuring results in solutions containing zinc, cyanide, cadmium or nickel, Hach recommends using the pHD sc ORP sensor equipped with an optional gold electrode.

#### Measuring Range

-1500 to +1500 mV

#### Sensitivity

± 0.5 mV

#### Stability

2 mV per 24 hours, non-cumulative

#### Operating Temperature

Digital Sensor: -5 to 70°C (23 to 158°F)

Analog Sensor with Digital Gateway: -5 to 105°C (23 to 221°F)

Immersion Sensor: 0 to 50°C (32 to 122°F)

#### Flow Rate

3 m (10 ft.) per second, maximum

#### Sensor Pressure/Temperature Limits

Digital: 6.9 bar at 70°C (100 psi at 158°F)

Analog: 6.9 bar at 105°C (100 psi at 221°F)

#### Built-in Temperature Element

NTC 300 ohm thermistor for analyzer temperature readout only—no automatic temperature compensation necessary for ORP measurement

#### Transmission Distance

100 m (328 ft.), maximum

1000 m (3280 ft.), maximum when used with a termination box

#### Sensor Cable (integral)

4 conductor cable with one shield and polyurethane jacket; rated to 105°C (221°F); 10 m (33 ft.) standard length

#### Wetted Materials

PEEK® or Ryton® (PVDF), salt bridge of matching material with Kynar® junction, glass and platinum (or plastic and gold) process electrode, titanium ground electrode, and Viton® O-ring seals

\*Specifications subject to change without notice.