OPERATION AND MAINTENANCE MANUAL

WATER TREATMENT SYSTEM

CITY OF IQALUIT LANDFILL SITE

FINAL

February 2018

O/Ref.: QE15-107-4

Confidential document

Qikiqtaaluk environmental

Operation and Maintenance Manual

Water Treatment System

City of Iqaluit Landfill Site

FINAL

Confidential document presented to

CITY OF IQALUIT

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Qikiqtaaluk environmental
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February 16, 2018

O/Ref.: QE15-107-4

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LIST OF ABBREVIATIONS AND ACRONYMS

BOD	Biological oxygen demand
BTU	British thermal unit
CFM	Cubic feet per minute
GAC	Granular activated carbon
HP	Horsepower
LCP	Leachate catchment pond
NH_4^+	Ammonium
pH	Potential of hydrogen
RP	Retention pond
TSS	Total suspended solids

1. INTRODUCTION

Qikiqtaaluk Environmental Inc. (QE) has provided the City of Iqaluit with a water treatment system to treat the contaminants present in the leachate from the municipal landfill site. The water treatment system is a manual system that needs to be operated under surveillance. There are no controls or alarms on the water treatment system, except for 2 discharge pumps (P10 and C4) on the filtration unit, which are triggered by a floating switch. Moreover, the system operator must provide expendables such as nutrients, lime, polymers, filtration bags, and adsorption media. The fuel and electric power for the equipment must also be provided by the operator. A Lamotte Smart 3 Colorimeter field test kit and a Hanna Instruments HI9829 multiparameter probe are available on-site to help operate and optimise the water treatment system. These field test kits are located in the water heater unit.

2. SYSTEM DESCRIPTION

The water treatment consists of a pH adjustment, a flocculation and settling process for the removal of metals and suspended solids, a 2-step biological process (bio-oxidation and bio-nitrification) for BOD and NH_4^+ removal, and a physical/chemical filtration process for the removal of TSS and organic contaminant molecules. A Site Plan and the Complete Water Treatment System are presented in Figures 1 and 2 of Appendix A.

During the water treatment, 3 ponds are used: the Leachate Catchment Pond (LCP), the bioreactor, and the Retention Pond (RP). The LCP is used to collect and store the leachate from the landfill site. Its capacity is estimated at approximately 5,000 to 6,000 m^3. The bioreactor contains floating barriers to separate the oxidation and nitrification areas, and the 2 decantation zones. A blower and an air distribution system are also present to maintain an aerobic condition for the biological treatment of the contaminants. Its capacity is estimated at 4,500 m^3. The retention pond (RP) is used for the clarification and storage of pretreated water before its transfer to the bioreactor. Its capacity is estimated at 4,000 m^3. The water pretreatment system is designed to treat a total volume of 600 m^3 per day (10 hour operation), while the biological and the filtration systems can treat approximately 175 to 225 m^3 per day.

2.1 Water Pretreatment

The first step of the treatment consists of removing metals. The pretreatment is also known to impact other parameters such as TSS, BOD, turbidity and pH.

Figure 3 of Appendix A presents the pretreatment set-up, which is located near the LCP. The pretreated water is transferred to the RP for passive decantation and clarification.

Raw water is transferred from Tank No. 1 (T1), by being submerged in the LCP, using 2 submersible pumps (P1 and P2), then transferred via 2-inch hoses to the retention pond (RP). A small portion of the flow is diverted (using a manual valve) to Tank No. 2 (T2) for lime mixing/injection. Lime is manually added to this tank at specific intervals, depending on the characteristics of the water (pH, metal content, suspended solids concentrations, etc.). Mixing is ensured by a centrifugal pump (C1). The milk of lime is gravity injected from T2 to T1 by an overflow pump.

The system allows for the injection of 2 different polymers. The mixing tanks (T4 and T6) allow for the preparation of the polymer solutions using warm water obtained from the water heater. Polymers must be manually added to T4 and T6. Pumps P3 and P5 provide the mixing and allow for transfer to the injection tanks T3 and T5. The injection tanks allow for the gravity injection of stock polymer solutions from T3 to T1, or in-line injection with pump P4 from T5 for the raw water. The in-line polymer injection is performed before a 6-inch diameter, 50 foot length of hose, to ensure appropriate contact and mixing of the polymer.

The pretreatment system has an approximate capacity of 1,000 L/min, and requires 2 people for operation.

2.2 Biological Treatment (Activated Sludge)

Figure 4 of Appendix A presents the Bioreactor Biological Treatment System at the Site. Once the pretreated water has clarified in the RP, the water can be transferred to the bioreactor for the removal of BOD and NH_4^+. The pretreated water must first pass through a sand filter (S1) and a bag filter (F1), before passing into a water heating unit to increase the temperature of the water to approximately 10°C. It should be noted that biological treatments perform well at temperatures above 10 °C. If needed, nutrients can be injected into the incoming water from Tank No. 7 (T7), which is located at the bioreactor water inlet to favour the growth of the microorganisms responsible for the oxidation of contaminants. A HeliFlow® HF406 industrial blower (delivering 30 HP - 300 CFM), and an air distribution system are also present to maintain aerobic conditions for the biological treatment of contaminants at the Site. The air distribution system connects to the air blower, distributing air microbubbles to the bottom of the BOD and NH_4^+ removal sections of the bioreactor. The 3 floating barriers are used to separate the oxidation of the BOD zone from the oxidation of the NH_4^+ zone. The floating barriers also create 2 decantation zones in the bioreactor. Their purpose is to passively decant the biomass from the BOD and NH_4^+ oxidation zones, and recirculate it with submersible pumps P7 and P8. The biomass recycling aims to increase the suspended biomass present in each oxidation zone. The efficiency of an activated sludge technology (mixed liquor) is directly correlated to the amount of biomass in suspension.

The biological treatment system is designed to continuously treat approximately 200 m^3 of water/day, once the acclimation of the bioreactor is complete.

2.3 Filtration Unit

Figure 5 of Appendix A presents the filtration unit, which consists of 3 sand/anthracite filters (S2, S3, S4), 4 bag filters (F2, F3, F4 and F5), and a filtration module (E1) with 3 compartments available for adsorption media, and 1 compartment for acid injection and pumping to the discharge point. A metering pump (MP1) is used to inject acid solution directly from Tank No. 8 (T8) to the pumping compartment, if a pH correction is required. The first water meter (M1) is located posterior to the bag filters, and precedes the filtration container. A second water meter (M2) is located at the discharge hose to determine the exact volume of water treated and discharged.

The container is comprised of 4 compartments. The first is to be filled with 2 m^3 of adsorption media (ULTRASORPTION™). The following 2 compartments are each to be filled with 1 m^3 of GAC. The water moves by gravity, flowing downward between compartments. The last compartment is used for pumping the water to the discharge location and sampling the treated water. A submersible pump (P10), followed by a centrifugal pump (C4), both controlled by a floating switch, transfer the treated water to the discharge point in the Frobisher Bay. The discharge location is indicated on the Site Plan, presented in Figure 1 of Appendix A. Purge or sampling ports are present at the bottom of each compartment.

3. SYSTEM COMPONENTS

3.1 Pretreatment

The pretreatment system consists of the following components:

- 2 submersible 1 HP pumps:
  - P1;
  - P2;
- 3 submersible ⅓ HP pumps:
  - P3;
  - P4;
  - P5;
- 1 centrifugal 3 HP pump:
  - C1;
- 1 open top tote tank submerged in the LCP:
  - T1;
- 1 open top tote tank for lime mixing and injection:
  - T2;
- 2 open top tote tanks for polymer mixing:
  - T4;
  - T5;
- 2 open top tote tanks for polymer injection:
  - T3;
  - T5;
- 1 electrical panel.

3.2 Bioreactor

The bioreactor system consists of the following components:

- 2 submersible 1 HP pumps for sludge recirculation:
  - P7;
  - P8;
- 1 submersible 1 HP pump for water feeding:
  - P6;

- 1 centrifugal 3 HP pump for water feeding:
  - C2;
- 1 sand/anthracite filter for TSS removal:
  - S1;
- 1 bag filter for TSS removal:
  - F1;
- 1 open top tote tank for nutrient injections:
  - T7;
- 1 water heating unit (900, 000 BTU);
- 1 industrial 30 HP-300 CFM air blower (HeliFlow HF406);
- 1 air distribution system (distribution main with perforated pipes in the pond);
- 3 floating barriers to create 2 zones for the passive decantation of biomass.

3.3 Filtration

The filtration system consists of the following components:

- 1 submersible 1HP pump for water feeding:
  - P9;
- 1 centrifugal 3 HP pump for water feeding:
  - C3;
- 3 sand/anthracite filters for TSS removal:
  - S2;
  - S3;
  - S4;
- 4 bag filters for TSS removal:
  - F2;
  - F3;
  - F4;
  - F5;
- 2 (2-inch) water meters:
  - M1;
  - M2;
- 1 filtration container for adsorption media and a pumping compartment:
  - E1;

- 1 submersible 1 HP pump P10 for discharging treated water:
  - P10;
- 1 centrifugal 3 HP pump for discharging treated water:
  - C4;
- 1 control panel to trigger the discharge pumps P10 and C4 using a float switch;
- 1 metering pump:
  - MP1.

3.4 Energy

The water treatment system must be powered by generators, which are not included in the system. For the past 2 years, an 8 kW rented generator was used, along with an electrical panel (where the pumps were connected) to operate the water pretreatment system. A second 8 kW rented generator was used to power the pumping station at the RP. Finally, a 135 kW generator, also rented, was used to power the blower and all the biological treatment and filtration unit equipment. The water heater unit is equipped with its own fuel tank.

4. COMPONENTS MAINTENANCE

For technical details or maintenance regarding the equipment, please refer to the specification sheet or the Operation Manuals for System Parts, presented in Appendix B. This section will only provide a breakdown of the basic actions that must be performed on a regular basis for the water treatment system operation.

On a daily basis, the following activities must be achieved:

- Check the system integrity (generator, pumps, water heater, blower, volume discharged, level in the fuel tanks, etc.);
- Perform water chemical analyses at various points of the system;
- Perform a backwash of the sand filters;
- Replace the bag filter;
- Check the levels of chemical product solutions in the tanks.

At the end of the treatment season, most of the equipment must be removed and properly stored or protected. Humidity can damage sensitive parts, therefore they must be properly stored. All equipment containing water or fluids subject to freezing must be drained and/or properly stored to avoid damage. A list of some examples are provided below:

- Bubble tubes must be rolled and stored properly;
- Blower must be disconnected and protected from humidity;
- Pumps must be purged, cleaned, and stored properly;
- Water heater system must be properly shut down by an authorized agent;
- Heat exchanger must be cleaned using a descaling agent;
- Filtration elements (container, bag and sand filters) must be drained and protected;
- Saturation level of adsorption media must be evaluated;
- Floating curtains must be removed, cleaned and stored.

APPENDIX A

Figures

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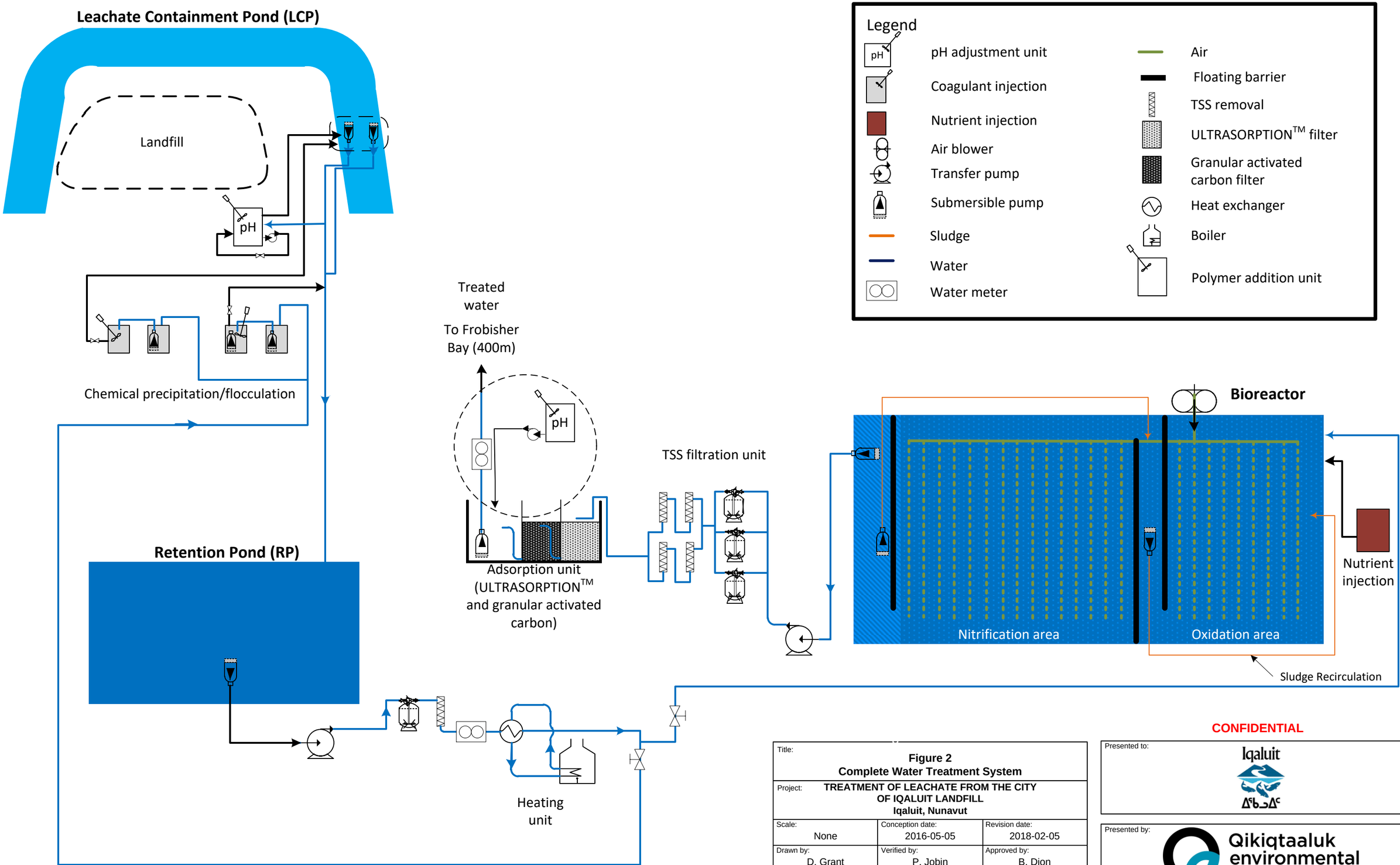
Client: Iqaluit	Title: **Figure 1 Site Plan**	Scale: None	Conception date: 2018-01-11	Revision date: 2018-02-05	Qikiqtaaluk environmental
		Drawn by: D. Grant	Verified by: P. Jobin	Approved by: B. Dion	
	Project: **TREATMENT OF LEACHATE FROM THE CITY OF IQALUIT LANDFILL Iqaluit, Nunavut**	Project No.: QE15-107-4	Drawing No.: QE15-107-4-07.vsd	Layout: A	



CONFIDENTIAL

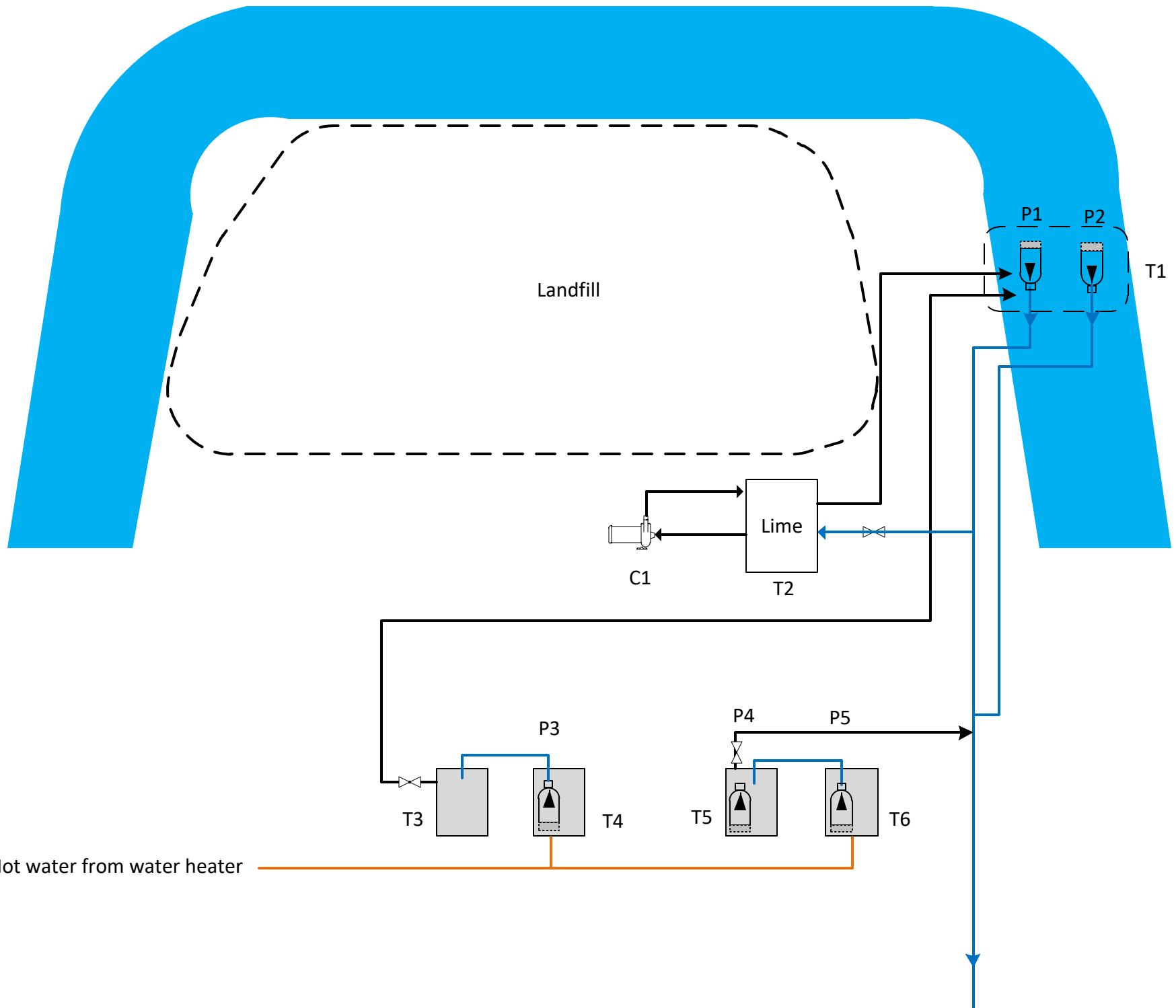
Title: **Figure 2 Complete Water Treatment System**		
Project: **TREATMENT OF LEACHATE FROM THE CITY OF IQALUIT LANDFILL Iqaluit, Nunavut**		
Scale: None	Conception date: 2016-05-05	Revision date: 2018-02-05
Drawn by: D. Grant	Verified by: P. Jobin	Approved by: B. Dion
Project No.: QE15-107-4	Drawing No.: QE15-107-4-08.vsd	Layout: A

Presented to: Iqaluit

Presented by: Qikiqtaaluk environmental

P: Submersible pump
C: Centrifugal pump
T1: Submerged tank in LCP
T2: Lime mixing/injection tank
T3: Polymer 1 injection tank
T4: Polymer 1 mixing tank
T5: Polymer 2 injection tank
T6: Polymer 2 mixing tank

Leachate Containment Pond (LCP)



Retention Pond (RP)

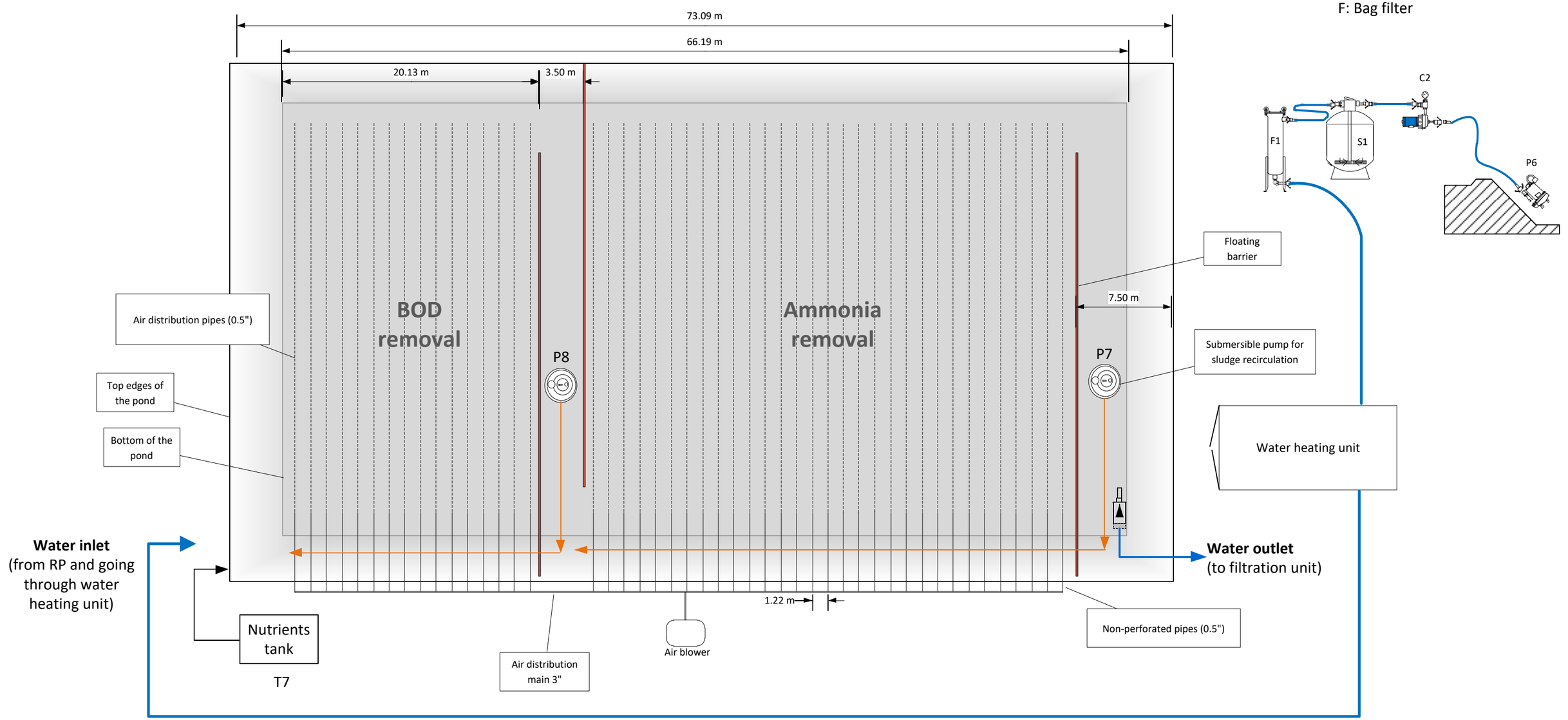
CONFIDENTIAL

Title: **Figure 3 Pretreatment of the Raw Water**		
Project: **TREATMENT OF LEACHATE FROM THE CITY OF IQALUIT LANDFILL Iqaluit, Nunavut**		
Scale: None	Conception date: 2018-01-25	Revision date: 2018-02-05
Drawn by: D. Grant	Verified by: P. Jobin	Approved by: B. Dion
Project No.: QE15-107-4	Drawing No.: QE15-107-4-09.vsd	Layout: B

Presented to: Iqaluit ᐃᖃᓗᐃᑦ

Presented by: Qikiqtaaluk environmental ᕿᑭᖅᑕᓗᒃ ᐊᓯᑎᓕᕆᔨᒃ

P: Submersible pump
C: Centrifugal pump
S: Sand/anthracite filter
F: Bag filter



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Title: **Figure 4 Bioreactor Biological Treatment**	Scale: None	Conception date: 2018-01-11	Revision date: 2018-02-05	Client: Iqaluit	Presented to: Qikiqtaaluk environmental
Project : **TREATMENT OF LEACHATE FROM THE CITY OF IQALUIT LANDFILL Iqaluit, Nunavut**	Drawn by: D. Grant	Verified by: P. Jobin	Approved by: B. Dion		
	Project No.: QE15-107-4	Drawing No.: QE15-107-4-04.vsd	Layout: A		

P: Submersible pump
C: Centrifugal pump
S: Sand/anthracite filter
F: Bag filter
M: Water meter
MP: Metering pump
GAC: Granular activated carbon

P9

Water from bioreactor

C3

S4

S3

S2

F2

F3

F4

F5

M1

Floating switch control panel

off
auto
man

2 m³ of ULTRASORPTION™

1 m³ of GAC

1 m³ of GAC

P10

M2

C4

MP1

pH adjustment

T8

E1

E1

Distribution of water and collection (strainers) in filtration container

To discharge location

CONFIDENTIAL

Title: **Figure 5 Filtration**	Scale: None	Conception date: 2018-01-11	Revision date: 2018-02-05	Client: Iqaluit	Presented to: Qikiqtaaluk environmental
Project : **TREATMENT OF LEACHATE FROM THE CITY OF IQALUIT LANDFILL Iqaluit, Nunavut**	Drawn by: D. Grant	Verified by: P. Jobin	Approved by: B. Dion		
	Project No.: QE15-107-4	Drawing No.: QE15-107-4-05.vsd	Layout: A		

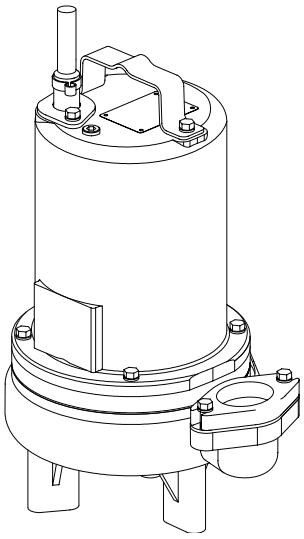
APPENDIX B

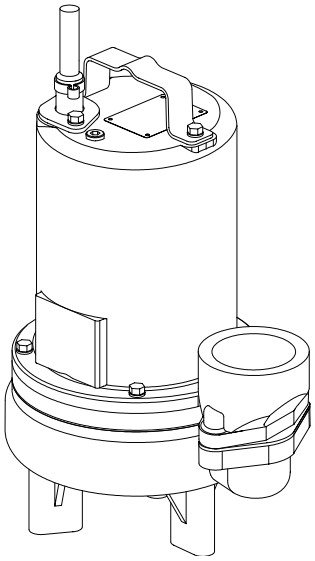
Operation Manuals for System Parts

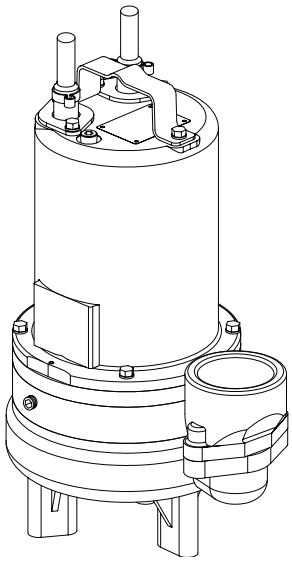
Manual Index

BARNES®

INSTALLATION and OPERATION MANUAL
Submersible Sewage Ejector







Series: *SE & 3SE-L & DS
.5, .75 & 1 HP, 1750RPM, 60 Hz.

Single and Double Seal
***(Standard and High Temperature)**

IMPORTANT! ***Read all instructions in this manual before operating pump. As a result of Crane Pumps & Systems, Inc., constant product improvement program, product changes may occur. As such Crane Pumps & Systems reserves the right to change product without prior written notification.***

CRANE®
A Crane Co. Company

PUMPS & SYSTEMS

420 Third Street
Piqua, Ohio 45356
Phone: (937) 778-8947
Fax: (937) 773-7157
www.cranepumps.com

83 West Drive, Bramton
Ontario, Canada L6T 2J6
Phone: (905) 457-6223
Fax: (905) 457-2650

Submersible Wastewater Pump Association SWPA MEMBER

Form No. 105240-Rev. AD

TABLE OF CONTENTS

SPECIAL TOOLS AND EQUIPMENT
INSULATION TESTER (MEGGER)
DIELECTRIC TESTER
SEAL TOOL KIT (see parts list)
PRESSURE GAUGE KIT (see parts list)

SAFETY FIRST!

Please Read This Before Installing Or Operating Pump.
This information is provided for **SAFETY and to PREVENT EQUIPMENT PROBLEMS**. To help recognize this information, observe the following symbols:

IMPORTANT! Warns about hazards that can result in personal injury or Indicates factors concerned with assembly, installation, operation, or maintenance which could result in damage to the machine or equipment if ignored.

CAUTION ! Warns about hazards that can or will cause minor personal injury or property damage if ignored. Used with symbols below.

WARNING ! Warns about hazards that can or will cause serious personal injury, death, or major property damage if ignored. Used with symbols below.


Hazardous fluids can cause fire or explosions, burnes or death could result.


Extremely hot - Severe burnes can occur on contact.


Biohazard can cause serious personal injury.


Hazardous fluids can Hazardous pressure, eruptions or explosions could cause personal injury or property damage.


Rotating machinery Amputation or severe laceration can result.


Hazardous voltage can shock, burn or cause death.

Only qualified personnel should install, operate and repair pump. Any wiring of pumps should be performed by a qualified electrician.

WARNING ! - To reduce risk of electrical shock, pumps and control panels must be properly grounded in accordance with the National Electric Code (NEC) or the Canadian Electrical Code (CEC) and all applicable state, province, local codes and ordinances.

WARNING! - To reduce risk of electrical shock, always disconnect the pump from the power source before handling or servicing. Lock out power and tag.


WARNING! Operation against a closed discharge valve will cause premature bearing and seal failure on any pump, and on end suction and self priming pump the heat build may cause the generation of steam with resulting dangerous pressures. It is recommended that a high case temperature switch or pressure relief valve be installed on the pump body.

CAUTION ! Never operate a pump with a plug-in type power cord without a ground fault circuit interrupter.


CAUTION! Pumps build up heat and pressure during operation-allow time for pumps to cool before handling or servicing.

WARNING! - **DO NOT** pump hazardous materials (flammable, caustic, etc.) unless the pump is specifically designed and designated to handle them.

Do not block or restrict discharge hose, as discharge hose may whip under pressure.

WARNING! - DO NOT wear loose clothing that may become entangled in the impeller or other moving parts.

WARNING! - Keep clear of suction and discharge openings. **DO NOT** insert fingers in pump with power connected.

Always wear eye protection when working on pumps.

Make sure lifting handles are securely fastened each time before lifting. **DO NOT** operate pump without safety devices in place. Always replace safety devices that have been removed during service or repair. Secure the pump in its operating position so it can not tip over, fall or slide.

DO NOT exceed manufacturers recommendation for maximum performance, as this could cause the motor to overheat.

DO NOT remove cord and strain relief. Do not connect conduit to pump.

WARNING! Cable should be protected at all times to avoid punctures, cut, bruises and abrasions - inspect frequently. Never handle connected power cords with wet hands.

WARNING! To reduce risk of electrical shock, all wiring and junction connections should be made per the NEC or CEC and applicable state or province and local codes. Requirements may vary depending on usage and location.

WARNING! Submersible Pumps are not approved for use in swimming pools, recreational water installations, decorative fountains or any installation where human contact with the pumped fluid is common.

WARNING! Products Returned Must Be Cleaned, Sanitized, Or Decontaminated As Necessary Prior To Shipment, To Insure That Employees Will Not Be Exposed To Health Hazards In Handling Said Material. All Applicable Laws And Regulations Shall Apply.

Bronze/brass and bronze/brass fitted pumps may contain lead levels higher than considered safe for potable water systems. Lead is known to cause cancer and birth defects or other reproductive harm. Various government agencies have determined that leaded copper alloys should not be used in potable water applications. For non-leaded copper alloy materials of construction, please contact factory.

IMPORTANT! - Crane Pumps & Systems, Inc. is not responsible for losses, injury, or death resulting from a failure to observe these safety precautions, misuse or abuse of pumps or equipment.

SECTION: A - PUMP SPECIFICATIONS:

2” Pumps (Standard & High Temperature)

DISCHARGE.....2” NPT, Female, Vertical, Bolt-on Flange
LIQUID TEMPERATURE:
Standard.....104°F (40°C) Continuous
High Temp.....200°F (93°C) Continuous
VOLUTE.....Cast Iron ASTM A-48, Class 30
MOTOR HOUSING...Cast Iron ASTM A-48, Class 30
SEAL PLATE.....Cast Iron ASTM A-48, Class 30
IMPELLER:
Design.....2 Vane, open, with pump out vanes on back side. Dynamically balanced, ISO G6.3
Material.....Cast Iron ASTM A-48, Class 30
SHAFT.....416 Stainless Steel
SQUARE RINGS.....Buna-N
HARDWARE.....300 Series Stainless Steel
PAINT.....Air Dry Enamel
SEAL:
Design.....Single Mechanical
Material.....Carbon/Ceramic/Buna-N
Hardware -300 Series Stainless
CORD ENTRY.....15 ft. (5 m), 20ft. (6.1 m) Cord with plug on 120 volt & .5HP, 240 volt, 1 phase. Quick connect custom molded for sealing and strain relief
SPEED.....1750 RPM (Nominal)
UPPER BEARING.....Single Row, Ball, Oil lubricated
Load.....Radial
LOWER BEARING....Single Row, Ball, Oil lubricated
Load.....Radial & Thrust
MOTOR:
Design.....NEMA L -Single Phase, NEMA B -Three phase Torque Curve, Oil Filled, Squirrel Cage Induction
Insulation.....Class B, Class F for High Temp. Class F on selected models
SINGLE PHASE.....Permanent Split Capacitor (PSC) Includes Overload Protection in Motor
THREE PHASE.....200-240/480 is Tri-Voltage notor 600V. Requires overload Protection to be included in control panel
LEVEL CONTROL....**"A" -** Wide Angle, PVC, Mechanical, 20 ft (6.1m) cord with Piggy-Back Plug, N/O
"AU"- Wide Angle, Polypropylene, Mechanical, N/O Integral to pump. ON and OFF Points are adjustable

OPTIONAL EQUIPMENT Seal Material, Impeller Trims, Additional cord, Normally Closed Temperature Sensors with cord for 3 phase pumps (Requires relay in control panel), *Inlet Strainer for High Temperature Models.
(*) 3/4” Spherical solids handling with optional inlet stainer.

IMPORTANT ! - High Temperature

1.) PUMP MAY BE OPERATED “DRY” FOR EXTENDED PERIODS WITHOUT DAMAGE TO MOTOR AND/OR SEALS.
2.) THIS PUMP IS NOT APPROPRIATE FOR THOSE APPLICATIONS SPECIFIED AS CLASS I DIVISION I HAZARDOUS LOCATIONS.
3.) INSTALLATIONS SUCH AS DECORATIVE FOUNTAINS OR WATER FEATURES PROVIDED FOR VISUAL ENJOYMENT MUST BE INSTALLED IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE ANSI/NFPA 70 AND/OR THE AUTHORITY HAVING JURISDICTION. THIS PUMP IS NOT INTENDED FOR USE IN SWIMMING POOLS, RECREATIONAL WATER PARKS, OR INSTALLATIONS IN WHICH HUMAN CONTACT WITH PUMPED MEDIA IS A COMMON OCCURRENCE.
4.) MUST USE A **HIGH TEMPERATURE** WIDE ANGLE LEVEL CONTROL IN HIGH TEMPERATURE APPLICATIONS.

3” Pumps

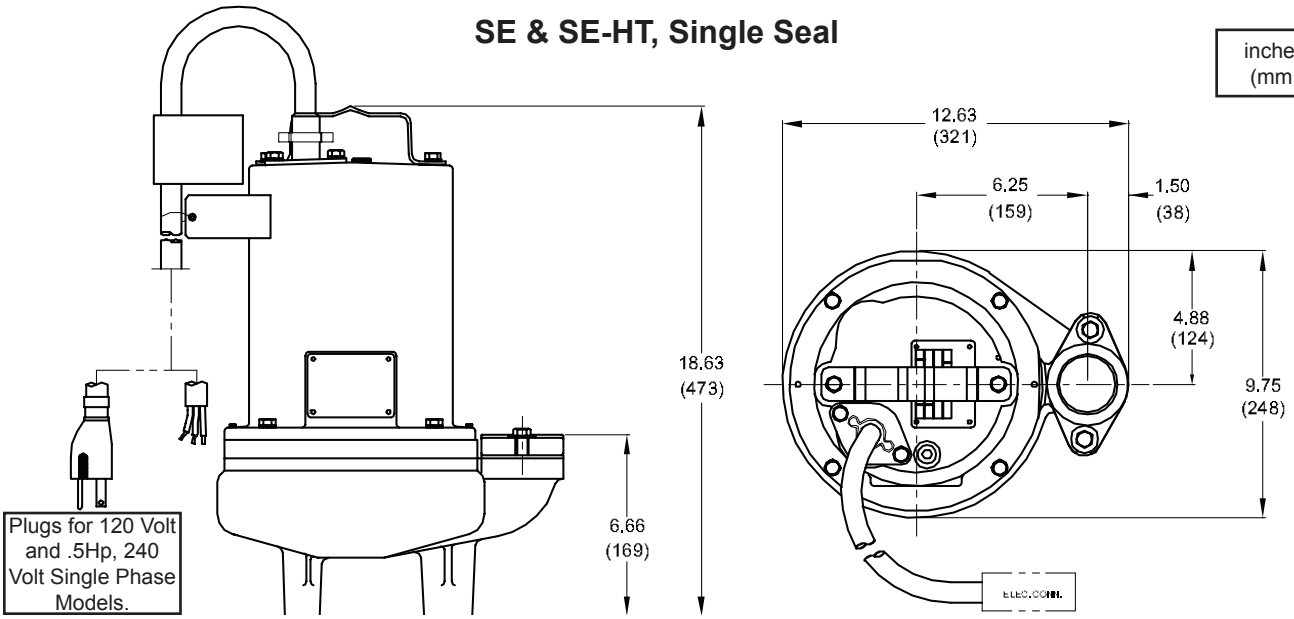
DISCHARGE.....3” NPT, Female, Vertical, Bolt-on Flange
LIQUID TEMP.....104°F (40°C) Continuous
VOLUTE.....Cast Iron ASTM A-48, Class 30
MOTOR HOUSING...Cast Iron ASTM A-48, Class 30
SEAL PLATE.....Cast Iron ASTM A-48, Class 30
IMPELLER:
Design.....2 Vane, open, with pump out vanes on back side. Dynamically balanced, ISO G6.3
Material.....Cast Iron ASTM A-48, Class 30
SHAFT.....416 Stainless Steel
SQUARE RINGS.....Buna-N
HARDWARE.....300 Series Stainless Steel
PAINT.....Air Dry Enamel
SEAL:
Design.....Single Mechanical or Tandem Mechanical with Oil Filled Reservoir
Material.....Carbon/Ceramic/Buna-N
Hardware -300 Series Stainless
CORD ENTRY..... 15 ft. (5 m), 20 ft. (6.1 m) Cord. Plug on 120 Volt & .5HP. 240 Volt 1 Phase Quick connect custom molded for sealing and strain relief
SPEED.....1750 RPM (Nominal)
UPPER BEARING.....Single Row, Ball, Oil lubricated
Load.....Radial
LOWER BEARING....Single Row, Ball, Oil lubricated
Load.....Radial & Thrust
MOTOR:
Design.....NEMA L -Single Phase, NEMA B -Three phase Torque Curve, Oil Filled, Squirrel Cage Induction
Insulation.....Class B
Class F on selected models
SINGLE PHASE.....Permanent Split Capacitor (PSC) Includes Overload Protection in Motor
THREE PHASE.....200-240/480 is Tri-Voltage. 600V. Requires Overload Protection to be included in control panel
OPTIONAL EQUIPMENT.....Seal Material, Impeller Trims, Additional cord, Normally Closed Temperature Sensors with cord for 3 phase pumps (Requires relay in control panel), Normally Open Moisture Sensor with cord for DS pumps.

IMPORTANT ! - Standard Temperature

1.) PUMP MAY BE OPERATED “DRY” FOR EXTENDED PERIODS WITHOUT DAMAGE TO MOTOR AND/OR SEALS.
2.) THIS PUMP IS APPROPRIATE FOR THOSE APPLICATIONS SPECIFIED AS CLASS I DIVISION II HAZARDOUS LOCATIONS.
3.) THIS PUMP IS NOT APPROPRIATE FOR THOSE APPLICATIONS SPECIFIED AS CLASS I DIVISION I HAZARDOUS LOCATIONS.
4.) INSTALLATIONS SUCH AS DECORATIVE FOUNTAINS OR WATER FEATURES PROVIDED FOR VISUAL ENJOYMENT MUST BE INSTALLED IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE ANSI/NFPA 70 AND/OR THE AUTHORITY HAVING JURISDICTION. THIS PUMP IS NOT INTENDED FOR USE IN SWIMMING POOLS, RECREATIONAL WATER PARKS, OR INSTALLATIONS IN WHICH HUMAN CONTACT WITH PUMPED MEDIA IS A COMMON OCCURRENCE.

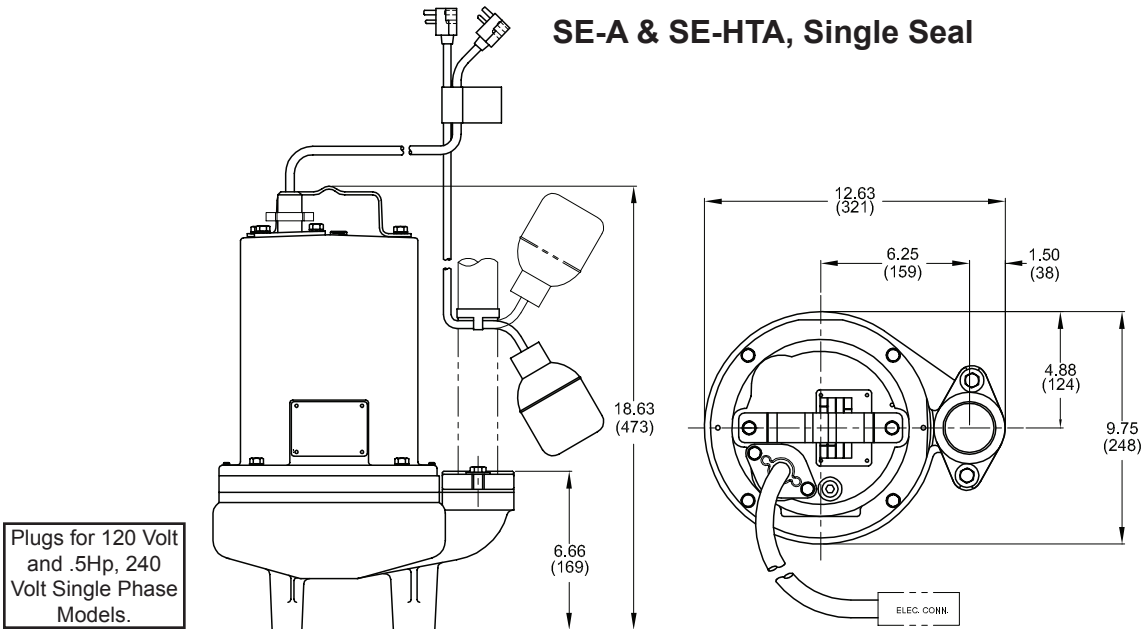
SE & SE-HT, Single Seal

inches
(mm)



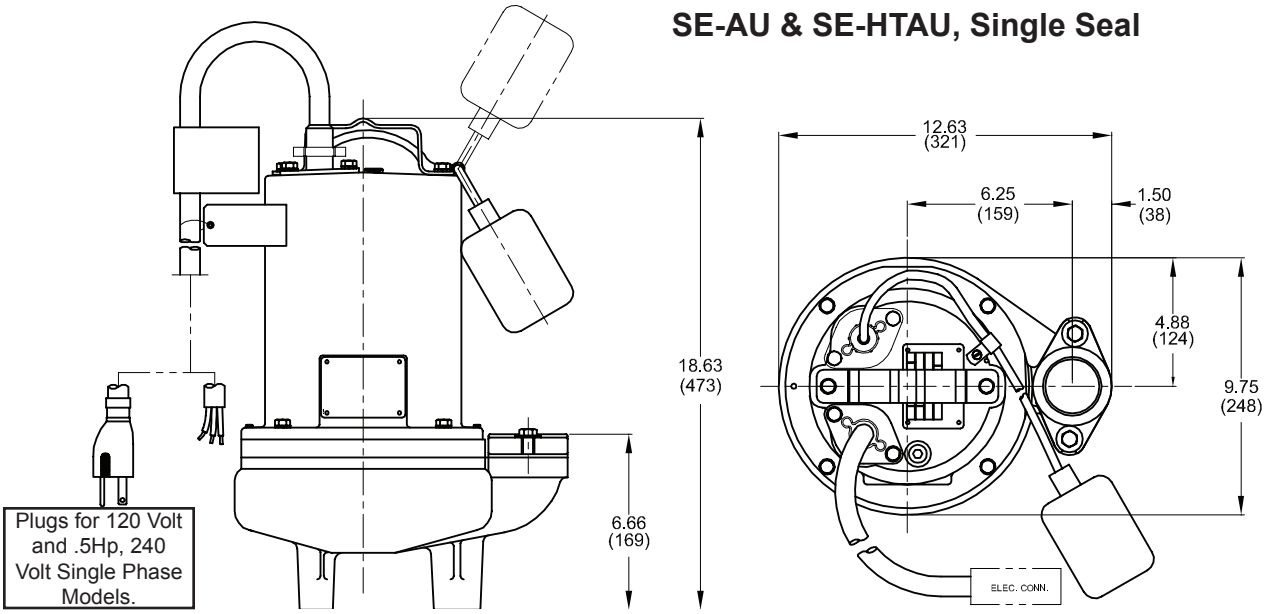
Plugs for 120 Volt and .5Hp, 240 Volt Single Phase Models.

SE-A & SE-HTA, Single Seal



Plugs for 120 Volt and .5Hp, 240 Volt Single Phase Models.

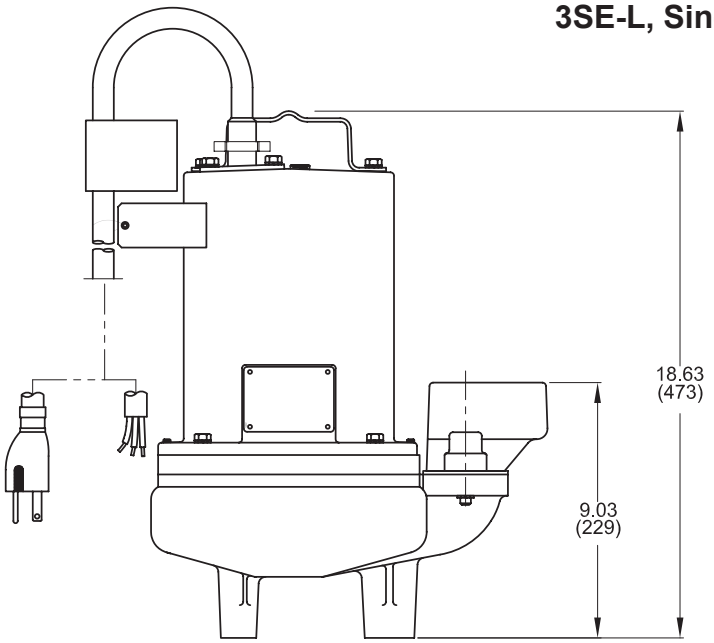
SE-AU & SE-HTAU, Single Seal

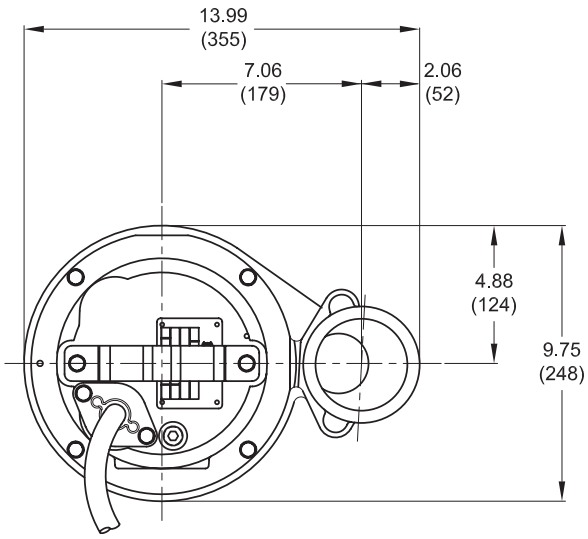


Plugs for 120 Volt and .5Hp, 240 Volt Single Phase Models.

3SE-L, Single Seal

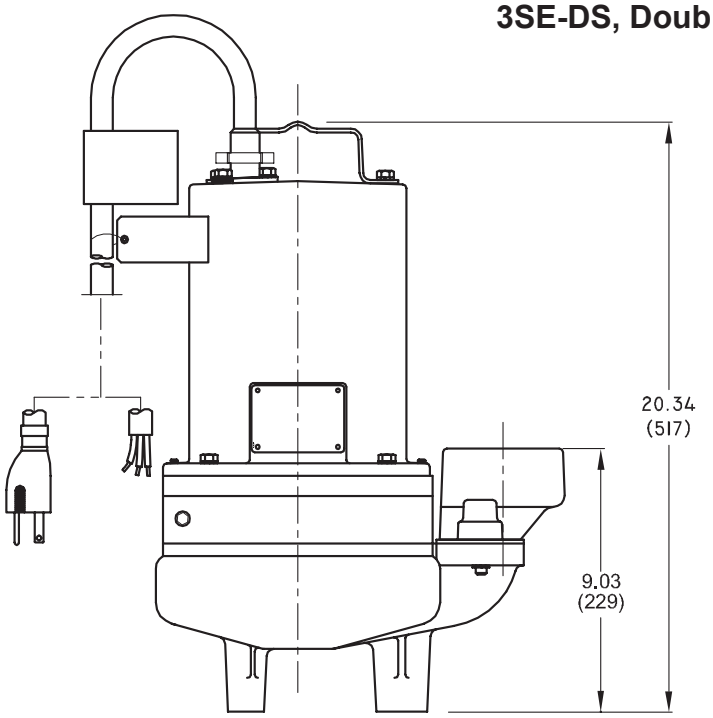
inches
(mm)

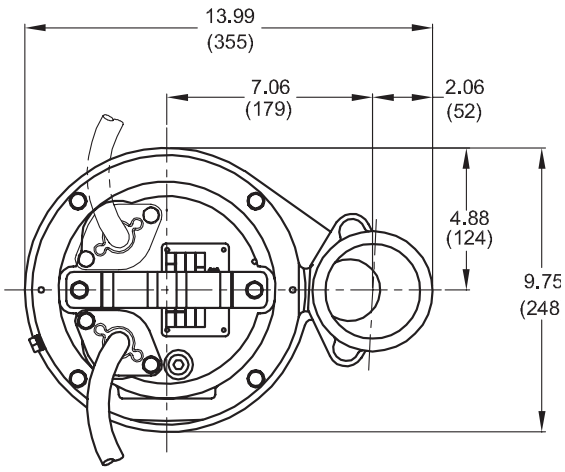




Plugs for 120 Volt and .5Hp, 240 Volt Single Phase Models.

3SE-DS, Double Seal





Plugs for 120 Volt and .5Hp, 240 Volt Single Phase Models.

SECTION B: GENERAL INFORMATION

B-1) To the Purchaser:
Congratulations! You are the owner of one of the finest pumps on the market today. CP&S pumps are products engineered and manufactured of high quality components. Over one hundred years of pump building experience along with a continuing quality assurance program combine to produce a pump which will stand up to the toughest applications. This manual will provide helpful information concerning installation, maintenance, and proper service guidelines.

B-2) Receiving:
Upon receiving the pump, it should be inspected for damage or shortages. If damage has occurred, file a claim immediately with the company that delivered the pump. If the manual is removed from the packaging, do not lose or misplace.

B-3) Storage:
Short Term- CP&S Pumps are manufactured for efficient performance following short inoperative periods in storage. For best results, pumps can be retained in storage, as factory assembled, in a dry atmosphere with constant temperatures for up to six (6) months. Long Term- Any length of time exceeding six (6) months, but not more than twenty-four (24) months. The unit should be stored in a temperature controlled area, a roofed over walled enclosure that provides protection from the elements (rain, snow, wind-blown dust, etc.), and whose temperature can be maintained between +40 deg. F and +120 deg. F. (4.4 - 49°C). Pump should be stored in its original shipping container. On initial start up, rotate impeller by hand to assure seal and impeller rotate freely. If it is required that the pump be installed and tested before the long term storage begins, such installation will be allowed provided:

1.) The pump is not installed under water for more than one (1) month.
2.) Immediately upon satisfactory completion of the test, the pump is removed, thoroughly dried, repacked in the original shipping container, and placed in a temperature controlled storage area.

B-4) Service Centers:
For the location of the nearest Barnes Service Center, check your Barnes representative or Crane Pumps & Systems, Inc., Service Department in Piqua, Ohio, telephone (937) 778-8947 or Crane Pumps & Systems Canada, in Brampton, Ontario, (905) 457-6223.

SECTION C: INSTALLATION

C-1) Location:
These pumping units are self-contained and are recommended for use in a sump, lift station or basin that is free of hard debris like gravel, stones, sand or earth. The sump, lift station or basin shall be vented in accordance with local plumbing codes. This pump is designed to pump sewage, effluent, or other nonexplosive or noncorrosive wastewater. and shall **NOT** be installed in locations classified as hazardous in accordance with the National Electrical Code (NEC), ANSI/NFPA 70 or the Canadian Electrical Code (CEC). Never install the pump in a trench, ditch or hole with gravel, stones, sand, or earth bottom; the legs will sink into the dirt and the suction will become plugged, or the pump impeller will be damaged.

C-1.1) Submergence:
It is recommended that the pump be operated in the submerged condition and the sump liquid level should never be lower than the top of the pump. (see Fig. 2)

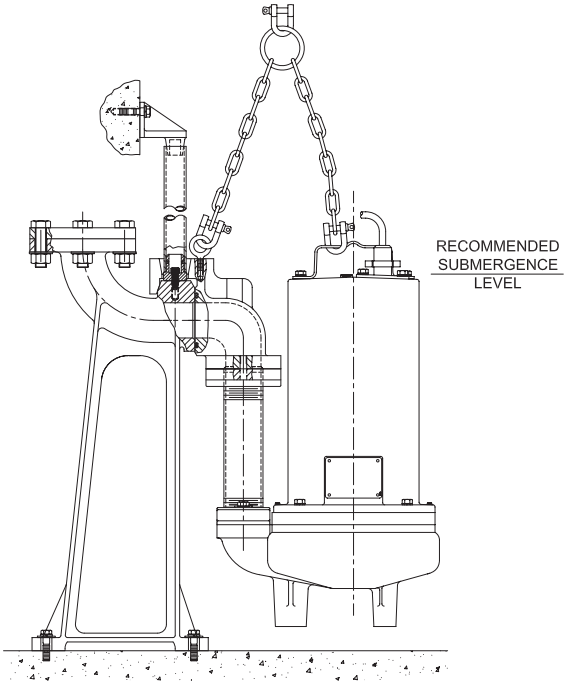


FIGURE 1

C-2) Discharge:
Discharge piping should be as short as possible. Both a check valve and a shut-off valve are recommended for each pump being used. The check valve is used to prevent backflow into the sump. Excessive backflow can cause flooding and/or damage to the pump. The shut-off valve is used to stop system flow during pump or check valve servicing.

Barnes Pumps supplies a Stainless Rail Package for the 2” models and also a variety of 2” and 3” break-away fitting discharge systems (see Fig. 1) designed to allow the submersible wastewater pump to be installed or removed without requiring personnel to enter the wet well. Contact your local Barnes Pumps distributor for complete details.

Stainless Rail Package (Not Shown) - The package system comes complete and ready to place into the ground as outlined in the project specifications. The moveable portion of the Break Away Fitting (BAF), check valve, piping and guide bracket comes assembled on the pump along with the lifting cord. Insert pump bracket and moveable portion of BAF into the guide channel and lower pump into basin **(DO NOT DROP)**. Now connect power and control cords to the junction box or control panel depending on system design.

C-3) Liquid Level Controls:
The level controls are to be supported by a mounting bracket that is attached to the sump wall, cover or junction box. Cord grips are used to hold the cords in place on the mounting bracket. The control level can be changed by loosening the grip and adjusting the cord length as per the plans and specifications. Be certain that the level controls cannot hang up or foul in it’s swing and that the pump is completely submerged when the level control is in the “Off” mode.

TYPICAL INSTALLATION WITH WIDE ANGLE LEVEL CONTROL

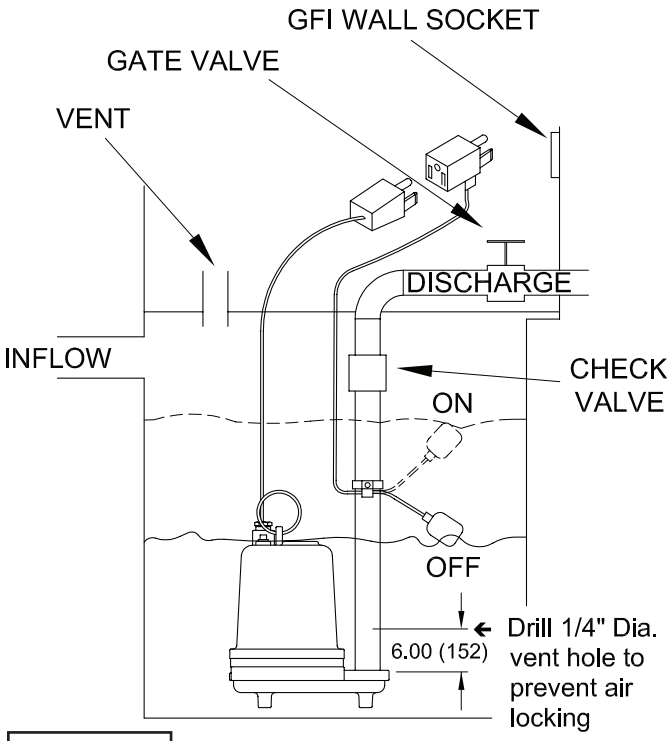


FIGURE 2

Figure 2 shows a typical installation of an “A” version float, (an “AU” version will attach to the pump), using a piggy-back plug.

General Comments:
1) Never work in the sump with the power on.

2) Level controls are factory set for a pumping differential of 9 inches. If that is the cycle desired, simply circle the discharge pipe with the pipe mounting strap, feed the end through the worm drive, and tighten with a screwdriver. Be certain that the level control cannot hang up or foul in it’s swing. Also, make certain the top of the pump is still submerged when the level control is in the ‘off’ mode.

3) If a higher pump differential is needed, grip the cord near the neck of the float, then using the other hand, exert a steady force on the lower edge of the cable clamp. The cable clamp should slide up to the new pivot point. Attach the level control to the discharge hose in the manner described above.

4) Plug the level control plug into the receptacle, then plug the pump into the piggyback plug. One cycle of operation should be observed, so that any potential problems can be corrected.

5) It is recommended that the float should be set to insure that the sump well liquid level never drops below the top of the motor housing.

6.) Figure 3 shows a typical connection for pumps with the wide angle float and piggy-back plug. For manual and automatic operations.

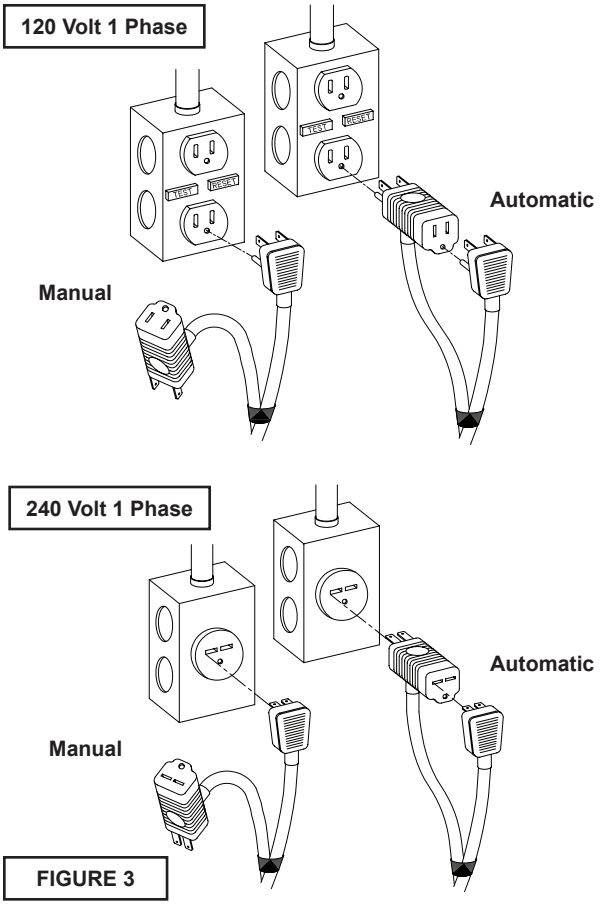


FIGURE 3

Automatic - Plug float cord into outlet, then plug pump cord into float cord.

Manual - Plug pump cord directly int outlet.

C-4) Electrical Connections:
C-4.1) Power and Control Cable:
The cord assembly mounted to the pump must not be modified in any way except for shortening to a specific application. Any splice between the pump and the control panel must be made in accordance with all applicable electric codes. It is recommended that a junction box, if used, be mounted outside the sump or be of at least Nema 4 (EEMAC-4) construction if located within the wet well. **Do not use the power or control cable to lift pump. NOTE: The white wire is NOT a neutral or ground lead, but a power carrying conductor.**

C-4.2) Overload Protection :
C-4.2-1) Three Phase (Optional) - The normally closed (N/C) thermal sensor is embedded in the motor windings and will detect excessive heat in the event an overload condition occurs. The thermal sensor will trip when the windings become too hot and will automatically reset itself when the pump motor cools to a safe temperature. It is recommended that the thermal sensor be connected in series to an alarm device to alert the operator of an overload condition, and/or the motor starter coil to stop the pump. In the event of an overload, the source of this condition should be determined and rectified immediately. **DO NOT LET THE PUMP CYCLE OR RUN IF AN OVERLOAD CONDITION OCCURS !**

If current through the temperature sensor exceeds the values listed, an intermediate control circuit relay must be used to reduce the current or the sensor will not work properly.

TEMPERATURE SENSOR ELECTRICAL RATINGS		
Volts	**Continuous Amperes**	**Inrush Amperes**
110-120	3.00	30.0
220-240	1.50	15.0
440-480	0.75	7.5
600	0.60	6.0

C-4.2-2) Single Phase (Standard) - The type of in-winding overload protector used is referred to as an inherent overheating protector and operates on the combined effect of temperature and current. This means that the overload protector will trip out and shut the pump off if the windings become too hot, or the load current passing through them becomes too high. It will then automatically reset and start the pump up after the motor cools to a safe temperature. In the event of an overload, the source of this condition should be determined and rectified immediately. **DO NOT LET THE PUMP CYCLE OR RUN IF AN OVERLOAD CONDITION OCCURS !**

C-4.3) Moisture Sensors- DS Models: (Optional)
A normally open (N/O) detector is installed in the pump seal chamber which will detect any moisture present. It is recommended that this detector be connected in series to an alarm device or the motor started coil to alert the operator that a moisture detect has occurred. In the event of a moisture detect, check the individual moisture sensor probe leads for continuity, (∞ resistance = no moisture) and the junction box/control box for moisture content. The above situations may induce a false signal in the moisture detecting circuit. If none of the above tests prove conclusive, the pump(s) should be pulled and the source of the failure identified and repaired. **IF A MOISTURE DETECT HAS OCCURRED SCHEDULE MAINTENANCE AS SOON AS POSSIBLE.**

C-4.4) Wire Size:
Consult a qualified electrician for proper wire size if additional power cord length is required. See table on pages 9 and 10 for electrical information.

SECTION: D START-UP OPERATION

D-1) Check Voltage and Phase:
Before operating pump, compare the voltage and phase information stamped on the pump identification plate to the available power.

D-2) Check Pump Rotation:
Before putting pump into service for the first time, the motor rotation must be checked. Improper motor rotation can result in poor pump performance and can damage the motor and/or pump. To check the rotation, suspend the pump freely, momentarily apply power and observe the “kickback”. “Kickback” should always be in a counter-clockwise direction as viewed from the top of the pump motor housing.

D-2.1) Incorrect Rotation for Three-Phase Pumps:
In the event that the rotation is incorrect for a three-phase installation, interchange any two power cord leads at the control box. **DO NOT** change leads in the cord housing in the motor. Recheck the “kickback” rotation again by momentarily applying power.

D-2.2) Incorrect Rotation for Single-Phase Pumps:
In the unlikely event that the rotation is incorrect for a single phase pump, contact a Barnes Pumps Service Center.

D-3) Identification Plate:
Record future serial plate information in the “NOTES” section.

D-3.1) Pump-Down Test:
After the pump has been properly wired and lowered into the basin, sump or lift station, it is advisable to check the system by filling with liquid and allowing the pump to operate through its pumping cycle. The time needed to empty the system, or pump-down time along with the volume of water, should be recorded on the start-up report.

SECTION E: PREVENTATIVE MAINTENANCE

As the motor is oil filled, no lubrication or other maintenance is required, and generally Barnes Pumps will give very reliable service and can be expected to operate for years on normal sewage pumping without failing. In our experience attempts at preventative maintenance are more likely to reduce, rather than extend the life of our pumps. However, if you are inclined to perform preventative maintenance, the following are the steps that should be performed.

1) Inspect motor chamber for oil level and contamination and repair as required per section F-1.
2) Inspect impeller and body for excessive build-up or clogging and repair as required per section F-2.
3) Inspect motor and bearings and replace as required per section F-3.
4) Inspect seal for wear or leakage and repair as required per section F-4.

MODEL NO	HP	VOLT/PH	Hz	RPM (Nom)	NEMA START CODE	INSUL. CLASS	FULL LOAD AMPS	LOCKED ROTOR AMPS	CORD SIZE	CORD TYPE	CORD O.D inch (mm)	WINDING RESISTANCE		
												Emerson Main-Start	Bluffton Main-Start	G.E. Main-Start
SE51	0.5	120/1	60	1750	F	B	11.6	21.3	14/3	SJTOW	0.375 (9.5)			1.51 - 16.10
SE51A	0.5	120/1	60	1750	F	B	11.6	21.3	14/3	SJTOW	0.375 (9.5)			1.51 - 16.10
SE51AU	0.5	120/1	60	1750	F	B	11.6	21.3	14/3	SJTOW	0.375 (9.5)			1.51 - 16.10
SE52	0.5	240/1	60	1750	J	B	5.9	14.9	14/3	SOW	0.530 (13.5)	3.38 - 9.30		5.69 - 18.74
SE52AU	0.5	240/1	60	1750	J	B	5.9	14.9	14/3	SOW	0.530 (13.5)	3.38 - 9.30		5.69 - 18.74
SE594L	0.5	200-240/3	60	1750	H/L	B	3.2/3.0	9.8/11.0	14/4	SOW	0.570 (14.5)	10.20	13.00	
SE544L	0.5	480/3	60	1750	K	B	1.5	5.3	14/4	SOW	0.570 (14.5)	40.80	52.00	
SE554L	0.5	600/3	60	1750	H	B	1.0	3.4	14/4	SOW	0.570 (14.5)		77.60	89.76
SE774L	0.75	200-240/1	60	1750	G/K	F	7.4/7.0	21.5/25.8	14/3	SOW	0.530 (13.5)	1.86 - 10.20		2.74 - 10.56
SE794L	0.75	200-240/3	60	1750	H/K	F	4.8/4.5	13.7/15.4	14/4	SOW	0.570 (14.5)		5.49	6.28
SE744L	0.75	480/3	60	1750	K	F	2.2	7.7	14/4	SOW	0.570 (14.5)		21.96	24.51
SE754L	0.75	600/3	60	1750	L	B	1.5	7.2	14/4	SOW	0.570 (14.5)		34.36	36.60
SE1074L	1.0	200-240/1	60	1750	D/G	F	8.8/8.3	21.5/25.8	14/3	SOW	0.530 (13.5)	1.86 - 10.20		2.74 - 10.56
SE1094L	1.0	200-240/3	60	1750	E/H	F	5.1/4.9	13.7/15.4	14/4	SOW	0.570 (14.5)		5.49	6.28
SE1044L	1.0	480/3	60	1750	H	F	2.4	7.7	14/4	SOW	0.570 (14.5)		21.96	24.51
SE1054L	1.0	600/3	60	1750	J	B	1.9	7.2	14/4	SOW	0.570 (14.5)		34.36	36.60
SE51HT	0.5	120/1	60	1750	R	F	17.0	63.8	14/3	SOW	0.530 (13.5)		1.79 - 5.99	1.64 - 3.05
SE51HTA	0.5	120/1	60	1750	R	F	17.0	63.8	14/3	SOW	0.530 (13.5)		1.79 - 5.99	1.64 - 3.05
SE51HTAU	0.5	120/1	60	1750	R	F	17.0	63.8	14/3	SOW	0.530 (13.5)		1.79 - 5.99	1.64 - 3.05
SE52HT	0.5	240/1	60	1750	R	F	8.5	30.1	14/3	SOW	0.530 (13.5)		1.79 - 5.99	1.64 - 3.05
SE52HTAU	0.5	240/1	60	1750	R	F	8.5	30.1	14/3	SOW	0.530 (13.5)		1.79 - 5.99	1.64 - 3.05
3SE514L	0.5	120/1	60	1750	F	B	11.6	21.3	14/3	SJTOW	0.375 (9.5)			1.51 - 16.10
3SE524L	0.5	240/1	60	1750	J	B	5.9	14.9	14/3	SOW	0.530 (13.5)	3.38 - 9.30		5.69 - 18.74
3SE594L	0.5	200-240/3	60	1750	H/L	B	3.2/3.0	9.8/11.0	14/4	SOW	0.570 (14.5)	10.20	13.00	
3SE544L	0.5	480/3	60	1750	K	B	1.5	5.3	14/4	SOW	0.570 (14.5)	40.80	52.00	
3SE554L	0.5	600/3	60	1750	H	B	1.0	3.4	14/4	SOW	0.570 (14.5)		77.60	89.76
3SE774L	0.75	200-240/1	60	1750	G/K	F	7.4/7.0	21.5/25.8	14/3	SOW	0.530 (13.5)	1.86 - 10.20		2.74 - 10.56
3SE794L	0.75	200-240/3	60	1750	H/K	F	4.8/4.5	13.7/15.4	14/4	SOW	0.570 (14.5)		5.49	6.28
3SE744L	0.75	480/3	60	1750	K	F	2.2	7.7	14/4	SOW	0.570 (14.5)		21.96	24.51
3SE754L	0.75	600/3	60	1750	L	B	1.5	7.2	14/4	SOW	0.570 (14.5)		34.36	36.60
3SE1074L	1.0	200-240/1	60	1750	D/G	F	8.8/8.3	21.5/25.8	14/3	SOW	0.530 (13.5)	1.86 - 10.20		2.74 - 10.56
3SE1094L	1.0	200-240/3	60	1750	E/H	F	5.14/4.9	13.7/15.4	14/3	SOW	0.570 (14.5)		5.49	6.28
3SE1044L	1.0	480/3	60	1750	H	F	2.4	7.7	14/4	SOW	0.570 (14.5)		21.96	24.51
3SE1054L	1.0	600/3	60	1750	J	B	1.9	7.2	14/4	SOW	0.570 (14.5)		34.36	36.60
3SE514DS	0.5	120/1	60	1750	F	B	11.6	21.3	14/3	SJTOW	0.375 (9.5)			1.51 - 16.10
3SE524DS	0.5	240/1	60	1750	J	B	5.9	14.9	14/3	SOW	0.530 (13.5)	3.38 - 9.30		5.69 - 18.74
3SE594DS	0.5	200-240/3	60	1750	H/L	B	3.2/3.0	9.8/11.0	14/4	SOW	0.570 (14.5)	10.20	13.00	
3SE544DS	0.5	480/3	60	1750	K	B	1.5	5.3	14/4	SOW	0.570 (14.5)	40.80	52.00	
3SE554DS	0.5	600/3	60	1750	H	B	1.0	3.4	14/4	SOW	0.570 (14.5)		77.60	89.76
3SE774DS	0.75	200-240/1	60	1750	G/K	F	7.4/7.0	21.5/25.8	14/3	SOW	0.530 (13.5)	1.86 - 10.20		2.74 - 10.56
3SE794DS	0.75	200-240/3	60	1750	H/K	F	4.8/4.5	13.7/15.4	14/4	SOW	0.570 (14.5)		5.49	6.28
3SE744DS	0.75	480/3	60	1750	K	F	2.2	7.7	14/4	SOW	0.570 (14.5)		21.96	24.51
3SE754DS	0.75	600/3	60	1750	L	F	1.5	7.2	14/4	SOW	0.570 (14.5)		34.36	36.60
3SE1074DS	1.0	200-240/1	60	1750	D/G	F	8.8/8.3	21.5/25.8	14/3	SOW	0.530 (13.5)	1.86 - 10.20		2.74 - 10.56
3SE1094DS	1.0	200-240/3	60	1750	E/H	F	5.14/4.9	13.7/15.4	14/3	SOW	0.570 (14.5)		5.49	6.28
3SE1044DS	1.0	480/3	60	1750	H	F	2.4	7.7	14/4	SOW	0.570 (14.5)		21.96	24.51
3SE1054DS	1.0	600/3	60	1750	J	B	1.9	7.2	14/4	SOW	0.570 (14.5)		34.36	36.60

Winding Resistance ± 5%, measured from terminal block. Pump rated for operation at ± 10% voltage at motor.
2" Pumps ONLY: Mechanical Switch on SE51A, Cable 16/2, SJOW, 0.320 (8.1 mm) O.D. Piggy-Back Plug.
Mechanical Switch on SE51AU & SE52AU, Cable 14/2, SJOW, 0.345 (8.8 mm) O.D.
OPTIONAL - Moisture Sensor cable for DS models is 18/5, SOW, 0.470 (11.9 mm) O.D.
OPTIONAL - Temperature Sensor cable for 3 phase models is 14/3 SOW, 0.530 (13.5 mm) O.D.
OPTIONAL - Moisture & Temperature Sensor cable for 3 phase DS models is 18/5, SOW, 0.470 (11.9 mm) O.D.

SECTION F: SERVICE AND REPAIR
NOTE: All item numbers in ( ) refer to Figures 16 thru 21.

CAUTION ! - Operating pump builds up heat and pressure; allow time for pump to cool to room temperature before handling or servicing. Slowly remove pipe plug prior to servicing as housing may be pressurized.

F-1) Lubrication:
Anytime the pump is removed from operation, the cooling oil in the motor housing (6) should be checked visually for oil level and contamination.

F-1.1) Checking Oil:
Motor Housing - To check oil, set unit upright. Remove pipe plug (39) from housing (6). With a flashlight, visually inspect the oil in the motor housing (6) to make sure it is clean and clear, light amber in color and free from suspended particles. Milky white oil indicates the presence of water. Oil level should be just above the motor when pump is in vertical position.

F-1.2) Testing Oil:
1.) Place pump on it's side, remove pipe plug (39), from motor housing (6) and drain oil into a clean, dry container.
2.) Check oil for contamination using an oil tester with a range to 30 Kilovolts breakdown.
3.) If oil is found to be clean and uncontaminated (measuring above 15 KV. breakdown), refill the motor housing as per section F-1.4.
4.) If oil is found to be dirty or contaminated (or measures below 15 KV. breakdown), the pump must be carefully inspected for leaks at the shaft seal (28), cable assemblies (16) and (56 if used), square ring (27) and pipe plug (39), before refilling with oil. To locate the leak, perform a pressure test as per section F-1.3. After leak is repaired, dispose of old oil properly, and refill with new oil as per section F-1.4.

F-1.3) Pressure Test:
Pumps that have had the oil drained from the Motor Housing - Apply pipe sealant to pressure gauge assembly and tighten into pipe plug hole (See Figure 4). Pressurize motor housing to 10 P.S.I. Use soap solution around the sealed areas and inspect joints for "air bubbles". If, after five minutes, the pressure is still holding constant, and no "bubbles" are observed, slowly bleed the pressure and remove the gauge assembly. Replace oil as described in section F-1.4. If the pressure does not hold, then the leak must be located and repaired. **Pumps that have NOT had the oil drained from the Motor Housing -** The pressure test may be done with the oil at its normal level. Remove pipe plug (39) from motor housing (6). Apply pipe sealant to pressure gauge assembly and tighten into hole (see Figure 4). Pressurize motor housing to 10 P.S.I. Use soap solution around the sealed areas above the oil level and inspect joints for "air bubbles". For sealed areas below the oil level, leaks will seep oil.

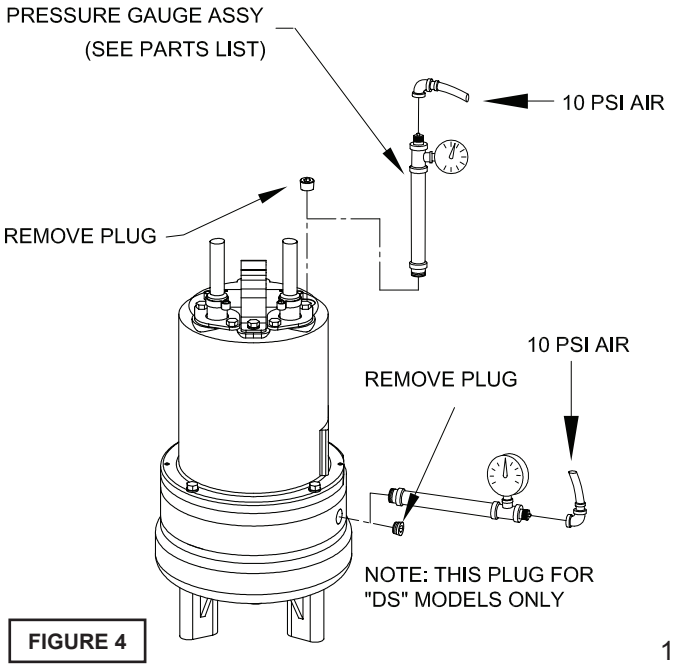


FIGURE 4

If, after five minutes, the pressure is still holding constant, and no "bubbles"/oil seepage is observed, slowly bleed the pressure and remove the gauge assembly. If the pressure does not hold, then the leak must be located and repaired.

Seal Chamber (DS Units Only)- Set unit on its side with fill plug (44) downward, remove plug (44) and drain all oil from seal chamber. Apply pipe sealant to pressure gauge assembly and tighten into hole in outer seal plate (29). Pressurize seal chamber to 10 P.S.I. and check for leaks as outlined above.


CAUTION ! - Pressure builds up extremely fast, increase pressure by "TAPPING" air nozzle. Too much pressure will damage seal. DO NOT exceed 10 P.S.I.

F-1.4) Replacing Oil:
Motor Housing- Set unit upright and refill with new cooling oil as per Table 1 (see parts list for amount). Fill to just above motor as an air space must remain in the top of the motor housing to compensate for oil expansion (see Fig 16, 18 or 20). Apply pipe thread compound to threads of pipe plug (39) then assemble to motor housing (6).

IMPORTANT! - For single phase units, oil level should be below capacitor.

Seal Chamber (DS Units Only)- Set unit on its side, with plug (44) upward, and refill with new oil as per Table 1 (see parts list for amount). Apply pipe thread compound to threads of pipe plug (44) and assemble to outer seal plate (29).


WARNING ! - DO NOT overfill oil. Overfilling of motor housing with oil can create excessive and dangerous hydraulic pressure which can destroy the pump and create a hazard. Overfilling oil voids warranty.

TABLE 1 - COOLING OIL - Dielectric	
SUPPLIER	**GRADE**
BP	Enerpar SE100
Conoco	Pale Paraffin 22
Mobile	D.T.E. Oil Light
G & G Oil	Circulating 22
Imperial Oil	Voltesso-35
Shell Canada	Transformer-10
Texaco	Diala-Oil-AX
Woco	Premium 100

F-2) Impeller and Volute Service:

F-2.1) Disassembly and Inspection:

To clean out volute (1) or replace impeller (33), disconnect power, remove hex bolts (26), and lockwashers (12), vertically lift motor and seal plate assembly from volute (1) see Figure 5. Clean out body if necessary. Clean and examine impeller (33), for pitting or wear and replace if required, inspect gasket (36) and replace if cut or damaged. If the impeller (33) needs replacing, place a flat screwdriver in the slot of the end of the shaft to hold the shaft stationary while unscrewing the jam nut (66) and impeller (33).

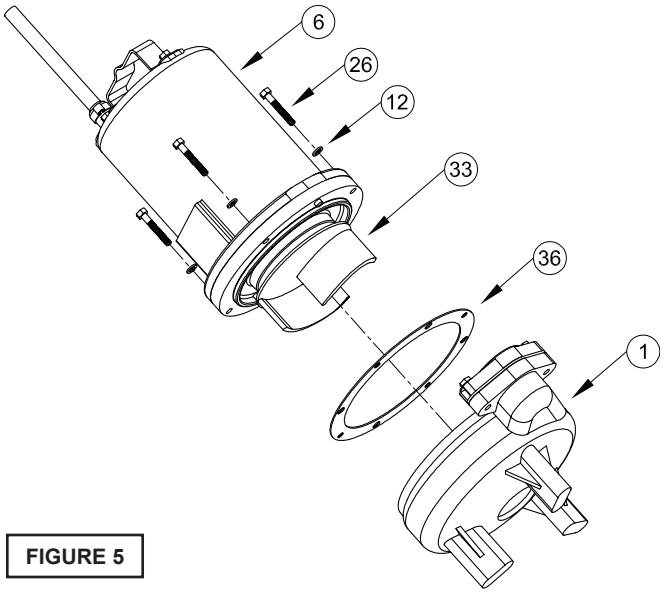


FIGURE 5

F-2.2) Reassembly:

To install impeller (33), clean the threads with thread locking compound cleaner. Apply removable Loctite® 603 or equivalent to shaft threads. Screw impeller onto the shaft hand tight while using a screwdriver in the slot at the end of the shaft to hold it stationary. Apply thread locking compound (60) to shaft threads. Then install jam nut (66) and torque to 40 ft. lbs.

It is important that the spring of the lower shaft seal (28) seats in the hub of the impeller (33). Rotate impeller to check for binding. Position gasket (36) on volute flange and position impeller and motor housing on volute (1). Position lockwasher (12) on cap screw (26) and screw into volute (1). Torque to 100 in-lbs. Check for free rotation of motor and impeller.

F-3) Shaft Seal Service:

CAUTION ! - Handle seal parts with extreme care. DO NOT scratch or mar lapped surfaces.

F-3.1) Disassembly and Inspection:

Outer Seal (All Units) - To expose shaft seal (28) for examination, disassemble volute and impeller as outlined in paragraph F-2.1. If further repair is required, remove retaining ring (28d), spring (28c) and rotating member (28b) from shaft (see Figure 6 & 7). Examine all seal parts and especially contact faces. Inspect seal for signs of wear such as uneven wear pattern on stationary members, chips and scratches on either seal face. **DO NOT** interchange seal components, replace the entire shaft seal (28). If replacing seal, remove stationary (28a) by prying out with flat screwdriver.

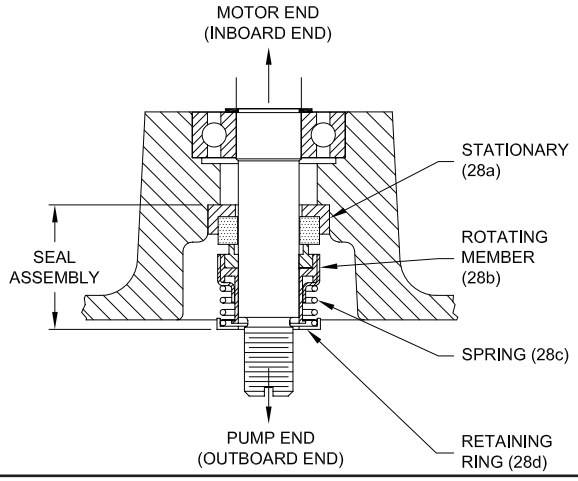


FIGURE 6 - SINGLE SEAL

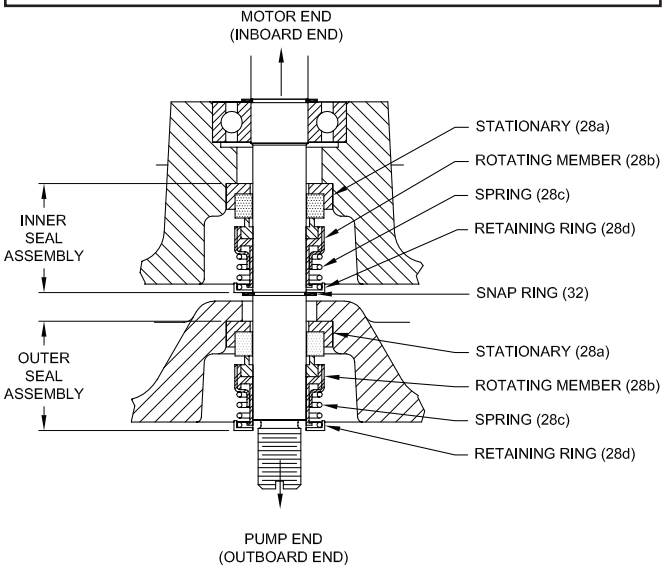


FIGURE 6 - DOUBLE SEAL

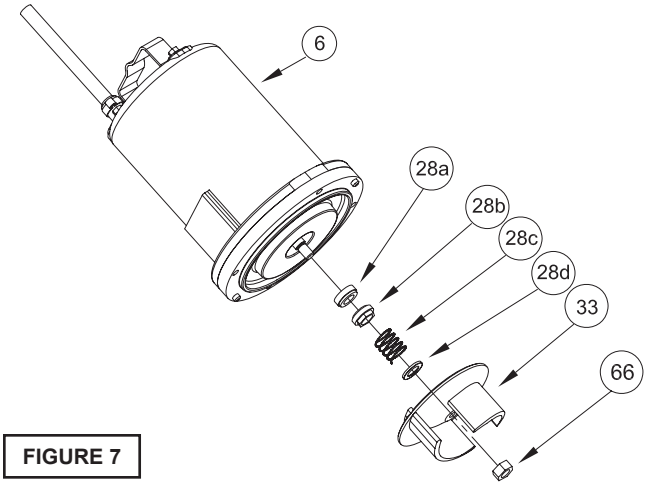


FIGURE 7

Inner Seal (DS Units Only)- To expose inner shaft seal (28) for examination, remove outer seal as outlined above. Remove socket head cap screws (64). Lift outer seal plate (29) and square-ring (27) from inner seal plate (5) see Figure 8. If further repair is required, remove snap ring (32), retaining ring (28d), spring (28c) and rotating member (28b) from shaft. Examine as outlined in outer seal paragraph. If replacing seal, remove stationary (28a) by prying out with flat screwdriver.

F-3.2) Reassembly:

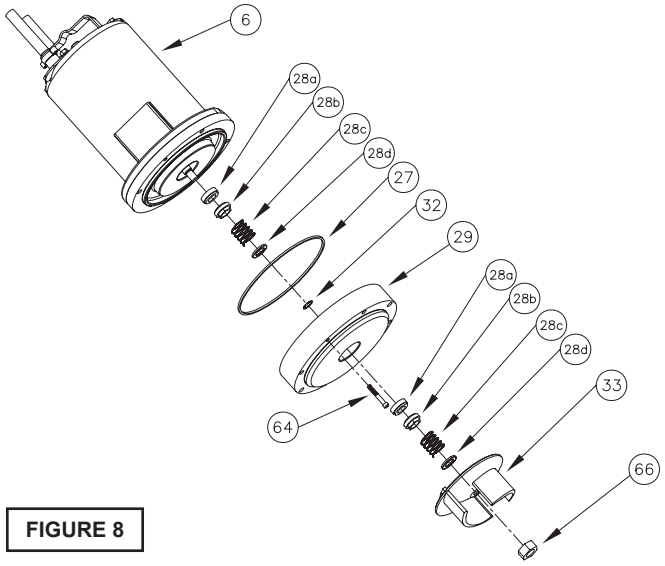


FIGURE 8

Inner Seal (DS Units Only)- Clean and oil seal cavities in seal plates (5, 29). Lightly oil **(DO NOT use grease)** outer surface of stationary member (28a). Press stationary member (28a) firmly into inner seal plate (5), using a seal pusher (see parts list - seal tool kit). Nothing but the seal pusher is to come in contact with seal face (see Fig 9).

IMPORTANT! - DO NOT hammer on the seal pusher- it will damage the seal face.

Make sure the stationary member is in straight. Slide a bullet (see parts list - seal tool kit) over motor shaft. Lightly oil **(DO NOT use grease)** shaft, bullet and inner surface of bellows on rotating member (28b) see Figure 10. With lapped surface of rotating member (28b) facing inward toward stationary member, slide rotating member over bullet and onto shaft, using seal pusher, until lapped faces of (28a) and (28b) are together (see Figure 9).

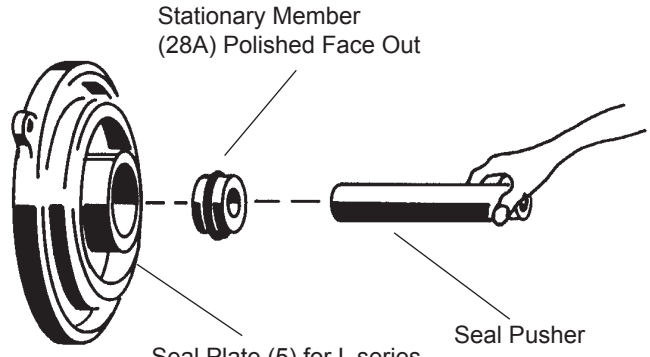


FIGURE 9

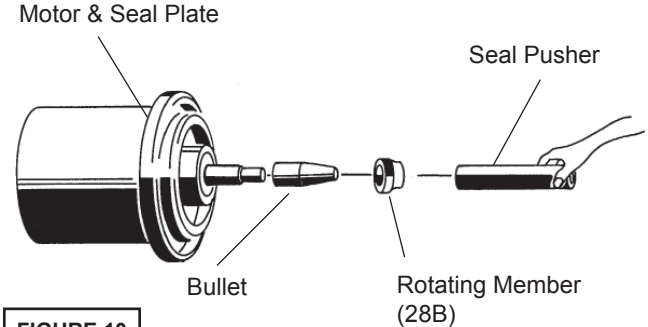


FIGURE 10

It is extremely important to keep seal faces clean during assembly. Dirt particles lodged between these faces will cause the seal to leak. Place spring (28c) over shaft and in place on rotating member (28b), making sure it is seated on retainer and not cocked or resting on bellows tail. Slide retaining ring (28d) over shaft and let rest on spring (28c). Replace snap ring (32) in groove of shaft. Set square-ring (27) in groove on outer seal plate (29) and place outer seal plate (29) onto inner seal plate (5). Replace socket head cap screws (64) and torque to 60 in-lbs.

Outer Seal (All Units)- Press stationary member (28a) firmly into outer seal plate (5, or 29 on DS Units) as described above. Slide rotating member (28b) onto stationary member using seal pusher as described above. Place spring (28c) and retaining ring (28d) onto rotating member (28b). Assemble impeller and volute as outlined in paragraph F-2.2. Replace oil as outlined in paragraph F-1.4.

F-4) Motor and Bearing Service
F-4.1) Disassembly and Inspection:
To examine or replace the motor (7), capacitor (9, single phase units), controls (55, 56, optional), and bearing (25), drain oil from motor as outlined in paragraph F-1.1. Disassemble volute and impeller as outlined in paragraph F-2.1 and disassemble shaft seal as outlined in paragraph F-3.1.

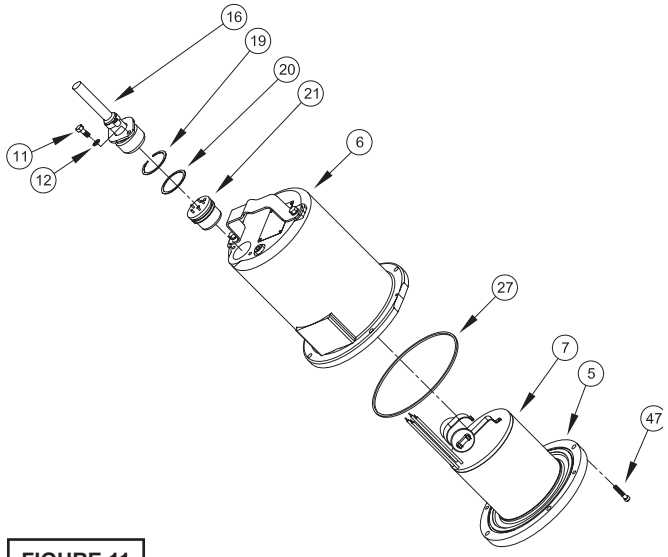


FIGURE 11

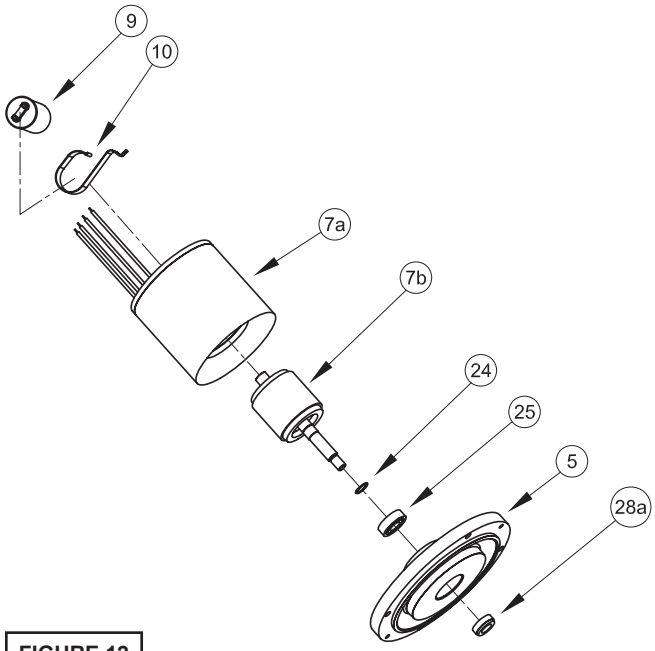


FIGURE 12

Position unit upright, using blocks to avoid resting unit on shaft. Unscrew cable hex bolts (11) and remove compression flange (16a) and power cord (16). Remove snap ring (19) with a flat head screwdriver. Pull the terminal block (21) out of the housing (6) using a T-bolt or pair of pliers and a .25-20 screw in the threads of the terminal block (21). Be sure to leave slack on the motor leads connected underneath. Use needle nose pliers to pull each female connector off of the pins on the underside of the terminal block (21) see Figure 11. The unit voltage should be noted. Repeat cable and terminal block removal procedure for any control cables (56) if equipped. Remove socket head cap screws (47). Vertically lift the motor housing (6) from seal plate (5) by lifting handle (13). Inspect square ring (27) for damage or cuts. Remove the motor bolts and lift motor stator from seal plate (5). Disconnect capacitor leads from capacitor (9, single phase units). Examine bearing (25) and replace if required. If replacement is required, remove bearing (25) from motor shaft using a wheel puller or arbor press, see Figure 12

Check motor capacitor (9, single phase units) with an Ohm meter by first grounding the capacitor by placing a screwdriver across both terminals and then removing screwdriver. Connect Ohm meter (set on high scale) to terminals. If needle moves to infinity (∞) then drifts back, the capacitor is good. If needle does not move or moves to infinity (∞) and does not drift back, replace capacitor (9). To test the float switch (55 or 56 optional), check for continuity between the pin receptacles of the cord with the float in an “up” position. There should be no continuity with the switch in the “down” position. Replace switch (55 or 56) if malfunctioning. If moisture sensors (4, optional) are damaged, disconnect leads by removing machine screws (45) and washers (46) from probes (4). Remove probes (4) from seal plate (5). To test the temperature sensor (50, optional), check for continuity between the black and white wires. If found to be defective, contact a motor service station or Barnes Pumps Service department. Inspect motor winding for shorts and check resistance values. Check rotor for wear. If rotor or the stator windings are defective, the complete motor must be replaced.

IMPORTANT! - All parts must be clean before reassembly.

F-4.2) Reassembly:

Moisture Sensors, DS Models - If pump is equipped with optional moisture sensors, reassemble by applying thread compound to threads on probes (4) and install in upper seal plate (5), see Figure 20 & 21. Connect wire assemblies (53) to probes (4) with washers (46) and machine screws (45).

Thermal Sensors - If pump is equipped with optional thermal sensors, use terminal connectors (52) to connect wire assemblies (51) to sensor leads. If sensor is not functioning, contact factory approved Service Center or Contact factory Service Department.

Bearings - When replacing bearing, be careful not to damage the rotor or shaft threads. Clean the shaft thoroughly. Press bearing (25) on the motor shaft, position squarely onto the shaft applying force to the inner race of the bearing only, until bearing seats against the retaining ring (24) (Included with motor).

Motor - Slide lower bearing (25) and motor shaft squarely into the seal plate (5) until bearing seats on the bottom. Place stator over rotor, lining up motor bolts with holes in seal plate (5). Position capacitor (9, single phase units) so that it will lay on the opposite side of the cable entry bosses of the motor housing (6). Reconnect capacitor leads. Torque motor tie bolts to 17 in-lbs. Set square ring (27) in groove on seal plate (5).

F-4.3) Wiring Connections:

Check power cables (16) and control cable (56, if used), for cracks or damage and replace if required (see Figure 14). Make internal wiring connections which are independent of the terminal block as shown, using connectors (48) and wire assemblies (49) and (63) as required. Do not use wire nuts. Slip motor leads and groud wire through fiberglass sleeve. Lower motor housing (6) down onto seal plate (5) while aligning holes and stringing motor leads through the cable entry bore(s). (Slipping cords inside a 1 ft. length of .5” conduit makes this easier). Place socket head cap screws (47) through seal plate (5) into motor housing (6) and torque to 60 in-lbs.

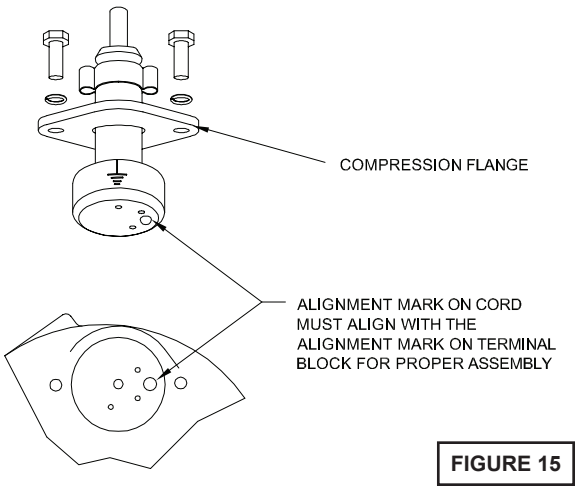


FIGURE 15

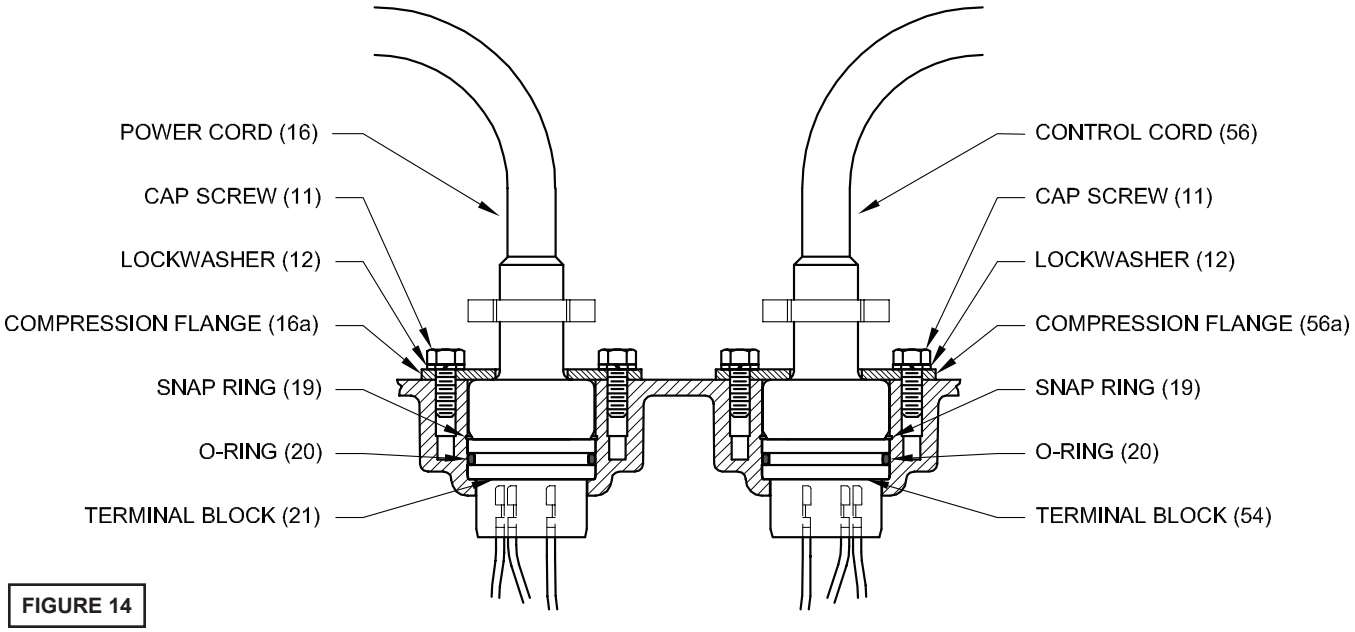


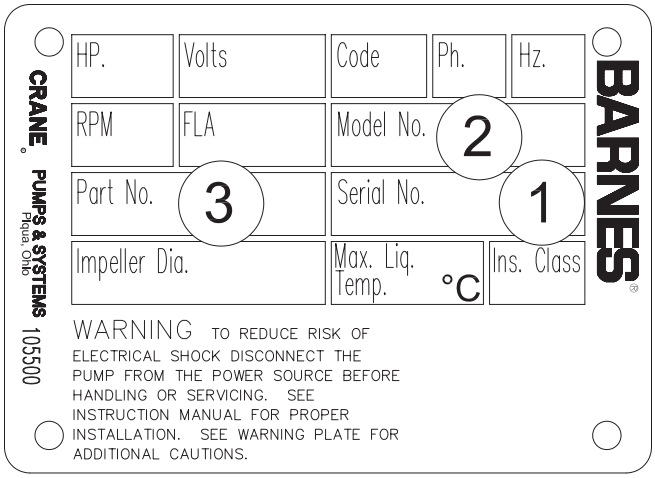
FIGURE 14

Reconnect motor and optional control leads to the underside of the terminal block(s) (21), (54 optional) as shown in Figure 13. Note that the pins are numbered underneath the terminal block. Place o-ring (20) into groove in terminal block and lubricate with dielectric oil. Press the terminal block (21) into the housing so it seats completely below the snap ring groove. Place snap ring (19) into groove in cable entry bore of housing. Repeat terminal block installation for control cable, if equipped.

F-4.4) Cable Assemblies:
Power/Control Cable- Refill the cooling oil as outlined in paragraph F-1.3. Make wire connections as outlined in paragraph F-4.3. Insert female end of cable plug into housing bore aligning timing mark with hole in terminal block (21) see Figure 15. Compress cable plug with compression flange (16a) by tightening hex bolts (11) into the housing (6). Torque to 132 in-lbs.

SECTION: G REPLACEMENT PARTS

G-1 ORDERING REPLACEMENT PARTS:
When ordering replacement parts, ALWAYS furnish the following information:
1. Pump serial number and date code. (Paragraph G-4)
2. Pump model number. (Paragraph G-3)
3. Pump part number. (Paragraph G-2)
4. Part description.
5. Item part number.
6. Quantity required.
7. Shipping instructions.
8. Billing Instructions.

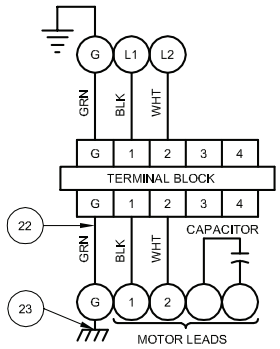


G-2 PART NUMBER:
The part number consists of a six (6) digit number, which appears in the catalog. A one or two letter suffix may follow this number to designate the design configuration. This number is used for ordering and obtaining information.

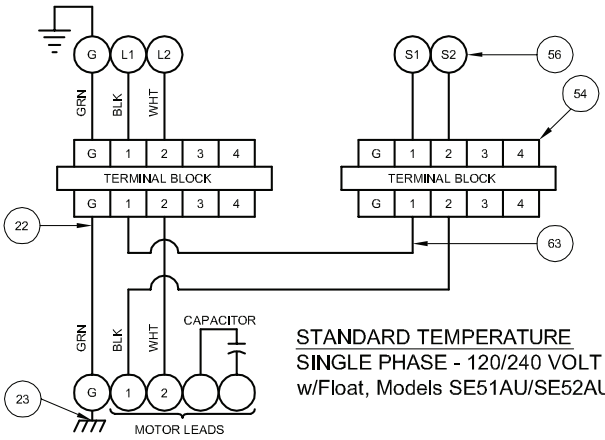
G-3 MODEL NUMBER:
This designation consists of numbers and letters which represent the discharge size, series, horsepower, motor phase and voltage, speed and pump design. This number is used for ordering and obtaining information.

G-4 SERIAL NUMBER:
The serial number block will consist of a six digit number, which is specific to each pump and may be preceded by a alpha character, which indicates the plant location. This number will also be suffixed with a four digit number, which indicates the date the unit was built (Date Code).
EXAMPLE: A012345 0490.

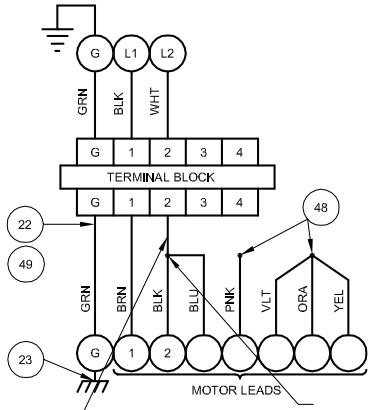
Reference the six digit portion (Serial Number) of this number when referring to the product.



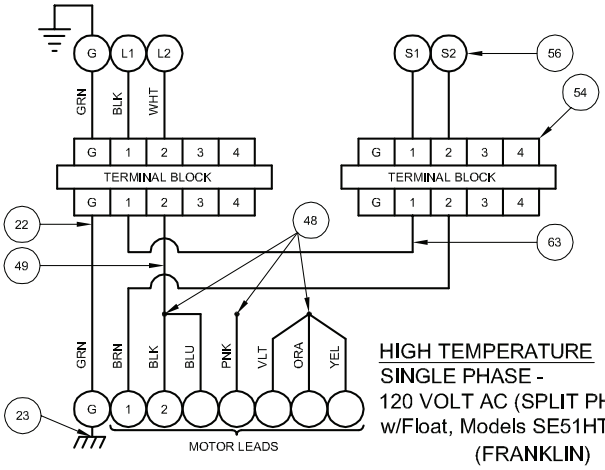
STANDARD TEMPERATURE
SINGLE PHASE - 120/240 VOLT AC (PSC)



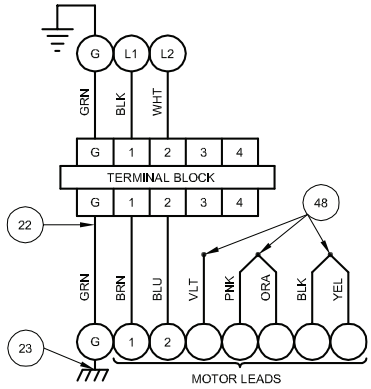
STANDARD TEMPERATURE
SINGLE PHASE - 120/240 VOLT AC (PSC)
w/Float, Models SE51AU/SE52AU



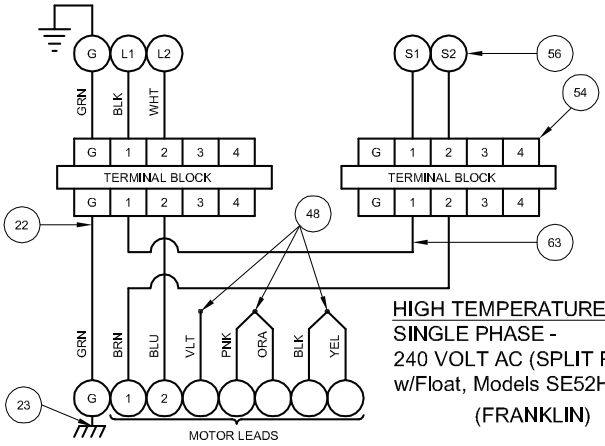
HIGH TEMPERATURE
SINGLE PHASE - 120 VOLT AC (SPLIT PHASE)
(FRANKLIN)



HIGH TEMPERATURE
SINGLE PHASE -
120 VOLT AC (SPLIT PHASE)
w/Float, Models SE51HTAU
(FRANKLIN)

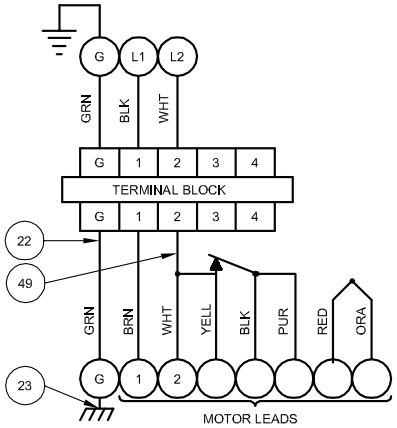


HIGH TEMPERATURE
SINGLE PHASE - 240 VOLT AC (SPLIT PHASE)
(FRANKLIN)

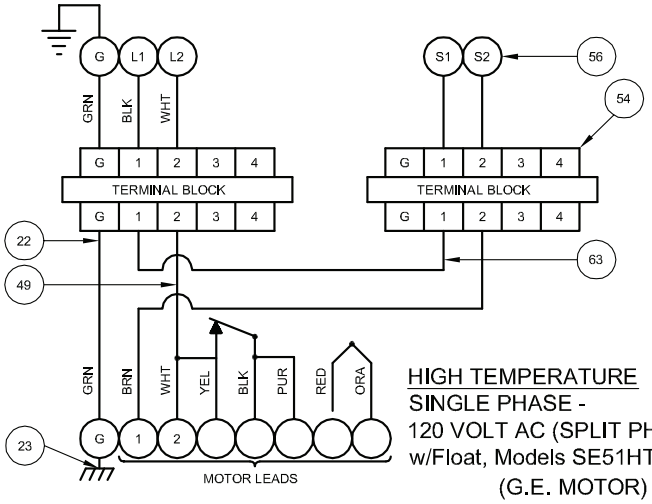


HIGH TEMPERATURE
SINGLE PHASE -
240 VOLT AC (SPLIT PHASE)
w/Float, Models SE52HTAU
(FRANKLIN)

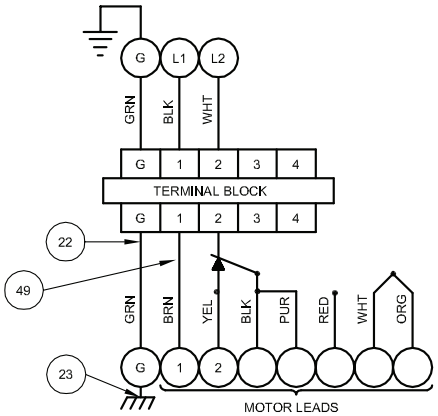
FIGURE 13



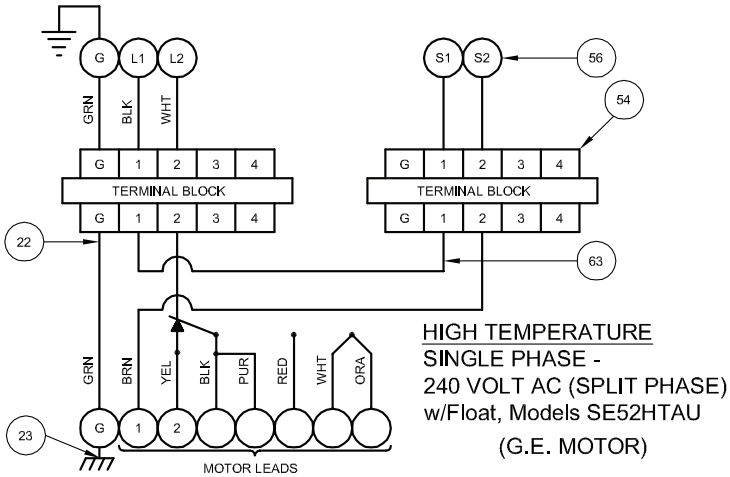
HIGH TEMPERATURE
SINGLE PHASE - 120 VOLT AC (SPLIT PHASE)
(G.E. MOTOR)



HIGH TEMPERATURE
SINGLE PHASE -
120 VOLT AC (SPLIT PHASE)
w/Float, Models SE51HTAU
(G.E. MOTOR)

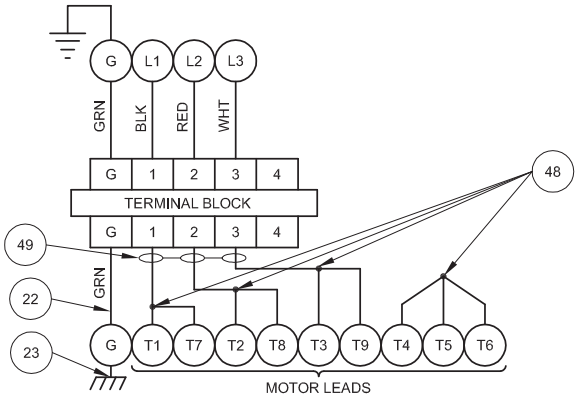


HIGH TEMPERATURE
SINGLE PHASE - 240 VOLT AC (SPLIT PHASE)
(G.E.MOTOR)

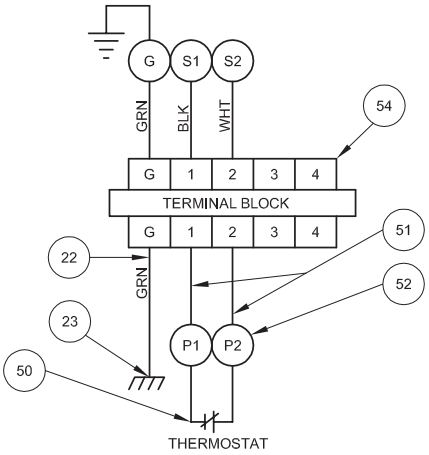


HIGH TEMPERATURE
SINGLE PHASE -
240 VOLT AC (SPLIT PHASE)
w/Float, Models SE52HTAU
(G.E. MOTOR)

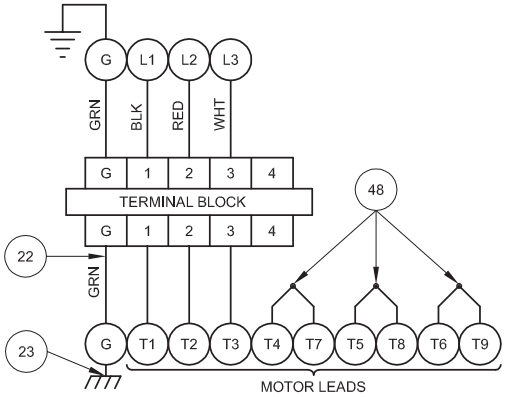
FIGURE 13



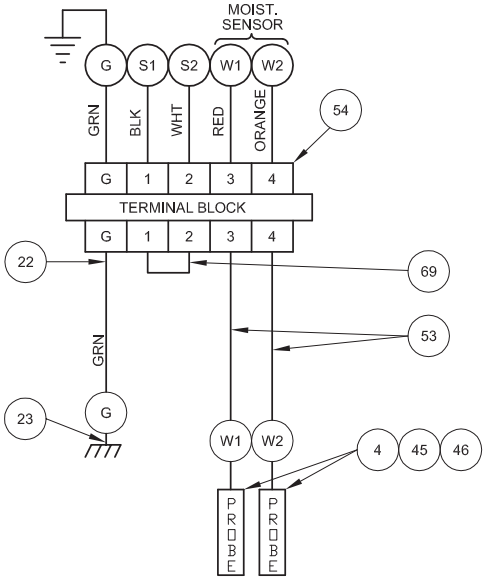
THREE PHASE - 200/240 VOLT AC



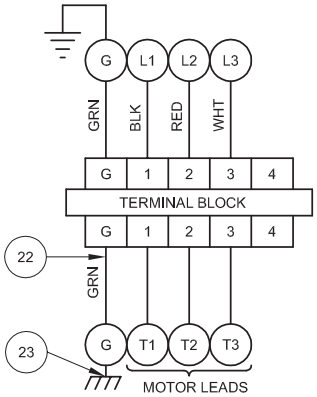
TEMPERATURE SENSORS:
Three Phase (Optional)



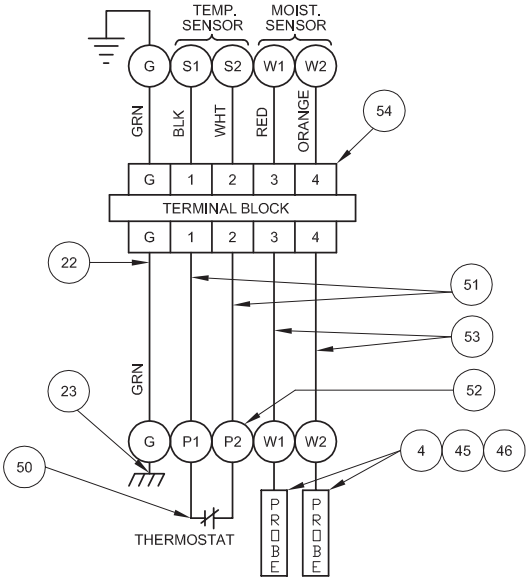
THREE PHASE - 480 VOLT AC



MOISTURE SENSORS
SINGLE PHASE DS MODELS (Standard)



THREE PHASE - 600 VOLT AC



MOISTURE AND TEMPERATURE SENORS:
Three Phase DS Models (Standard)

FIGURE 13 - CONTIUED

TROUBLE SHOOTING

CAUTION ! Always disconnect the pump from the electrical power source before handling.
If the system fails to operate properly, carefully read instructions and perform maintenance recommendations.
If operating problems persist, the following chart may be of assistance in identifying and correcting them:
MATCH "CAUSE" NUMBER WITH CORRELATING "CORRECTION" NUMBER.

NOTE: Not all problems and corrections will apply to each pump model.

PROBLEM	CAUSE	CORRECTION
Pump will not run	**1.** Poor electrical connection, blown fuse, tripped breaker or other interruption of power, improper power supply. **2.** Motor or switch inoperative (to isolate cause, go to manual operation of pump). **2a.** Flaot movement restricted. 2b. Switch will not activate pump or is defective. **3.** Insufficient liquid level.	1. Check all electrical connections for security. Have electrician measure current in motor leads, if current is within ±20% of locked rotor Amps, impeller is probably locked. If current is 0, overload may be tripped. Remove power, allow pump to cool, then recheck current. 2a. Reposition pump or clean basin as required to provide adequate clearance for float. 2b. Disconnect level control. Set ohmmeter for a low range, such as 100 ohms full scale and connect to level control leads. Actuate level control manually and check to see that ohmmeter shows zero ohms for closed switch and full scale for open switch. (Float Switch). 3. Make sure liquid level is at least equal to suggested turn-on point. 4. Recheck all sizing calculations to determine proper pump size. 5. Check discharge line for restrictions, including ice if line passes through or into cold areas. 6. Remove and examine check valve for proper installation and freedom of operation. 7. Open valve. 8. Check cutter for freedom of operation, security and condition. Clean cutter and inlet of any obstruction. 9. Loosen union slightly to allow trapped air to escape.Verify that turn-off level of switch is set so that the suction is always flooded. Clean vent hole. 10. Remove & examine for damage. Replace pump stator if required. 11. Repair fixtures as required to eliminate leakage. 12. Check pump temperature limits & fluid temperature. 13. Replace portion of discharge pipe with flexible connector. 14. Turn to automatic position. 15. Check for leaks around basin inlet and outlets.
Pump will not turn off	2a. Float movement restricted. 2b. Switch will not activate pump or is defective. 4. Excessive inflow or pump not properly sized for application. 9. Pump may be airlocked. 14. H-O-A switch on panel is in "HAND" position	
Pump hums but does not run	1. Incorrect voltage 8. Cutter jammed or loose on shaft, worn or damaged, inlet plugged.	
Pump delivers insufficient capacity	1. Incorrect voltage. 4. Excessive inflow or pump not properly sized for application. 5. Discharge restricted. 6. Check valve stuck closed or installed backwards. 7. Shut-off valve closed. 8. Cutter jammed or loose on shaft, worn or damaged, inlet plugged. 9. Pump may be airlocked. 10. Pump stator damaged/torn.	
Pump cycles too frequently or runs periodically when fixtures are not in use	6. Check valve stuck closed or installed backwards. 11. Fixtures are leaking. 15. Ground water entering basin.	
Pump shuts off and turns on independent of switch, (trips thermal overload protector). **CAUTION!** Pump may start unexpectedly. Disconnect power supply.	1. Incorrect voltage. 4. Excessive inflow or pump not properly sized for application. 8. Cutter jammed, loose on shaft, worn or damaged, inlet plugged. 12. Excessive water temperature.	
Pump operates noisily or vibrates excessively	4. Operating at too high a pressure. 5. Discharge restricted. 8. Cutter broken. 13. Piping attachments to buiding structure too rigid or too loose.	

SE- L & 3SE- L Series, Single Seal

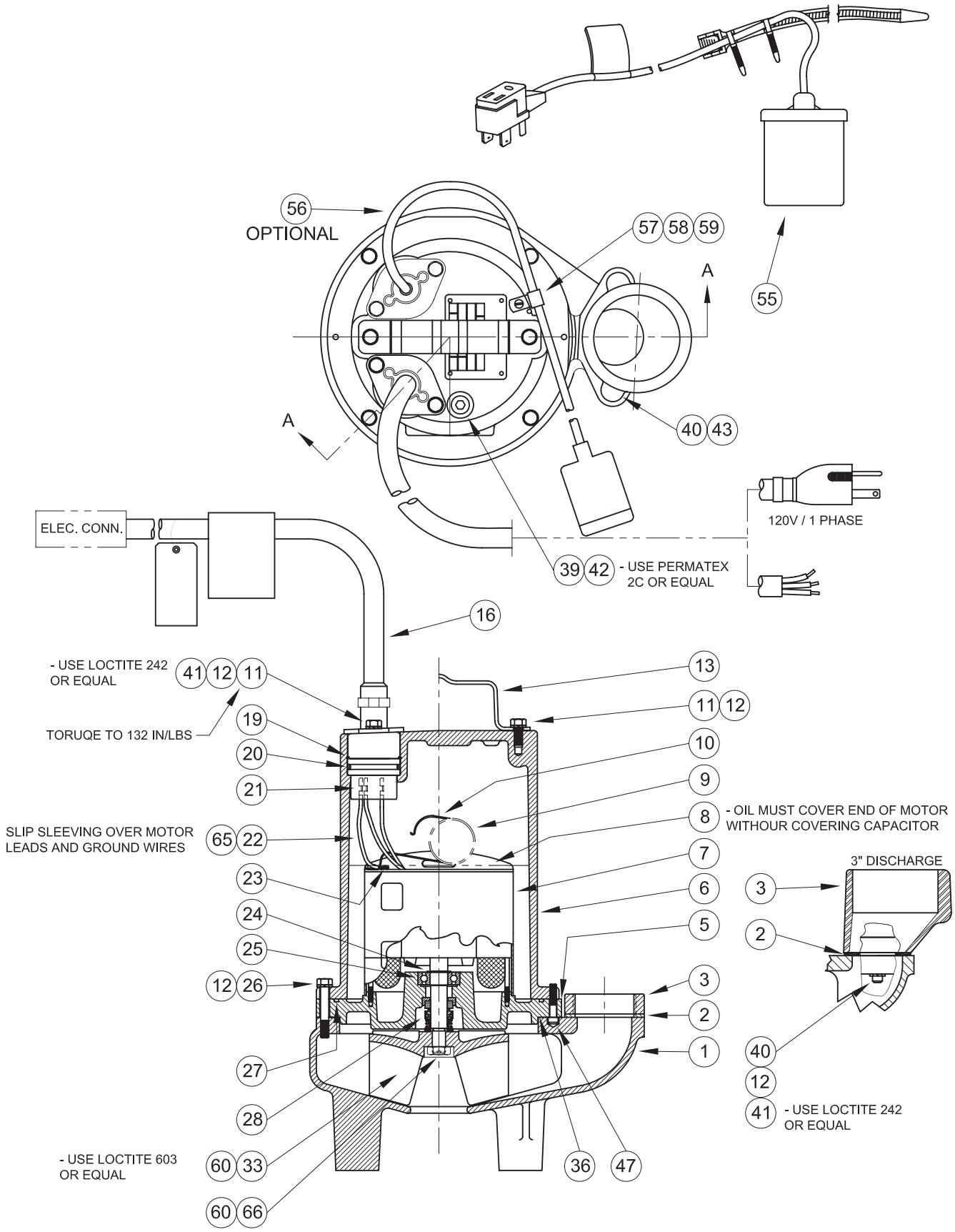


FIGURE 16

SE- L & 3SE- L Series, Single Seal

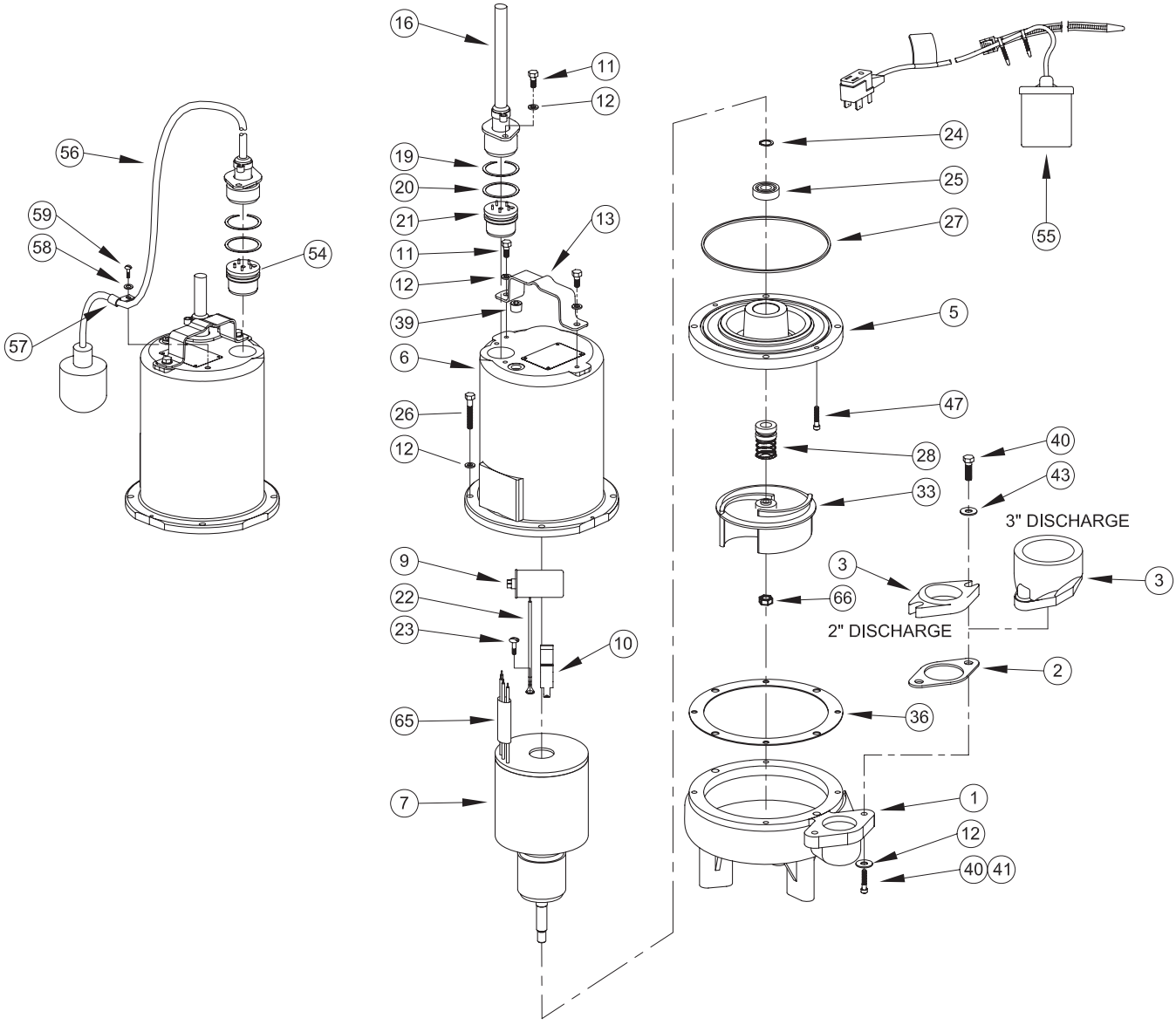


FIGURE 17

SE-HT (High Temp) Series - Single Seal

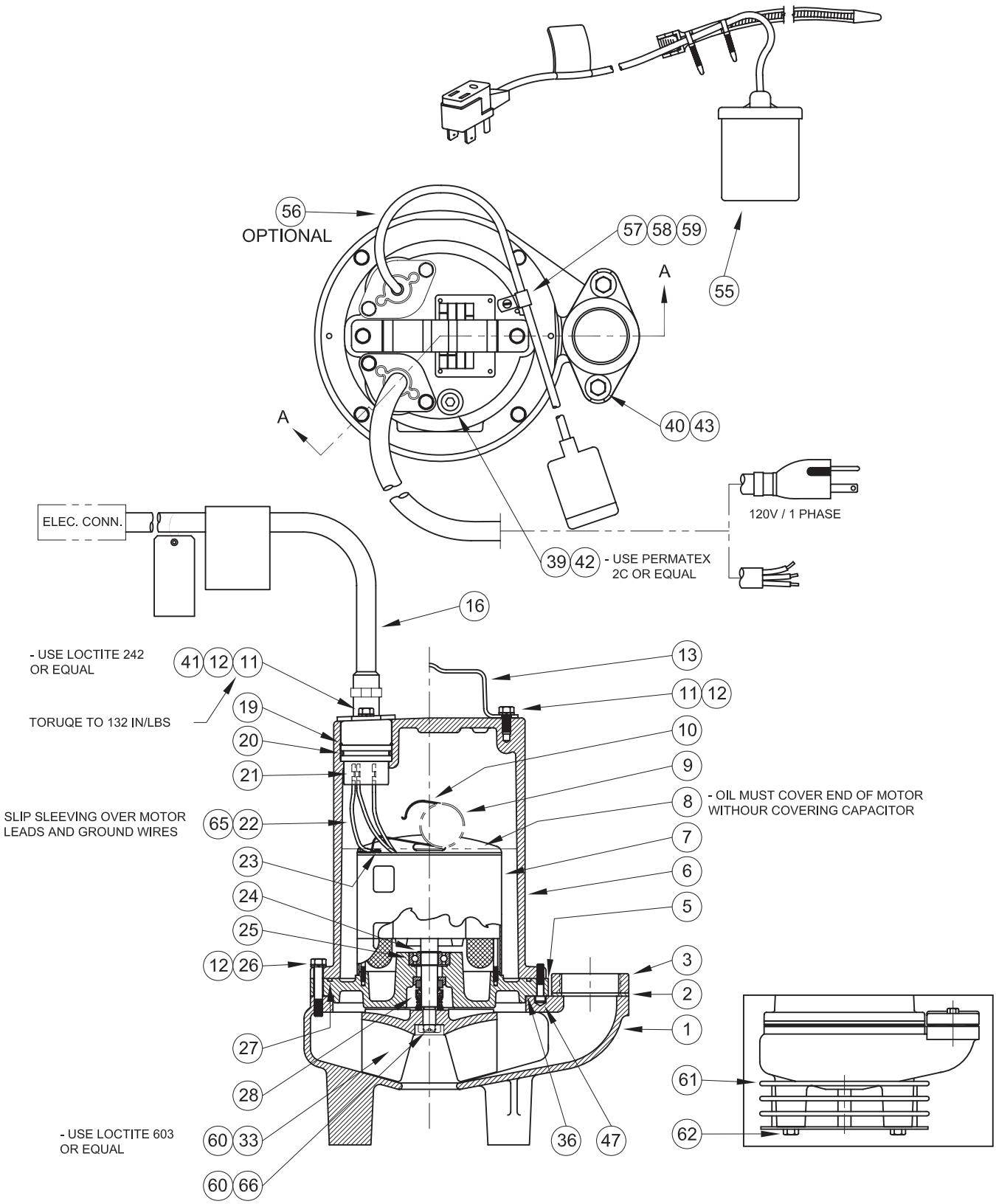


FIGURE 18

SE-HT (High Temp) Series - Single Seal

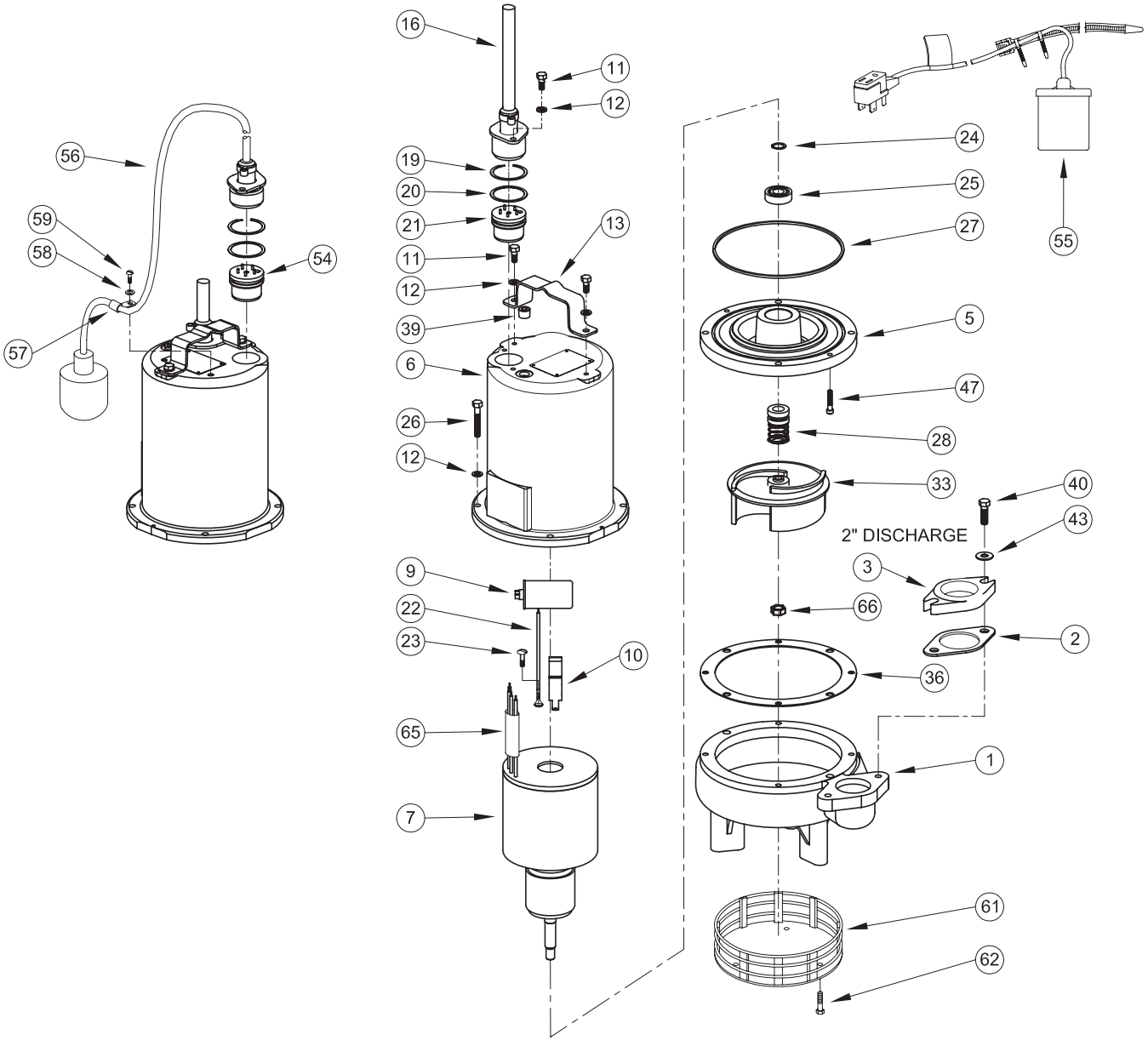


FIGURE 19

3SE-DS Series - Double Seal

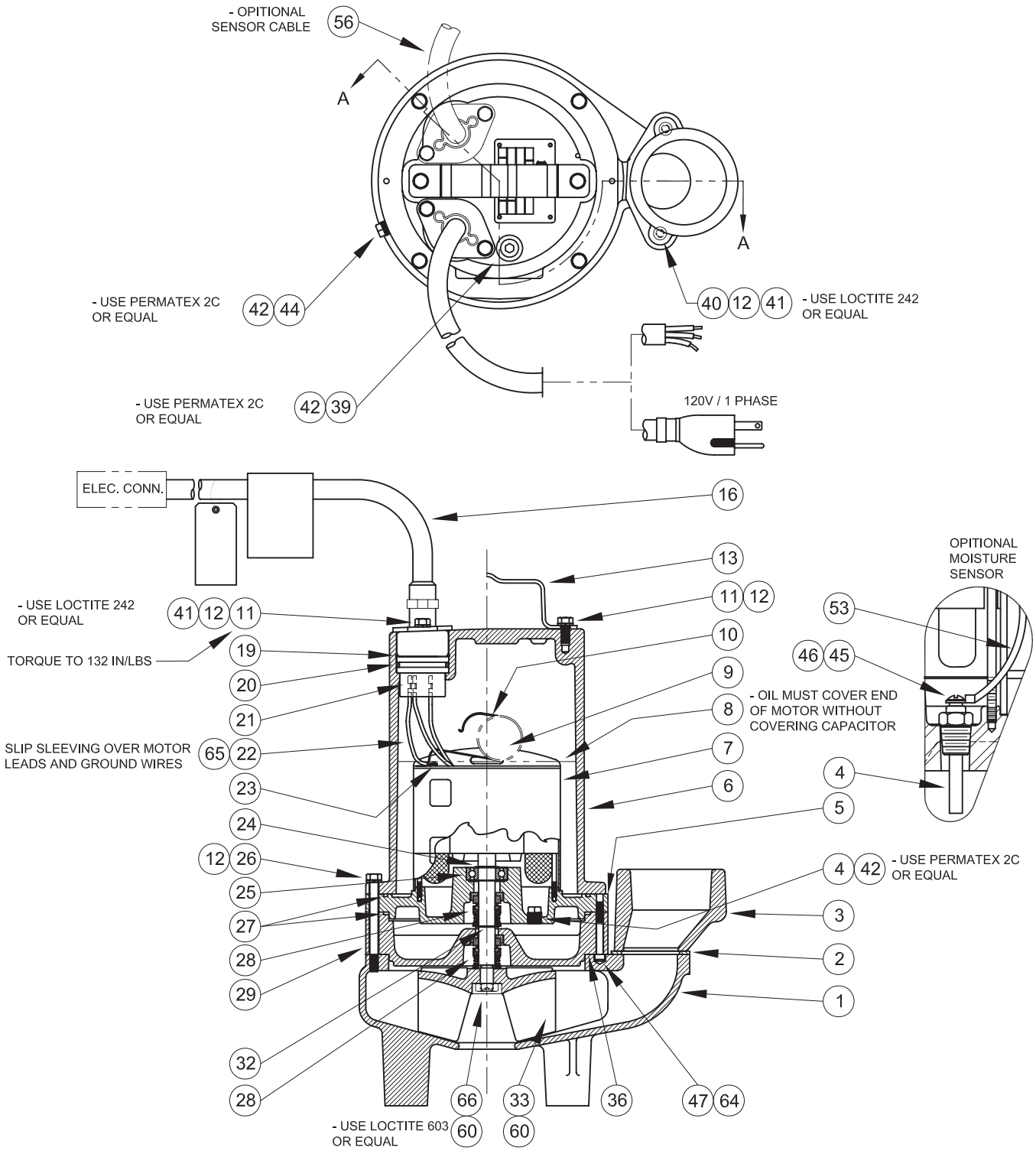


FIGURE 20

3SE-DS Series - Double Seal

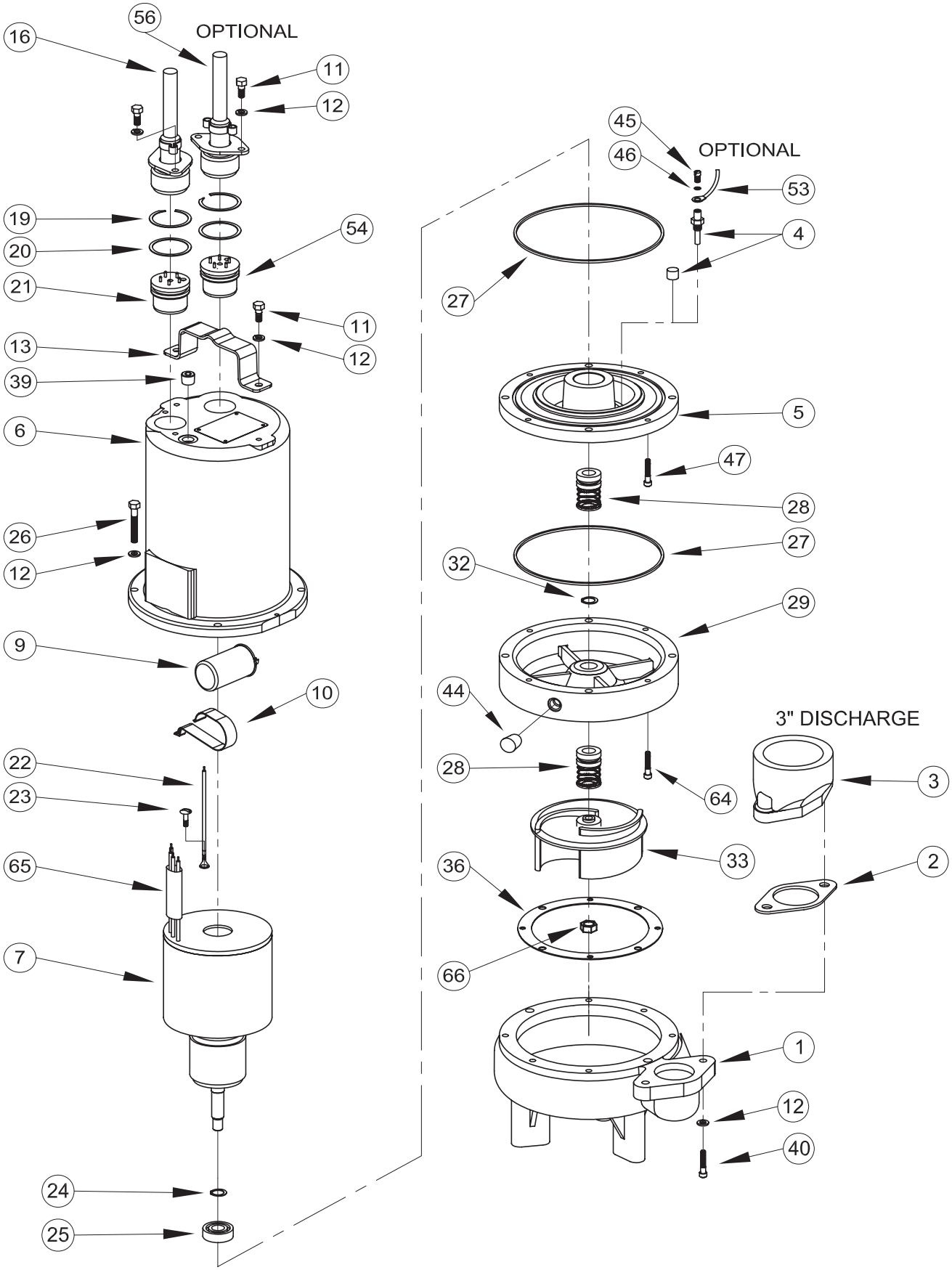


FIGURE 21

PARTS KITS

Seal Repair Kits:

Single Seal .....P/N - 130180 (+) 2, 20, 27, 28, 36

Double Seal .....P/N - 130176 (†) 2, 20, 27, 28, 32, 36

Service Kits:

Single Seal.....P/N - 130207 (◊) 2, 19, 20, 22, 24, 25, 27, 28, 36, 49, 65, 66

Double Seal .....P/N - 130172 (♦) 2, 19, 20, 22, 24, 25, 27, 28, 32, 36, 44, 49, 65, 66

Seal Tool Kit .....P/N - 107271

Pressure Gauge Kit .....P/N - 085343

PARTS LIST

ITEM	QTY.	PART NO.		DESCRIPTION	
1	1	055400		Volute	(Std)
	1	071114		Volute	(For use with Optional Strainer)
2	1	069140	+†◊♦	Gasket	
3	1	026210		Flange	2” Discharge
		105153			3” Discharge
4	2	003217		Pipe Plug	All double seal (Std), .25” NPT, ZP
	2	039383		Moisture Sensor Probes (Optional) moisture sensor	
5	1	084532		Seal Plate	All single seal
		084906			All double seal
6	1	105196		Motor Housing	(Std)
		105196HA			(Optional) for all AU and HTAU, moisture and temp. sensors
7	1	**Motor:**		**Capacitor (item 9):**	
		030369BS		034964	SE51, SE51A, SE51AU, 3SE514L
		030369BD		070963	3SE514DS
		030370BS		070963	SE52, SE52AU, 3SE524L
		030370BD		070963	3SE524DS
		085472BS		None	SE51HT, SE51HTA, SE51HTAU, SE52HT, SE52HTAU
		071352BS		None	SE594L, 3SE594L, SE544L, 3SE544L
		071352BD		None	3SE594DS, 3SE544DS
		092854BS		None	SE554L, 3SE554L
		092854BD		None	3SE554DS
		029792BS		070963	SE774L, 3SE774L, SE1074L, 3SE1074L
		029792BD		070963	3SE774DS, 3SE1074DS
		071354BS		None	SE794L, SE744L, 3SE794L, 3SE744L, SE1094L,
				None	SE1044L, 3SE1094L, 3SE1044L
		071354BD		None	3SE794DS, 3SE744DS, 3SE1094DS, 3SE1044DS
		092855BS		None	SE754L, 3SE754L, SE1054L, 3SE1054L
		092855BD		None	3SE754DS, 3SE1054DS
8	96 oz	029034		Oil	All single seal
	120oz	029034		Oil	All double seal (Includes 24 oz. in Seal Chamber)
9	1	034964	*	Capacitor (30MFD)	1 Phase
	1	070963		Capacitor (20 MFD)	1 Phase
10	1	039858		Capacitor Bracket	1 Phase
11	4	1-156-1		Hex. Hd. Cap Screw	(Std), 5/16-18 x 1.00” Lg., Stainless
	6	1-156-1		Hex. Hd. Cap Screw	(Optional) for all AU and HTAU, moisture and temp. sensors
12	10	026322		Lockwasher	(Std), 5/16, Stainless
	12	026322		Lockwasher	(Optional) for all AU and HTAU, moisture and temp. sensors
13	1	103503		Handle	
16	1	See Table 2		Power Cable Set	
16a	1	103582		Compression Flange, Included with Cable Set	
19	1	105197	◊	Snap Ring	(Std)
	2	105197	♦	Snap Ring	(Optional) for all AU and HTAU, moisture and temp. sensors
20	1	2-31051-224	+◊	O-ring	(Std)
	2	2-31051-224	†♦	O-ring	(Optional) for all AU and HTAU, moisture and temp. sensors
21	1	103584		Terminal Block	1 Phase
		103583			3 Phase
22	1	105111	◊♦	Ground Wire Assembly	(Std)

** Units with build code date (see section G-4) before -0901 may use capacitor part number, 070963 or the 034964 part number.*

	2	105111		Ground Wire Assembly	(Optional) for moisture and temp. sensors
23	1	016660		Screw, Self Tapping	#8-32 x .375” Lg.
24	1	085326	◊♦	Retaining Ring	Included with Motor
25	1	017414	◊♦	Bearing	
26	4	1-135-1		Cap Screw	All single seal, 5/16-18 x 1.75” Lg., Stainless
		1-168-1		Cap Screw	All double seal, 5/16-18 x 3.50” Lg. Stainless
27	1	027269	+†◊	Square Ring	All single seal
	2	027269	♦	Square Ring	All double seal
28	1		+†◊♦	Shaft Seal - (Qty 2 for DS)	
		005080		Carbon/Ceramic/Buna-N (STD)	
		005080SB		Tungsten/Tungsten/Buna-N	
		005080SD		Silicon Carbide/Silicon Carbide/Buna-N	
		005080SF		Carbon/Ceramic/Viton	
		005080SH		Tungsten/Tungsten/Viton	
		005080SK		Silicon Carbide/Silicon Carbide/Viton	
		005080SM		Silicon Carbide/Tungsten/Buna-N	
		005080SN		Carbon/Ni-Resistant/Buna-N	
		005080SP		Carbon/Ni-Resistant/Neoprene	
		082850		Carbon/Ni-Resistant/Viton	
29	1	103587		Seal Housing	All double seal
32	1	2-27008-62	†♦	Retaining Ring	All double seal
33	1			Impeller, Cast Iron	
		084346		6.00 Dia. (STD for 1 HP)	
		084346TA		5.88 Dia.	
		084346TB		5.75 Dia.	
		084346TC		5.63 Dia. (STD for .75 HP)	
		084346TD		5.50 Dia.	
		084346TE		5.38 Dia.	
		084346TF		5.25 Dia. (STD for .5 HP)	
		084346TG		5.13 Dia.	
		084346TH		5.00 Dia.	
		084346TJ		4.88 Dia.	
		084346TK		4.75 Dia.	
		084346TL		4.63 Dia.	
		084346TM		4.50 Dia.	
		084346TN		4.38 Dia.	
		084346TP		4.25 Dia.	
		084346TQ		4.13 Dia.	
		084346TR		4.00 Dia.	
36	1	027344	+†◊♦	Gasket	
39	1	014270		Pipe Plug	.375” NPT
40	2	1-36-1		Hex. Hd. Cap Screw	2” Discharge, 3/8-16 x 1.25” Lg., Stainless
		2-23030-59		Hex. Hd. Cap Screw	3” Discharge, 5/16-18 x 1.50” Lg., Stainless
41	A/R	-----		Loctite 242	
42	A/R	-----		Permatex 2C	
43	2	082727		Washer	2” Discharge, 3/8” Stainless
44	1	003217	♦	Pipe Plug	All double seal, .25” NPT
45	2	5-32-6		Screw	(Optional) moisture sensor, #6-32 x .25” Lg., ZP
46	2	052563		Lockwasher	(Optional) moisture sensor, #6 Stl.
47	2	084948		Socket Head Cap Screw	1/4-20 x 1.25” Lg., Stainless
48	3	074449		Terminal Connector	HT Only
	4	105150		Terminal Connector	200-240V, 3Ph
	3	625-00163		Terminal Connector	480V, 3PH
49	1	105149		Wire Assembly	120V HT
	3	105149	◊♦	Wire Assembly	200-240V, 3Ph
50	1	051621		Thermal Sensor	Optional for temperature sensor (Not Shown)
51	2	105155		Wire Assembly	Optional for temperature sensor (Not Shown)
52	2	625-00163		Terminal Connector	Optional for temperature sensor (Not Shown)
53	2	105106		Wire Assembly	Optional for moisture sensor
54	1	103759		Terminal Block	All AU and HTAU
		103584			Optional for temperature sensor only
		113272			Optional for moisture and temp. sensors
55	1	See Table 2		Float Switch w/Plug	Piggyback

56	1	103746		Float Switch	SE51AU, SE52AU
	1	103755		Float Switch, High Temp.	SE51HTAU, SE52HTAU
	1	See Table 2		Control Cable	Optional for moisture and/or temp. sensors
56a	1	103582		Compression Flange	Included with Cable Set
57	1	090516		Cord Clip,	(For SE51AU, SE52AU, SE51HTAU & SE52HTAU)
58	1	20-12-1		Washer,	(For SE51AU, SE52AU, SE51HTAU & SE52HTAU)
59	1	2-88-1		Screw,	(For SE51AU, SE52AU, SE51HTAU & SE52HTAU)
60	A/R	-----		Loctite 603	
61	1	082852		Inlet Strainer, Stainless	(Optional)
62	3	028913		Hex Hd, Screw, Stainless	(Optional), 3/8-16 x .875” Lg., Stainless
63	1	105147		Wire Assembly	All AU Series
64	2	030337		Socket Head Cap Screw	Double seal Only, 1/4-20 x 2.00” Lg., Stainless
65	1	625-02117	◊♦	Sleeve, Fiberglass	
66	1	030068	◊♦	Jam Nut	½ - 20, S.S.
69	1	111909		Jumper Wire	

TABLE 2 - POWER & SENSOR CORD SETS

CABLE LENGTH	**ITEM #16** 120 VOLT 1 PHASE STD. Temp	**ITEM #16** 120 VOLT 1 PHASE High Temp	**ITEM #16** 240 VOLT 1 PHASE 0.5HP STD & HT	**ITEM #16** 240 VOLT 1 PHASE 0.75 & 1HP STD & HT	**ITEM #16** 3 PHASE	**ITEM #55** (OPTIONAL) STD. Temp Piggy-Back Float Switch “A” Series	**ITEM #55** (OPTIONAL) High Temp. Piggy-Back Float Switch “A” Series	**ITEM #56** (OPTIONAL) Temperature 3 Phase	**ITEM #56** (OPTIONAL) Moisture and Temperature Sensor 3 Phase or Moisture Sensor Only
8 FT	103756A	110416A	-----	103741A	103742A	---	---	103741A	113288A
15 FT	103756	110416	110949	103741	103742	125151-15	090269	103741	113288
20 FT	103756XA	110416XA	110949XA	103741XA	103742XA	125151-20	090269XA	103741XA	113288XA
30 FT	103756XC	110416XC	110949XC	103741XC	103742XC	125151-30	090269XC	103741XC	113288XC
50 FT	103756XF	110416XF	110949XF	103741XF	103742XF	125151-50	090269XF	103741XF	113288XF
75 FT	103756XJ	110416XJ	110949XJ	103741XJ	103742XJ		090269XJ	103741XJ	113288XJ
100 FT	103756XL	110416XL	110949XL	103741XL	103742XL		090269XL	103741XL	113288XL

Notes

Notes

BARNES® BARNES® PRESSURE PS SYSTEMS CROWN

burks® WEINMAN® DEMING® PROSSER®

Limited 24 Month Warranty

Crane Pumps & Systems warrants that products of our manufacture will be free of defects in material and workmanship under normal use and service for twenty-four (24) months after manufacture date, when installed and maintained in accordance with our instructions.This warranty gives you specific legal rights, and there may also be other rights which vary from state to state. In the event the product is covered by the Federal Consumer Product Warranties Law (1) the duration of any implied warranties associated with the product by virtue of said law is limited to the same duration as stated herein, (2) this warranty is a LIMITED WARRANTY, and (3) no claims of any nature whatsoever shall be made against us, until the ultimate consumer, his successor, or assigns, notifies us in writing of the defect, and delivers the product and/or defective part(s) freight prepaid to our factory or nearest authorized service station. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply. **THE SOLE AND EXCLUSIVE REMEDY FOR BREACH OF ANY AND ALL WARRANTIES WITH RESPECT TO ANY PRODUCT SHALL BE TO REPLACE OR REPAIR AT OUR ELECTION, F.O.B. POINT OF MANUFACTURE OR AUTHORIZED REPAIR STATION, SUCH PRODUCTS AND/OR PARTS AS PROVEN DEFECTIVE. THERE SHALL BE NO FURTHER LIABILITY, WHETHER BASED ON WARRANTY, NEGLIGENCE OR OTHERWISE.** Unless expressly stated otherwise, guarantees in the nature of performance specifications furnished in addition to the foregoing material and workmanship warranties on a product manufactured by us, if any, are subject to laboratory tests corrected for field performance. Any additional guarantees, in the nature of performance specifications must be in writing and such writing must be signed by our authorized representative. Due to inaccuracies in field testing if a conflict arises between the results of field testing conducted by or for user, and laboratory tests corrected for field performance, the latter shall control. **RECOMMENDATIONS FOR SPECIAL APPLICATIONS OR THOSE RESULTING FROM SYSTEMS ANALYSES AND EVALUATIONS WE CONDUCT WILL BE BASED ON OUR BEST AVAILABLE EXPERIENCE AND PUBLISHED INDUSTRY INFORMATION. SUCH RECOMMENDATIONS DO NOT CONSTITUTE A WARRANTY OF SATISFACTORY PERFORMANCE AND NO SUCH WARRANTY IS GIVEN.**

This warranty shall not apply when damage is caused by (a) improper installation, (b) improper voltage (c) lightning (d) excessive sand or other abrasive material (e) scale or corrosion build-up due to excessive chemical content. Any modification of the original equipment will also void the warranty. We will not be responsible for loss, damage or labor cost due to interruption of service caused by defective parts. Neither will we accept charges incurred by others without our prior written approval.

This warranty is void if our inspection reveals the product was used in a manner inconsistent with normal industry practice and\or our specific recommendations. The purchaser is responsible for communication of all necessary information regarding the application and use of the product. **UNDER NO CIRCUMSTANCES WILL WE BE RESPONSIBLE FOR ANY OTHER DIRECT OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO TRAVEL EXPENSES, RENTED EQUIPMENT, OUTSIDE CONTRACTOR FEES, UNAUTHORIZED REPAIR SHOP EXPENSES, LOST PROFITS, LOST INCOME, LABOR CHARGES, DELAYS IN PRODUCTION, IDLE PRODUCTION, WHICH DAMAGES ARE CAUSED BY ANY DEFECTS IN MATERIAL AND\OR WORKMANSHIP AND\OR DAMAGE OR DELAYS IN SHIPMENT. THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER EXPRESS OR IMPLIED WARRANTY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE**.

No rights extended under this warranty shall be assigned to any other person, whether by operation of law or otherwise, without our prior written approval.

CRANE® PUMPS & SYSTEMS

A Crane Co. Company

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(937) 778-8947
Fax (937) 773-7157
www.cranepumps.com

83 West Drive
Brampton, Ont. Canada L6T 2J6
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Fax (905) 457-2650

IMPORTANT!
WARRANTY REGISTRATION

Your product is covered by the enclosed Warranty.
To complete the Warranty Registration Form go to:

http://www.cranepumps.com/ProductRegistration/

If you have a claim under the provision of the warranty, contact your local Crane Pumps & Systems, Inc. Distributor.

RETURNED GOODS
RETURN OF MERCHANDISE REQUIRES A "RETURNED GOODS AUTHORIZATION".
CONTACT YOUR LOCAL CRANE PUMPS & SYSTEMS, INC. DISTRIBUTOR.

Products Returned <u>Must</u> Be Cleaned, Sanitized,
Or Decontaminated As Necessary Prior To Shipment,
To Insure That Employees Will Not Be Exposed To Health
Hazards In Handling Said Material. All Applicable Laws
And Regulations Shall Apply.

Concept PLUS

Solenoid driven diaphragm type metering pump

The **CONCEPT PLUS** product series covers a capacity range of **0.74 — 14.9 l/h (0.2 – 3.9 gph)** at pressures **21 — 145 psi.**

Its compact construction and features make it ideal for use in flow proportional or on – off control applications. It easily mounts onto a tank or wall mount bracket and fits into chlorination applications and others such as grinding, milling, car-wash and finishing processes.

Adjustment of the pump capacity is possible via stroke volume in the range of 10-100% or can be set at 1 of the 4 stroke frequency settings. This gives an **adjustment ratio of 1:40**. In addition to manually setting the stroke frequency, the pump can also be set up for external control for use with contact water meters for flow proportional chemical addition or accept a signal from any control system which can provide a voltage free pacing signal.

Unlimited flexibility means saving on storage costs. The material combination of NPB and PPE is available for dosing heads, providing a solution for almost every type of chemical in the area of water treatment.

CONCEPT PLUS offers uncompromising quality and reliability at the best possible price.

AVAILABLE

NSF

Certified to NSF/ANSI 61

NSF is an international standards organization whose testing and certifications ensure component safety for products that contact human consumables.

Features & Benefits

- Affordability - (low operation and installation costs)
- Durability - (PP and Acrylic liquid ends, with bleed valves)
- Versatility - compact construction ideal for foot, tank or wall mounted installations
  - “external control” retrofit kits available for on-site adaptability
  - retrofit kit available for low tank level indication / pump stop. (single stage level switch required)

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ConP 10/11/CA
Printed in Canada

Concept PLUS series

Capacity data

Pump Type CNPA	Pump Capacity at Maximum Back Pressure psig	(bar)	U.S. GPH	(L/h)	Output mL/ stroke	Maximum Stroke Frequency Stroke/ min	Maximum Suction Lift (water) ft.	(m)	Suction/ Discharge Tube Connections O.D. x I.D. (in.)	Shipping Weight (approx.) lbs.	(kg)
1000	145	(10)	0.19	(0.74)	0.07	180	20	(6)	1/4 x 3/16	3.97	(1.8)
1601	232	(16)	0.29	(1.1)	0.10	180	20	(6)	1/4 x 3/16	3.97	(1.8)
1002	145	(10)	0.55	(2.1)	0.19	180	16	(5)	1/4 x 3/16	3.97	(1.8)
0704	102	(7)	1.03	(3.9)	0.36	180	13	(4)	1/4 x 3/16	3.97	(1.8)
0308	43	(3)	2.25	(8.5)	0.79	180	6.5	(2)	1/2 x 3/8	3.97	(1.8)
0215	21	(1.5)	3.94	(14.9)	1.38	180	5	(1.5)	1/2 x 3/8	3.97	(1.8)

External retrofit kit available with 6.5 ft. (2 m) control cable: p.n. 1022099

Identity code pump configuration

CNPa **Concept PLUS**

1000 0704
1601 0308
1002 0215
pump version:

Liquid end materials:
PP Polypropylene
NP Acryllic/PVC

Seals:
B Viton/b (for NP liquid end only)
E EPDM (for PP liquid end only)

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Liquid end version:
0 Without bleed valve (only for 0704 PPE Liquid end)
1 Without bleed valve with springs (only for 0704 PPE Liquid end)
2 With bleed valve, w/o valve springs
3 With bleed valve, w/ valve springs

Hydraulic Connector:
0 Standard (In accordance with technical data)

Labeling:
0 Standard with logo

Electrical connection:
D 1 ph 115 V 50/60 Hz (US plug)
U 1 ph 230 V 50/60 Hz (US plug) (consult factory for pricing)

Control Option:
0 Standard (w/o external control)
B External control

Accessories:
1 With accessories (foot valve, injection valve, tubing)

CNPa	0215	PP	E	2	0	0	D	0	1

ProMinent®
Experts in Chemical Feed and Water Treatment

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136 Industry Drive
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Tel: (412) 787-2484
Fax: (412) 787-0704
eMail: sales@prominent.us
www.prominent.us

OPERATION MANUAL
FOR
BAG FILTERS

CAUTION

BEFORE OPERATING THIS FILTER, OPERATOR SHOULD WEAR PROTECTIVE CLOTHING, INCLUDING PROTECTIVE GLOVES AND FACE SHIELD. (HOT AND/OR CHEMICALLY ACTIVE LIQUIDS CAN CAUSE SERIOUS INJURY AND BLINDNESS)

MAXIMUM PRESSURE AND TEMPERATURE FOR THIS VESSEL IS MARKED ON NAME PLATE DO NOT EXCEED THIS PRESSURE OR TEMPERATURE.

INITIAL CLOSING OF THE VESSEL LID

Vessel must be isolated from system, pump turned off and locked out; inlet and outlet valves closed.

a) Insert basket into seat. The basket rim flange must cover entire opening. If not the basket may be cocked sideways and be forced through the opening under pressure.

b) Insert new filter bag making sure bag is properly seated in basket.

c) Check gasket area for irregularities. If gasket area has nicks or worn spots, replace it using a gasket that is compatible with the fluid you are filtering.

d) Position lid by hand for closing, line up bolts to match slots in filter lid, close lid.

e) Engage all bolts and hand tighten nuts.

f) Moderately torque nuts as per tightening sequence for your number of bolts. Then re-tighten bolts again same sequence as per torque spec. for the size of bolts you have.

g) Open vent valve.

h) Turn pump on.

i)Open inlet valve slowly and observe for leaks. Should any leaks appear, close valve immediately and continue tightening nuts until leak stops.

j) When filter fills, close vent valve.

k) Open outlet valve.

Make sure that the vent valve outlet is piped so that escaping fluids are so directed to prevent personnel injury of the operator and surrounding areas.

OPENING OF THE VESSEL LID

(Adhere to the following sequence)

Warning!! Do not open a vessel under pressure. Escaping fluid under pressure can cause serious injury and blindness.

a) Before opening Vessel:
   1. Turn off pump and lock it out.
   2. Close inlet and outlet valve.

b) Open vent valve. Make sure that the vent valve outlet is piped so that escaping fluids are so directed to prevent personnel injury of the operator and surrounding areas.

c) Check pressure gauge to make sure that the isolated vessels internal pressure is zero (0) p.s.i.

d) Drain fluid from vessel by gravity flow through drain valve. Close drain valve. Evacuation can be assisted with pressurization. (See blow down instructions)

e) Loosen Lid nuts and swing bolts out of way.

f) Lift Lid and remove from vessel.

g) Remove filter bag with caution.

h) Inspect basket for roundness and flange condition.

i) Verify that basket and bag bearing surfaces are clean.

j) Insert new filter bag making sure that the bag is properly seated in basket.

k) Return to **Closing of Vessel Lid** instructions part "C", and follow instructions through to the end.

BLOW DOWN PROCEDURE

To aid filter element changes, the liquid in the vessel can be evacuated prior to the change.

Warning !! The gas (air) used to blow down, must be stable in the environment of fluid being evacuated.

a) Close inlet valve.

b) Close outlet valve.

c) Open vent valve.

d) Check gauge - **note: internal pressure must be zero (0).**

e) Open drain valve.

f) Close vent.

g) Connect air to vessel via vent valve. Use only if gravity evacuation does not yield desired results.

h) Open vent valve slowly.

i) Close vent valve after metering out fluid.

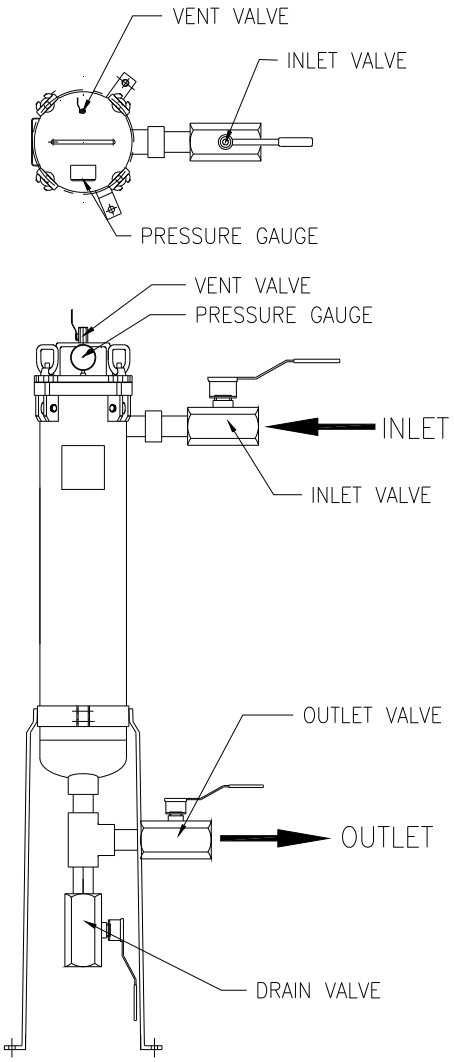
j) Disconnect air.

k) Close drain valve.

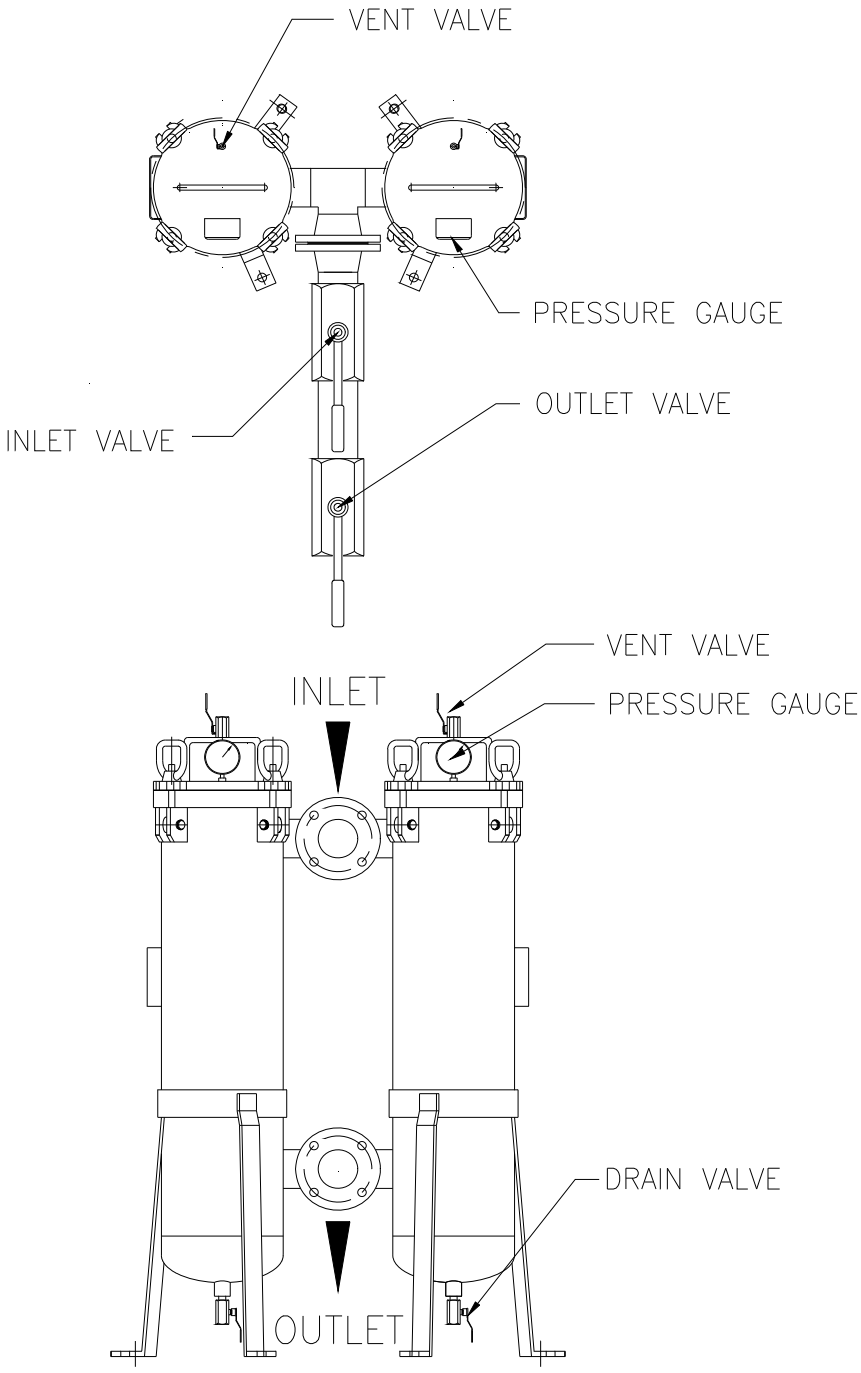
l) Make sure internal pressure is zero (0) and continue with **Opening of Vessel Lid** instructions.

FILTER IN OPERATION

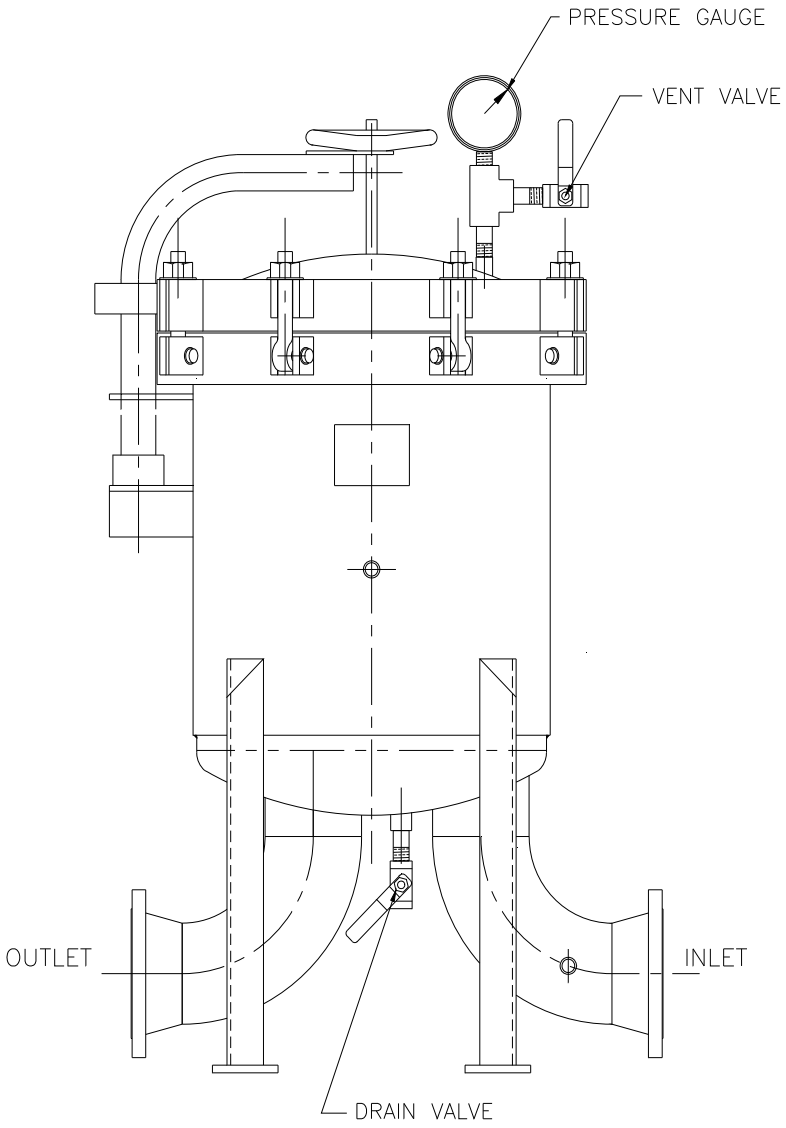
Once the filter is operational and in use the differential pressure should be checked regularly. It is suggested that when the differential pressure across the cartridge reaches a predetermined amount, the element be changed. If the differential pressure suddenly drops, stop filtration immediately, and check bag for proper seal or rupture.



SINGLE BAG FILTER HOUSING



DUPLEX BAG FILTER HOUSING



MULTIBAG FILTER HOUSING

MANUEL D'UTILISATION
IM013

Modèles NPE et NPE-F

DIRECTIVES D'INSTALLATION, D'UTILISATION ET D'ENTRETIEN

GOULDS
WATER TECHNOLOGY
a xylem brand

Table des matières

Informations pour le propriétaire

Numéro de modèle de la pompe : _____

Numéro de série de la pompe : _____

Détaillant : _____

N° de téléphone du détaillant : _____

Date d'achat : _____

Date d'installation : _____

Courant mesuré au démarrage :

1 Ø		3 Ø	L1-2	L2-3	L3-1
A :	_____	A :	_____	_____	_____
V :	_____	V :	_____	_____	_____

CONSIGNES DE SÉCURITÉ

AFIN DE PRÉVENIR LES BLESSURES GRAVES OU MORTELLES ET LES DOMMAGES MATÉRIELS IMPORTANTS, LIRE ET SUIVRE TOUTES LES CONSIGNES DE SÉCURITÉ FIGURANT DANS LE MANUEL ET SUR LA POMPE.

LE PRÉSENT MANUEL A POUR BUT DE FACILITER L'INSTALLATION ET L'UTILISATION DE LA POMPE ET DOIT RESTER PRÈS DE CELLE-CI.

Le symbole ci-contre est un **SYMBOLE DE SÉCURITÉ** employé pour signaler les mots-indicateurs dont on trouvera la description ci-dessous. Sa présence sert à attirer l'attention afin d'éviter les blessures et les dommages matériels.

⚠ DANGER Prévient des risques qui **VONT** causer des blessures graves, la mort ou des dommages matériels importants.

⚠ AVERTISSEMENT Prévient des risques qui **PEUVENT** causer des blessures graves, la mort ou des dommages matériels importants.

⚠ ATTENTION Prévient des risques qui **PEUVENT** causer des blessures ou des dommages matériels.

AVIS : SERT À ÉNONCER LES DIRECTIVES SPÉCIALES DE GRANDE IMPORTANCE QUE L'ON DOIT SUIVRE.

LIRE SOIGNEUSEMENT CHAQUE DIRECTIVE ET AVERTISSEMENT AVANT D'EFFECTUER TOUT TRAVAIL SUR LA POMPE.

N'ENLEVER AUCUN AUTOCOLLANT DE SÉCURITÉ.

⚠ AVERTISSEMENT

Les fluides dangereux peuvent causer un incendie, des brûlures et la mort.

APPAREIL NON CONÇU POUR LES LIQUIDES DANGEREUX NI POUR LES GAZ INFLAMMABLES. CES FLUIDES POURRAIENT ÊTRE PRÉSENTS DANS LES INSTALLATIONS DE CONFINEMENT (PUITS COLLECTEURS).

DESCRIPTION et CARACTÉRISTIQUES

Les pompes modèles NPE monobloc (sur moteur) et NPE-F (sur palier) sont des pompes centrifuges à un étage et à orifice d'aspiration en bout, utilisées pour le transfert général de liquides, l'augmentation de pression, etc. La tête de pompage est tout en inox AISI du type 316 estampé ou soudé. La roue, fermée, ne peut être réduite à un diamètre moindre par usinage. Le corps de pompe est muni d'un diffuseur pour en améliorer le rendement et diminuer la charge radiale de l'arbre.

Les NPE sont montées sur des moteurs NEMA 48J ou 56J à bride de fixation en C et à bout d'arbre fileté. Les pompes montées sur palier peuvent être entraînées par accouplement ou par courroie.

1. INFORMATIONS IMPORTANTES

1.1. Inspecter l'appareil et signaler immédiatement tout dommage au transporteur ou au détaillant.

1.2. L'alimentation en électricité doit être assurée par un circuit de dérivation distinct dont les fusibles ou les disjoncteurs, le calibre des fils, etc. sont conformes aux prescriptions du code provincial ou national de l'électricité. Poser un sectionneur tout conducteur prés de la pompe.

⚠ ATTENTION **On doit toujours couper le courant lorsque l'on effectue quelque travail que ce soit sur la pompe ou les commandes.**

1.3. Le câblage d'alimentation du moteur doit convenir à la tension de fonctionnement. Le schéma de câblage se trouve sur la plaque signalétique du moteur. Les fils doivent avoir un calibre limitant la chute de tension maximale, aux bornes du moteur, à 10 % de la valeur de tension indiquée sur la plaque signalétique, sinon la durée de vie du moteur et les performances de la pompe diminueront.

1.4. Il faut toujours employer des contacteurs et des démarreurs conçus pour les puissances nominales en horse-power (hp).

1.5. Protection du moteur

1.5.1. Moteurs monophasés — Ces moteurs sont parfois munis d'une protection thermique intégrée (consulter la plaque signalétique). Dans le cas contraire, utiliser un contacteur à protection appropriée contre les surcharges. Les dispositifs fusibles sont permis.

1.5.2. Moteurs triphasés — Employer une protection trois conducteurs appropriée contre les surcharges thermiques ainsi qu'un démarreur magnétique convenant à la charge électrique.

1.6. Limites d'utilisation maximales :

Température du liquide :	120 °C (250 °F)
Pression :	862 kPa (125 lb/po^2).
Démarrages par heure :	20, répartis uniformément.

1.7. Une inspection et un entretien réguliers augmenteront la durée de vie de l'appareil. Établir un programme d'entretien et d'inspection basé sur le temps de fonctionnement. Voir la section 8.

2. INSTALLATION

2.1. Généralités

2.1.1. Placer la pompe aussi prés de la source de liquide que possible, mais plus bas pour assurer l'amorçage automatique.

2.1.2. Protéger l'appareil contre les inondations et le gel.

2.1.3. Laisser assez d'espace pour l'entretien et l'aération.

2.1.4. La tuyauterie doit posséder ses propres supports et « s'aligner » correctement sur la pompe.

⚠ ATTENTION **Poser la tuyauterie de façon à n'appliquer aucune contrainte sur les raccords d'aspiration et de refoulement de la pompe.**

2.1.5. Ne poser aucun accessoire ni raccord de tuyauterie superflu. Choisir le calibre qui réduit les pertes de charge par frottement au minimum.

2.2. Pompes montées sur moteur

2.2.1. Les pompes peuvent être installées sur une surface horizontale, inclinée ou verticale.

⚠ ATTENTION **Ne pas placer le moteur plus bas que la pompe afin de le protéger contre les fuites et l'eau de condensation.**

2.2.2. L'assise doit être plane et solide pour empêcher que le serrage des boulons ne cause de contraintes. Monter l'appareil sur cautchouc pour réduire le bruit et les vibrations au minimum.

2.2.3. Serrer les boulons de fixation du moteur avant de raccorder la tuyauterie à la pompe.

2.3. Pompes montées sur palier

2.3.1. Il est recommandé de remplir de coulis le vide entre la plaque de base et la dalle reposant sur une semelle de fondations solide (v. figure 1).

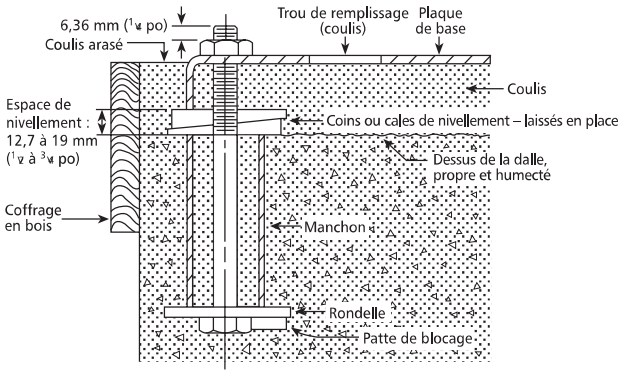


Figure 1

2.3.2. Placer l'appareil sur des coins de nivellement situés en quatre points distincts : deux sous le centre approximatif du moteur et deux sous celui de la pompe. Régler la position de l'appareil de manière à ce que la bride des raccords d'aspiration et de refoulement soit de niveau (avec un fil à plomb ou un niveau).

2.3.3. S'assurer que la plaque de base n'est pas déformée et que l'alignement final de l'accouplement est possible dans les limites de déplacement ou de calage du moteur.

2.3.4. Serrer les boulons d'ancrage à la main et construire un coffrage autour de la plaque de base. Verser du coulis sous la plaque et s'assurer qu'il n'y a aucun creux sous la plaque-support de la pompe et du moteur. Laisser le coulis durcir pendant 48 heures avant de serrer les boulons d'ancrage à fond.

2.3.5. Serrer les boulons de fixation de la pompe et du moteur avant de raccorder les tuyaux à la pompe.

3. TUYAUTERIE D'ASPIRATION

3.1. Une hauteur géométrique d'aspiration réduite et une tuyauterie directe et courte sont souhaitables. Si la hauteur d'aspiration dépasse 3 m (10 pi), et la température du liquide, 49 °C (120 °F), consulter la courbe de débit de la pompe pour obtenir la hauteur nette d'aspiration requise (NPSHR).

3.2. Le calibre du tuyau d'aspiration doit être au moins égal à celui du raccord d'aspiration de la pompe pour éviter une perte de performances.

3.3. S'il faut un tuyau plus gros, on doit installer prés de la pompe un raccord excentré (le côté non oblique en haut).

3.4. Pompe placée plus bas que la source de liquide

3.4.1. Poser un robinet d'isolement à passage intégral sur le tuyau d'aspiration pour l'inspection et l'entretien.

⚠ ATTENTION **Ne pas employer le robinet d'isolement pour réduire la section de passage vers la pompe.**

3.5. Pompe placée plus haut que la source de liquide

3.5.1. Afin de prévenir les poches d'air, aucun élément de la tuyauterie d'aspiration ne devrait être plus haut que le raccord d'aspiration de la pompe. Incliner la tuyauterie vers le haut à partir de la source de liquide.

3.5.2. Chaque joint doit être étanche.

3.5.3. N'employer un clapet de pied que s'il est nécessaire pour amorcer la pompe ou la maintenir amorcée durant les arrêts.

3.5.4. La section de passage de la crépine du tuyau d'aspiration doit être au moins le triple de celle du tuyau.

3.6. Le diamètre (*d*) et la hauteur d'immersion minimale (*h* min.) de l'entrée du tuyau d'aspiration doivent être suffisants pour empêcher l'aspiration d'air par vortex (v. figures 2 à 5).

3.7. Enrouler les filets des raccords de 3 ou 4 couches de ruban de téflon pour les étancher.

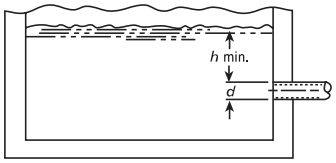


Figure 2

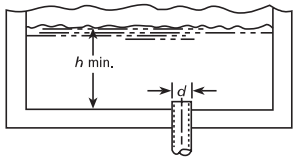


Figure 3

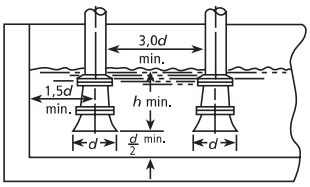


Figure 4

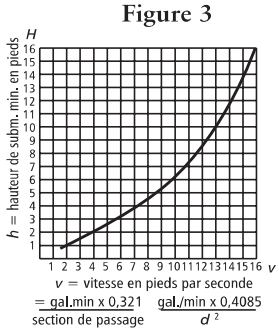


Figure 5

4. TUYAUTERIE DE REFOULEMENT

4.1. L'installation doit comporter un robinet-vanne, ainsi qu'un clapet de non-retour placé entre le robinet-vanne el la pompe. Le robinet-vanne sert à la régularisation du débit et à l'inspection de la pompe et du clapet de non-retour.

4.2. Si un raccord agrandisseur est nécessaire, le poser entre le clapet de non-retour et la pompe.

4.3. Enrouler les filets des raccords de 3 ou 4 couches de ruban de téflon pour les étancher.

5. ALIGNEMENT DES ARBRES — MOTEUR ET POMPE

5.1. Pompes montées sur moteur

5.1.1. Aucun alignement sur place n'est requis.

5.2. Pompes montées sur palier

5.2.1. Les arbres ont été alignés en usine, mais le transport peut parfois les désaligner. On doit donc vérifier l'alignement avant la mise en service de la pompe (v. figure 6).

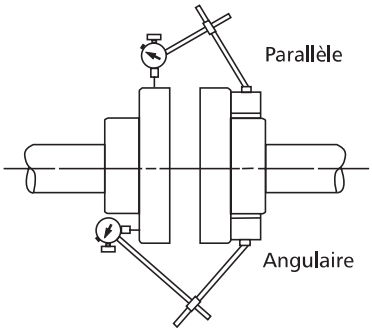


Figure 6

5.2.2. Serrer tous les boulons de fixation avant de vérifier l'alignement.

5.2.3. Si un alignement est nécessaire, on ne doit déplacer que le moteur. Employer des cales au besoin.

5.2.4. Désalignement parallèle (arbres parallèles mais non concentriques) — Fixer sur un moyeu un comparateur à cadran que l'on tourne de 360° le long de la périphérie de l'autre moyeu tout en notant l'amplitude de déplacement de l'aiguille. L'alignement est correct si le faux-rond total est de 0,127 mm (0,005 po) ou moins.

5.2.5. Désalignement angulaire (arbres concentriques mais non parallèles) — Fixer sur un moyeu un comparateur à cadran que l'on tourne de 360° le long du plateau de l'autre moyeu tout en notant l'amplitude de déplacement de l'aiguille. L'alignement est correct si le faux-rond total est de 0,127 mm (0,005 po) ou moins.

5.2.6. L'alignement final convient lorsqu'il satisfait aux exigences relatives à l'alignement parallèle et angulaire (après le serrage à fond des boulons de fixation du moteur).

⚠ ATTENTION **On doit toujours vérifier les deux types d'alignement après chaque réglage.**

6. ROTATION

6.1. La rotation appropriée s'effectue en sens horaire (vers la droite, vue de l'extrémité du moteur). Couper et rétablir le courant rapidement pour observer le sens de rotation de l'arbre. Changer le sens de rotation comme suit.

6.1.1. Moteur monophasé : irréversible.

6.1.2. Moteur triphasé : intervertir deux des conducteurs du moteur.

7. UTILISATION

7.1. Avant la mise en service, on doit amorcer la pompe (pour en faire sortir l'air), remplir de liquide le tuyau d'aspiration et entrouvrir le robinet de refoulement.

⚠ ATTENTION **Les liquides pompés servent de lubrifiant. Si la pompe tournait à sec, les pièces mobiles gripperaient, et la garniture mécanique se détériorerait. Ne pas faire marcher la pompe quand le débit est nul ou presque, car le liquide absorberait la chaleur produite par frottement et pourrait se changer rapidement en vapeur. Les pièces mobiles doivent être lubrifiées par le liquide pour ne pas se détériorer ni gripper.**

7.2. Faire fonctionner l'appareil dans des conditions de service normales jusqu'à ce que sa température se soit stabilisée, puis vérifier tout le système. Vérifier également si la tuyauterie se dilate. Dans le cas des pompes sur palier, la différence de température entre le moteur et la pompe peut causer le désalignement de l'accouplement. Vérifier l'alignement de nouveau.

8. ENTRETIEN

8.1. Dans le cas des pompes montées sur moteur, les roulements sont situés à l'intérieur du moteur et sont lubrifiés à vie. Aucun graissage n'est requis.

8.2. Pompes montées sur palier

8.2.1. Les roulements de palier devraient être graissés toutes les 2 000 heures ou tous les trois mois, soit la période prenant fin la première. Employer une graisse au lithium ou au sodium n° 2. Remplir le roulement jusqu'à ce que la graisse sorte par les garnitures ou par les joints à lèvres, puis essuyer le surplus.

8.2.2. Suivre les directives de lubrification du fabricant du moteur et de l'accouplement.

8.2.3. Vérifier l'alignement de nouveau après tout travail d'entretien nécessitant le déplacement de l'appareil.

9. DÉMONTAGE

Le démontage complet de la pompe est décrit ci-dessous. Ne démonter que ce qui permet d'effectuer l'entretien nécessaire.

9.1. Couper le courant.

9.2. Vidanger le système. Le rincer au besoin.

9.3. Dans le cas des pompes montées sur moteur, enlever les boulons de fixation de ce dernier. Quant aux pompes montées sur palier, enlever la bague et le carter d'accouplement ainsi que les boulons de fixation du palier.

9.4. Démontage de la tête de pompage

9.4.1. Enlever les vis de fixation (370) du corps de pompe.

9.4.2. Écarter l'ensemble d'entraînement de la roue d'avec le corps de pompe (100).

9.4.3. Enlever l'écrou autofreiné (304) de la roue.

⚠ ATTENTION **Ne pas insérer de tournevis entre les aubes de la roue pour l'empêcher de tourner : enlever le couvercle d'extrémité du moteur et utiliser la fente ou les méplats de blocage de l'arbre ; on préviendra ainsi l'endommagement de la roue.**

9.4.4. Dévisser la roue (101) dans le sens antihoraire (vu du devant de la pompe). Se protéger les mains avec un linge ou des gants.

⚠ ATTENTION **Toute tentative de dévissage dans le sens horaire peut endommager les filets de la roue ou de l'arbre, ou des deux.**

9.4.5. Retirer le logement de garniture (184) avec soin au moyen de deux leviers placés dans un angle de 180° entre le logement et l'adaptateur de moteur (108). L'élément mobile de la garniture mécanique (383) devrait sortir de l'arbre avec le logement.

9.4.6. Pousser l'élément fixe de la garniture mécanique hors du logement.

9.5. Démontage du palier

9.5.1. Enlever le couvercle de palier (109).

9.5.2. Sortir l'arbre (122) du palier (228).

9.5.3. Si les joints à lèvres (138 et 139) sont usés et doivent être remplacés, les retirer du palier et du couvercle de palier.

9.5.5. À l'aide d'un arrache-roulement ou d'une presse à mandriner, extraire les roulements (112 et 168).

10. REMONTAGE

10.1. Chaque pièce devrait être nettoyée avant le remontage.

10.2. Voir la liste de pièces pour déterminer celles qui sont requises. Préciser le numéro de pièce ou de catalogue de la pompe lorsque l'on commande des pièces.

10.3. Le remontage se fait dans l'ordre inverse du démontage.

10.3.1. Visser la roue et son écrou autofreiné sur l'arbre de moteur. Les serrer à 10 lbf•pi.

10.4. Observer les directives suivantes pendant le remontage du palier.

10.4.1. Remplacer les joints à lèvres s'ils sont usés ou endommagés.

10.4.2. Remplacer les roulements à billes s'ils ont du jeu, s'ils ne tournent pas rond ou s'ils sont bruyants.

10.4.3. Vérifier si l'arbre comporte des faux-ronds : le faux-rond maximal admissible est de 0,051 mm (0,002 po).

10.5. Observer les directives suivantes pendant le remontage de la tête de pompage :

10.5.1. Tous les éléments de la garniture mécanique doivent être en bon état pour empêcher les fuites. Le remplacement de la garniture en entier est une pratique courante appropriée chaque fois que la garniture est enlevée. On peut utiliser de la glycérine ou un autre lubrifiant léger pour faciliter la pose de la garniture, dont on ne doit pas contaminer la surface avec le lubrifiant.

10.5.2. Inspecter le joint torique (513) du corps de pompe et le remplacer s'il est endommagé. On peut employer du pétrolatum (vaseline) pour en faciliter la pose.

10.5.3. Inspecter le joint torique (349) du diffuseur et le remplacer s'il est endommagé.

⚠ ATTENTION **Ne pas lubrifier le joint torique (349) du diffuseur. S'assurer que le joint n'est pas pincé par la roue au cours du remontage.**

10.6. Une fois la pompe remontée, vérifier s'il y a grippage. Apporter les corrections nécessaires.

10.7. Serrer les vis de fixation du corps de pompe en étoile pour prévenir le coincement du joint torique.

11. DIAGNOSTIC DES ANOMALIES

NON-FONCTIONNEMENT DU MOTEUR
(V. causes probables 1 à 6)

DÉBIT DE LIQUIDE FAIBLE OU NUL
(V. causes probables 7 à 17)

CONSOMMATION D'ÉNERGIE EXCESSIVE
(V. causes probables 4, 17, 18, 19 et 22)

VIBRATION ET BRUIT EXCESSIFS
(V. causes probables 4, 6, 9, 13, 15, 16, 18, 20, 21 et 22)

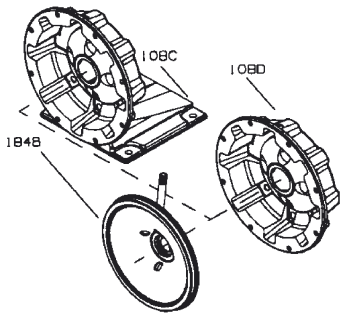
CAUSES PROBABLES :

1. Protecteur thermique déclenché
2. Disjoncteur ouvert
3. Fusible sauté
4. Pièces mobiles grippées
5. Moteur mal connecté
6. Moteur défectueux
7. Pompe non amorcée
8. Tuyau de refoulement obstrué ou robinet fermé
9. Mauvais sens de rotation
10. Clapet de pied trop petit, entrée de tuyau d'aspiration non immergée, crépine de tuyau d'aspiration obstruée
11. Basse tension électrique
12. Perte de phase (moteurs triphasés seulement)
13. Présence d'air ou de gaz dans le liquide
14. Hauteur de charge trop élevée du système
15. Hauteur nette d'aspiration disponible (NPSHA) trop faible — hauteur ou perte d'aspiration excessives — à vérifier avec un vacuomètre
16. Roue usée ou engorgée
17. Diamètre de roue inapproprié
18. Hauteur de charge trop faible : débit excessif
19. Viscosité ou densité trop élevées
20. Roulements usés
21. Pompe ou tuyauterie mal assujetties
22. Pompe et moteur désalignés

LISTE DE PIÈCES DE RECHANGE DE LA NPE STANDARD

N° d'article	Description	Matériau
100	Corps de pompe	Inox AISI 316L
101	Roue	
108A	Adaptateur de moteur et plaque-support	
108B	Adaptateur de moteur sans plaque-support	
108C	Adaptateur de mot., plaque-supp. et rinceur	
108D	Adaptateur de moteur et rinceur sans plaque-supp.	
123	Déflecteur	Buna-N
184A	Logement de garniture standard	Inox AISI 316L
184B	Logement de garniture et rinceur	
240	Plaque-support (moteur)	Inox 300
	Profilé en U	Caoutchouc
304	Écrou autofreiné (roue)	Inox AISI 316
347	Diffuseur	Inox AISI 316L
349	Joint d'étanchéité (diffuseur)	Viton (standard)
		Éthylène-propylène
		Buna
370	Vis à pans creux (corps de pompe)	Inox AISI 410
371	Vis (moteur)	Acier (galvanisé)
383	Garniture mécanique	(Voir table)
408	Bouchons — vidange et MAL (corps de pompe)	Inox AISI 316
412B	Joints toriques (bouchons)	Viton (standard)
		Éthylène-propylène
		Buna
513	Joint torique (corps de pompe)	Viton (standard)
		Éthylène-propylène
		Buna

MAL = mise à l'air libre



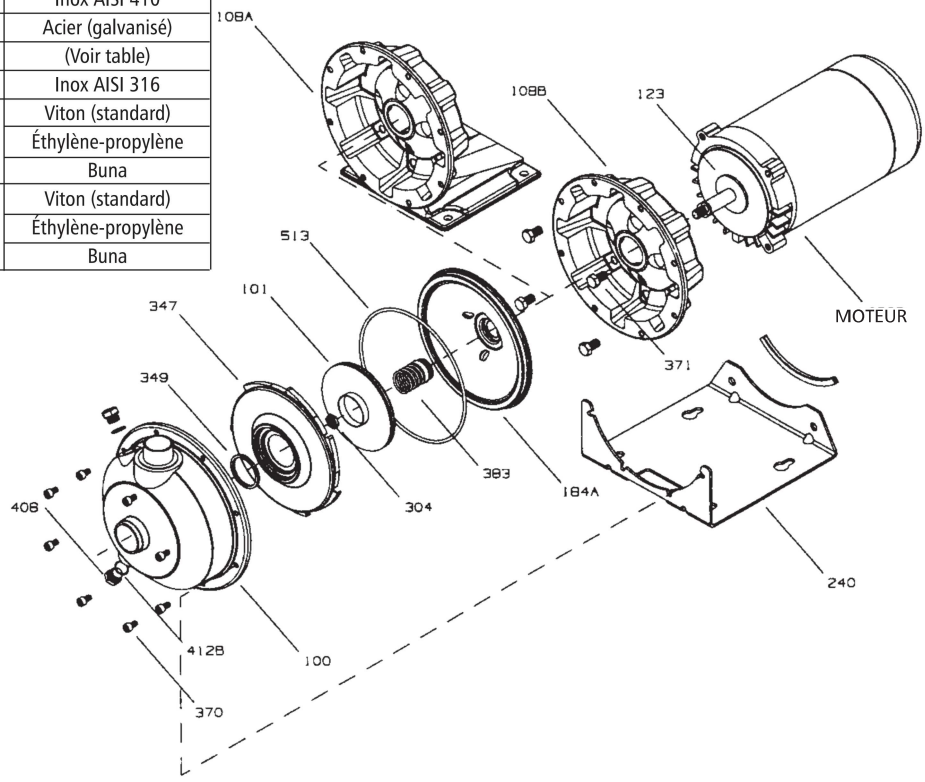
COMPOSANTS EN OPTION AVEC RINCEUR DE GARNITURE

TABLE DES GARNITURES MÉCANIQUES

Garnitures mécaniques (⅝ po) — article n° 383				
Élément mobile	**Élément fixe**	**Élastomère**	**Métal**	**N° de pièce**
Carbone	Carbure de silicium	Éthyl.-propyl.	Inox 316	10K18
		Viton		10K55
Carbure de silicium		Éthyl.-propyl.		10K81
		Viton		10K62

NOTA : Les moteurs de ½ hp, tournant à 1 750 r/min, ainsi que les moteurs antidéflagrants de ½-3 hp et les moteurs de 5 hp, livrés avec les NPE monobloc (sur moteur), comportent une plaque-support, mais leur adaptateur en est dépourvu.

NOTA : Les NPE-F sont montées sur un palier XS dont l'adaptateur est dépourvu de plaque-support. Pour obtenir les pièces de rechange du palier XS, voir la page pertinente dans le catalogue des pièces. Le numéro d'article pour commander le palier complet est le 14L61.



GARANTIE LIMITÉE DE GOULDS WATER TECHNOLOGY

La présente garantie s'applique à chaque pompe de système d'alimentation en eau fabriquée par Goulds Water Technology.

Toute pièce se révélant défectueuse durant la période de garantie sera remplacée sans frais pour le détaillant durant ladite période, qui dure douze (12) mois à compter de la date d'installation ou dix-huit (18) mois à partir de la date de fabrication, soit la période qui expirera la première.

Le détaillant qui, aux termes de cette garantie, désire effectuer une demande de règlement doit s'adresser au distributeur Goulds Water Technology agréé chez lequel la pompe a été achetée et fournir tous les détails à l'appui de sa demande. Le distributeur est autorisé à régler toute demande par le biais du service à la clientèle de Goulds Water Technology.

La garantie ne couvre pas :

a) les frais de main-d'oeuvre ou de transport ni les frais connexes encourus par le détaillant ;

b) les frais de réinstallation de l'équipement réparé ;

c) les frais de réinstallation de l'équipement de remplacement ;

d) les dommages indirects de quelque nature que ce soit ;

e) ni les pertes découlant de la panne.

Aux fins de la présente garantie, les termes ci-dessous sont définis comme suit :

1) "Distributeur" signifie une personne, une société de personnes, une société de capitaux, une association ou autre entité juridique servant d'intermédiaire entre Goulds Water Technology et le détaillant pour les achats, les consignations ou les contrats de vente des pompes en question.
2) "Détaillant" veut dire une personne, une société de personnes, une société de capitaux, une association ou autre entité juridique dont les activités commerciales sont la vente ou la location de pompes à des clients.
3) "Client" signifie une entité qui achète ou loue les pompes en question chez un détaillant. Un "client" peut être une personne, une société de personnes, une société de capitaux, une société à responsabilité limitée, une association ou autre entité juridique se livrant à quelque activité que ce soit.

CETTE GARANTIE SE RAPPORTE AU DÉTAILLANT SEULEMENT.

Declaration of Conformity

We at,
Goulds Water Technology / Xylem Inc.
1 Goulds Drive
Auburn, NY 13021
Declare that the following products: NPE, MCS, MCC, 3656, 3656 SP, GB, e-SV, SVI, NPO, Prime Line SP, HB, HMS, LC, NPV, LB, LBS comply with Machine Directive 06/42/EC. This equipment is intended to be incorporated with machinery covered by this directive, but must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the actual provisions of the directive.

Declaración de Conformidad

Nosotros en
Goulds Water Technology / Xylem Inc.
1 Goulds Drive
Auburn, NY 13021
Declaramos que los siguientes productos: NPE, MCS, MCC, 3656, 3656 SP, GB, e-SV, SVI, NPO, Prime Line SP, HB, HMS, LC, NPV, LB, LBS cumplen con las Directivas para Maquinarias 06/42/EC. Este equipo ha sido diseñado para ser incorporado a la maquinaria cubierta por esta directiva pero no debe ponerse en funcionamiento hasta que se declare que la maquinaria en la que será incorporado cumple con las disposiciones reales de la directiva.

Déclaration de Conformité

Nous, à
Goulds Water Technology, Xylem Inc.
1 Goulds Drive
Auburn, NY, U.S.A. 13021,
déclarons que les produits NPE, MCS, MCC, 3656, 3656 SP, GB, e-SV, SVI, NPO, Prime Line SP, HB, HMS, LC, NPV, LB et LBS sont conformes à la directive 06/42/EC (législation relative aux machines). Ils sont destinés à être intégrés dans la machinerie faisant l'objet de ladite directive, mais ne doivent pas être mis en service tant que la machinerie en question ne sera pas déclarée conforme aux stipulations de la directive.

xylem
Let's Solve Water

Xylem, Inc.
2881 East Bayard Street Ext., Suite A
Seneca Falls, NY 13148
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www.xyleminc.com/brands/gouldswatertechnology

 IM013 Révision numéro 9 Juillet 2012

Instruction Manual

HI 9829

Multiparameter Meter

With available GPS, logging probe, turbidity and ion measurements

HANNA instruments

www.hannainst.com

Dear Customer,

Thank you for choosing a HANNA instruments® product.
Please read this instruction manual carefully before using the instrument.
It will provide you with the necessary information for correct use of the instrument, as well as it's versatility.
If you need additional technical information, do not hesitate to e-mail us at **tech@hannainst.com** or visit our website www.hannainst.com for our worldwide contact list.
This instrument is in compliance with the CE directives.

TABLE OF CONTENTS

Chapter 1 - INTRODUCTION

1.1 PRELIMINARY EXAMINATION

Remove the instrument from the packing material and examine it carefully to make sure that no damage has occurred during shipping. If there is any damage, notify your Dealer or the nearest HANNA Customer Service Center immediately.

Note Save all packing materials until you are sure that the instrument functions correctly. Any damaged or defective items must be returned in their original packing material with the supplied accessories.

1.2 MODEL IDENTIFICATION

Meter: There are two models for the meter:

HI 9829: Portable multiparameter meter

HI 98290: Portable multiparameter meter with GPS

Probe: There are two base models of multiparameter probes:

HI 7609829: Standard multiparameter probe

HI 7629829: Multiparameter probe with autonomous logging capability

All meters and probes are fully compatible with each other, and all available measurement sensors can be used on both probe models.

Different combinations of meters, probes, sensors and accessories can be ordered either in predefined configurations or individually. See Appendix D for ordering configurations.

For example, ordering codes of probes follow:

HI 7609829/X is a HI 7609829 probe with X meter cable for pH/pH+ORP/ISE, D.O., EC, temperature sensors with a short probe shield

HI 7619829/X is a HI 7609829 probe with X meter cable for pH/pH+ORP/ISE, D.O., EC+turbidity, temperature sensors with a long probe shield

HI 7629829/X is a HI 7629829 logging probe with X meter cable for pH/pH+ORP/ISE, D.O., EC, temperature sensors with a short probe shield

HI 7639829/X is a HI 7629829 logging probe with X meter cable for pH/pH+ORP/ISE, D.O., EC+turbidity, temperature sensors with a long probe shield

1.3 GENERAL DESCRIPTION

HI 9829 is a portable logging multiparameter system that monitors up to 14 different water quality parameters (7 measured, 7 calculated).

The microprocessor-based intelligent multisensor probe allows measurement of many water quality parameters such as pH, ORP, turbidity, dissolved oxygen,

conductivity, chloride, nitrate, ammonium and temperature with data logging. The system is easy to setup and easy to use.

The **HI 98290** with GPS option has a built-in 12 channel GPS receiver and antenna that guarantees a position accuracy of 10 m (30 ft).

Measurements from specific locations are tracked with detailed coordinate information that can be viewed immediately on the display.

GPS information can be transferred to a PC using HANNA's **HI 929829** software. GPS information can also be viewed using a GPS mapping software such as Google™ Maps. Clicking on visited locations using a mapping software displays the measurement information.

All **HI 9829** are equipped with Fast Tracker™ an invaluable tool for associating measurements with their locations. HANNA's exclusive Fast Tracker™—T.I.S. (Tag ID System) uses iButton®s that can be installed at any number of sampling sites.

The **HI 9829** features a graphic, backlit display that automatically sizes the digits to fit the screen with on-screen graphing capability. Each parameter is fully configurable.

HI 9829 was designed to withstand harsh environments and is the ideal solution for field measurements of lakes, rivers and sea.

The meter meets IP67 standards (30 minute immersion at a depth of 1 m) and the multisensor probe meets IP68 standards (continuous immersion in water).

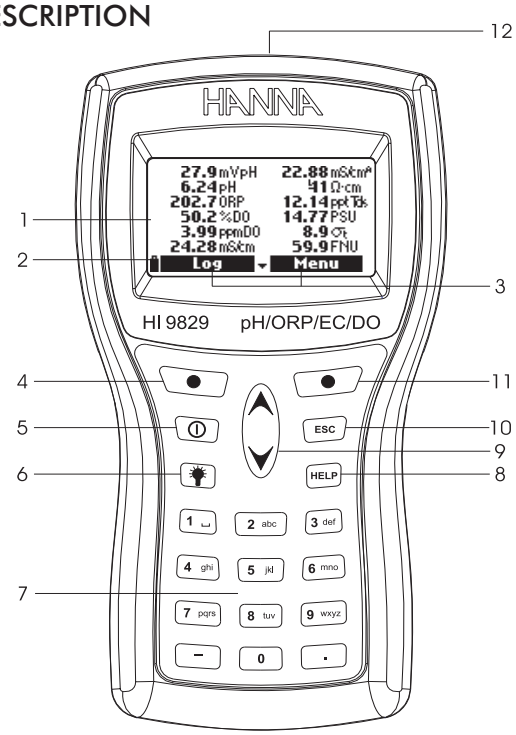
Settings and logged data can be protected with a passcode to avoid unauthorized modifications and context-sensitive help is always available.

Main features of the **HI 9829** system:

- Rugged meter and probe
- Easy to use
- Measure up to 16 parameters and display of up to 12 parameters
- Tracking of measurement locations with GPS (optional)
- Waterproof protection (IP67 for the meter and IP68 for the probe)
- Exclusive Fast Tracker™—T.I.S. (Tag ID System)
- Graphic LCD with backlight
- Built-in barometer for D.O. concentration compensation
- Quick calibration feature
- Measurement check to eliminate any erroneous readings
- Autorecognition of probe and sensors
- Log-on-demand and automatic logging (up to 45,000 samples) on meter for all parameters
- Graphical display of logged data

- USB interface for PC communication
- Auto-ranging for EC, ISE and turbidity readings
- Good Laboratory Practice feature, the last 5 calibrations are automatically stored
- Field-replaceable sensors with color coded caps
- Meter can be powered with either alkaline or rechargeable batteries
- Fast charging capability

1.4 DISPLAY & KEYBOARD DESCRIPTION



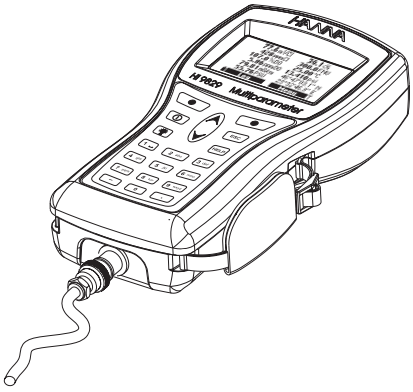
1. Graphic LCD
2. Battery level indicator
3. Softkey functions
4. Left softkey: function defined on display
5. On/Off key: turn the meter on and off
6. Lamp key: turn the backlight on and off
7. Alphanumeric keyboard: insert alphanumeric codes
8. HELP key: obtain information about the displayed screen
9. Arrow keys: scroll the displayed options/message
10. ESC key: return to the previous screen
11. Right softkey: function defined on display
12. GPS signal strength indicator (optional)
13. Tag reader

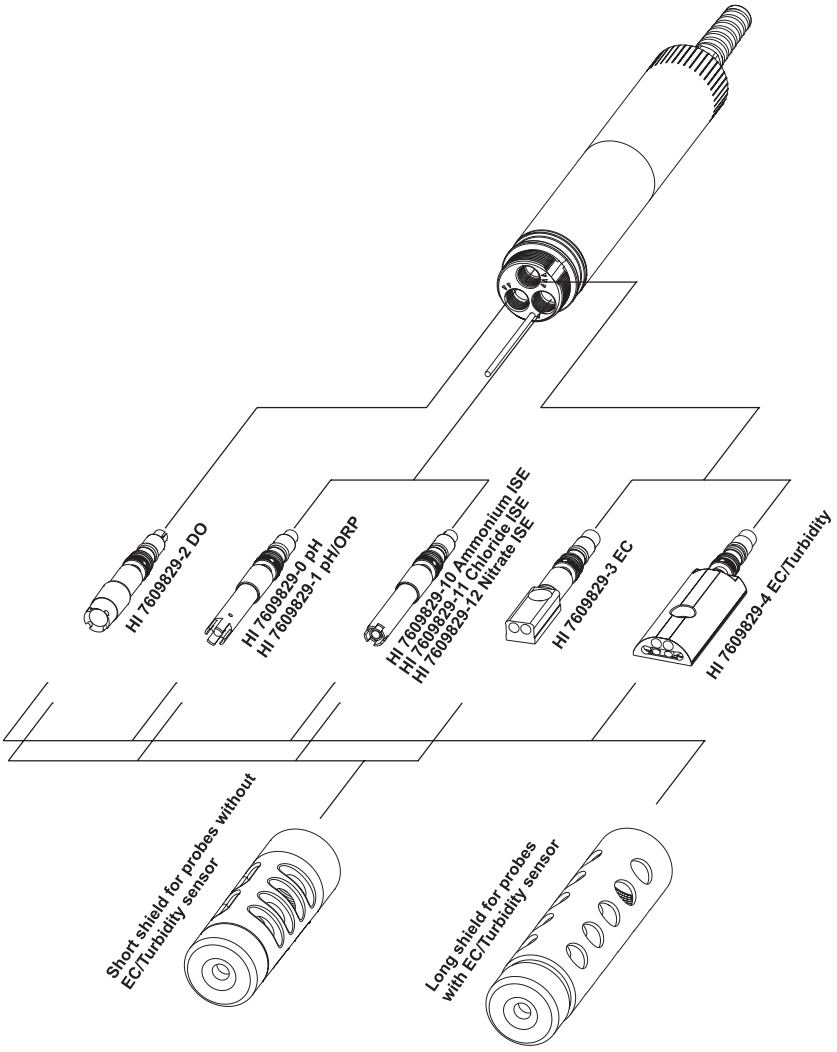
Chapter 2 - QUICK START

Before you begin using the **HI 9829** multiparameter system, either charge the included rechargeable C batteries for at least 6 hours or replace the rechargeable batteries with non-rechargeable alkaline batteries.

2.1 SENSOR AND PROBE INSTALLATION

- Sensor o-rings must be lubricated with the supplied grease prior to installation.
- **HI 76x9829** probes have 3 sensor connectors identified with color-coded triangles:
- Connector 1 (red): For either pH/ORP, pH, ammonium, chloride or nitrate sensor
- Connector 2 (white): For dissolved oxygen sensor
- Connector 3: (blue): For either EC or EC/turbidity sensor
- Position the connector key towards the center of the probe, make sure the connector is seated correctly (the sensor will no longer move freely) before tightening the locking threads.
- To protect the sensors, screw the protective shield onto the probe body.
- Unscrew the battery cover of the HI 7629829 logging probe and install 4 AA batteries for autonomous logging before connecting to the meter.
- With the meter off, connect the probe to the DIN socket on the bottom of the meter. Align the pins and key then push the plug into the socket and tighten the thread.
- Turn the meter on by pressing the ON/OFF key. The meter will automatically recognize the probe and the installed sensors and identify them on the probe status screen.
- Press <Measure> to view the measurement screen.





2.2 BASIC OPERATION

The main operating modes for **HI 9829** are measurement, logging and setup.

The measurement screen can be configured to display a single measurement or up to 12 simultaneous measurements by using the numbers 1-7 on the keypad. Use the arrow keys to scroll through the measurements not being displayed. See section 5.3 for more details.

The measurement units will blink if the system has not been calibrated and the measurement number will blink when the reading is out of range.

Press <Log> to display the logging menu. You can either log a single sample on the meter, start an interval log on the meter, or start an interval log on a logging probe (HI 7629829). See chapter 11 for more details.

Press <Menu> to enter setup mode. You can configure which parameters you want to measure, calibrate the sensors, change system settings, access the GPS menu and view the meter and probe status.

2.3 HELP FUNCTION

HI 9829 features context sensitive HELP, which provides useful information regarding the displayed screen.

Simply press the HELP key to access this function, then use the arrow keys to scroll through the message.

To escape from the HELP window, press the HELP key again or ESC.

Chapter 3 - SPECIFICATIONS

3.1 SYSTEM SPECIFICATIONS

TEMPERATURE	
Range	-5.00 to 55.00 °C; 23.00 to 131.00 °F; 268.15 to 328.15 K
Resolution	0.01 °C; 0.01 °F; 0.01 K
Accuracy	± 0.15 °C; ± 0.27 °F; ±0.15 K
Calibration	Automatic at 1 custom point

pH/mV	
Range	0.00 to 14.00 pH; ± 600.0 mV
Resolution	0.01 pH; 0.1 mV
Accuracy	± 0.02 pH; ± 0.5 mV
Calibration	Automatic 1, 2 or 3 points with automatic recognition of 5 standard buffers (pH 4.01, 6.86, 7.01, 9.18, 10.01) and 1 custom buffer

ORP	
Range	± 2000.0 mV
Resolution	0.1 mV
Accuracy	± 1.0 mV
Calibration	Automatic at 1 custom point (relative mV)

DISSOLVED OXYGEN	
Range	0.0 to 500.0 % 0.00 to 50.00 ppm (mg/L)
Resolution	0.1 % 0.01 ppm (mg/L)
Accuracy	0.0 to 300.0 %: ± 1.5 % of reading or ± 1.0 % whichever is greater; 300.0 to 500.0 %: ± 3 % of reading 0.00 to 30.00 ppm (mg/L): ± 1.5 % of reading or ±0.10 ppm (mg/L) whichever is greater; 30.00 ppm (mg/L) to 50.00 ppm (mg/L): ± 3 % of reading
Calibration	Automatic 1 or 2 points at 0, 100 % or 1 custom point

CONDUCTIVITY

Range	0 to 200 mS/cm (absolute EC up to 400 mS/cm)
Resolution	
Manual	1 µS/cm; 0.001 mS/cm; 0.01 mS/cm; 0.1 mS/cm; 1 mS/cm
Automatic	1 µS/cm from 0 to 9999 µS/cm 0.01 mS/cm from 10.00 to 99.99 mS/cm 0.1 mS/cm from 100.0 to 400.0 mS/cm
Automatic (mS/cm)	0.001 mS/cm from 0.000 to 9.999 mS/cm 0.01 mS/cm from 10.00 to 99.99 mS/cm 0.1 mS/cm from 100.0 to 400.0 mS/cm
Accuracy	±1 % of reading or ±1 µS/cm whichever is greater
Calibration	Automatic single point, with 6 standard solutions (84 µS/cm, 1413 µS/cm, 5.00 mS/cm, 12.88 mS/cm, 80.0 mS/cm, 111.8 mS/cm) or custom point

RESISTIVITY

Range *(depending on measurement setup)*	0 to 999999 Ω·cm; 0 to 1000.0 kΩ·cm; 0 to 1.0000 MΩ·cm
Resolution	Depending on resistivity reading
Calibration	Based on conductivity or salinity calibration

TDS (Total Dissolved Solids)

Range	0 to 400000 ppm (mg/L); (the maximum value depends on the TDS factor)
Resolution	
Manual	1 ppm (mg/L); 0.001 ppt (g/L); 0.01 ppt (g/L); 0.1 ppt (g/L); 1 ppt (g/L)
Automatic	1 ppm (mg/L) from 0 to 9999 ppm (mg/L) 0.01 ppt (g/L) from 10.00 to 99.99 ppt (g/L) 0.1 ppt (g/L) from 100.0 to 400.0 ppt (g/L)
Automatic ppt (g/L)	0.001 ppt (g/L) from 0.000 to 9.999 ppt (g/L) 0.01 ppt (g/L) from 10.00 to 99.99 ppt (g/L) 0.1 ppt (g/L) from 100.0 to 400.0 ppt (g/L)
Accuracy	±1 % of reading or ±1 ppm (mg/L) whichever is greater
Calibration	Based on conductivity or salinity calibration

SALINITY	
Range	0.00 to 70.00 PSU
Resolution	0.01 PSU
Accuracy	±2% of reading or ±0.01 PSU whichever is greater
Calibration	Based on conductivity calibration

SEAWATER SIGMA	
Range	0.0 to 50.0 σ_t, σ_0, σ_{15}
Resolution	0.1 σ_t, σ_0, σ_{15}
Accuracy	± 1σ_t, σ_0, σ_{15}
Calibration	Based on conductivity or salinity calibration

TURBIDITY	
Range	0.0 to 99.9 FNU; 100 to 1000 FNU
Resolution	0.1 FNU from 0.0 to 99.9 FNU 1 FNU from 100 to 1000 FNU
Accuracy	±0.3 FNU or ±2 % of reading, whichever is greater
Calibration	Automatic 1, 2 or 3 points at 0, 20 and 200 FNU, or custom

ISE	
Ammonium-Nitrogen	
Range	0.02 to 200.0 ppm Am (as NH_4^+-N)
Resolution	0.01 ppm to 1 ppm 0.1 ppm to 200.0 ppm
Accuracy	±5 % of reading or 2 ppm
Calibration	1 or 2 point, 10 ppm and 100 ppm

Chloride	
Range	0.6 to 200.0 ppm Cl (as Cl^-)
Resolution	0.01 ppm to 1 ppm 0.1 ppm to 200.0 ppm
Accuracy	±5 % of reading or 2 ppm
Calibration	1 or 2 point, 10 ppm and 100 ppm

Nitrate-Nitrogen

Range	0.62 to 200.0 ppm Ni (as NO_3^--N)
Resolution	0.01 ppm to 1 ppm 0.1 ppm to 200 ppm
Accuracy	±5 % of reading or 2 ppm
Calibration	1 or 2 point, 10 ppm and 100 ppm

ATMOSPHERIC PRESSURE

Range	450 to 850 mm Hg; 17.72 to 33.46 in Hg; 600.0 to 1133.2 mbar; 8.702 to 16.436 psi; 0.5921 to 1.1184 atm; 60.00 to 113.32 kPa
Resolution	0.1 mm Hg; 0.01 in Hg; 0.1 mbar 0.001 psi; 0.0001 atm; 0.01 kPa
Accuracy	±3 mm Hg within ±15°C from calibration temperature
Calibration	Automatic at 1 custom point

METER SPECIFICATIONS

Temperature Compensation	Automatic from -5 to 55 °C (23 to 131 °F)
Logging Memory	44,000 records (continuous logging or log-on-demand of all parameters)
Logging Interval	1 second to 3 hours
PC Interface	USB (with HI 929829 software)
Waterproof Protection	IP67
Environment	0 to 50 °C (32 to 122 °F); RH 100 %
Battery Type	4 x 1.2 V, NiMH, rechargeable batteries, size C or 4 x 1.5 V alkaline, C size batteries
Battery Life	See below
Dimensions/Weight	221 x 115 x 55 mm (8.7 x 4.5 x 2.2") / 750 g (26.5 oz.)
GPS	12 channel receiver 10 m (30 ft) accuracy

METER BATTERY LIFE

The power consumption of the **HI 9829** multiparameter system is dependent on three things:

1. The measurement system configuration (probe type, sensor configuration)
2. The meter configuration (logging interval, GPS and backlight use)
3. The battery type (alkaline or rechargeable). Note: Alkaline batteries have two times the expected life.

The following table estimates the meter's battery life connected to a **HI 76X9829** probe with backlight off. The logging interval only affects meter battery life when GPS Powersave mode is used (units with GPS). (Note: GPS and backlighting use consume the most power). The table variables are GPS, battery selection and parameter selection. Note: When a **HI 7629829** logging probe is connected to a meter, it uses the meter's power.

	pH, ORP, DO, EC enabled Turbidity disabled	pH, ORP, DO, EC and Turbidity enabled
Alkaline batteries without GPS	280 hours	190 hours
Rechargeable batteries without GPS	140 hours	95 hours
Alkaline batteries with GPS	90 hours	70 hours
Rechargeable batteries with GPS	45 hours	35 hours
Alkaline batteries with GPS powersave on, 4 min log	110 hours	100 hours
Rechargeable batteries with GPS powersave on 4, min log	55 hours	50 hours
Alkaline batteries with GPS powersave on, 10 min log	180 hours	160 hours
Rechargeable batteries with GPS powersave on 10, min log	90 hours	80 hours

3.2 PROBE SPECIFICATIONS

	Non-logging Probe	Logging Probe
Sample Environment	Fresh, brackish, seawater	
Waterproof protection	IP68	
Computer Interface	NA	USB PC (HI 76982910)
Internal Battery Type	NA	4 X 1.5V Size AA Alkaline
Typical Battery Life	NA	See below
Memory	NA	140,000 measurements (single parameter logged)
		35,000 measurements (all parameters logged)
Operating Temperature	-5 to 55° C *	
Storage Temperature	-20 to 70° C	
Maximum Depth	20 m (66 ft.) *	
Dimensions (without cable)	**HI 7609829** 342mm (13.5"), dia=46 mm (1.8")	**HI 7629829** 442mm (17.4"), dia=46 mm (1.8")
	HI 7619829 382 mm (15.1"), dia=46 mm (1.8")	**HI 7639829** 482 mm (19.0"), dia=46 mm (1.8")
Weight (with batteries and sensors)	**HI 7609829** 570g (20.1 oz.) **HI 7619829** 650g (22.9 oz.)	**HI 7629829** 775g (27.3 oz.) **HI 7639829** 819g (28.9oz.)
Cable Specification	Multistrand-multiconductor shielded cable with internal strength member rated for 68 kg (150 lb) intermittent use	
Wetted Materials	Body: ABS Threads: Nylon Shield: ABS/ 316 SS Temp probe: 316 SS O-rings: EPDM	

* Reduced for ISE sensors

LOGGING PROBE BATTERY LIFE*

Interval	All channels logging (no averaging)	All channels logging (10 sample averaging)
1 - 5 sec	72 hours	72 hours
1 min	22 days	11 days
10 min	70 days	65 days

* Continuous logging is contingent on availability of log memory

3.3 SENSOR SPECIFICATIONS

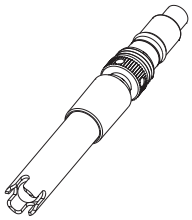
	HI 7609829-0	HI 7609829-1	HI 7609829-2	HI 7609829-3
Description	pH	pH/ORP	Dissolved Oxygen	EC
Measure Type Primary Unit	pH, mV (pH)	pH, mV (pH/ORP)	D.O. (% sat. & conc.)	EC
Measure Range	0.00 to 13.00 pH ±600.0 mV	0.00 to 13.00 pH ±600.0 mV ±2000.0 mV	0.0 to 500.0 % 0.00 to 50.00 mg/L	0.0 to 200.0 mS/cm 0.0 to 400 mS/cm (absolute)
Temperature Range	-5 to 55°C	-5 to 55°C	-5 to 55°C	-5 to 55°C
Color Code	Red	Red	White	Blue
Materials	Tip: glass (pH) Junction: ceramic Body: PEI Electrolyte: gel Reference: double	Tip: glass (pH); Pt (ORP) Junction: ceramic Body: PEI Electrolyte: gel Reference: double	Cat/An: Ag/Zn Membrane: HDPE Body: white top ABS CAP	Stainless steel electrodes AISI 316 Body: ABS/EPOXY
Maintenance Solution	HI 70300 (storage solution)	HI 70300 (storage solution)	HI 7042S (D.O. electrolyte)	none
Dimensions	118 x 15 mm	118 x 15 mm	99 x 17 mm	111 x 17 mm
Depth	20 m (65')	20 m (65')	20 m (65')	20 m (65')

	HI 7609829-4	HI 7609829-10	HI 7609829-11	HI 7609829-12
Description	EC/Turbidity	Ammonium ISE	Chloride ISE	Nitrate ISE
Measure Type Primary Unit	EC FTU	ppm	ppm	ppm
Measure Range	0 to 200.0 mS/cm 0.0 to 400 mS/cm (abs) 0.0 to 1000 FNU	0.02 to 200.0 ppm as NH_4^+-N	0.6 to 200.0 ppm Cl^-	0.6 to 200.0 ppm as NO_3^--N
Temperature Range	-5 to 55°C	0 to 40°C	0 to 40°C	0 to 40°C
Color Code		Red	Red	Red
Materials	Body: ABS/EPOXY PMMA	Tip: Polymeric Liquid Membrane Body: PEI Electrolyte: gel Reference: double	Tip: Solid State AgCl Pellet Body: PEI Electrolyte: gel Reference: double	Tip: Polymeric Liquid Membrane Body: PEI Electrolyte: gel Reference: double
Maintenance Solution	none	none	none	none
Dimensions	135 x 35 mm	118 x 15 mm	118 x 15 mm	118 x 15 mm
Depth	20 m (65')	5 m (16')	5 m (16')	5 m (16')

Chapter 4 - PROBE INSTALLATION

HI 7609829 and **HI 7629829** multisensor probes are used for the measurements of pH, ORP, conductivity, turbidity, dissolved oxygen, chloride, nitrate-nitrogen, ammonium-nitrogen and temperature. Each probe can utilize 3 sensors. A description of each sensor follows.

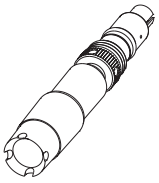
4.1 SENSOR DESCRIPTIONS



HI 7609829-0 Combination pH sensor features a glass pH sensitive bulb and a silver/silver chloride double junction reference with gelled electrolyte.

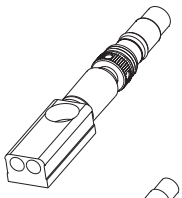
HI 7609829-1 Combination pH/ORP sensor features a glass sensitive bulb for pH readings, a platinum sensor for redox measurements and a silver/silver chloride double junction reference with gelled electrolyte.

Note See section 4.2.1 for pH preparation.
See section 4.2.2 for ORP activation.

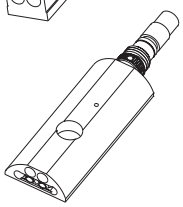


HI 7609829-2 Galvanic dissolved oxygen (D.O.) sensor. The thin gas permeable membrane isolates the sensor elements from the testing solution but allows oxygen to pass through. The oxygen that passes through the membrane is reduced at the cathode and causes a current, from which the oxygen concentration is determined. The D.O. sensor conforms to Standard Methods 4500-AG, EPA 360.1.

Note The D.O. sensor needs to be activated before installation. See section 4.2.3 for details.

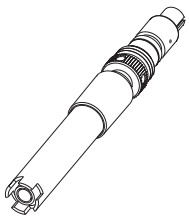


HI 7609829-3 4-electrode conductivity sensor. The sensor is immune to polarization or surface coatings.



The **HI 7609829-4** Combination EC/Turbidity sensor. It includes a 4-electrode conductivity sensor and a turbidity sensor that conforms to ISO 7027 standards in a single sensor body. The turbidity sensor uses an optical technique to measure suspended particles in water.

HI 7609829-10: Ammonium selective electrode (ISE) is a combination liquid membrane sensor used for the detection of free ammonium-nitrogen in freshwater samples. The sensor utilizes a polymeric membrane made with ammonium ionophore in a PVC head and silver/silver chloride double junction gel filled reference electrode. This sensor is used in place of the pH sensor in the probe.



HI 7609829-11: The Chloride ISE is a combination solid state sensor used for the detection of free chloride ions in freshwater samples. The sensor utilizes a silver chloride pellet housed in a PEI head and a silver/silver chloride double junction gel filled reference electrode. This sensor is used in place of the pH sensor in the probe.

HI 7609829-12: The Nitrate ISE is a combination liquid membrane sensor used for the detection of nitrate nitrogen in freshwater samples. The sensor utilizes a polymeric membrane made with nitrate ionophore in a PVC head and a silver/silver chloride double junction gel filled reference electrode. This sensor is used in place of the pH sensor in the probe.

See Appendix C for details regarding the ISE sensors.

4.2 SENSOR PREPARATION / ACTIVATION

4.2.1 pH Preparation

Remove the shipping cap from the pH sensor. If the shipping cap does not contain any liquid, pour HI 70300 into shipping cap, place it back on the sensor and soak for at least 1/2 hour before use. If HI 70300 is not available, pH 4.01 buffer may be substituted.

4.2.2 ORP Activation

For improved redox measurements, the surface of the sensor must be clean and smooth. A pretreatment procedure should be performed to ensure quick response.

The pretreatment of the sensor is determined by the pH and the ORP potential values of the sample. Use the table below to determine the treatment required.

First locate the typical sample pH. If the corresponding ORP value (mV) is higher than the values in the table below, an oxidizing pretreatment is necessary. If the value is lower, a reducing pretreatment is necessary.

pH	mV	pH	mV	pH	mV	pH	mV	pH	mV
0	990	1	920	2	860	3	800	4	740
5	680	6	640	7	580	8	520	9	460
10	400	11	340	12	280	13	220	14	160

For reducing pretreatment: immerse the electrode for at least five minutes in HI 7091.

For oxidizing pretreatment: immerse the electrode for at least five minutes in HI 7092.

4.2.3 D.O. Sensor Activation

The D.O. probe is shipped dry. To prepare the sensor for use:

- Remove the black & red plastic shipping cap and discard.
- Insert the supplied O-ring in to the membrane cap.
- Rinse the membrane with some electrolyte solution. Refill with clean electrolyte. Gently tap the black membrane cap to dislodge air bubbles. To avoid damaging the membrane, do not touch it with your fingers or directly tap the membrane.

- With the sensor facing down screw the membrane cap counterclockwise to the end of the threads. Some electrolyte will overflow.
- Rinse outside of sensor with deionized water.
- Invert sensor and inspect. There should be no bubbles or debris between the membrane and sensor body.

4.2.4 EC and EC/Turbidity Sensor Preparation

The EC and EC/Turbidity sensors do not need to be soaked or hydrated before use. Use the small brush included in the probe maintenance kit to clean and loosen any debris before using.

4.2.5 Ammonium Sensor Preparation

Remove the shipping cap and inspect sensor. Verify no air pockets have developed near the ceramic junction during shipping. Hold the sensor at the connector and shake it down (like a mercury thermometer). Condition the sensor by soaking it in a small amount of **HI 9829-10**, 10 ppm NH_4^+-N standard for at least a 1/2 hour.

4.2.6 Chloride Sensor Preparation

Remove the shipping cap and inspect sensor. Verify no air pockets have developed near the ceramic junction during shipping. Hold the sensor at the connector and shake it down (like a mercury thermometer). Condition the sensor by soaking it in a small amount of **HI 9829-12**, 10 ppm Cl^- standard for at least a 1/2 hour.

4.2.7 Nitrate Sensor Preparation

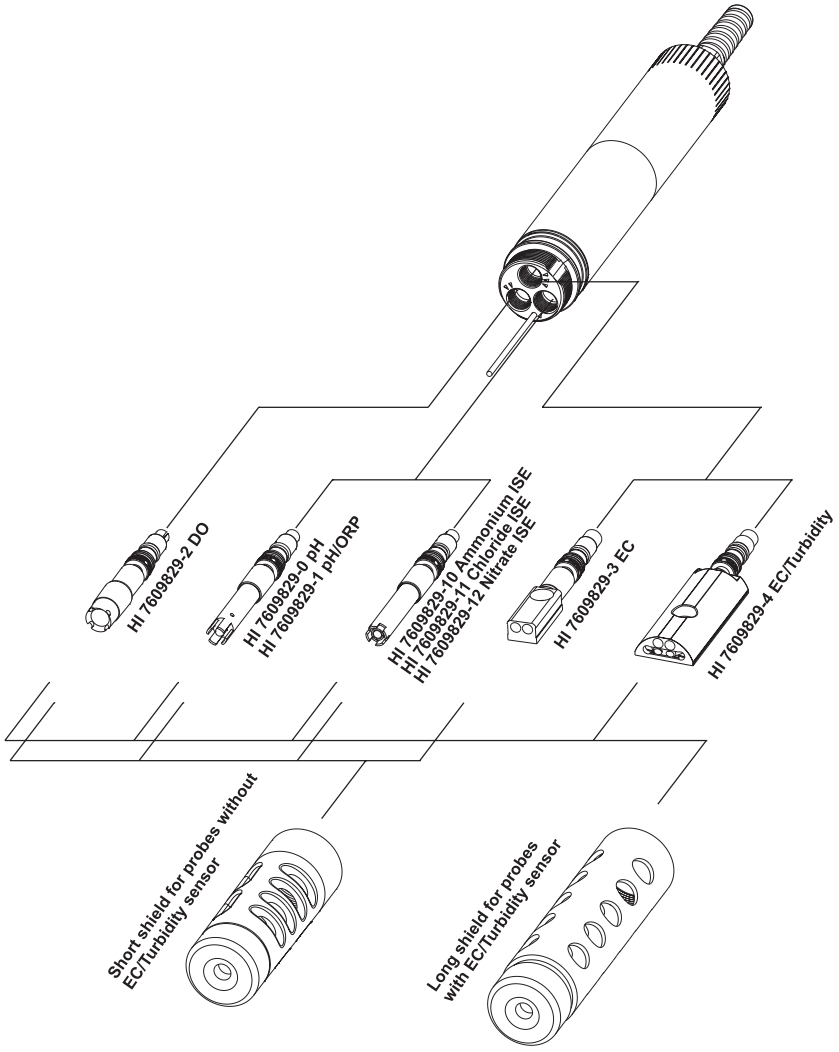
Remove the shipping cap and inspect sensor. Verify no air pockets have developed near the ceramic junction during shipping. Hold the sensor at the connector and shake it down (like a mercury thermometer). Condition the sensor by soaking it in a small amount of **HI 9829-14**, 10 ppm NO_3^--N standard for at least a 1/2 hour.

4.3 SENSOR INSTALLATION

The **HI 76x9829** can support 3 different sensors: Connector 1: pH, pH/ORP or ISE (Ammonium, Chloride, Nitrate), Connector 2: D.O., Connector 3: EC or EC/Turbidity.

To make installation easier, the sensors have color-coded caps and the sockets are identified with colored triangles.

Note The EC/Turbidity sensor with 9 pin connector does not have a color-coded cap. It is always installed into the socket with three blue triangles.



For a correct installation:

- Grease the sensor O-ring with the lubricant found in the probe maintenance kit. DO NOT SUBSTITUTE other grease/lubricants as it may cause the O-ring to swell.
- Insert the sensor into the correctly color coded opening while positioning the connector key toward the center of the probe. Make sure the connector is seated correctly (the sensor will no longer move freely) before tightening the locking threads with your fingers.
- Continue to tighten the locking threads with the tool supplied in the mainte nance kit until the sensor is secured tightly against the probe body.
- To protect the sensors, screw the protective shield onto the probe body.
- With the meter off, connect the probe to the DIN socket on the bottom of the meter. Align the pins and key then push the plug into the socket. Tighten the knurled, threaded shell.
- Turn on the meter by pressing the ON/OFF key. The meter should automatically recognize the installed sensors and identify them on the probe status screen. If you have an error message or the sensor is not recognized, reconnect the sensor(s) or probe and try again.

Chapter 5 - INITIALIZATION AND MEASUREMENT

5.1 BATTERY INSTALLATION

HI 9829 is supplied with 4 rechargeable, size C NiMH (Nickel-metal hydride) batteries.

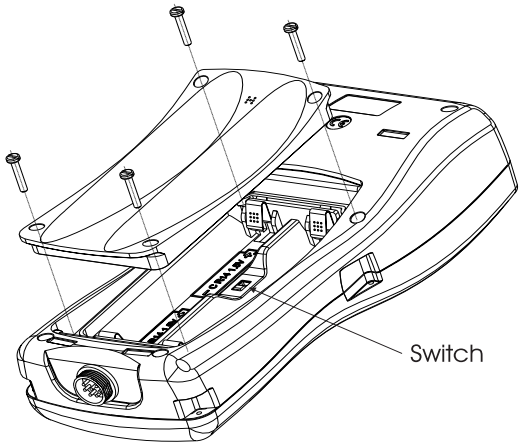
The battery symbol on the LCD indicates the remaining battery charge. The meter has a low battery warning, and when the symbol starts blinking, batteries should be charged or replaced with new ones. When the batteries are discharged the meter will automatically shut off to avoid erroneous readings.

5.1.1 Meter Battery Installation

Replace batteries in nonhazardous areas only.

Remove the 4 screws on the rear of the instrument and insert the batteries observing polarity.

If you wish to replace the supplied rechargeable batteries with nonrechargeble alkaline batteries, move the switch in the battery compartment upward.



A warning message is displayed if you connect the charging cable to a meter with alkaline batteries.

Nonrechargeable alkaline batteries can explode or leak if you try to charge them. Verify that the switch is in the up position when using alkaline batteries to prevent recharging.

Note: Do not mix old and new alkaline batteries.

5.1.2 Charging Meter Batteries

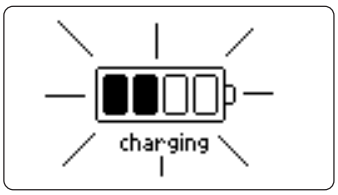
Two cables are available for charging the **HI 9829** batteries: **HI 710045** and **HI 710046**.

AC power supply

In order to charge the rechargeable batteries, use the **HI 710045** cable and the 12 Vdc power adapter.

- With the meter OFF, disconnect the probe.

- Connect the **HI 710045** cable to the probe connector on the meter and power adapter, then connect the adapter to an AC power outlet.
- The battery charging animation will be displayed.



It takes about 6 hours to completely charge fully discharged batteries.

Note The meter log, GPS information, system setup and status can be viewed during battery charging. The battery charging status is indicated by a small animated battery icon found in the lower left corner.

During charging the meter may feel quite warm. This is normal. "Battery temp" (under "Meter Status") may display values approaching 50 °C.

Automotive auxiliary power outlet (Cigarette lighter receptacle)

To charge batteries from a automotive auxiliary power outlet, use **HI 710046** cable.

- Connect the **HI 710046** cable to the probe connector on the meter and to the auxiliary plug.
- The battery charging animation will be displayed.

A complete battery charging will take about 6 hours if they are completely discharged.

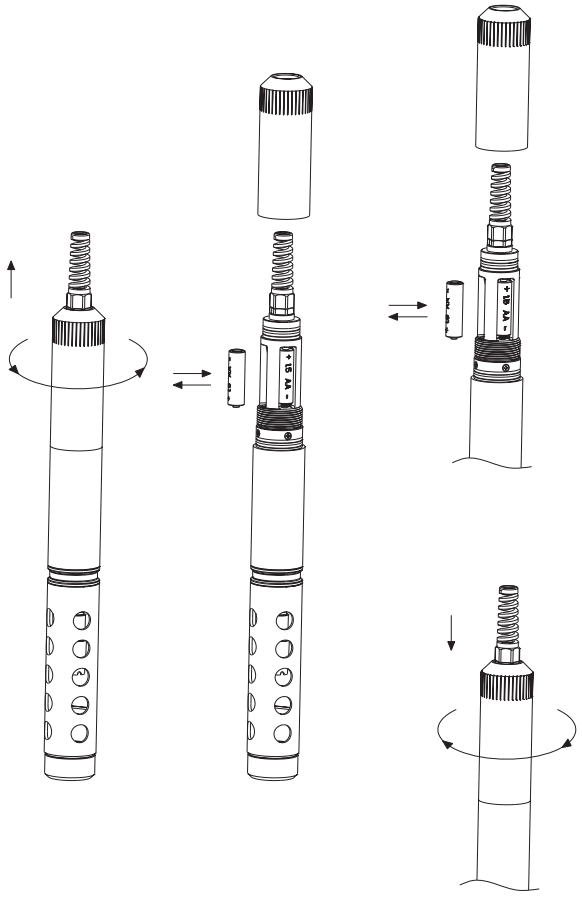
5.1.3 Probe Battery Installation (for logging probes only)

To install probe batteries:

Replace batteries in a nonhazardous area only. Remove the battery cover by turning it counterclockwise. Insert the batteries observing polarity.

Note: Do not mix old and new batteries.

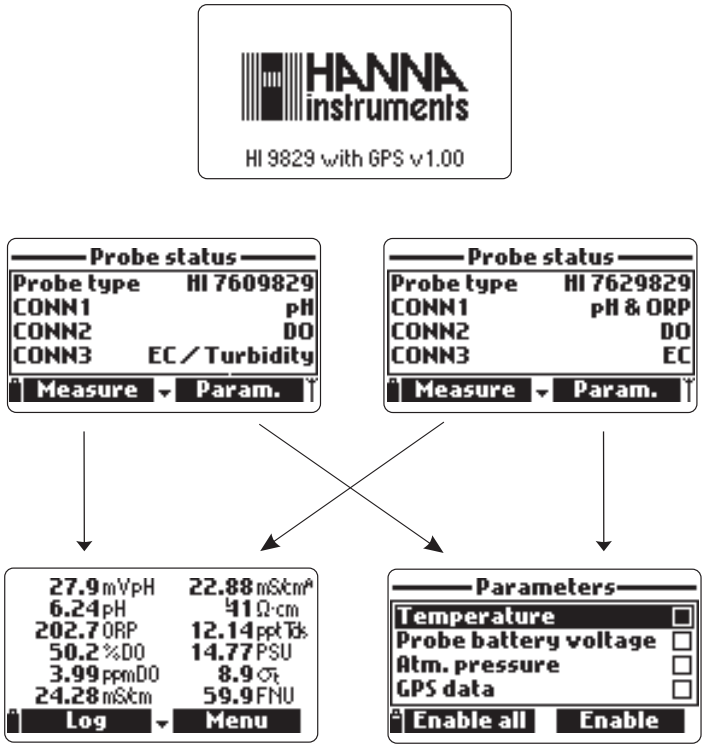
Replace the battery cover by engaging the threads and turning it clockwise. Continue turning until it is flush with probe body.



5.2 METER INITIALIZATION

After connecting the desired sensors to the probe and connecting the probe to the meter (see previous chapter), turn the meter on by pressing ON/OFF.

After the initialization has been completed, the meter displays the PROBE STATUS SCREEN.



The probe status screen identifies the probe and attached sensors. Non-logging probes are identified as **HI 7609829** and logging probes are identified as **HI 7629829**.

Two active soft keys are found at the bottom of the status screen.

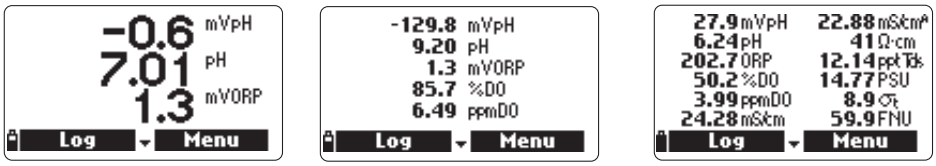
- Press <Measure> to access the measurement mode.
- Press <Param> to access the "Select Parameter" menu. (This screen can also be accessed from the main menu, see Chapter 6 for a detailed description.).
- Press the DOWN arrow to view additional information about the probe.

5.3 MEASUREMENT MODE

Measurement mode is one of the three main operating modes of **HI 9829** (along with logging mode and setup mode).

During measurement mode **HI 9829** will simultaneously measure data for all enabled parameters.

- Use the numbers on the keyboard to select the number of parameters that are shown on the screen at one time. The display will automatically resize the font.

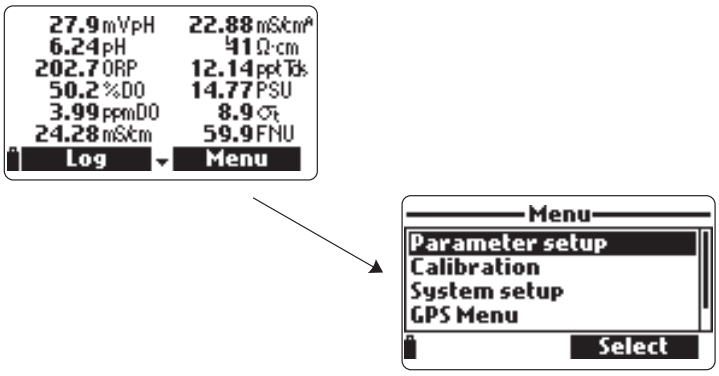


- Press the [up] and [down] arrows to scroll through the enabled parameters if they do not fit on one screen.

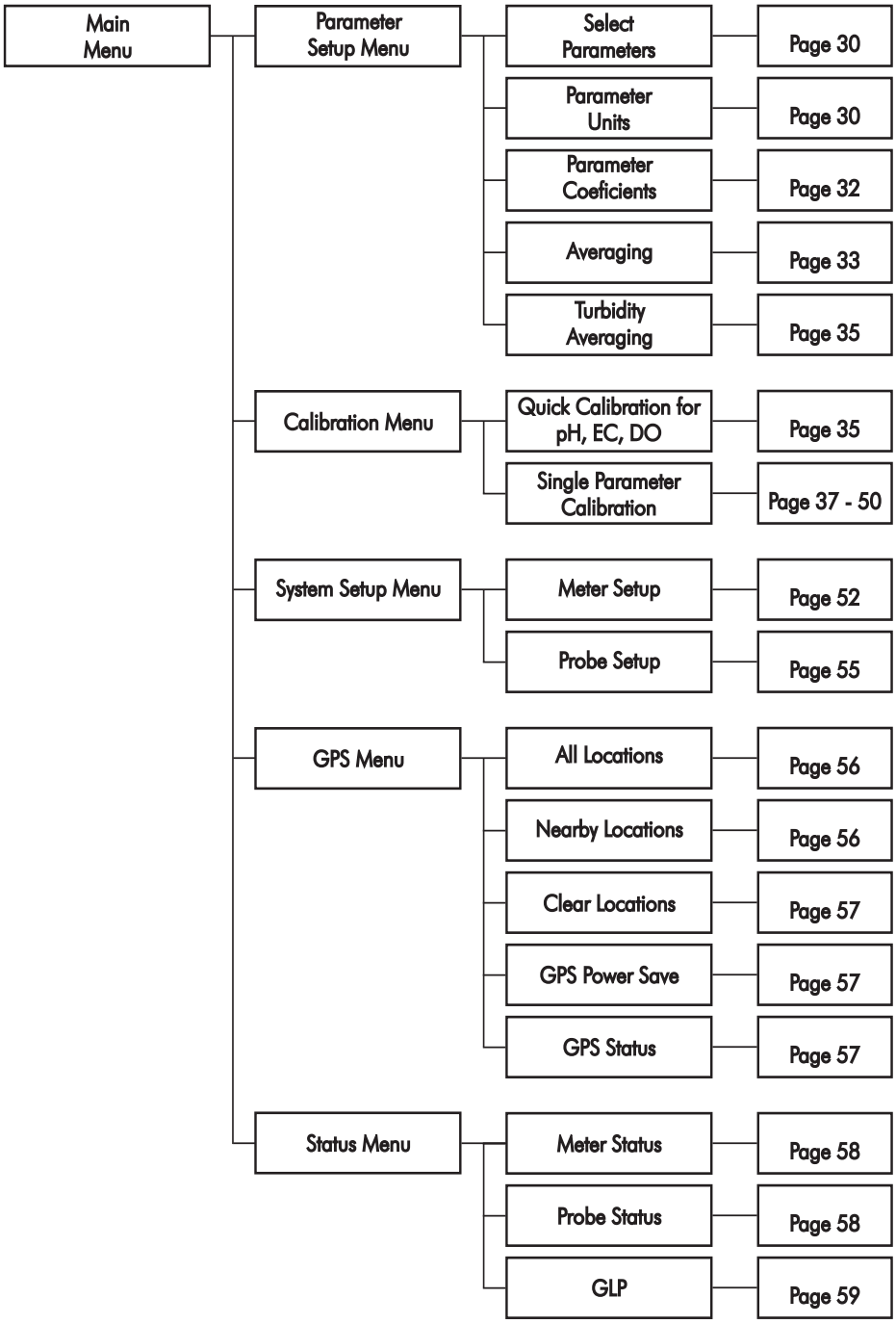
Note A flashing measurement value indicates that the measurement is out of range.

A flashing measurement unit indicates that the user calibration has not been done and is needed for accurate readings.

- Press <Log> to enter the log menu. See Chapter 11 for details.
- Press <Menu> to enter the main setup menu. The main menu accesses the parameter setup, calibration, system setup, GPS and status options. See the following chapters for details.



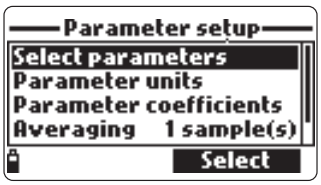
5.4 SETUP MENU STRUCTURE



Chapter 6 - PARAMETER SETUP MENU

From the main menu, use the arrow keys to highlight "Parameter Setup" and then press <Select>.

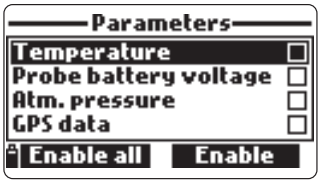
The following options will be displayed:



6.1 SELECT PARAMETERS

Use the arrow keys to scroll through the menu. Press the right softkey to enable or disable a single parameter, or the left softkey to enable or disable all parameters. A checked box means that the parameter is enabled.

Only the available parameters are present in the list.

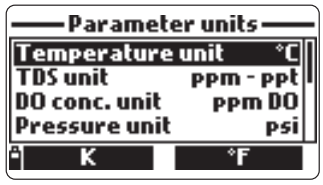


Note: If the password protection is enabled, you will be required to enter the password before any parameters can be modified.

6.2 PARAMETER UNITS

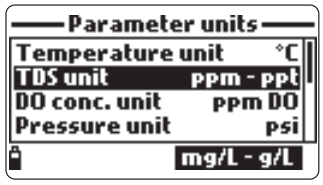
6.2.1 Temperature Unit

The user can select the measurement unit: °C, °F or K. The default value is °C.



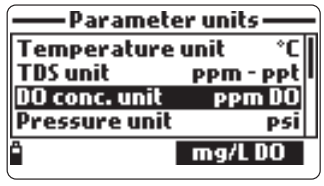
6.2.2 TDS Unit

The user can select ppm - ppt or mg/L - g/L measurement unit. The default value is ppm - ppt.



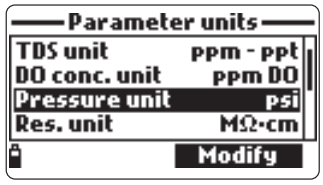
6.2.3 DO Concentration Unit

The user can select ppm or mg/L. Dissolved Oxygen concentration is calculated using % saturation, conductivity and atmospheric pressure. The default value is ppm.

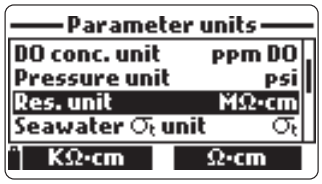


6.2.4 Pressure Unit

The user can select one the following measurement units: psi, mmHg, inHg, mbar, atm, kPA. The default value is psi.

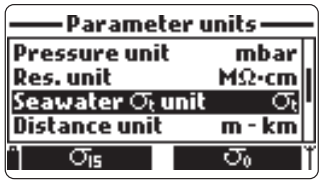


6.2.5 Resistivity Unit



The user can select resistivity from one of the following measurement units: Ω·cm, kΩ·cm or MΩ·cm. Resistivity is calculated from the conductivity measurement. The default unit is MΩ·cm.

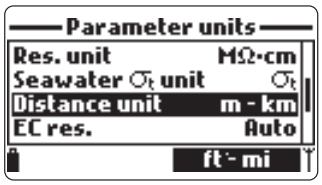
6.2.6 Seawater Sigma Unit



This parameter is used for seawater analysis. It is calculated from the conductivity measurement and depends on water pressure, temperature and salinity. The default value is σ_t.

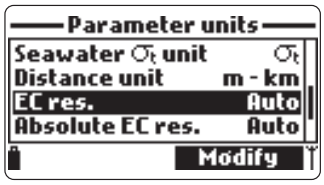
Users can select the reference temperature: σ_t, σ_0 and σ_{15} (i.e. current temperature, 0°C or 15°C).

6.2.7 Distance Unit (GPS unit)



Select between m - km or ft - mi. This unit will be associated with position. The default values is m - km.

6.2.8 EC Resolution



The user can configure the conductivity resolution with one of the following options:

Auto: the meter automatically chooses the range to optimize the measurement. Readings can be in µS/cm or mS/cm.

Auto mS/cm: the meter automatically chooses the range to optimize the measurement, readings will be in mS/cm only.

1µS/cm, 0.001 mS/cm, 0.01mS/cm, 0.1mS/cm or 1mS/cm: the meter will not autorange, the measurement will be displayed with the selected resolution. The default value is Auto.

6.2.9 Absolute EC Resolution

Absolute conductivity displays the conductivity without temperature compensation. See 6.2.8 EC resolution for resolution details.

Note A small letter "A" added to the µS/cm or mS/cm unit refers to an absolute conductivity value (i.e. a conductivity reading with no temperature compensation).

6.2.10 TDS Resolution

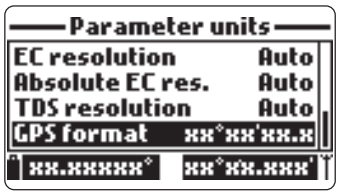
The user can configure the TDS resolution with one of the following options:

Auto: the meter automatically chooses the range to optimize the measurement, readings can be in ppt or ppm.

Auto ppt: the meter automatically chooses the range to optimize the measurement, readings will be in ppt only.

1 ppm, 0.001 ppt, 0.01 ppt, 0.1 ppt or 1 ppt: the meter will display the measurement with selected resolution. The default value is Auto.

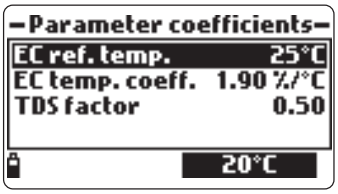
6.2.11 GPS Format (optional)



Global positioning coordinates have three standard formats: XX°XX'XX.X'', XX°XX.XXX' and XX.XXXXX°. The selected format will be used in any screen where the GPS coordinates are displayed. The default format is XX°XX'XX.X.

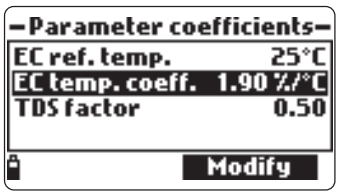
6.3 PARAMETER COEFFICIENTS

6.3.1 EC Reference Temperature



This value is used for temperature compensated conductivity. All EC measurements will be referenced to the conductivity of a sample at this temperature. Press the softkey to select the desired option; 20 °C or at 25 °C. The default value is 25 °C.

6.3.2 EC Temperature Coefficient

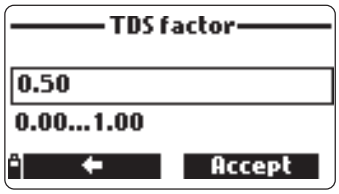


The temperature coefficient Beta (β) is defined by the following equation (using 25 °C as an example):

$EC_{25} = EC_x / (1 + \beta(T_x - 25))$

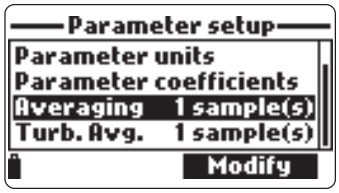
Beta is a function of the solution being measured. For freshwater samples Beta is approximately 1.90%/°C. If the actual temperature coefficient of your sample is known, press <Modify> to enter the value. To confirm press <Accept>. The value can be within 0.00 and 6.00%/°C. The default value is 1.90%/°C.

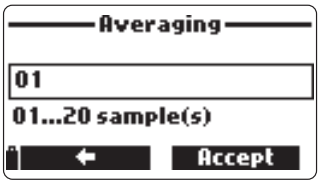
6.3.3 TDS Factor



TDS stands for total dissolved solids, and it is a calculated value based on the conductivity of the solution (TDS = factor x EC_{25}). The TDS conversion factor can be set from 0.00 to 1.00. A typical TDS factor for strong ionic solutions is 0.5, while for weak ionic solutions (e.g. fertilizers) is 0.7. Press <Modify> to enter the value, press <Accept> to confirm. The default value is 0.50.

6.4 AVERAGING

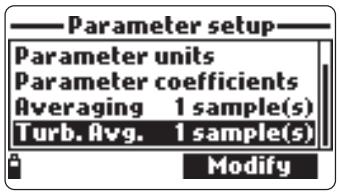




Averaging is a software filter to minimize sensor noise and provide more stable readings. Averaging is particularly useful to get a representative reading of the "average" value from flowing water. Averaging will affect all measurements (except Turbidity which can be set separately). This value should be kept low if you want a fast response. Press <Modify> to select the desired number of samples to average. This value can be set from 1 to 20 samples. The default value is 1.

Note Each reading takes 1 second, so when logging the first sample will be delayed by a few seconds if averaging is used.

6.5 TURBIDITY AVERAGING



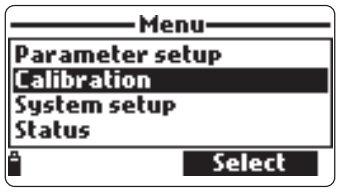
Turbidity averaging is software filter to minimize noise and provide more stable readings for turbidity. This parameter can be set without affecting the response times of other measurements.

As is the case for the other measurements, averaging is useful to provide representative readings of the "average" value in flowing water. Turbidity averaging can be set separately because the optical turbidity sensor is more strongly affected by bubbles and debris in the water stream than the other sensors.

Press <Modify> to enter the number of samples to average. The value can be set from 1 to 20 samples. The default value is 1.

Chapter 7 - CALIBRATION MODE

HI 9829's calibration routines are accessed by highlighting "Calibration" and pressing <Select> from the main menu. Calibration is the process that standardizes the electrical or optical signals from the sensors to reagent standards of known value.



Calibrations are intuitive and menu driven. All calibration data is stored in the non volatile probe memory, allowing probes to be connected to different meters without recalibration.

There are two types of calibrations available: the **"Quick calibration"**, which is used for a single point calibration of pH, Conductivity, and/or Dissolved Oxygen and is handy for field work; and the **"Single param. calibration"** that allows each parameter to be calibrated individually. The user may also restore each parameter to a factory default calibration.

Note The password will be required if password protection is enabled.

To optimize measurements, it is advisable to establish the optimum calibration period required for the measurement environment.

Calibration requirements vary with deployment conditions, for example very turbid biologically-active waters may require more frequent cleanings and calibrations than cleaner waters.

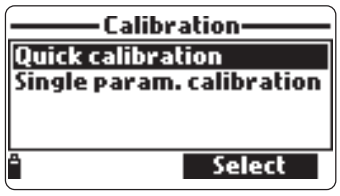
General calibration guidelines are listed below:

- Set up a routine service schedule where measurement integrity is validated. This is especially important for new installation sites or long deployments.
- Inspect sensor connectors for corrosion and replace damaged sensors.
- Inspect sensor o-rings for damage and if necessary replace and lubricate with the grease found in the probe maintenance kit.
- Do not handle the sensing surfaces of the sensors.
- Avoid rough handling and abrasive environments that can scratch the reactive surfaces of the sensors.
- Avoid long-term exposure of sensors to bright sunlight (especially chloride ISEand turbidity sensor). If possible, calibrate in a shaded area.
- Discard standards after use. Do not return the used standards to the bottles of "fresh" solution.
- For measurements across a temperature gradient (when water temperature is drastically different from the standards), permit the sensors to reach thermal equilibrium before conducting calibrations or making measurements. The heat capacity of the probe is much greater than the air and the small beakers of calibration standards.

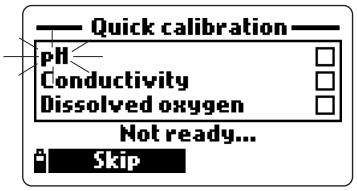
7.1 QUICK CALIBRATION

The quick calibration method provides a quick single point calibration for pH, conductivity and dissolved oxygen sensors. **HI 9828-25** calibration solution is used for both pH and conductivity.

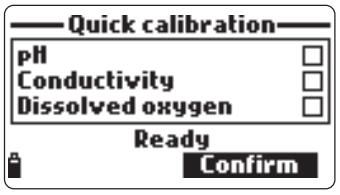
- Fill the calibration beaker 2/3 full with **HI 9828-25** calibration solution.
- Slowly place the sensors into the solution and dislodge bubbles that may adhere to the sensors.
- Screw the calibration beaker completely on the probe body. Some solution may overflow.
- Wait a few minutes for the system to stabilize.
- From the "Calibration" menu select "Quick calibration".



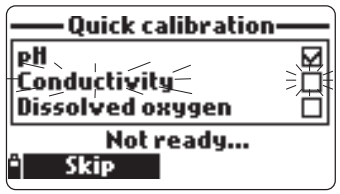
- A three item calibration menu will appear (pH, Conductivity and Dissolved oxygen) and "pH" will start to blink along with the "Not ready" message.



- When the pH signal is stable, the "Ready" message appears. Press <Confirm> to store the calibration data.
- The "Storing" message will appear as the calibration proceeds to the next sensor. A checkmark will appear in the box next to "pH" to indicate a successful calibration.



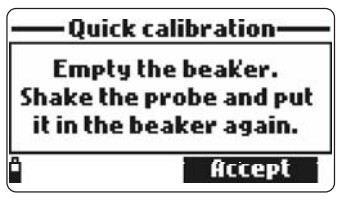
Note To bypass any of the calibrations press <Skip> to move to the next sensor in the quick calibration menu.
If the pH sensor is not installed the message "pH sensor not installed! Skip to conductivity calibration" will appear.



- Following the pH calibration, "Conductivity" will start to blink along with the "Not ready" message.
- When the measurement is stable, "Ready" appears. Press <Confirm> to store the calibration data and the "Storing" message will appear.

Note If EC calibration is not required, skip to the D.O. quick calibration by pressing the <Skip> softkey.

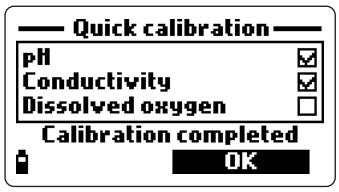
- The message "Empty the beaker." will appear.



- Unscrew the calibration beaker and empty the solution.
- Shake any remaining liquid off the probe and beaker. No droplets should remain on the D.O. sensor membrane.

Note Do not attempt to dry wipe the D.O. sensor as damage to the mem brane may occur.

- Screw the empty calibration beaker on the probe body. The beaker should not be dry.
- Press <Accept> to close the displayed message.
- When the measurement is stable, "Ready" appears. Press <Confirm> to store the calibration data and the "Storing" message will appear.
- Press <OK> to return to "Calibration" menu.

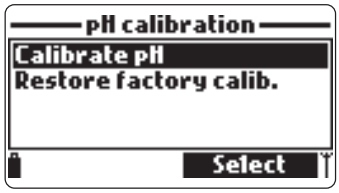


Note To quit the quick calibration procedure, press ESC at any time.

After every calibration the quick calibration window will show a check mark in the box next to the calibrated parameter.

7.2 pH CALIBRATION

To optimize the pH measurement follow the general guidelines mentioned in the Chapter 7 introduction.



From the "Calibration" menu select "Single param. calibration" and then "pH calibration". The display shows two options: "Calibrate pH" and "Restore factory calib.".

If a new pH sensor has been installed use "Restore factory calib." before performing a user calibration as some warning messages are based on changes from previous calibrations.

If "Restore Factory Calib" is selected, all user calibration data will be deleted and the factory default calibration is restored. A user calibration should follow immediately.

If "Calibrate pH" is selected, the user can perform a new calibration using up to 3 buffers (pH 4.01, 6.86, 7.01, 9.18, 10.01 or one custom buffer).

When a 3-point calibration is performed, all old data are overwritten, while with a single or 2-point calibration the meter will also use information from the previous calibration.

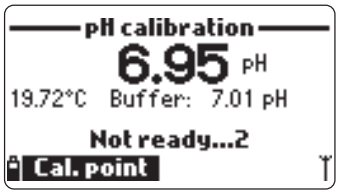
7.2.1 Preparation

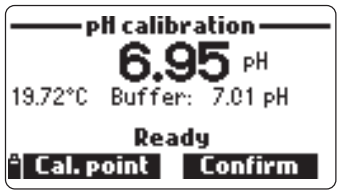
Pour small quantities of the selected buffer solutions into clean beakers. To minimize cross contamination, use two beakers for each buffer solution: the first one for rinsing the sensor and the second one for calibration.

7.2.2 Procedure

The measured pH value is displayed, along with the temperature and the buffer value on the second level.

If necessary, press the <Cal point> softkey and use the arrow keys to select the correct buffer.





- Immerse the pH sensor in the first buffer rinse solution and stir gently.
- Immerse the pH sensor *and temperature probe* into the selected buffer and stir gently. The temperature, pH buffer value and the "Not ready" message are displayed.
- Once the reading has stabilized the countdown timer will count down until the display shows the "Ready" message.
- Press <Confirm> to accept the calibration point.

- After the calibration point is confirmed, to avoid cross-contamination immerse the sensors in the next calibration buffer rinse solution and stir gently.
- Press <Cal Point> to select the next buffer (if necessary), and repeat the calibration procedure outlined above with the second and third buffers.

Note The calibration procedure can be terminated after a single or 2 point calibration by pressing <ESC>. The message "Storing" followed by "Calibration completed" will be displayed.

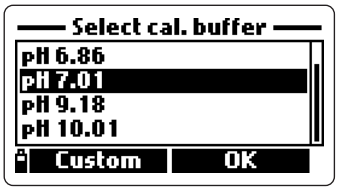
- Press <OK> to return to the Calibration menu.
- Press <Measure> to return to the measurement screen.

Note: If a single point calibration is conducted after restoring the factory calibration, it will offset the entire factory probe values by the same offset required to calibrate the sensor to the single buffer value.

Custom buffer calibration

The **HI 9829** permits a single custom buffer to be used for pH calibration. This can be used along with standard buffers as part of a 2 or 3 point calibration or as a single point.

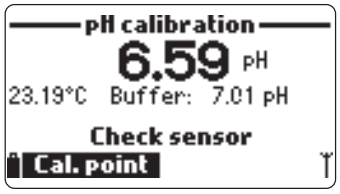
- To select this option first press <Cal. point> and then <Custom> while the meter is waiting for stable reading.
- A text box window will appear. Use the keypad to enter the value of the buffer at the current temperature. The valid range for custom a buffer is from 0.00 to 14.00 pH.

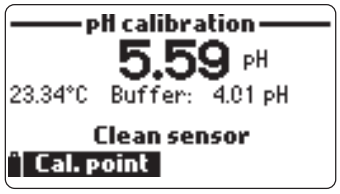


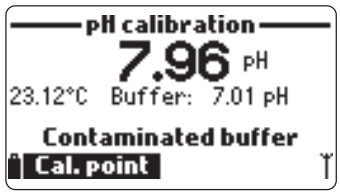
7.2.3 pH Calibration Error Messages

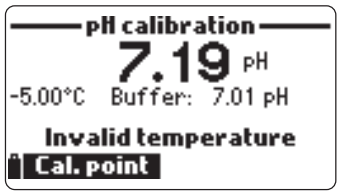
The **HI 9829** displays a series of messages if an error has occurred during calibration.

If the meter does not accept a pH calibration point, a short message is displayed to indicate the possible error source. The following screens are examples:







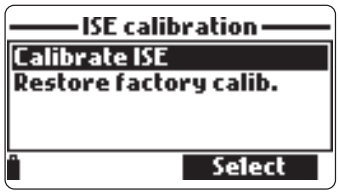


These are the available messages:

- "Input out of scale": the pH value is out of range. The pH sensor may require replacement.
- "Check sensor": the electrode may be broken, very dirty or the user has attempted to calibrate the same buffer value twice. This may also occur if a new pH sensor has been installed and"restore factory calib" has not been exercised.
- "Wrong buffer": the displayed pH reading is too far from the selected buffer value. This is often seen immediately after a buffer calibration has been completed but before the pH sensor has been moved to the next buffer. Check if the correct calibration buffer has been selected.
- "Invalid temperature": the buffer temperature is outside the acceptable range.
- "Wrong buffer" / "Contaminated buffer" / "Check electrode": the buffer is contaminated or the sensor is broken or very dirty.
- "Check sensor" / "Clean sensor": the electrode is broken or very dirty.
- "Wrong" / "Clear old calibration": erroneous slope condition. These messages appear if the slope difference between the current and previous calibration exceeds the slope window (80% to 110%). Press <Restore Factory calib.> to clear old data and continue the calibration procedure, or press ESC to quit the pH calibration mode.

7.3 ISE CALIBRATION

From the "Calibration" menu select "Single param. calibration" and then "ISE calibration". The display shows two options: "Calibrate ISE" and "Restore factory calib".



When an ISE replaces a pH sensor or another ISE model, previous calibrations need to be cleared using the <Restore factory calib.> option first.

If "Calibrate ISE" is selected, the user can perform a single (10 ppm) or 2 point calibration with standard 10 ppm and 100 ppm solutions.

If "Restore Factory Calib" is selected, all user calibration data will be deleted and the default calibration is restored.

Notes The ppm tag will blink when a user calibration was not performed.

When a 2-point calibration is performed, all of the old data is overwritten, whereas for a single point calibration the meter will also use information from the previous calibration.

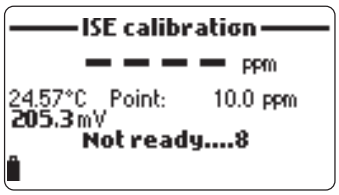
7.3.1 Preparation

Prepackaged standards are available in single use sachets. Rinse the ISE with water and shake off excess water. The procedure always uses 10 ppm first.

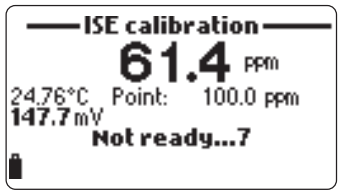
7.3.2 Procedure

Cut open the 10 ppm sachet and pour a small quantity of standard over the ISE tip to rinse the sensor. This should be done over a waste container. Immerse the **ISE sensor and temperature probe** into the standard. Position the sachet to ensure sensor membrane and ceramic junction are completely covered with solution.

The current measurement or dashes, temperature, the standard value and the "Not ready" message are displayed.



- Once the ISE has stabilized the countdown timer will count down until the display shows the "Ready" message.
- Press <Confirm> to accept the calibration point.
- After the first calibration point is confirmed, remove sensor from sachet packet and shake standard off. Blot excess with a soft tissue. Cut open the 100 ppm sachet. Immerse the ISE sensor and temperature probe into the standard.



Position the sachet to ensure sensor membrane and ceramic junction are completely immersed in solution. A value close to 100 ppm and the message "Not ready..." will be displayed.

- When the reading is stable, the countdown timer will count down until the display shows the "Ready" message.
- Press <Confirm> to accept the calibration.
- After the second calibration point is confirmed the display shows the following messages: "Storing" and "Calibration completed".
- Press <OK> to return to the Calibration menu.
- Press <Measure> to return to the measurement screen.

Note The ISE calibration mode can be exited at any time, by pressing the ESC key.

7.4 ORP CALIBRATION

The "ORP calibration" allows the user to perform a single point custom calibration (relative mV) or to restore the factory calibration.

The Oxidation-Reduction Potential (ORP), displayed in mV, is the voltage that results from the difference in potential between the platinum ORP sensor and the silver/silver chloride reference electrode. ORP values are not temperature compensated, although ORP values can change with temperature (e.g. reference electrode potential changes, sample equilibrium changes). It is important to report ORP values together with the reference electrode used and the temperature.

The inert platinum ORP surface provides an electron exchange site with the sample (or standard) and its surface. The electron exchange is typically very fast in well-poised solutions (standards for example), but may be more lengthy in natural water samples.

Calibration is typically not required for a new ORP sensor, but the process does establish a baseline that can be used as a comparison for future validations.

Calibration is used to compensate for changes due to contamination of the platinum surface and drift in the reference electrode.

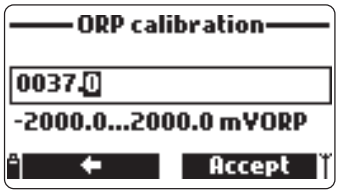
A relative mV calibration can also be made to remove the voltage attributable to the Ag/AgCl reference electrode (to display the ORP versus a SHE (standard hydrogen electrode). This is really an arithmetic correction and is correct only at the standard temperature. For example, HI 7022L reads 470 mV at 20°C versus the Ag/AgCl reference. The ORP mV versus a SHE would be 675 mV. (add 205 mV to the observed value).

7.4.1 Preparation

Appendix D – ACCESSORIES lists Hanna solutions used for ORP calibrations. The calibration should be conducted at temperatures between 20-26°C. The sensor should be clean and oil free.

7.4.2 Procedure

- From the "Calibration" menu select "Single param. calibration" and then "ORP calibration". The display shows two options: "Custom ORP" and "Restore factory calib.".
- For a user calibration select "Custom ORP".
- Fill a beaker with an ORP test solution (see APPENDIX D "Accessories").
- Using the keypad, insert the numerical ORP value and then press <Accept> to confirm.
- The stability counter will count down and the message "Ready" and <Confirm> will be displayed.
- Press <Confirm> to accept the calibration point.



- After confirmation, the following messages are displayed: "Storing" and "Calibration completed".
- Press OK to return to the Calibration menu.
- Press <Measure> to return to the measurement screen.
- To restore the factory calibration data, select the corresponding option in the "ORP calibration" menu and then press <Select>.

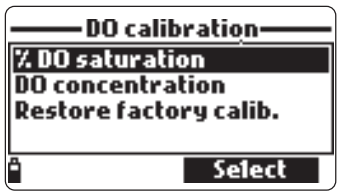
7.5 DISSOLVED OXYGEN CALIBRATION

The accuracy of dissolved oxygen measurements is directly related to membrane cleanliness and calibration technique. Oily coating and biological contaminants are the primary cause of calibration drift in dissolved oxygen sensors. Unfortunately, brushes or other cleaning objects may damage the membrane. Replacing the membrane cap and electrolyte is the best way to perform periodic maintenance.

Although it may be easier to calibrate the D.O. sensor prior to deployment, it is advised to calibrate at the site of deployment. Errors in measurement may result if altitude and barometric pressure differ between the calibration and measurement site. This is very important for autonomously logging probes.

Note Perform either the % D.O. Saturation or D.O. Concentration calibration.

If the % D.O. saturation range is calibrated, the D.O. concentration range will also be calibrated, and vice versa.

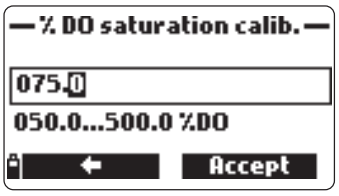


Dissolved oxygen concentration values are based on % D.O. saturation, temperature, salinity and atmospheric pressure. A standard solution or a reference D.O. meter may be used to compare readings during calibration.
The calibration of the D.O. concentration range can only be performed at a single custom point (4 to 50 mg/L). It is recommended to calibrate the D.O. sensor close to the values that will be measured.

Choose "DO calibration" from the "Calibration" menu, select the D.O. calibration type using the arrow keys and press <Select> to confirm.

<u>% D.O. saturation</u>

The calibration of the % D.O. saturation range can be performed at a single or 2 standard points (0 % and 100 %), or at a single custom point (50 % to 500 %).



Procedure:

- To calibrate at 100 %, fill the calibration beaker with approximately 4 mm (5/32") of water and screw it onto the probe. The membrane should not be wet. This condition corresponds to air 100 % saturated with oxygen and water vapor.
- The reading, temperature, calibration point and the "Not ready" message are displayed.
- Once the reading has stabilized the countdown timer will count down until the display shows the "Ready" message.
- Press <Confirm> to accept the calibration point. After confirmation, put the D.O. and temperature sensors into **HI 7040L** zero oxygen solution and wait for stability to be reached. The stability timer will count down and <Confirm> will appear. Press <Confirm> to store the calibration.
- The following messages will appear: "Storing" and "Calibration completed".
- Press <OK> to return to the "Calibration" menu.
- Press ESC twice to return to the main menu.
- Press <Measure> to return to the measurement screen.

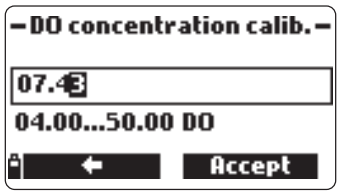
Note The user can perform a single point calibration by pressing <ESC> after the first point is accepted.

Note If the D.O. input is not within the acceptable range, the message "Invalid input" is displayed.

Single point Custom % saturation calibration

- For a calibration at another known value place sensor and temperature probe into the known solution and change the calibration value, press the <Cal. point> softkey and select the desired point.
- To insert a different calibration value, press <Cal. point> and then <Custom>. Insert the desired value using the keypad, then press <Accept>.
- When the reading is stable, the "Ready" message is displayed. Press <Confirm> to store the calibration point.
- The following messages will appear: "Storing" and "Calibration completed".
- Press <OK> to return to the "Calibration" menu.
- Press ESC twice to return to the main menu.
- Press <Measure> to return to the measurement screen.

D.O. concentration



Verify the barometric pressure, conductivity and temperature reading are correct. Calibrate them if necessary. To calibrate the D.O. concentration range, a solution with known Dissolved Oxygen concentration value is needed. The solutions used to calibrate with should be determined independently (for instance by Winkler titration). Place the D.O. sensor with temperature sensor into the known solution.

- From the "DO calibration" menu, select the "DO concentration" option, insert the known concentration. Allow the sensors to reach thermal equilibrium with the solution. Stir or agitate if possible to keep fresh solution in front of the membrane and press <OK>.
- When the reading is stable, the stability timer will count down and <Confirm> will appear. Press <Confirm> to accept the value.
- When the messages "Storing" and "Calibration completed" appear, the calibration is completed. To return to the "Calibration" menu, press <OK>.
- To return to the main menu, press ESC twice.

7.6 CONDUCTIVITY CALIBRATION

A conductivity calibration is used to adjust for variations in cell factors by using a standard solution of known conductivity. Oily coating and biological contaminants are the primary cause of calibration drift in conductivity sensors. This type of fouling changes the apparent cell geometry, resulting in a shift in cell constant. Before performing a conductivity calibration inspect the EC sensor for debris or blockages. The EC electrodes are situated inside the two small channels

found in the bottom of the conductivity sensor. Clean using the small brush from the probe maintenance kit. Flush with water. A mild detergent may be used to remove oily coatings. Always flush with clean water after cleaning.

Note For a correct conductivity calibration, the probe shield or the calibration beaker must be used.

The conductivity calibration menu includes 3 different types of calibration: Conductivity, Absolute conductivity and Salinity.

The "Conductivity" option allows a single point calibration with a standard solution selectable by the user. This calibration is temperature compensated.

The "Absolute conductivity" option allows a single point calibration with a conductivity solution of known non-temperature compensated value at the current temperature.

The "Salinity" option allows calibration with a standard salinity solution.

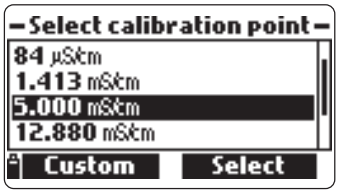
The 3 calibrations are related, so that each one will calibrate all 3 measurements.

Note To improve accuracy, choose a calibration standard near the sample conductivity.

Choose "Conductivity calibration" from the "Calibration" menu, select the calibration type using the arrow keys and press <Select> to confirm.

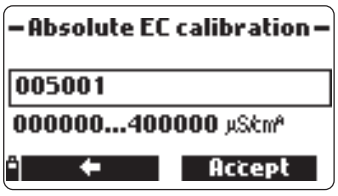
Conductivity

- Select the "Conductivity" option and press <Select> to confirm.
- Fill the calibration beaker with a conductivity standard (see APPENDIX D - "Accessories" for choosing the proper HANNA standard solution).
- Pour additional standard into a second beaker to be used to rinse the sensor.
- Immerse the sensor into the rinse standard by raising and lowering the beaker a few times to ensure that the EC sensor channels are filled with fresh standard.
- Place the calibration beaker over the EC sensor and dislodge any trapped bubbles. Screw the beaker into place. Wait for the reading to stabilize.



- The main display shows the actual reading, while the secondary level displays the current temperature and the standard value.
- To change the standard value, press <Cal. point> and the list of available standard values is displayed: 0 µS/cm, 84 µS/cm, 1413 µS/cm, 5.00 mS/cm, 12.88 mS/cm, 80.0 mS/cm and 111.8 mS/cm.
- The third level displays the status message.
- Press <Custom> to insert a custom value (temperature compensated value). Insert the desired value using the keypad, then press <Accept>.
- When the reading becomes stable, the stability timer will count down and <Confirm> will appear. Press <Confirm> to save the calibration.
- After confirmation, the following messages are displayed: "Storing" and "Calibration completed".
- Press <OK> to return to the "Calibration" menu.
- Press ESC twice to return to main menu.
- Press <Measure> to return to the measurement screen.

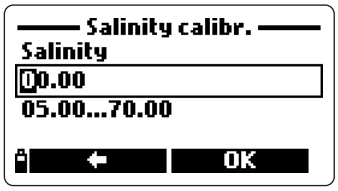
Absolute Conductivity



- Select "Absolute conductivity" from the "Conductivity calibration" menu.
- Use the keypad to enter the custom value with the desired resolution. Press <Accept> to confirm.
- Fill the calibration beaker with conductivity standard with known conductivity at the temperature of standardization.
- Pour additional standard into a second beaker to be used to rinse the sensor.
- Immerse the sensor into the rinse beaker and raise and lower the beaker to ensure that the EC sensor channels are filled with fresh standard.
- Place the calibration beaker over the EC sensor and dislodge any trapped bubbles. Screw the beaker into place.
- Wait for the reading to stabilize. The stability timer will count down and <Confirm> will appear.
- Note the temperature and adjust the conductivity value if needed.
- Press <Confirm> to save the calibration.
- After confirmation, the following messages are displayed: "Storing" and "Calibration completed".
- Press <OK> to return to the "Calibration" menu.
- Press ESC twice to return to the main menu.
- Press <Measure> to return to the measurement screen.

Salinity

The measurement of salinity is based on the Practical Salinity Scale which uses the EC measurement. If the user has a standard with known PSU value it may be used to calibrate the conductivity sensor.



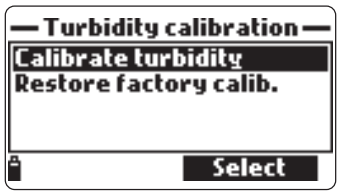
- Select "Salinity" from the "Conductivity calibration" menu.
- Use the keypad to enter the known salinity value of the calibration solution. Press <Accept> to confirm.
- Fill the calibration beaker with salinity standard of known value.
- Pour additional standard into a second beaker to be used to rinse the sensor.
- Immerse the sensor into the rinse beaker and raise and lower the beaker to ensure that the EC sensor channels are filled with fresh standard.
- Place the calibration beaker with standard over the EC sensor and dislodge any trapped gas bubbles. Screw the beaker into place.
- Wait for the reading to stabilize. The stability timer will count down and <Confirm> will appear.
- Note the temperature and adjust the salinity value if needed.
- Press <Confirm> to save the calibration.
- After confirmation, the following messages are displayed: "Storing" and "Calibration completed".
- Press <OK> to return to the "Calibration" menu.
- Press ESC twice to return to the main menu.
- Press <Measure> to return to the measurement screen.

Notes These procedures calibrate the slope value. To calibrate the offset, set the calibration point at 0 µS/cm and repeat the procedure.

If the temperature input is not within the acceptable range (0 to 50°C), the message "Invalid temperature" is displayed.

If the conductivity input is not within the acceptable range, the message "Wrong standard" is displayed.

7.7 TURBIDITY CALIBRATION



From the "Calibration" menu select "Single param. calibration" and then "Turbidity calibration". The display shows two options: "Calibrate turbidity" and "Restore factory calib".

The Hanna turbidity sensor conforms to ISO 7027 standards which specifies the angle between the emitted and detected light and the light source wavelength. For best results perform a three point calibration at 0.0, 20.0, and 200.0 FNU. Although the basis of calibration for this measurement is the standard Formazin, from a practical point of view, these standards require daily preparation. A secondary standard based upon polystyrene beads is a more practical approach. See APPENDIX D – Accessories for information regarding Hanna calibration solutions.

Note: Turbidity standard formulations made with polystyrene beads are instrument specific and cannot be swapped with standards made for another turbidity sensor model.

Verify the sensor is clean before calibrating. The use of the **HI 7698293** calibration beaker is required for this procedure.

Warning: Do not calibrate in bring sunlight.

Calibration is required every time the sensor is replaced and is recommended to be part of yearly validation of your system.

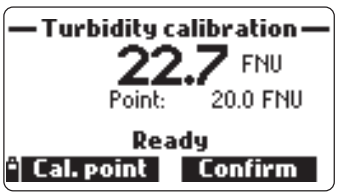
7.7.1 Preparation

Pour quantities of selected standard solutions into clean beakers for rinse. Fill the **HI 7698293** calibration beaker with the zero standard. Submerse the turbidity sensor into zero rinse beaker and then shake off excess solution. Place the sensor into the calibration beaker. It is extremely important that no bubbles are present on the optical area. Gentle agitation of sensor or beaker may be required to dislodge bubbles before screwing the beaker on fully. Do not place hands on the calibration beaker during calibration.

7.7.2 Standard Procedure

Select "Calibrate turbidity" from the menu.
The measured value is shown on the main part of the display, while the standard value appears on the secondary level.

- The current turbidity value, the standard value and “Not ready...” are displayed and a stability timer counts down.
- When the reading becomes stable, the display shows the “Ready” message.
- Press <Confirm> to accept the calibration point and to continue with second standard.



- Clean out the calibration beaker and refill with 20.0 FNU standard.
- Immerse the sensor in the 20.0 FNU rinse beaker and then shake off excess solution. Place the sensor into the 20.0 FNU calibration beaker and take measures to eliminate bubbles from the optical area.
- When the reading is stable the display shows the “Ready” message.
- Press <Confirm> to accept the second calibration point. The calibration can be stopped after the 20FNU point. Press ESC. Storring will be displayed followed by Calibration completed. Press <OK> or <Measure>.

Alternately, to continue with third standard:

- Clean out the calibration beaker and refill with 200.0 FNU standard.
- Immerse the sensor in the 200.0 FNU rinse beaker and then shake off excess solution. Place the sensor into the 200.0 FNU calibration beaker and take measures to eliminate bubbles from the optical area.
- When the reading is stable the display shows the “Ready” message.
- Press <Confirm> to accept the third point and save the calibration.
- After confirmation, the following messages are displayed: “Storing” and “Calibration completed”.
- Press <OK> to return to the “Calibration” menu.
- To return to the main menu, press ESC twice.
- Press <Measure> to return to the measurement screen.
- To restore the factory calibration data, select the corresponding option in the “Turbidity calibration” menu and then press <Select>.

Note The calibration procedure can be terminated after 1 or 2 points by pressing <ESC>. A single point calibration is only recommended to update the offset of a previous 2 or 3 point calibration. A 2 point calibration is recommended when the expected turbidity readings are below 100 FNU.

7.7.3 Custom Turbidity Calibration Procedure

If the user wishes to calibrate with standard Formazin standards it is possible using the custom point. Prepare standards based upon published international protocols.

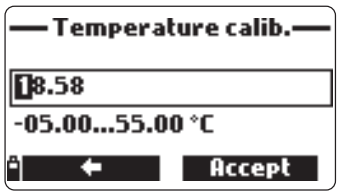
The first point is zero. The second point must be a standard between 10 and 30 FNU. The third point must must be a standard prepared between 100 and 500 FNU.

Pour quantities of standard solutions into clean beakers for rinse. Fill the **HI 7698293** calibration beaker with the zero standard and follow the procedure for calibrating zero from section 7.7.2.

- After confirming zero, clean out the calibration beaker and refill with custom point 2 FNU standard. Immerse the sensor in the Point 2 custom FNU rinse beaker and then shake off excess solution. Place the sensor into the Point 2 custom FNU calibration beaker and take measures to eliminate bubbles from the optical area. Press <Cal. point> and T9 key pad to display the standards value. Press <Accept>.
- When the reading is stable the display shows the "Ready" message.
- Press <Confirm> to accept the second calibration point. The calibration can be stopped after the 2nd Custom FNU point. Press ESC. Storring will be displayed followed by Calibration completed. Press <OK> or <Measure>. Alternately, continue with Custom Point 3 standard using the procedure described above.

7.8 TEMPERATURE CALIBRATION

The probe is factory calibrated for temperature readings. The user can perform a single point temperature calibration or restore factory calibration. This procedure requires a reference temperature measuring instrument.



- Select "Temperature" from the "Calibration" menu.
- Select "Calibrate temperature".
- Insert the probe in an isothermal bath with reference instrument and allow the probe to come to thermal equilibrum.
- Use the keypad to enter the known temperature and then press <Accept> to confirm.
- The stability timer will count down and the message "Ready" and <Confirm> will be displayed.
- Press <Confirm> to store the calibration point.

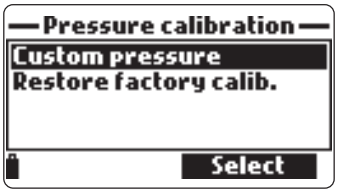
7.9 ATMOSPHERIC PRESSURE CALIBRATION

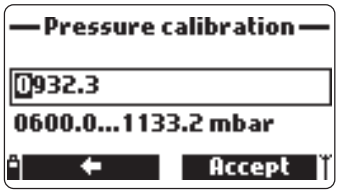
Place **HI 9829** in a wind-free area and choose "Custom pressure" to perform a user calibration or "Restore factory calib".

Note "Custom pressure" procedure requires a reference barometer.

Select the "Atm. pressure" from the "Calibration" menu.

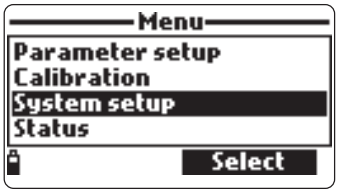
- Select the "Custom pressure" option.
- Using the keypad, insert the numeric value that agrees with the reference meter and then press <Accept> to confirm.
- The stability counter will count down and the message "Ready" and "Confirm" will be displayed. Press <Confirm> to store the calibration point.
- After confirmation, the following messages are displayed: "Storing" and "Calibration completed".
- Press <Measure> to return to the measurement screen.
- Press <OK> to return to the "Calibration" menu.
- To restore the factory calibration, select "Restore factory calib." in the "Pressure calibration" menu and press <Select>.
- After confirmation, the following messages are displayed "Storing" and "Calibration completed".
- Press <OK> to return to the "Calibration" menu.
- Press <Measure> to return to the measurement screen.
- To restore the factory calibration, select the corresponding option in the "Temperature calib." menu and then press <Select>.

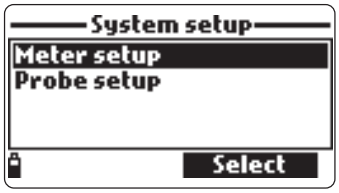




Chapter 8 - SYSTEM SETUP

From the main menu, select “System setup” and then “Meter setup” or “Probe setup”.





8.1 METER SETUP

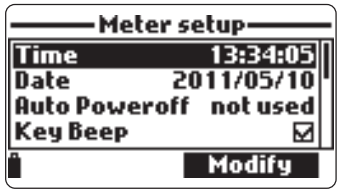
Note If the password protection is enabled, you will be required to enter the password before any settings can be modified.

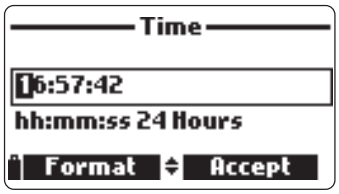
8.1.1 Time

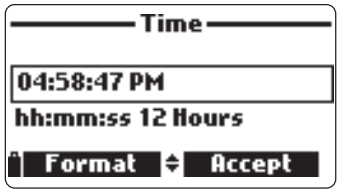
The meter uses a real time clock for logging. The time and time format are set in this function.

Press <Modify> and set the time using the keypad. Press <Accept> to save the time. When using the 12 hour format, press A or P on the keypad for AM or PM after you set the time.

Press <Format> to change between 12 and 24 hour formats. The default format is 24 hours.





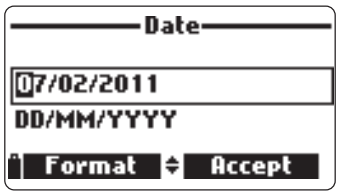


8.1.2 Date

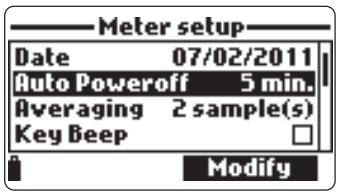
The date and date format are set in this function.

Press <Modify> and set the date using the keypad. Press <Accept> to save the date.

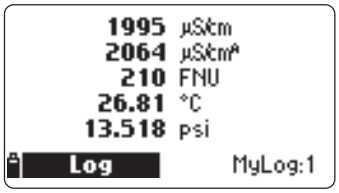
Press <Format> to change between the available date formats: DD/MM/YYYY, MM/DD/YYYY, YYYY/MM/DD, YYYY-MM-DD, MM-DD-YYYY, and DD-MM-YYYY. The default format is YYYY/MM/DD.



8.1.3 Auto Poweroff

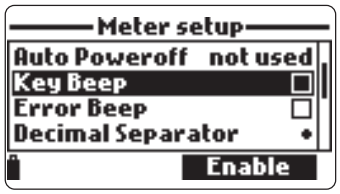


The Auto Poweroff function is used to save battery life. After the set time is elapsed, the meter will:
1. automatically switch off, if in normal measurement mode. Press On/Off to switch on again.
2. enter a sleeping mode, if the continuous logging mode is selected with a logging interval of at least 30 seconds. The "Auto Poweroff" message and the <Wake up> softkey appear on the LCD; logging is not stopped. Press <Wake up> to reactivate the display.



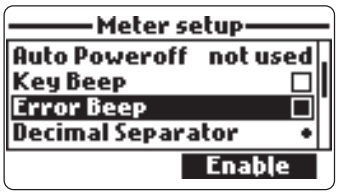
Available options are: Not used (disabled), 5, 10, 15, 20, 30 or 60 minutes. Press <Modify> to select the desired time interval. The default value is "not used".

8.1.4 Key Beep



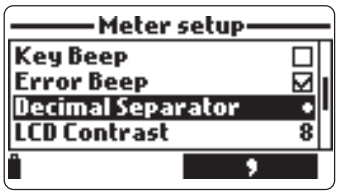
If enabled, an acoustic signal sounds every time a key is pressed. A checked box indicates this function has been enabled. The default setting is disabled.

8.1.5 Error Beep



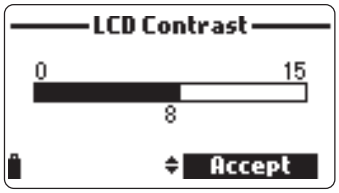
If enabled, an acoustic signal sounds every time an incorrect key is pressed, or when an error occurs. A checked box indicates this function has been enabled. The default setting is disabled.

8.1.6 Decimal Separator



The user can select the type of decimal separator: "dot" or "comma". Press the softkey to select the desired option. The default setting is "dot".

8.1.7 LCD Contrast



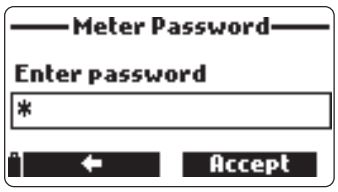
The LCD contrast can be adjusted with this function. Press <Modify> to enter this function. Use the arrow keys to change the contrast level and press <Accept> to save the new value. The default value is 8.

8.1.8 Meter Password

The Meter Password protects against unauthorized configuration changes and log data erasure. When implemented, many setting and functions cannot be modified or viewed.

To enable the password proceed as follows:

- Highlight "Meter Password" and press <Modify>.
- Enter the desired password in the text box and press <Accept>.



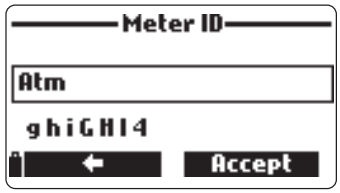
Note While typing, the characters are masked with a "*" (star) symbol.

- The meter will require password confirmation. Retype the same password and press <Accept> to confirm.
- The meter returns to the "Meter Setup" menu. The checkbox corresponding to the meter password is checked.

To disable the password protection highlight "Meter Password" and press <Modify>, enter the password and then press <Disable>. "No password" appears in the text box. Press <Accept> to confirm.

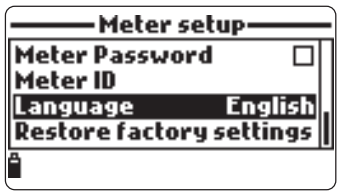
8.1.9 Meter ID

The Meter ID may be used to uniquely identify a meter/operator. Press <Modify> and a text box appears. Use the keypad to insert the desired alphanumeric ID and press <Accept> to store the identification. A maximum of 14 characters can be used.



8.1.10 Language

The language used in the meter user interface can be changed. The default language is English. Please contact your local Hanna office for currently available languages.



8.1.11 Restore factory settings

This function restores measurement settings to their original factory values. This includes measurement units, coefficients, other measurement configurations and all logged data. The factory calibration for the sensor channels is not affected.

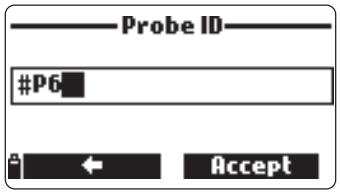
• Select the “Restore factory settings” and press <Select>.

• The meter will ask to confirm: press <Yes> to confirm or <No> to escape.

8.2 PROBE SETUP

8.2.1 Probe ID

The probe can be labeled with an identification code: press <Modify> and a text box will be displayed. Use the keypad to enter the desired alphanumeric code and then press <Accept>.
A maximum of 14 characters can be used.



8.2.2 Probe Password

The Probe Password protects the probe against unauthorized configuration changes and log data erasure. When implemented, many setting and functions cannot be modified or viewed.

To enable the password:

• Highlight the “Probe Password” and press <Modify>.

• Enter the desired password in the text box and press <Accept>.

Note While typing, the characters are masked with “*” (star) symbols.

• The probe will require confirmation. Retype the same password and press <Accept> to confirm.

• The meter returns to the “Probe Setup” menu. The checkbox corresponding to the probe password is checked.

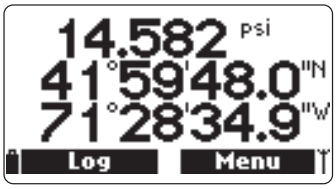
To disable the password, highlight the “Probe Password” and press <Modify>. Enter the password and then press <Disable>. “No password” appears in the text box. Press <Accept> to confirm.

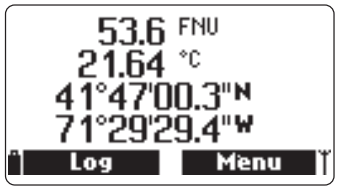
Chapter 9 - GPS MENU (optional)

HI 9829 model featuring GPS (Global Positioning System) is provided with a built-in 12 channel receiver and antenna to calculate meter position and track locations along with measurement data.

The GPS has a position accuracy of 10 meters (30 ft).

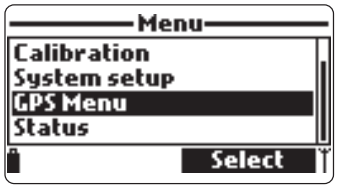
The GPS coordinates can be shown on the LCD together with up to 10 measurement parameters, and are recorded with logged data.





The GPS signal strength is always displayed through a 3 length antenna indicator on the bottom right corner of the LCD. If the antenna symbol is blinking, the satellite acquisition is not yet completed or the signal strength is not sufficient. Signal strength can be improved by moving outdoors and away from buildings and trees.

The user can associate GPS coordinates with alphanumeric locations, which will be assigned to the logged data.



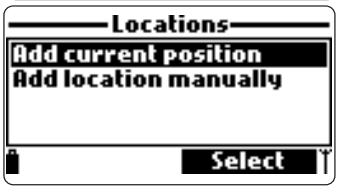
- To enter the GPS menu, press <Menu> from measurement mode and select "GPS menu".

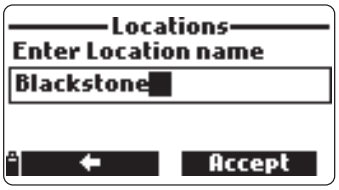
<u>All locations / Nearby locations</u>

These options display all stored locations. Selecting "Nearby locations" will filter out locations that are further than 100 km (or 100 mi) from the current location. If a GPS signal has been obtained, the distance from the current position to the nearby locations is also displayed.

Press <Info> to view the GPS coordinates of the selected location. Press <Delete> to erase the selected location.

Press <New> to add a new location. Coordinates for a new location can be entered manually or by using the current GPS coordinates.

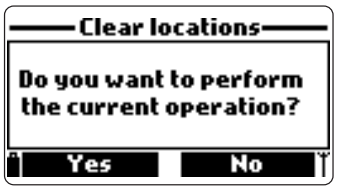




Clear all locations

This option deletes all locations. The meter will ask for confirmation before proceeding, by displaying the message "All location information will be erased. Continue?".

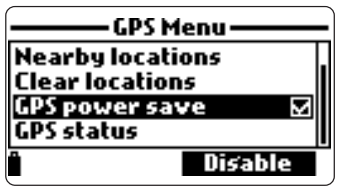
Press <Yes> to confirm deletion or <No> to return to the previous screen.



GPS power save

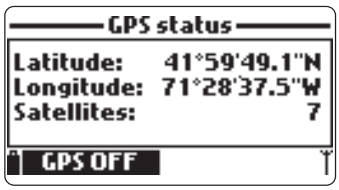
This feature saves battery life by automatically switching the GPS unit off when the meter is in continuous logging mode with a logging interval of at least 4 minutes. The GPS unit will turn off after each measurement and turn on again 3 minutes before the next measurement is taken.

If the GPS unit cannot obtain a position fix within two minutes, it will keep the GPS on by disabling the power save feature.



GPS status

This screen displays the following GPS information: latitude and longitude of the current position, number of acquired satellites, time elapsed since last detected position (if the GPS signal is not currently available).



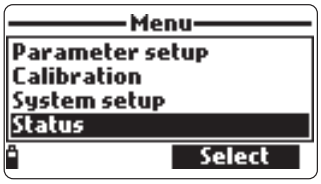
Pressing <GPS OFF> will disable the GPS unit.

Pressing <GPS ON> will enable the GPS unit and show the GPS receiver model and version.

Since the power consumption of the GPS unit is significant, it is recommended to turn the GPS unit off when it is not needed.

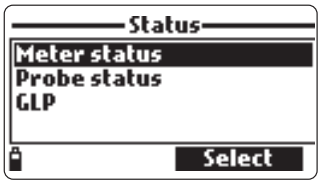
Chapter 10 - STATUS

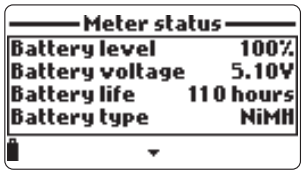
Useful information regarding the meter, probe (if connected) and GLP calibration data are available for viewing by selecting "Status" from the main menu.

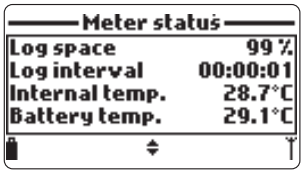


10.1 METER STATUS

Select "Meter Status" to display information related to the battery, logging, internal temperature, password, Meter ID, serial number and firmware version. Press [up] and [down] to scroll through the status screens. Press ESC to return to the "Status" menu.



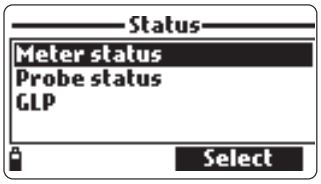


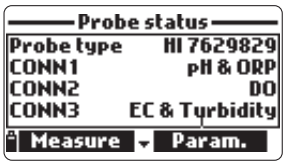


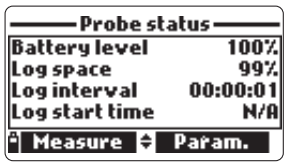
10.2 PROBE STATUS

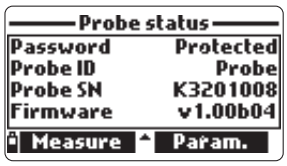
Select "Probe Status" to display information related to the probe type, connected sensors, battery level, logging (if logging probe), password, Probe ID, serial number and firmware version.

- Press [up] and [down] to scroll through the status screens.
- Press ESC to return to the "Status" menu.







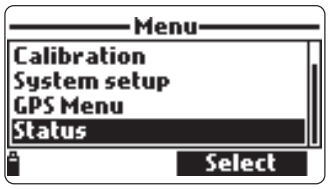


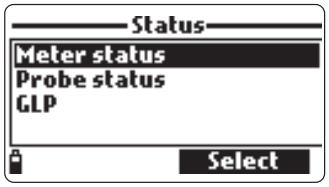
Note The probe status screen will automatically be displayed when the probe sensor status has changed. If this occurs, the "Measurement Screen" and "Parameter Selection" softkeys are available (see Section 5.2).

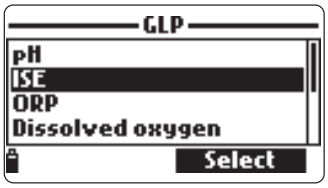
10.3 GLP Data

GLP (Good Laboratory Practice) is a set of functions that allows the user to store or recall data regarding the probe calibration. This feature also allows the user to associate readings with specific calibrations.

To view GLP data select "GLP" from the "Status" menu. The complete list of available parameters appears. Select the desired parameter to view the stored GLP information.

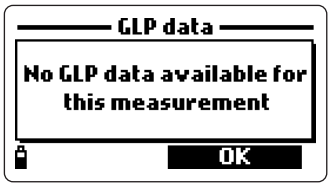






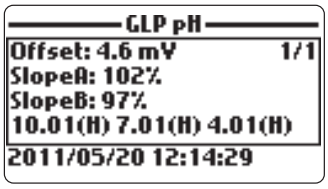
Note If no calibration data is available for the selected parameter, the display shows the message "No GLP data available for this measurement". Press <OK> to return to the previous screen.

Note GLP data is stored for the last 5 calibrations. This calibration history allows the user to detect when readings start to change and sensors may require cleaning or replacement.



pH

- From the "GLP" menu, select the "pH" option.
- Data regarding the last pH calibration will be displayed: offset, acidic slope, basic slope, buffers used, time and date of the calibration.
- Use the arrow keys to scroll through the stored data for the last 5 calibrations.
- Press ESC to return to the "GLP" menu.

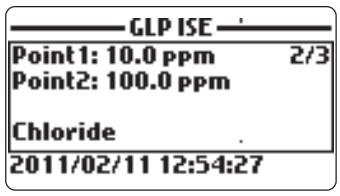


Note A "C" label near the buffer value indicates a custom point, while an "H" indicates a HANNA standard buffer value.

If a quick calibration was performed, the buffer values are replaced with the "Quick calibration" indication.

If no pH calibration has been performed or if calibration was cleared using the the "Restore factory calib." option the offset and slope values are set to default, and the message "Factory calibration" is displayed. Press <ESC> to return to the previous screen.

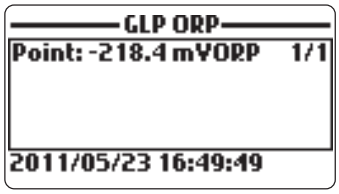
ISE



- From the "GLP" menu, select the "ISE" option.
- Data regarding the last ISE calibration will be displayed: standards used, sensor type, time and date of the calibration.
- Use the arrow keys to scroll through the stored data for the last 5 calibrations.
- Press ESC to return to the "GLP" menu.

Notes If no ISE calibration has been performed or if calibration was cleared using the "Restore factory calib." option the offset and slope values are set to default, and the message "Factory calibration" is displayed. Press <ESC> to return to the previous screen.

ORP



- From the "GLP" menu select the "ORP" option.
- Data regarding the last ORP calibration will be displayed: calibration point, time and date.
- Use the arrow keys to scroll through the stored data for the last 5 calibrations.
- Press ESC to return to the "GLP" menu.

Notes If no ORP calibration has been performed or if calibration was cleared using the "Restore factory calib." option the offset and slope values are set to default, and the message "Factory calibration" is displayed. Press <ESC> to return to the previous screen.

Dissolved Oxygen

- From the "GLP" menu select the "Dissolved oxygen" option.
- Data regarding the last D.O. calibration will be displayed: calibration points, % saturation or concentration, time and date.
- Use the arrow keys to scroll throught the stored data for the last 5 calibrations.

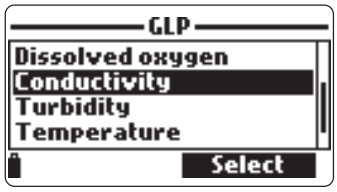
Notes A "C" label near the calibration point indicates a custom point, while an "H" indicates a HANNA standard value.

When the % D.O. range is calibrated, also the D.O. concentration range is calibrated, and vice versa.

If no D.O. calibration has been performed or if calibration was cleared using the "Restore factory calib." option the offset and slope values are set to default, and the message "Factory calibration" is displayed. Press <ESC> to return to the previous screen.

Conductivity

- From the "GLP" menu select the "Conductivity" option.
- Data regarding the last conductivity calibration will be displayed: calibration point, cell constant value, calibration type (conductivity, absolute conductivity or salinity), time and date of the calibration.



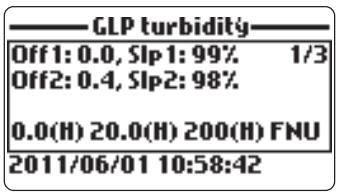
- Use the arrow keys to scroll through the stored data for the last 5 calibrations.

Notes A "C" letter near the conductivity calibration indicates a custom point, while an "H" indicates a HANNA standard value.

If no conductivity calibration has been performed or if calibration was cleared using the "Restore factory calib." option the offset and slope values are set to default, and the message "Factory calibration" is displayed. Press <ESC> to return to the previous screen.

Turbidity

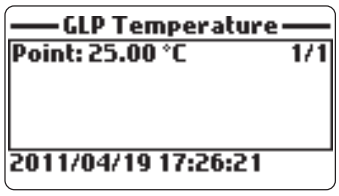
- From the "GLP" menu select the "Turbidity" option.
- Data regarding the last turbidity calibration will be displayed: standards used, time and date of the calibration.
- Use the arrow keys to scroll through the stored data for the last 5 calibrations.
- Press <ESC> to return to the "GLP" menu.



Notes If no turbidity calibration has been performed or if calibration was cleared using the "Restore factory calib." option the offset and slope values are set to default, and the message "Factory calibration" is displayed. Press <ESC> to return to the previous screen.

Temperature

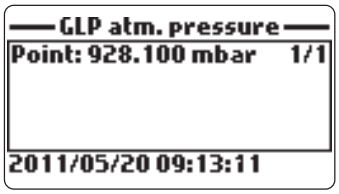
- From the "GLP" menu select the "Temperature" option.
- Data regarding the last temperature calibration will be displayed: calibrated point, time and date.
- Use the arrow keys to scroll through the stored data for the last 5 calibrations.



Notes If no user temperature calibration has been performed or if calibration was cleared using the "Restore factory calib." option the offset value is set to default, and the message "Factory calibration" is displayed. Press <ESC> to return to the previous screen.

Atmospheric Pressure

- From the "GLP" menu select "Atm. pressure".
- Data regarding the last atmospheric pressure calibration will be displayed: custom calibration point, time and date.
- Use the arrow keys to scroll through the stored data for the last 5 calibrations.

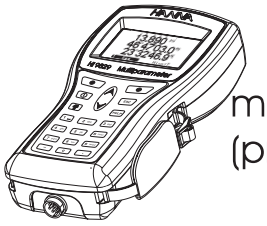


Notes If no atmospheric pressure calibration has been performed or if calibration was cleared using the "Restore factory calib." option the offset value is set to default, and the message "Factory calibration" is displayed. Press <ESC> to return to the previous screen.

Chapter 11 - LOGGING MODE

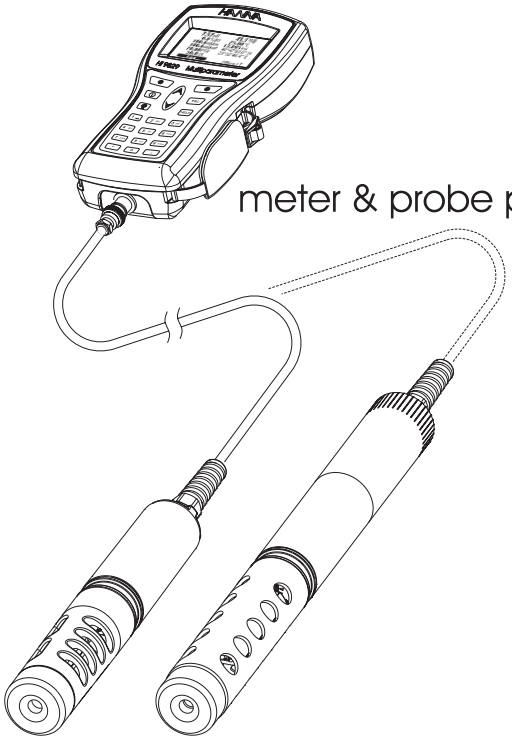
The **HI 9829** and **HI 76x9829** system offers many logging options that can be combined based on user needs. The following figures describe the available logging options.

Logging on meter



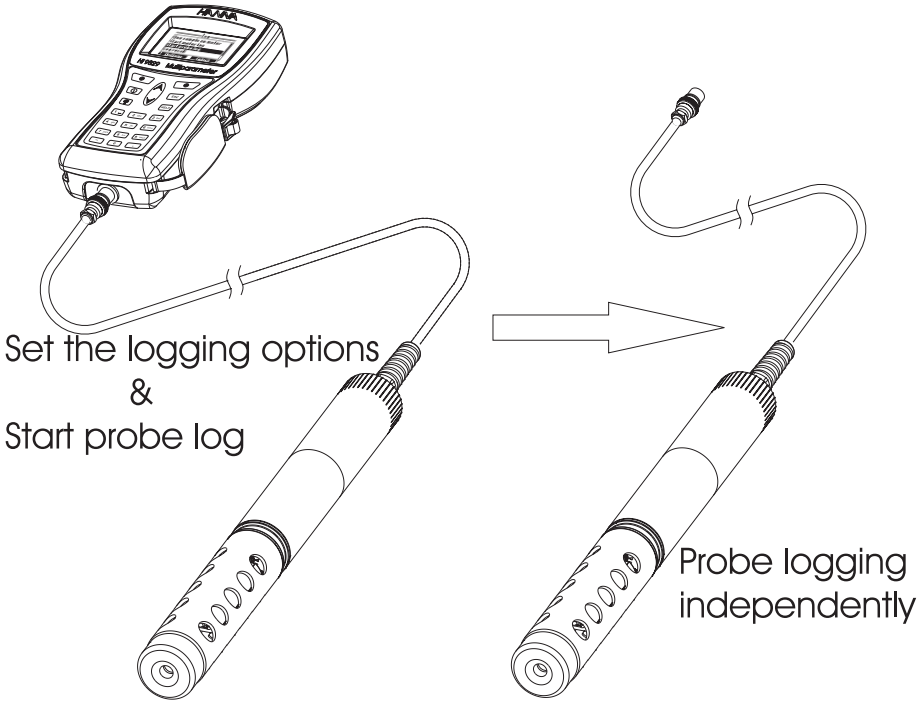
meter parameters only
(pressure, GPS)

Or



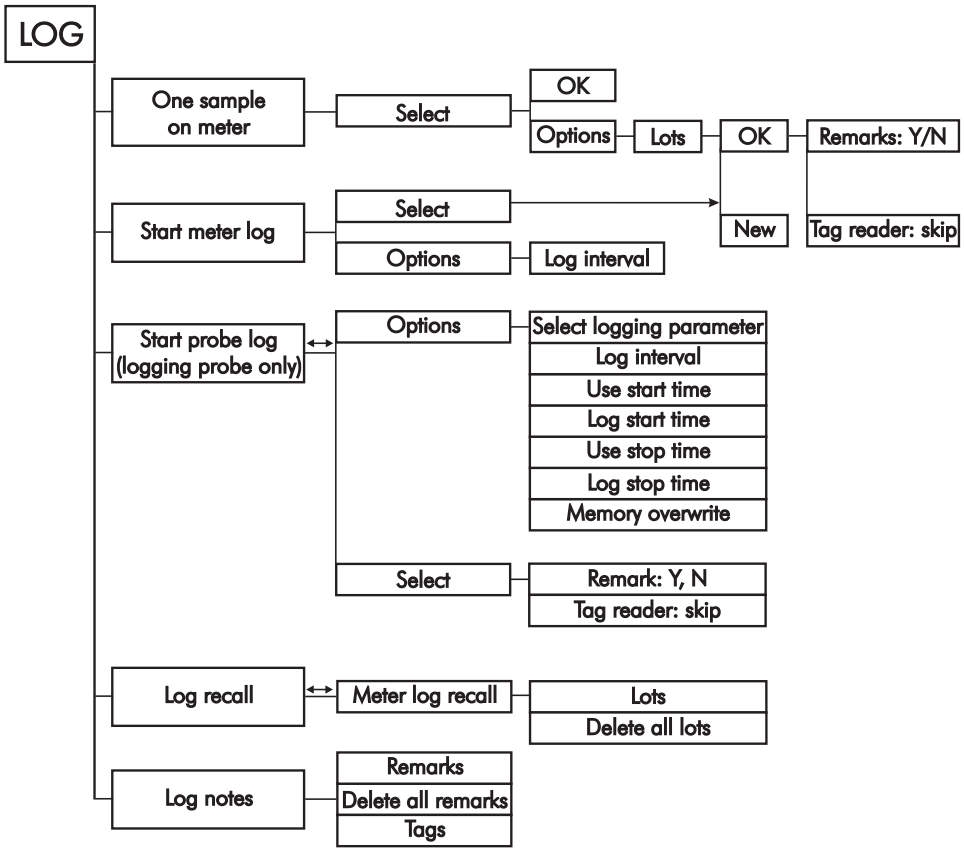
meter & probe parameters

Logging on probe (HI 7629829 & HI 7639829 only)



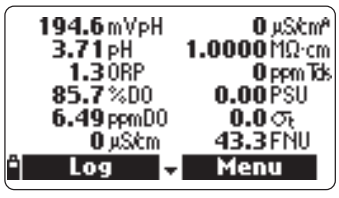
11.1 LOGGING MENU STRUCTURE

From measurement mode, press <Log> to access the log menu.



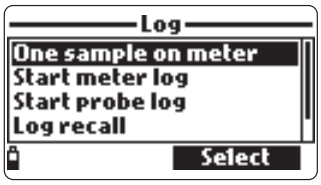
11.2 LOGGING ON METER

- The data logged on the meter are organized by lots. Up to 44,000 complete records can be stored in up to 100 lots. Each lot can store log-on-demand records and/or continuous records with different parameter configurations.

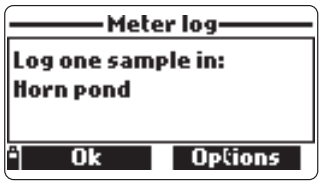


11.2.1 One Sample On Meter

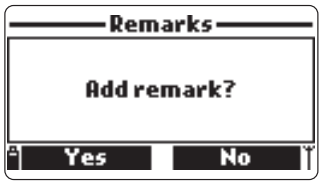
Use this option to log one set of enabled measurement parameters to the meter memory.



- If there are no lots saved on the meter, press <New> to create a new lot. Use the keypad to enter the desired lot name and press <Accept> to confirm. Press <OK> to log the sample in the selected lot.



- If there are existing lots on the meter, the meter will suggest a lot to store the sample. Press <OK> to use the selected lot. This will add the new sample data to the displayed lot. Press <Options> to select a different lot or the creat a new lot. (Note: If you press <OK> you cannot add a remark or Tag the data. Use <Option> to add remarks or Tag data.) A new lot can be created by pressing <New>. Press <OK> to log the sample in the selected lot.



- On the "Remarks" window, select <Yes> to go to the Remarks screen. Press <No> to skip this option. If <Yes> is selected, select a remark from the list, or press <New> to create a new remark.

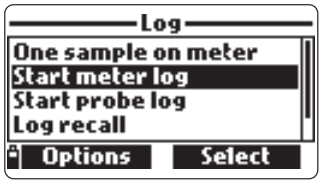
- On the "Read tag" screen, touch the location's iButton® with the meter's tag reader. Otherwise, press <Skip> to skip this option.

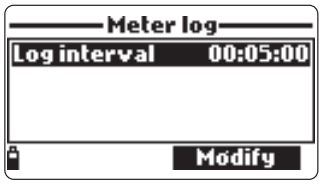
- If t he tag is touched, the associated ID will be displayed. If no ID is associated to the tag, the serial number is shown.

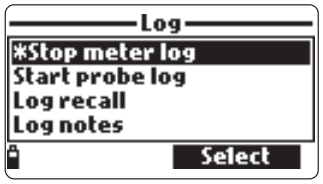
- The message "Sample logged" will flash momentarily and the display will automatically return to the measurement screen.

11.2.2 Continuous meter log

- Select "Start meter log" to log the currently enabled parameters at the set logging interval on the meter.
- To set the logging interval, highlight "Start meter log" and press <Options>. The log interval time can set from 1 second to 3 hours. Press <Modify> and use the arrow keys and keypad to enter the desired log interval. Press <Accept> to confirm.
- Press <Select> to edit the lot, remark, or tag, see section 11.4.
- To stop the meter log, enter the log menu and select <Stop meter log> .

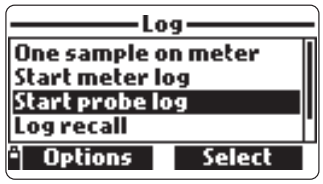






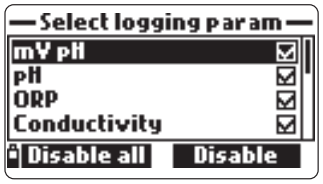
11.3 PROBE LOG (only for logging probes)

- Select "Start probe log" to start a log with the current settings. Press <Options> to change the log settings.



Probe Log Options

- To edit the lot remark, or tag, see section 11.5.
- The log interval time can be set from 1 second to 3 hours. Press <Modify> to change the logging interval. Press <Accept> to confirm.
- "Select logging param." to modify the parameters to be logged.
- To specify the log start time, highlight "Use start time" and press <Enable>. Highlight "Log start time" and press "Select". Enter the desired time and press <Accept> to confirm.



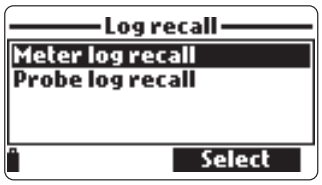
- To specify the log stop time, highlight "Use stop time" and press <Enable>. Highlight "Log stop time" and press <Select>. Enter the desired time and press <Accept> to confirm.
- Enable <Memory Overwrite> feature to overwrite the oldest records in the current log. (Note: If the memory is full, a new log can not be started).

11.4 LOG RECALL

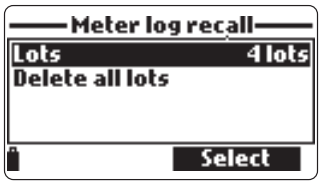
• All logged data can be viewed using two log recall options. The data logged on probe can be accessed only if the probe is connected to the meter or to the **HI 929829** PC application by using the "Probe log recall" option. The probe logs that have already been downloaded to the meter and the data logged on the meter can be viewed using the "Meter log recall" option.

11.4.1 Meter log recall

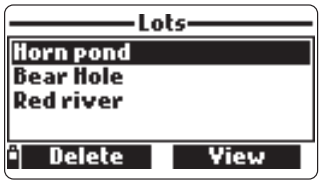
• Select "Meter log recall" to view logs that are stored on the meter. The meter will show the number of available lots. Select "Lots" to view or delete individual lots.



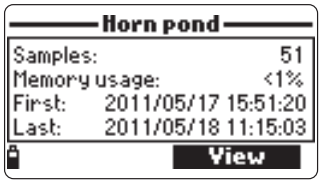
• Use the arrow keys to select the desired lot and then press <View>.



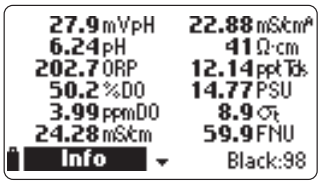
• The meter displays a summary of all data related to the selected lot: number of samples, memory space used, time and date of the first and last readings.



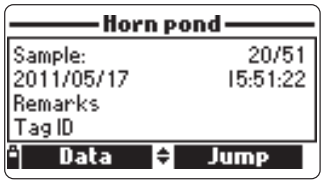
• Press <View> to display the sample details for each point. Use the arrow keys to change the sample number in the selected lot. The sample number is shown on the bottom right corner of the display.



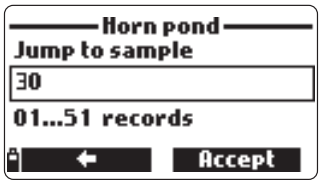
Note Details are available only for the enabled parameters.



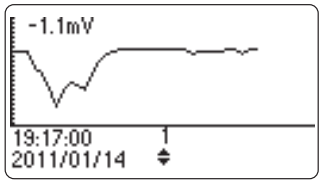
- Press <Info> to see record information for the current sample (time & date, remark, location (only for model with GPS) and tag ID or serial number (if available).
- Press <Data> to return to the previous screen or <Jump> to select a different sample in the same lot. When <Jump> is pressed, a text box appears to insert the desired sample number.



- Press ESC to return to the menu.
- Choose "Plot" and the meter will create a list with all available parameters that can be plotted.



- Use the arrow keys to select the desired parameter. Press <Select> to view the graph.
- Use the arrow keys to move the cursor in the graph and highlight a sample. The sample data are displayed below the graph.

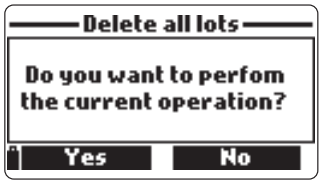


- Press ESC once to return to the parameter list or twice to return to the menu.

Note The number of lot samples that can be plotted is limited by the display resolution. To view a complete graph download data to PC.

<u>Delete all lots</u>

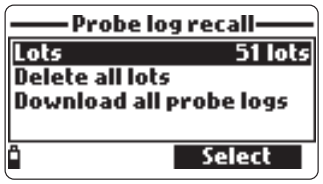
- From ''Meter log recall'' choose "Delete all lots" and the meter will display the message "Do you want to perform the current operation?". Press <Yes> to delete or <No> to return to the previous screen.



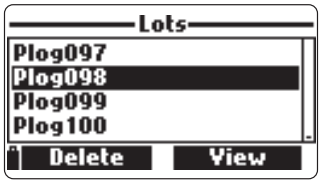
- To return to the "Log recall" menu, press ESC.

11.4.2 Probe log recall (Logging Probe only)

- Select "Probe log recall" to view and manage lots that are stored on the probe.

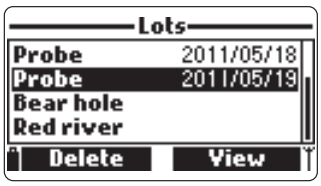


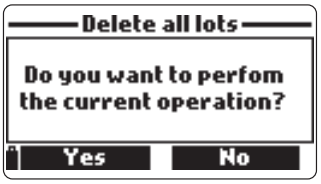
- Select "Lots" to display a list of available lots on the probe (logs have a Plog prefix). The most recent log will have the highest numerical assignment.



- To view basic information about the highlighted lot, press <View>.

- After <View> is pressed, the meter displays all data related to the selected lot: number of samples, memory space used, time and date of the first and the last readings.
- To see all the sample details press <Download>. When the download is completed, the log is now stored on the meter and can be accessed from the ''Meter log recall'' menu. The data can be viewed as described in ''Meter log recall'' in section 11.4.1. The probe log (on the meter) will take the ID of the probe (see Probe setup Section 8.2), or take the generic name Probe.
- The downloaded lots are not deleted from the probe and are available for other downloads (e.g. **HI 929829** PC application).
- If a probe log has been downloaded to the meter, a warning message will be displayed if you try to download it again.





Delete all lots

- From ''Probe log recall'', select "Delete all lots" and the meter will display the message "Do you want to perform the current operation?". Press <Yes> to delete or <No> to return to the previous screen.
- To return to the "Log recall" menu, press ESC.

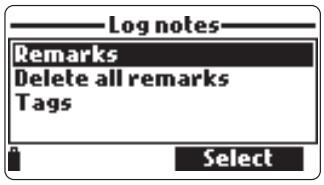
Download all probe logs

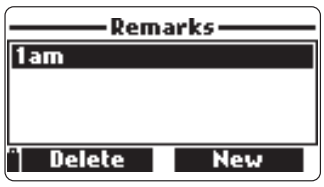
- From ''Probe log recall'', select "Download all probe logs". The meter will download all lots to the meter.

11.5 LOG NOTES

11.5.1 Remarks

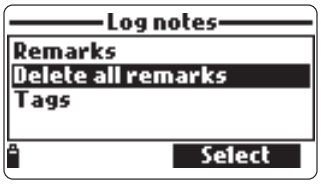
A remark can be associated with each sample. The meter can store up to 20 remarks.





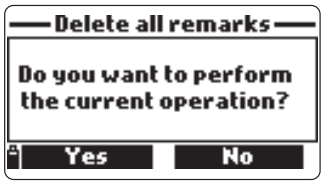
- To add a remark, select "Log notes" from the Log menu, and then select "Remarks".
- The display shows a list of stored remarks.
- Press <New> to create a new remark, and use the keypad to enter the new remark in the text box.

• Press <Delete> to delete the selected remark from the meter. If the deleted remark is used in an existing lot, the information will be still available in the lot data.



11.5.2 Delete all remarks

• Select "Delete all remarks" to delete all remarks. The display will show the message "Do you want to perform the current operation?". Press <Yes> to delete or <No> to return to the previous screen.



11.5.3 Tag Identification System

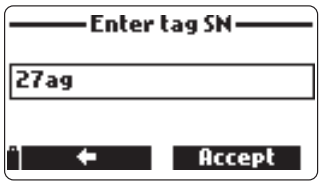
iButton® tags can be installed at sampling sites to simplify data logging. Tags have a unique serial number and a user-entered alphanumeric tag identifier. When the matching connector on the meter contacts the tag, logged measurements are labeled with the tag serial number and tag identifier. Tag configuration is accessed through the Log menu. Tag ID's should be entered on all meters used.

Read tag

• Select the "Tags"followed by "Read Tag" option to view and modify the information associated with tag, or to insert new tag IDs.
• The display shows the message "Touch the tag with the tag reader". Touch the tag with the tag reader located on the top of the meter.
• When the tag is detected the meter displays the tag serial number and ID (if available).
• Press <Modify> to insert a new tag ID or change a previous one. Use keypad to type ID and press <Accept> to save it.

Search SN

• Select "Search SN" to search for a tag by serial number.
• Insert the serial number using the meter keypad and then press <Accept>.

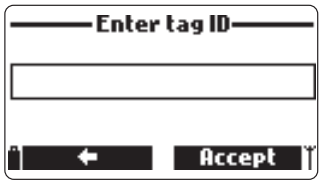


• The tag information window will appear. Press <OK> to return to the previous screen or <Modify> to modify the tag ID.

Note If the typed SN is not stored in memory, the warning message "SN not found" will be displayed.

Search ID

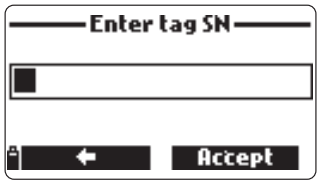
• Select "Search ID" to search for a tag by ID.
• Enter the identification code using the meter keypad and then press <Accept>.
• The tag information window will appear. Press <OK> to return to the previous screen or <Modify> to modify the tag ID.



Note If the inserted ID is not present in memory, a warning message will be displayed.

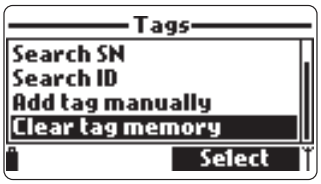
Add tag manually

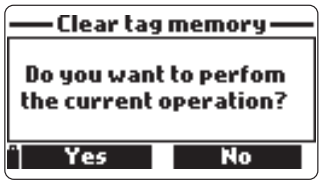
• Select "Add tag manually" to enter an ID code for a tag without using the tag reader (e.g. if the tag is not physically available).
• Enter the tag serial number using the meter keypad and then press <OK>.
• Enter the ID code for the tag and then press <OK>.
• The meter will now display the new tag information.



Clear tag memory

• Select "Clear tag memory" to clear all tag information from the meter memory.





• The message "Do you want to perform the current operation?" appears.
• Press <Yes> to confirm or <No> to return to the previous screen.
• To return to measurement mode, press ESC.

Chapter 12 - PC CONNECTION MODE

The logged data from a probe or meter can be transferred to a PC using the **HI 929829** Windows® compatible application software. **HI 929829** offers a variety of features and on-line-help is available.

HI 929829 allows data to be imported into most spreadsheet programs (e.g. Excel©, Lotus 1-2-3©). After the data has been imported into a spreadsheet, all features of the spreadsheet program can be used to analyze and graph the data.

HI 929829 will automatically generate a map for samples logged with GPS coordinates. **HI 929829** uses an external GPS tracking software such as Google™ Maps to view locations where measurements have been taken, therefore an internet connection is required to use this function.

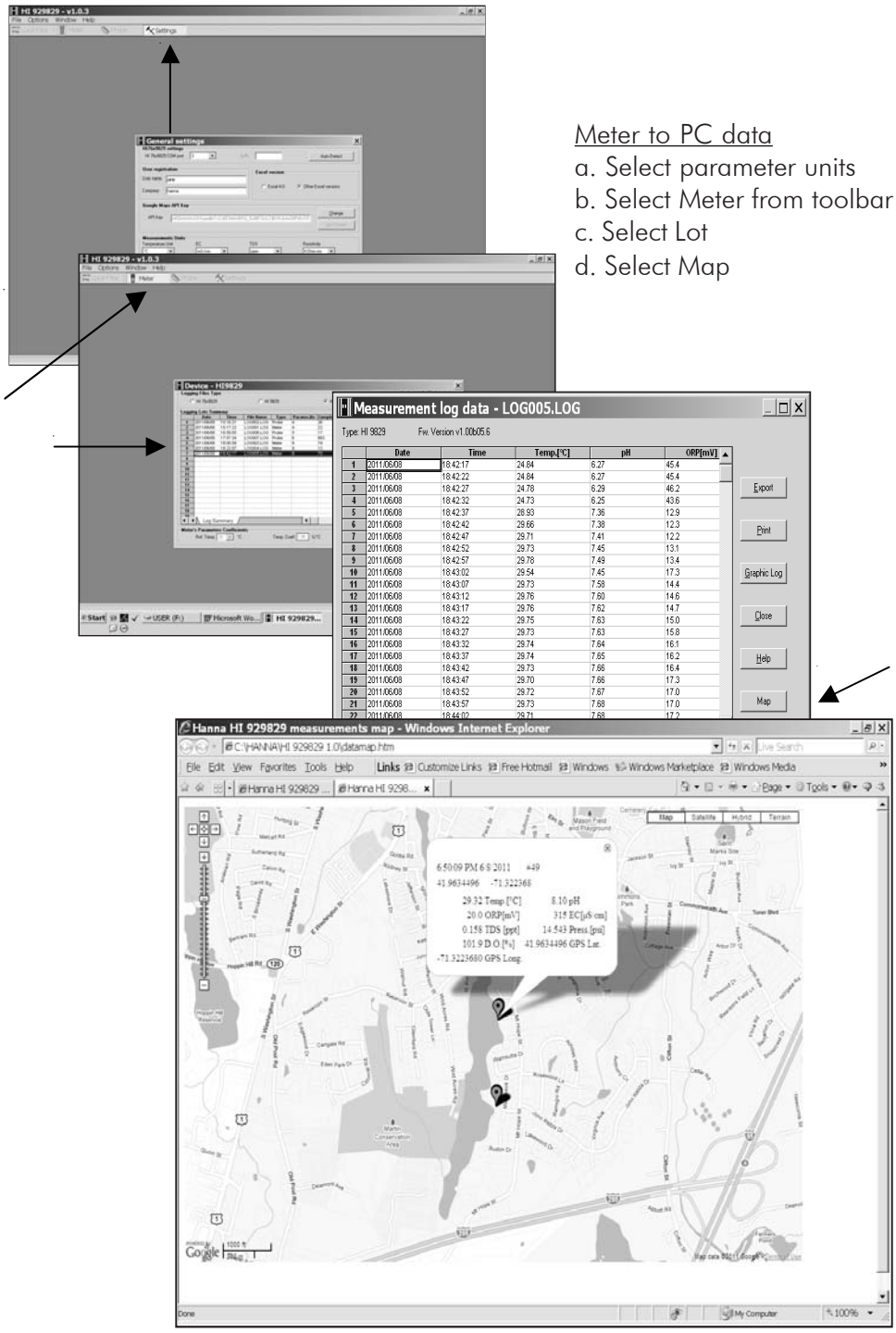
12.1 SOFTWARE INSTALLATION

- Insert the installation CD into the PC.
- The software menu window should start automatically (if it does not, navigate to the main CD folder and double-click "hi929829start.exe"). Click "Install software" and follow the instructions.

12.2 METER TO PC CONNECTION

- With the meter OFF, disconnect the probe.
- Connect the **HI 7698291** USB adapter to the meter and to a USB port on the PC.
- Turn the meter ON and the message "PC connected" will be displayed.

- Run the **HI 929829** application software.
- Press Setting button on the top of the screen and select the measurement units you which your data to appear with.
- To access the meter data select the "Meter" button on the toolbar at the top of the screen. The PC-Meter connection will be established and a new window will be displayed with meter data: status information (software version and date, SN, ID, GPS info, battery level and free memory info), as well as a summary of logged data lots. Both lots logged directly on the meter as well as lots logged on a probe and downloaded to the meter can be saved to the PC by pressing the "Download lot" button after the desired lot is selected.
- Once the lot has been downloaded, all the logged samples can be viewed.



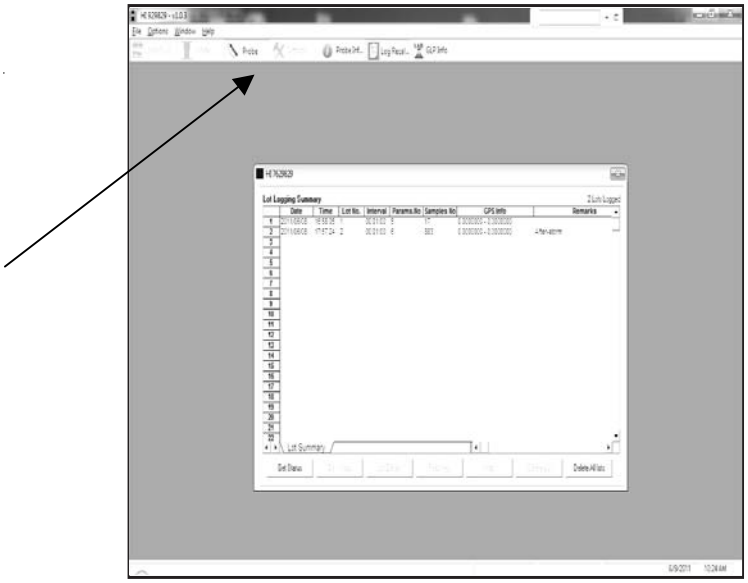
Meter to PC data

a. Select parameter units
b. Select Meter from toolbar
c. Select Lot
d. Select Map

12.3 PROBE TO PC CONNECTION

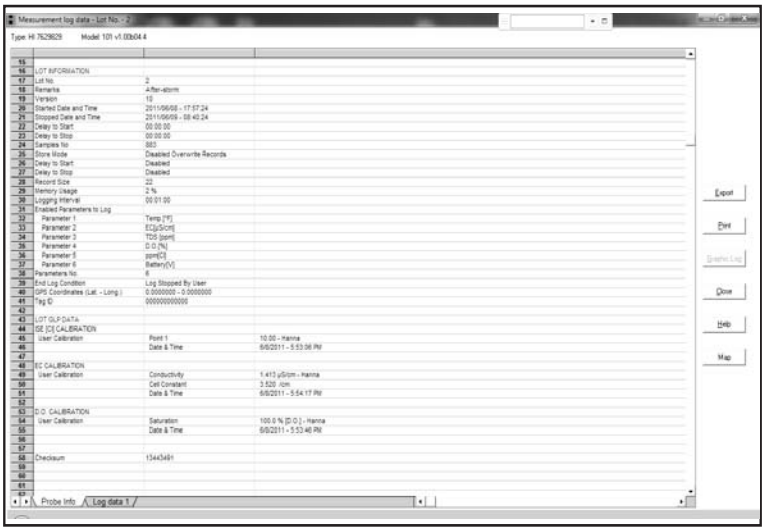
- Connect the **HI 76982910** adapter to the probe and to a USB port on the PC.
- Run the **HI 929829** application software.
- To access the probe, press the "Probe" button from the toolbar on the top of the screen.
- A Communication Settings window will open. Select the correct COM port and press OK.

Note The Windows "Device Manager" can be used to verify which COM port number is used for connecting to the probe. Press START on the Windows® task bar and select "Control panel". In the Control Panel select "System", "Hardware", "Device Manager", "Ports". The Ports menu shows the number of the virtual COM port associated with the **HI 76982910** USB adapter.

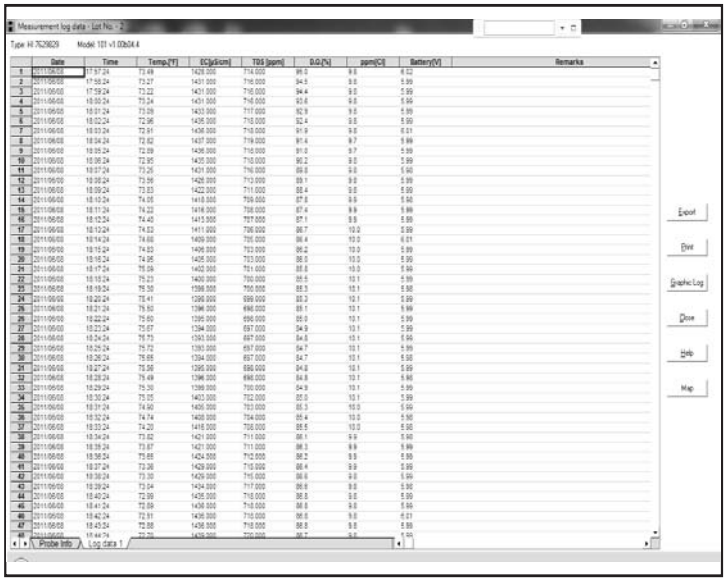


- Once the PC-Probe connection has been established a new window is displayed with probe data: status information (software version, SN, Connector Status, Available Parameters, Password Protection and free memory info) as well as available data lots.
- Select the desired lot and Press the "Download" button to download the data to the PC.
- Press the "GLP Info" button to get the probe GLP info.

Probe Info Screen



Lot Data Screen



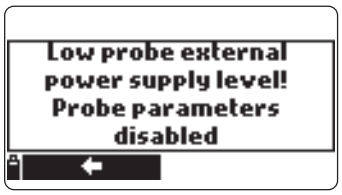
Chapter 13 - TROUBLESHOOTING / ERROR MESSAGES

HI 9829 displays error messages to aid in troubleshooting. Warnings are displayed for most issues, while Errors are displayed for critical issues.

See the calibration chapter for messages that can occur during calibration. Other messages are listed below.

- "Log space full" appears when the meter memory is full and additional data cannot be logged or downloaded from a logging probe. Delete one or more lots from the meter (Log / Meter Log), or download and delete one or more logs from the probe.

- "Low probe external power supply level! Probe parameters disabled": the battery voltage supplied from the meter to the probe is too low and the measurements could be adversely affected. All parameters set on probe are disabled. Press left soft key, check the connection between meter and probe. If the problem persists, contact the HANNA service center.



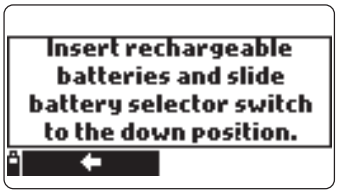
- "Power fault. Check the probe cable": this message may appear when powering up the meter with a probe connected. If the meter detects a high load on the probe connection this message is triggered. Check the probe cable. If the problem persists, contact the HANNA service center.

- "Language data not available": this message appears when powering up the meter if the language file is not seen by the meter. Restart the meter to verify this is a true meter error. If the problem persists, contact the HANNA service center.

• ''GPS error'' (only for models with GPS): the communication with the internal GPS unit cannot be established. Switch the meter off and on again, then retry. If the problem persists, remove the batteries, wait for 5 minutes and install them again. If the problem persists, contact the HANNA service center.

• ''Dead meter battery!'': This message appears if the meter batteries are too low to power the meter and it will automatically turn off. Connect the charger if using rechargeable C batteries or replace the alkaline batteries to continue.

• ''Insert rechargeable batteries and slide battery selector switch to the down position.'': This message appears when non-rechargeable alkaline batteries are installed on the meter and/ or the battery selector switch in is the wrong position, and the user is attempting to charge then batteries.



• ''Dead probe battery!'': This message appears if the logging probes batteries are not supplying enough voltage to power the logging probe. Replace the probe batteries.

• ''User data corrupted!'': This message appears when powering up the user data stored on meter are corrupted. Restart the meter. If the problem persists, contact the HANNA service center.

• ''Warning x'': Any other warning that appears at power-on is identified using a numeric code. Restart the meter. If the problem persists, contact the HANNA service center. Some meter/probe features can be accessed but with no guarantee.

• ''Errors x'': Any critical errors that appear are identified using a numeric code, and the meter is automatically switched off. Contact the HANNA service center.

APPENDIX A - PROBE MAINTENANCE

The **HI 7698292** probe maintenance kit includes **HI 7042S** (electrolyte solution for D.O. sensor), spare membranes with o-rings for D.O. sensor, a small brush for cleaning EC , o-rings for sensor connectors and a syringe with grease to lubricate these o-rings.

General Maintenance

- Inspect all sensor connectors for corrosion and replace sensors if necessary.
- Inspect sensor o-rings for nicks or other damage and replace sensor if necessary. Lubricate only with grease from kit.

Use only the supplied grease as some lubricants can cause the o-rings to expand or affect the turbidity calibration standards.

- After prolonged storage or cleaning, calibration of the sensors is required.
- After use rinse the probe with tap water and dry it. The pH electrode bulb must be kept moist. Dry the D.O., EC and EC/Turbidity sensors. Dry ISE sensors and return to their storage caps if they will not be used for a period of time.
- Check GLP data under "Status" to ensure the sensor is still functioning properly.

pH and pH/ORP Sensor Maintenance

- Remove the sensor protective cap. Do not be alarmed if any salt deposits are present. This is normal with pH/ORP electrodes and they will disappear when rinsed with water.
- Shake down the sensor as you would do with a clinical thermometer to eliminate any air bubbles inside the glass bulb.
- If the bulb and/or junction are dry, soak the electrode in **HI 70300** storage solution for at least one hour.
- To ensure a quick response time, the glass bulb and the junction should be kept moist and not allowed to dry. Store the sensor with a few drops of **HI 70300** storage solution or pH 4.01 buffer in the protective cap. Tap water may also be used for a very short period (few days).

Never use distilled or deionized water to store pH sensors

- Inspect the sensor for scratches or cracks. If any are present, replace the sensor.
- Cleaning procedure: clean the sensor frequently by soaking it for 1 minute in **HI 70670** or **HI 70671** cleaning solution. After cleaning soak the sensor in **HI 70300** storage solution before taking measurements.

D.O. Sensor Maintenance

I•Before sevicing, rinse the probe with tap water.

- If a more thorough cleaning is required, clean the probe body and sensor with the supplied brush or a non-abrasive detergent. If any deposit scales the sensor, gently brush the sensor surface with the supplied brush, while paying attention to not damage the plastic body. Do not use the brush on the membrane.

For a top performance probe, it is recommended to replace the membrane every 2 months and the electrolyte monthly. While the cap is off, inspect the sensor internal electrodes.

- If the zinc anode (Concentric metal electode than surrounds internal stem) appears coated with a white substance or is dull, clean by gently wiping with the plastic scouring pad that is included in the maintenance kit.

To replace the membrane cap or electrolyte proceed as follows:

- Unscrew the membrane by turning it counterclockwise.
- Rinse a spare membrane with some electrolyte while shaking it gently. Refill with clean electrolyte.
- Gently tap the cap over a surface to ensure that no air bubbles remain trapped. Avoid touching the membrane.
- With the sensor facing down, completely screw the cap clockwise. Some electrolyte will overflow.

EC Sensor Maintenance

- After every series of measurements, rinse the probe with tap water.
- If a more thorough cleaning is required, clean the sensor with the supplied brush or a non-abrasive detergent. Ensure that the two cylindrical holes in the sensor are free of foreign material.

EC/Turbidity Sensor Maintenance

- After every series of measurements, rinse the probe with tap water.
- If a more thorough cleaning of the sensor is required, clean the EC cylindrical holes in the sensor with the supplied brush or a non-abrasive detergent. Ensure that the two cylindrical holes are free of foreign material.
- Gently remove any material that is attached to the face of the turbidity sensor taking care to not scratch the optical windows. Use a soft cloth and non-abrasive detergent.
- If there are cracks or scratches on the optical windows, the EC/turbidity sensor must be replaced.

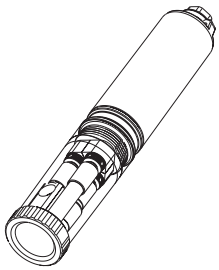
ISE Sensor Maintenance

- After measurements inspect o-ring, connector and body. Rinse ISE sensor with tap water to remove films or other coatings.
- Shake down the sensor as you would do with a clinical thermometer to eliminate any air bubbles.
- Soak the electrode in its corresponding 10 ppm calibration solution for at least 1/2 hour prior to calibration. Store dry in protective cap when not in use.
- For long-term storage rinse the electrodes with water. Shake off the excess water and replace the storage cap to prevent evaporation of the reference electrolyte. Do not use hard pH caps used for other product lines. Do not store in water or pH storage solution.
- For chloride sensors **(HI 7609829-11)**, if the sensor pellet appears tarnished, use a polishing strip to remove the oxidized surface. Cut off approximately a 1 inch piece of the strip. Wet the frosted side with water and place against damaged surface. Place your thumb against the shiny backing and slowly rotate back and forth while applying gentle pressure.If dark deposits appear on the frosted surface, move the paper slightly. Continue polishing until you are satisfied with the surface. Rinse sensor with water. Do not use hard pH caps used for other product lines. Do not store in water or pH storage solution

APPENDIX B - PROBE DEPLOYMENT

General Guidelines for fixed installation:

- Select a water-sampling site that will allow collection of representative water samples.
- Position the probe so the sensor surfaces face toward the flow. This will minimize air bubble or fluid cavitation. Limit flow rate to moderate
- Mount Probe 0 to 45° angle from vertical to avoid sensors (pH, pH/ORP, ISE) from becoming electrically discontinuous due to internal electrolytes flowing away from their internal cells.
- Install meter or probe where they will be accessible for maintenance as required.
- Regularly visit water sampling sites to: check for damage to sensors, the installation mountings, and the probe/meter battery power.
- Remove aquatic weed growth that may be interfering with water sample collection.
- Set up devices and programs for water monitoring and sampling.
- If the probe is suspended from a pier or bridge ensure that it is protected from debris by positioning behind a support and anchoring the cable /probe to a pipe.
- Have access to spare sensors and proper range standard solutions or buffers.
- Strictly follow the established SOP's.
- Download data to a laptop computer or meter on site.
- Protect probe and sensors from excessive sunlight.
- Flow cell installation; Avoid trapped air. Maintain constant flow rate.



The Hanna HI 76X0929 has been designed for a variety of water quality measurements both in situ or in active deployments in urban or natural waters. The HI 9829 systems may be used for discrete spot sampling with a meter and the meter's log on demand function, unattended with continuous monitoring and logging from the meter, or unattended using a logging probe. These data are then downloaded to a meter or PC and can be plotted with logging software to obtain the graphical log needed for interpretation of the essential physical property of the aqueous body of water. In all of these deployment situations data quality is dependent upon the site location, service intervals, amount of coatings, sedimentation and vegetation, and the actual installation. The probe may be installed in a horizontal bank (fixed installation) or a vertical suspension. The maximum depth rating of 20 m (65') for the probe should be adhered to. (Note: actual sensor specifications may be less). The location must be accessible for the duration of the measurement (consider seasonal flooding, freezing and other acts of nature) when selecting a site. Many conditions may affect the quality of measurements. Select an installation site that is representative of the water body being monitored. Avoid areas without adequate water circulation. To protect equipment it is best to avoid exposure to wind, foam, turbulence, air temperature gradients/sun, extended periods of high flow, extended periods of high sediment and floating debris. The standard operating procedures (SOP) for the data gathering must be upheld. This typically includes pre and post deployment checks of the sensors to validate data gathered between calibrations, upholding service intervals, and following any other site-specific procedures. Grab samples for laboratory analysis or spot sampling with another probe are addition ways to validate the measurements taken by unattended continuous logging probes.

The probe is suitable for installation in confined locations such as air vaults, river intakes, vertical wells, tanks, etc.. The streamline diameter of the probe permits insertion into 2" pipelines. Unlike probes that require a cable support for active deployments the probe can be manually lowered and raised by the cable due to it's superior strength member.

It is suitable for installation in open moving waters; rivers, streams, ditches (farmland drainage), conveyance canals, etc.. In these cases protecting the probe from debris is important. If the probe is suspended from a pier or bridge position it behind a support and anchor the cable/probe to a pipe.

It is suitable for deployment in open waters; monitoring lakes, ponds, wetland basin, infiltration basins, bays. Schedule regular service to remove aquatic weed

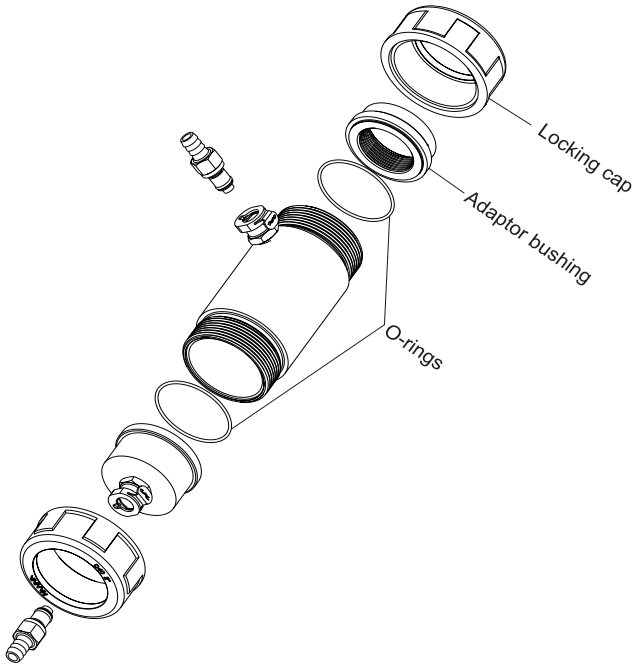
The probe is suitable for measurements in a flow cell. Pumping water to a flow-through monitoring station has obvious pros and cons. Typically a shelter is required to secure a pump, and flow chamber. A power requirement, shelter, pump maintenance and higher installation cost need to be considered. Freeze protection, security, and convenience of calibration and possibility of adding multiple measurement points and antifouling preconditioning systems are advantages to this type of installation.

Hanna HI 7698297 Quick Release Flow Cell:

The HI 7698297 flow cell is shipped tested and ready for installation and use. The following exploded view is provided to aid in reassembling and inspecting after cleaning.

⚠Warning: Do not use organic solvents to clean flow cell.

When dissassembled for cleaning, inspect o-ring for nicks, cracks and damage that may cause leakage. Replace o-rings as required and always lubricate with grease provided in probe maintenance kit.



Flow Cell Stabilization:

Mount the flow cell to a rigid surface with hardware provided.

When selecting location, provide space for removal of the probe from the flow cell.

Mount the flow cell so that the probe (when installed) will be located between vertical and 45° with the sensors facing down.

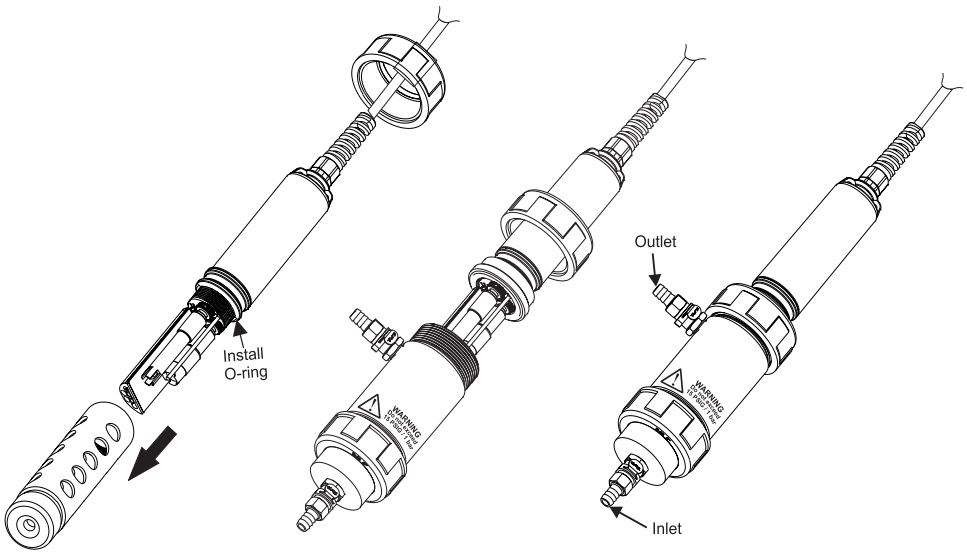
Direct the outlet piping upward a minimum of 50 mm (2″) so that bubbles do not settle on the measuring sensors.

Install 5/8″ID tubing onto barbed fittings.

Do not restrict flow at the outlet as the flow cell may exceed pressure rating.

Probe Installation in the Flow Cell:

- Remove probe shield from probe body.
- Insert probe through locking cap and slide locking cap up probe body.
- Install o-ring on probe body (see figure) and lubricate with grease provided in probe maintenance kit.
- Thread the adapter bushing on probe and tighten as required.



Flow Cell Guidelines:

Do not exceed pressure specification of flow cell.
Strictly follow established operating procedures from regulatory or governing bodies.
Avoid trapped gas in flow cell especially on the measuring sensors.
Maintain a constant flow rate.
Freeze protection is required if flow cell is left unattended.
If flow cell and probe is used in direct sunlight it is advised to cover flow cell with foil or other material after determining sensors are free of gas bubbles.

Flow Cell Specifications:

Intended sample:	Water or aqueous solution
Flow Rate:	2.0 L/min. maximum (Typical 0.1 to 0.5 L/min.)
Sample Temperature:	0°C (non-freezing) to 55°C
Wetted Materials:	PVC, PMMA, EPDM o-ring, 316 Stainless Steel
Tube Connections:	3/8" barb on quick disconnect coupling

⚠ Warning ⚠

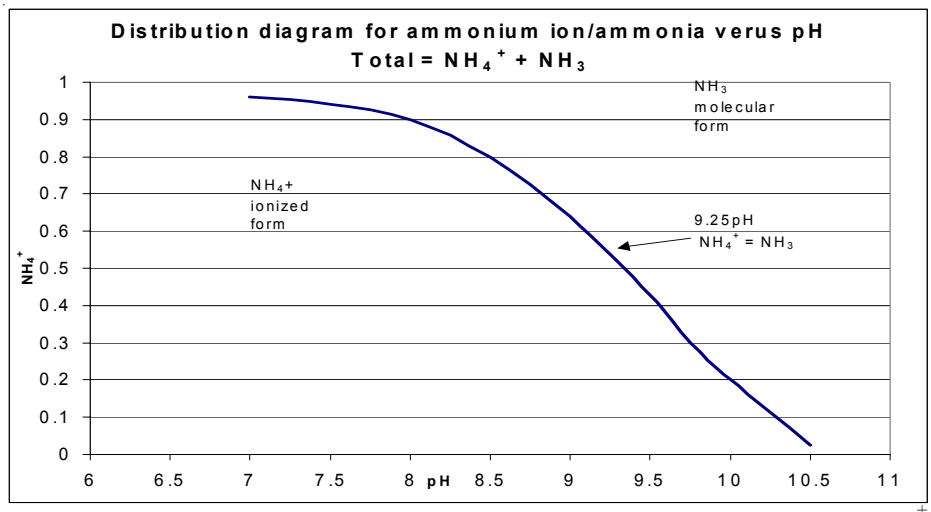
Do not exceed 15 psig (1 bar) pressure in the flow cell or outlet line. The flow cell is rated for open flow operation only. Operate with outlet line open to atmosphere.

APPENDIX C - ISE INFORMATION

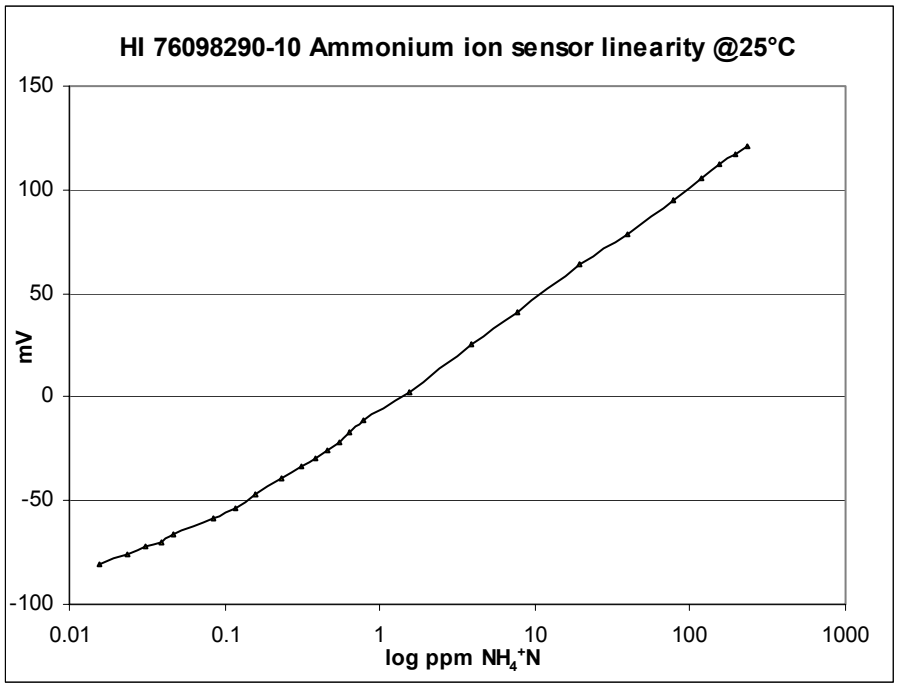
This Appendix describes additional information about the ISE sensors used on the HI76x9829 Probe.

HI 7609829-10: Ammonium selective electrode (ISE) is a combination liquid membrane sensor used for the detection of free ammonium-nitrogen in fresh-water samples. The sensor utilizes a polymeric membrane made with ammonium ionophore in a PVC head and silver/silver chloride double junction gel filled reference electrode. The outer body of the sensor is the thermoplastic PEI. This sensor is used in place of the pH.

The measurement of ammonium-nitrogen, NH_4^+-N is a useful tool in the measurement of surface water contaminants such as tracing the source of agricultural operations runoff or studying nutrient levels in natural waters.
HI 7609829-10 is an ion selective sensor that responds to the free Ammonium ion. Ammonium ion is the ionized portion of the total ammonia concentration and the amount present depends on pH. When the pH of the sample is below 8 pH, the primary form of ammonia is ammonium ion. See figure below.
The relationship is more complicated with increasing salinity but the two forms together equal total ammonia.



The **HI 7609829-10** sensor is specified for 0.02 to 200 ppm (mg/L) NH_4^+-N (equivalent to 0.026-260 ppm (mg/L) NH_4^+). Based on the corresponding molecular weights of nitrogen and ammonium, the relationship is: **NH_4^+-N** $=(NH_4^+)(14/18) = (NH_4^+) \times 0.7778$. NH_4^+-N is also called ionized ammonia. The sensor responds in a Nernstian manner (like a pH sensor) and produces a voltage that the meter converts to a concentration value.



The calibration solutions and displayed measurements are as ppm **Ammonium-nitrogen**. Due to the space restriction of the display the unit of measurement will be displayed as **"ppmAm".**

The ammonium sensor will last longer in colder clean waters than in severely contaminated water or warmer waters. This is because the active chemicals responsible for the ammonium ion sensitivity are leached out of the membrane with continued exposure. As the sensor ages there will be a decreased sensitivity until the sensor will no longer calibrate or operate properly. The lifetime of the sensor depends greatly on deployment conditions.

Although **HI 7609829-10** is selective toward ammonium ions, it also responds to other ions which can interfere with the measurement. The ratio of interfering ion to ammonium ion must be less than the ratio indicated below:

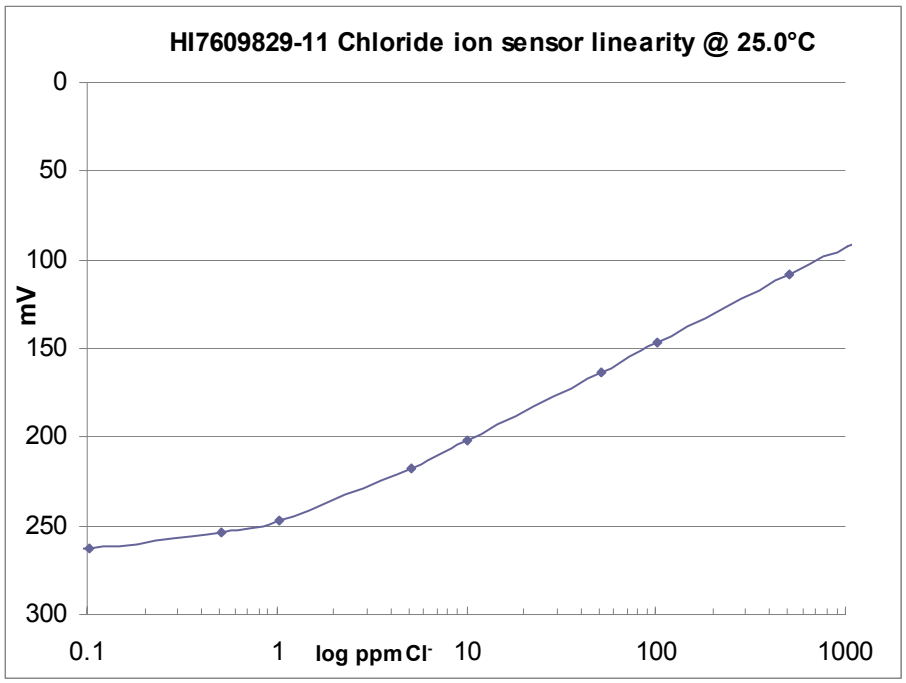
Sodium:	90
Potassium:	0.75
Calcium:	125
Magnesium:	4000

Exposure to these interferences does not cause permanent damage to the sensor. Note that the potassium ion interference is the strongest, and its concentration must be less than the ammonium concentration to have no effect.

HI 7609829-11: Chloride ion selective electrode is a combination solid state sensor used for the detection of free chloride ions in freshwater samples. The sensor utilizes a silver chloride pellet housed in a PEI head and a silver/silver chloride double junction gel filled reference electrode. The outer body of the sensor is the thermoplastic PEI. This sensor is used in place of the pH sensor in the probe.

The measurement of chloride, Cl^- is a useful tool in the measurement of surface water contaminants such as tracing the source of roadway run off or studying naturally occurring chloride levels in natural waters. **HI 7609829-11** is an ion selective sensor that responds to the free chloride ion. Chloride ion is the ionized form of chlorine.

HI 7609829-11 is specified for 0.6 to 200.0 ppm (mg/L) Cl^-. The sensor responds in a Nernstian manner (like a pH sensor) and produces a voltage that the meter converts to a concentration value.



The calibration solutions and displayed measurements are as ppm **Chloride ions**. Due to the space restriction of the display the unit of measurement will be displayed as **"ppmCl"** (without charge).

The chloride sensor will last longer in colder clean waters than in severely contaminated water or warmer waters. This is because the external surface of the sensor responsible for the chloride ion sensitivity can react with water contaminants or be leached out of the sensor with continued exposure. As the sensor ages there will be a decreased sensitivity until the sensor will no longer calibrate or operate properly. The lifetime of the sensor depends greatly on deployment conditions.

Although **HI 7609829-11** is selective toward chloride ions, it also responds to other ions.

The interfering ions sulfide, cyanide, and mercury ions must be absent.

The interfering ion to Cl^- ratio must be less than the ratio indicated below:

Iodine: 1.0
Bromide: 3.5
Carbonate: 3.5
Hydroxide: 1.0
Thiosulfate: 0.01

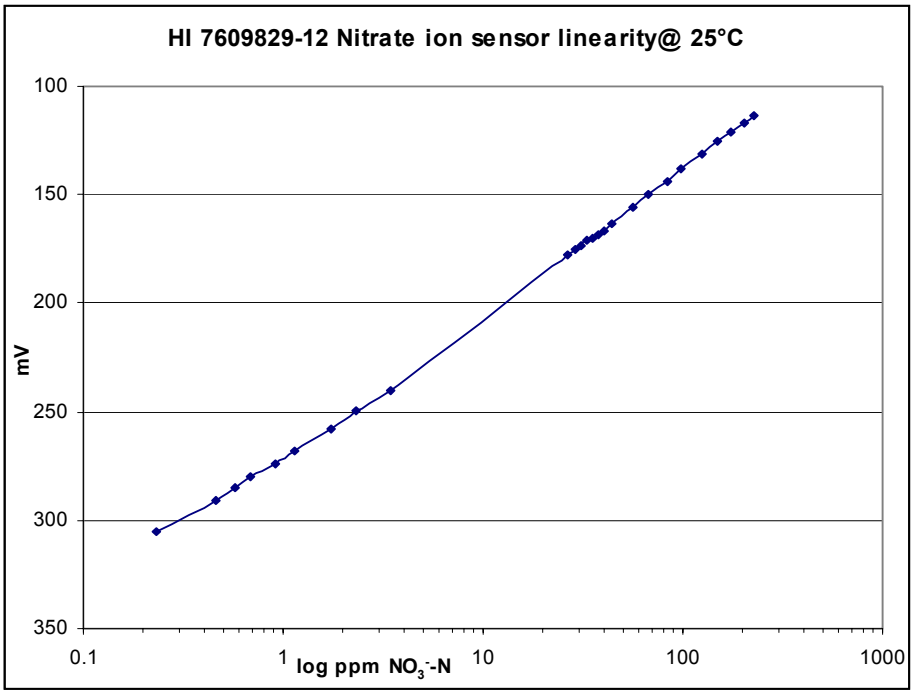
HI 7609829-12: Nitrate ion selective electrode is a combination liquid membrane sensor used for the detection of nitrate nitrogen in freshwater samples. The sensor utilizes a polymeric membrane made with nitrate ionophore in a PVC head and a silver/silver chloride double junction gel filled reference electrode. The outer body of the sensor is the thermoplastic PEI. This sensor is used in place of the pH sensor in the probe.

The measurement of Nitrate-Nitrogen, NO_3^--N is a useful tool in the measurement of surface water contaminants such as tracing the source of agricultural operations runoff or studying nutrient levels in natural waters. **HI 7609829-12** is an ion selective sensor that responds to the free nitrate ion.

Although all forms of nitrogen including nitrogen gas (N_2) are interconvertible within the nitrogen cycle as a function of oxidation state, the nitrate sensor only detects the ionized form.

HI 7609829-12 is specified for 0.62 to 200 ppm (mg/L) NO_3^--N (equivalent to 2.74 - 885.6 ppm (mg/L) NO_3^-). Based on the corresponding molecular weights of nitrogen and nitrate, the relationship is: NO_3^--N $=(NO_3^-)(14/62)=(NO_3^-) \times 0.2258$.

The sensor responds in a Nernstian manner (like a pH sensor) and produces a voltage that the meter converts to a concentration value.



The calibration solutions and displayed measurements are as **ppm Nitrate-nitrogen**. Due to the space restriction of the display the unit of measurement will be displayed as **"ppmNi".**

The nitrate sensor will last longer in colder clean waters than in severely contaminated water or warmer waters. This is because the active chemicals responsible for the nitrate ion sensitivity are leached out of the membrane with continued exposure. As the sensor ages there will be a decreased sensitivity until the sensor will no longer calibrate or operate properly. The lifetime of the sensor depends greatly on deployment conditions.

Although **HI 7609829-12** is selective toward nitrate ions, it also responds to other ions which can interfere with the measurement. Organic solvents and cationic detergents must be absent. Chloride has the largest interference for natural waters.

The ratio of interfering ion to nitrate ion must be less than the ratio indicated below:

Fluoride: 300	Nitrite: 4
Chloride:100	Iodide: 0.01
Carbonate: 4	Perchlorate: 0.0045

APPENDIX D - ACCESSORIES

METERS (packed in carton box, no probe)

HI 9829-01	Meter only, manual, charging cable adapter for 115VAC
HI 9829-02	Meter only, manual, charging cable adapter for 230VAC
HI 98290-01	HI 9829 with GPS, manual, charging cable adapter for 115VAC
HI 98290-02	HI 9829 with GPS, manual, charging cable adapter for 230VAC

PROBES (packed in carton box, without sensors)

HI 7609829/4	HI 7609829 probe for pH/pH+ORP/ISE, D.O., EC, temperature with HI 7698295 short protective shield and 4 meter (13.1') cable
HI 7609829/10	HI 7609829 probe for pH/pH+ORP/ISE, D.O., EC, temperature with HI 7698295 short protective shield and 10 meter (33') cable
HI 7619829/4	HI 7609829 probe for pH/pH+ORP/ISE, D.O., EC/EC+turbidity, temperature with HI 7698296 long protective shield and 4 meter (13.1') cable
HI 7619829/10	HI 7609829 probe for pH/pH+ORP/ISE, D.O., EC/EC+turbidity, temperature with HI 7698296 long protective shield and 10 meter (33') cable
HI 7629829/4	HI 7629829 logging probe for pH/pH+ORP/ISE, D.O., EC, temperature with HI 7698295 short protective shield and 4 meter (13.1') cable
HI 7629829/10	HI 7629829 logging probe for pH/pH+ORP/ISE, D.O., EC, temperature with HI 7698295 short protective shield and 10 meter (33') cable
HI 7639829/4	HI 7629829 logging probe for pH/pH+ORP/ISE, D.O., EC/EC+turbidity, temperature with HI 7698296 long protective shield and 4 meter (13.1') cable
HI 7639829/10	HI 7629829 logging probe for pH/pH+ORP/ISE, D.O., EC/EC+turbidity, temperature with HI 7698296 long protective shield and 10 meter (33') cable

Note: Probes with different cable length are available upon request.

METERS WITH PROBES (packed in carrying case with maintenance kit, charging adapter, sensors not included)

HI 98291-01 HI 9829 and HI 7629829/4 logging probe for pH/ pH+ORP/ISE, D.O., EC, temperature with HI 7698295 short protective shield and 4 meter (13.1') cable, probe maintenance kit, manual, charging cable adapter, for 115VAC

HI 98291-02 Same as HI 98291-01, for 230VAC

HI 98292-01 HI 9829 and HI 7639829/4 logging probe for pH/ pH+ORP/ISE, D.O., EC/EC+turbidity, temperature with HI 7698296 long protective shield and 4 meter (13.1') cable, probe maintenance kit, manual, charging cable adapter, for 115VAC

HI 98292-02 Same as HI 98292-01, for 230VAC

HI 98293-01 HI 9829 and HI 7629829/10 logging probe for pH/ pH+ORP/ISE, D.O., EC, temperature with HI 7698295 short protective shield and 10 meter (33') cable, probe maintenance kit, manual, charging cable adapter, for 115VAC

HI 98293-02 Same as HI 98293-01, for 230VAC

HI 98294-01 HI 9829 and HI 7639829/10 logging probe for pH/ pH+ORP/ISE, D.O., EC/EC+turbidity, temperature with HI 7698296 long protective shield and 10 meter (33') cable, probe maintenance kit, manual, charging cable adapter, for 115VAC

HI 98294-02 Same as HI 98294-01, for 230VAC

HI 98295-01 HI 98290 with GPS and HI 7629829/4 logging probe for pH/pH+ORP/ISE, D.O., EC, temperature with HI 7698295 short protective shield and 4 meter (13.1') cable, probe maintenance kit, manual, charging cable adapter, for 115VAC

HI 98295-02 Same as HI 98295-01, for 230VAC

HI 98296-01 HI 98290 with GPS and HI 9829 and HI 7639829/4 logging probe for pH/pH+ORP/ISE, D.O., EC/EC+turbidity, temperature with HI 7698296 long protective shield and 4 meter (13.1') cable, probe maintenance kit, manual, charging cable adapter, for 115VAC

HI 98296-02 Same as HI 98296-01, for 230VAC

HI 98297-01	HI 98290 with GPS and HI 7629829/10 logging probe for pH/pH+ORP/ISE, D.O., EC, temperature with HI 7698295 short protective shield and 10 meter (33') cable, probe maintenance kit, manual, charging cable adapter, for 115VAC
HI 98297-02	Same as HI 98297-01, for 230VAC
HI 98298-01	HI98290 with GPS and HI 7639829/10 logging probe for pH/pH+ORP/ISE, D.O., EC/EC+turbidity, temperature with HI 7698296 long protective shield and 10 meter (33') cable, probe maintenance kit, manual, charging cable adapter, for 115VAC
HI 98298-02	Same as HI 98298-01, for 230VAC

SENSORS

HI 7609829-0	pH sensor
HI 7609829-1	pH/ORP sensor
HI 7609829-2	Dissolved Oxygen sensor
HI 7609829-3	EC sensor
HI 7609829-4	EC/Turbidity sensor
HI 7609829-10	Ammonium ISE
HI 7609829-11	Chloride ISE
HI 7609829-12	Nitrate ISE

CABLES, CONNECTORS, ACCESSORIES

HI 7698290	Short calibration beaker
HI 7698293	Long calibration beaker
HI 7698295	Short probe shield
HI 7698296	Long probe shield
HI 7698294	Short flow cell
HI 7698297	Long quick release flow cell
HI 7698292	Probe maintenance kit with HI 7042S (electrolyte for D.O. sensor), D.O. membrane O-rings, small brush, o-rings, syringe with grease to lubricate external o-rings.
HI 920005	iButton® with holder (5 pcs)

HI 929829	PC application software
HI 7698291	USB cable PC to meter
HI 76982910	USB cable PC to probe
HI 710045	Power supply cable
HI 710046	Cigarette lighter cable
HI 710005	115 VAC/12 VDC adapter, US plug
HI 710006	230 VAC/12 VDC adapter, European plug
HI 710012	230 VAC/12 VDC adapter, UK plug
HI 710013	230 VAC/12 VDC adapter, South African plug
HI 710014	230 VAC/12 VDC adapter, Australian plug
HI 710140	Hard carrying case for HI 9829

QUICK CALIBRATION SOLUTIONS

HI 9828-25	Quick calibration solution, 500 mL
HI 9828-27	Quick calibration solution, 1 gal.

pH BUFFERS

HI 5004	pH 4.01 buffer solution, 500 mL
HI 5068	pH 6.86 buffer solution, 500 mL
HI 5007	pH 7.01 buffer solution, 500 mL
HI 5091	pH 9.18 buffer solution, 500 mL
HI 5010	pH 10.01 buffer solution, 500 mL

ORP SOLUTIONS

HI 7020L	ORP test solution, 200/275 mV @ 20°C, 500 mL
HI 7021L	ORP test solution, 240 mV @ 20°C, 500 mL
HI 7022L	ORP test solution, 470 mV @ 20°C, 500 mL
HI 7091L	Reducing pretreatment solution, 500 mL
HI 7092L	Oxidizing pretreatment solution, 500 mL

pH/ORP MAINTENANCE SOLUTIONS (do not use for ISE)

HI 70670L	pH/ORP cleaning solution for salt deposits, 500 mL
HI 70671L	pH/ORP cleaning and disinfecting solution for algae, fungi and bacteria, 500 mL
HI 70300L	pH/ORP electrode storage solution, 500 mL

DO SOLUTIONS

HI 7040L	Zero oxygen solution, 500 mL
HI 7042S	Electrolyte solution for DO sensor, 30 mL
HI 76409A/P	Spare membrane with O-ring (5 pcs)

CONDUCTIVITY STANDARD SOLUTIONS

HI 7030L	12880 µS/cm calibration solution, 500 mL
HI 7031L	1413 µS/cm calibration solution, 500 mL
HI 7033L	84 µS/cm calibration solution, 500 mL
HI 7034L	80000 µS/cm calibration solution, 500 mL
HI 7035L	111800 µS/cm calibration solution, 500 mL
HI 7039L	5000 µS/cm calibration solution, 500 mL

TURBIDITY SOLUTIONS

HI 9829-16	0 FNU turbidity calibration solution, 230 mL
HI 9829-17	20 FNU turbidity calibration solution, 230 mL
HI 9829-18	200 FNU turbidity calibration solution, 230 mL

ISE SOLUTIONS

HI 9829-10	10 ppm ammonium (as N) standard for HI 7609829-10, 25 x 25 mL sachet
HI 9829-11	100 ppm ammonium (as N) standard for HI 7609829-10, 25 x 25 mL sachet
HI 9829-10/11	Kit containing 10 sachets each of 10 ppm and 100 ppm ammonium (as N) for HI 7609829-10 ammonium ISE.
HI 9829-12	10 ppm chloride standard for HI 7609829-11, 25 x 25 mL sachet
HI 9829-13	100 ppm chloride standard for HI 7609829-11, 25 x 25 mL sachet
HI 9829-12/13	Kit containing 10 sachets each of 10 ppm and 100 ppm chloride for HI 7609829-11 chloride ISE.
HI 9829-14	10 ppm nitrate (as N) standard for HI 7609829-12, 25 x 25 mL sachet
HI 9829-15	100 ppm nitrate (as N) standard for HI 7609829-12, 25 x 25 mL sachet
HI 9829-14/15	Kit containing 10 sachets each of 10 ppm and 100 ppm nitrate (as N) for HI 7609829-12 nitrate ISE.

APPENDIX E - WARRANTY

All HANNA instruments® **meters are guaranteed for two years (sensors, electrodes and probes for six months)** against defects in workmanship and materials when used for their intended purpose and maintained according to instructions.

This warranty is limited to repair or replacement free of charge. Damage due to accident, misuse, tampering or lack of prescribed maintenance are not covered.

If service is required, contact the dealer from whom you purchased the instrument. If under warranty, report the model number, date of purchase, serial number and the nature of the failure.

If the repair is not covered by the warranty, you will be notified of the charges incurred.

If the instrument is to be returned to HANNA instruments®, first obtain a Returned Goods Authorization number from the Customer Service department and then send it with shipping costs prepaid.

When shipping any instrument, make sure it is properly packaged for complete protection.

Recommendations for Users

Before using this product, make sure that it is entirely suitable for the environment in which it is used. Operation of this instrument in residential areas could cause unacceptable interferences to radio and TV equipment, requiring the operator to take all necessary steps to correct interferences. The glass bulb at the end of the electrode is sensitive to electrostatic discharges. Avoid touching this glass bulb at all time. To maintain the EMC performance of equipment, the recommended cables noted in the instruction manual must be used. Any variation introduced by the user to the supplied equipment may degrade the instruments' EMC performance. To avoid electrical shock, do not use these instruments when voltage at the measurement surface exceed 24 Vac or 60 Vdc. To avoid damage or burns, do not perform any measurement in microwave ovens.

Notes:

Hanna Instruments Inc.
Highland Industrial Park
584 Park East Drive
Woonsocket, RI 02895 USA

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www.hannainst.com

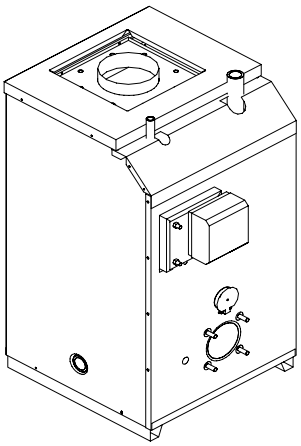
Local Sales and Customer Service Office

Printed in EUROPE
(ROMANIA)

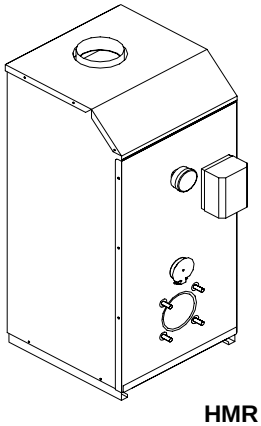
MAN9829 04//12

Installation Instructions and Homeowner's Manual

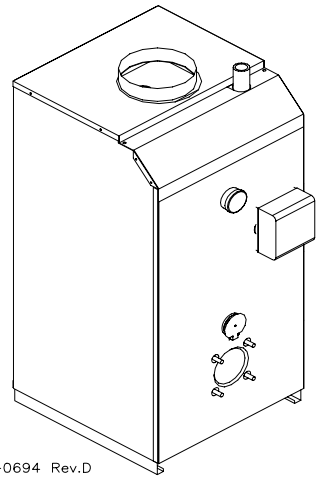
OIL FIRED
HOT WATER BOILER



HMT



HMR



HM2

DNS–0694 Rev.D

Models :

HMR
HMT
HM2

INSTALLER / SERVICE TECHNICIAN:

USE THE INFORMATION IN THIS MANUAL FOR THE INSTALLATION AND SERVICING OF THE FURNACE AND KEEP THE DOCUMENT NEAR THE UNIT FOR FUTURE REFERENCE.

HOMEOWNER:

PLEASE KEEP THIS MANUAL NEAR THE FURNACE FOR FUTURE REFERENCE.

Caution: Do not tamper with the unit or its controls. Call a qualified service technician.

Manufactured by:

DETTSON INDUSTRIES INC.
3400 Industrial Boulevard
Sherbrooke, Quebec – Canada - J1L 1V8
www.dettson.ca

Printed in Canada
Printed on 100% recycled paper

2011-07-06

X40019 Rev. AB

PART 1
INSTALLATION

1.1) SAFETY LABELLING AND SIGNAL WORDS

DANGER, WARNING AND CAUTION

The words DANGER, WARNING and CAUTION are used to identify the levels of seriousness of certain hazards. It is important that you understand their meaning. You will notice these words in the manual as follows:

DANGER

Immediate hazards which **WILL** result in death or serious bodily and/or material damage.

WARNING

Hazards or unsafe practices which CAN result in death or serious bodily and/or material damage.

CAUTION

Hazards or unsafe practices which **CAN** result in minor bodily and/or material damage.

It is important that you have a qualified technician install your boiler.

WARNING

- This boiler is designed to provide you with comfort, savings and reliability for many years to come. However, its performance depends on the appliance being installed, brought on-line, and maintained in accordance with the instructions provided in this manual.
- If the heat exchanger is subject to corrosion caused by the constant presence of air or oxygen in the water due to frequent water changes, an improperly designed distribution system or the use of plastic piping without oxygen barrier, the warranty will not be applicable.
- This boiler is equipped with a burner designed to burn only No. 2 fuel oil (furnace oil). Never attempt to burn used motor oil or any oil containing gasoline.
- Make sure that the boiler and system are filled with water and that all air has been bled before attempting to start the burner.
- Never operate the burner above the maximum temperature indicated on the boiler nameplate.
- Never attempt to start the burner when the combustion chamber contains excess oil, is overheated, or when a strong smell of oil permeates the appliance.
- Close oil valves if the boiler will not be in use for an extended period of time.
- Never store garbage or combustibles near the boiler.
- Never burn garbage or paper in your boiler.
- DO NOT TAMPER WITH THE UNIT OR ITS CONTROLS.

1.2) UNIT IDENTIFICATION

It is very important that you consult Figures 1 to 3 to identify the characteristics of each of the models offered in the “HMR - HMT – HM2” series.

Figure 1: “HMR” boilers without sanitary hot water coil and with a 13 cm (5") flue-pipe. The models are identified as HMR-080, HMR-092, HMR-103 and are available with either Beckett or Riello burners.

Figure 2: “HMT” boilers with or without sanitary hot water coil and with a 15 cm (6") flue-pipe. The models are identified as HMT12, HMT14, HMT16 and HMT18 and are available with either Beckett or Riello burners. These boilers are also approved with sealed combustion systems model VTK.

Figure 3: "HM2" boilers with or without sanitary hot water coil and with a 20 cm (8") flue-pipe. The models are identified as HM-185, HM-212, HM-240, HM-266 and HM-293. Available with the Beckett and Riello burners.

.

Each of these boilers has its own characteristics: location of return and supply pipes, sanitary hot water coil, relief valve and thermo manometer, diameter of the flue-pipe, etc.

1.3) DELIVERY

Carefully check your boiler upon delivery for any evidence of damage that may have occurred during shipping and handling. Any claims for damages or lost parts must be made with the Transport Company.

1.4) INSTALLATION

Your unit must be installed according to regulations as set out by competent authorities. Refer to the CSA B139 Installation Code.

1.4.1) Positioning

The boiler must be installed in a clean and dry area, as closely as possible to a chimney. The boiler is NOT approved for installation on a combustible floor.

The unit must be installed in a location where the ambient temperature is over 15°C (60°F).

1.4.2) Clearances

The following minimum clearances from combustible surfaces must be observed:

Top:	22.86 cm (9")
Flue-pipe:	22.86 cm (9")
One side:	7.62 cm (3")
Other side:	0.60 m (24")
Front (from the cabinet)	0.60 m (24")
Rear:	7.62 cm (3")

1.5) WIRING

The boiler must be connected to a 15 amp / 120 Vac protected circuit. The installer must wire the boiler according to the appropriate electrical diagram. Refer to typical wiring diagrams, Figures 5.1 to 5.5. All wiring must be in accordance with the "Canadian Electrical Code" CSA C22.1/ Part I.

CAUTION

Always select the wiring diagram based on the distribution system (piping) and whether or not the boiler has a sanitary hot water coil.

"HMR – HMT – HM2" boilers with integrated by-pass are designed for installation on any type of distribution (piping) system that is equipped with a circulating pump such as finned tube baseboard and cast iron radiators as shown in Figure 4. The integrated by-pass permits a stabilisation of the temperature rise between the supply and return pipes to approximately $\Delta 11^{o}C$ ($\Delta 20^{o}F$), whatever the return temperature. In addition, the integrated by-pass prevents condensation in the boiler when using the circulator contact available on the boiler aquastat.

This way, thermal shocks in the pipes are eliminated, off-cycling of the circulator is reduced and water temperature throughout the system is better controlled.

If more than 1 circulator is used, we recommend the use of an RC-02 circulator control.

1.6) OIL SUPPLY

The installation of the oil tank and lines must be in accordance with local codes and regulations. The burner can be hooked up to a one pipe system if the oil level in the tank is always above the burner. On an outside, above ground fuel tank hook-up, a one pipe system with a nominal dimension of 1.3 cm (½") diameter is ideal. Be sure to install the oil filter and at least 3 m (10') of piping inside the building, to allow the fuel oil to warm up in very cold weather, before reaching the burner.

The oil pump configuration is for a 1 pipe system. Insert the by-pass plug for a 2 pipe system (refer to the manufacturer's Instruction Manual).

The installation must include an oil filter and a shutoff valve. Ensure that the piping has no leaks and that there are no obstructions. Do not use couplings or compression fittings on oil lines. On a two pipe system, use the same diameter pipe for both the suction and the return lines and set them at the same depth in the oil tank. Additional information can be found in the burner installation manual provided with your boiler.

Check the entire oil distribution system for leaks at the beginning of each heating season.

TABLE 1
Chimney draft

Model	Chimney size		Connecting pipe	Recommended draft
	Minimum	Maximum		
HMR	12.70 cm (5")	15.24 cm (6")	12.70 cm (5")	8.71Pa (0.035")
HMT	12.70 cm (5")	15.24 cm (6")	15.24 cm (6")	8.71Pa (0.035")
HM2	17.78 cm (7")	20.32 cm (8")	20.32 cm (8")	12.44Pa (0.050")

1.7) CHIMNEY

1.7.1) Chimney draft

The chimney draft must be strong enough to ensure the safe and reliable operation of your unit.

1.7.2) Installation

The connecting flue pipe diameter must never exceed that of the chimney and its horizontal runs should have a minimum upward slope toward the chimney of 2 cm per 1 m (1/4" per foot) of run. The use of a damper in the connecting flue pipe is strictly prohibited. If more than one pipe is to be connected to the same chimney, the sectional area of the chimney must be equal to the total of the individual sectional areas. The use of a draft control is compulsory. Its omission constitutes sufficient grounds for voiding the warranty on the unit.

NOTICE

It is possible that an efficient hot water boiler will cause the formation of condensation on the three outer sides of an outside chimney. Should this happen, a chimney liner or an "SMH" side wall venting system should be installed.

1.7.3) Side wall venting

"HMR-HMT-HM2" hot water boilers are approved for installation with the SMH side wall venting system. HMT hot water boiler is also approved for installation with the VTK sealed combustion system.
If such a system is used, please refer to the installation manual supplied with the venting system.

1.8) BLOCKED VENT SHUT-OFF (BVSO) For chimney venting

WARNING

IT IS IMPERATIVE THAT THIS DEVICE BE INSTALLED BY A QUALIFIED SERVICE TECHNICIAN.

This device is designed to detect the insufficient evacuation of combustion gases in the event of a vent blockage. In such a case the thermal switch will shut down the oil burner. The device will then need to be restarted MANUALLY.

Refer to the wiring diagrams and the detailed instructions supplied with the BVSO for the installation and wiring procedures. The length of wires supplied with the unit is such that the safety device must be installed between the flue outlet of the appliance and the draft regulator, as indicated in the instructions.

It is further imperative that the BVSO be maintained annually. For more details refer to the instructions supplied with the device itself, as well as Section 3 of this Manual.

CAUTION

A positive pressure venting system (Sealed Combustion System or Direct Vent) MUST NOT use the BVSO. Follow the instructions supplied with the venting system.

1.9) BURNER INFORMATION

The burner is shipped in a box, separate from the boiler and must be installed as follows:

1. Check that the model number on the burner carton matches the one on the boiler nameplate;
2. Remove the burner from its box;
3. Check the electrode settings;
4. Install the burner on the boiler, using the nuts which are already on the studs. Be sure to install the fireproof gasket supplied with the burner. Also, ensure that the end of the blast tube is flush with the inside surface of the combustion chamber when installing a Riello burner with an adjustable flange;
5. Connect the oil pipe(s) to the burner pump;
6. Wire the electrical connections in accordance with the appropriate diagram (see Section 1.5.)

CAUTION

NEVER use the "interrupted ignition" function if a Honeywell R7184 series combustion relay is installed on the burner.

1.10) COMBUSTION AIR SUPPLY

In order to function reliably, every oil heating system requires an adequate supply of combustion air. If the boiler must be installed in a confined area, 2 permanent openings must be provided. Both openings must be sized at 240 cm^2/l (1 ft^2) per U.S. gallon of oil burned per hour. One opening must be located near the ceiling, the other near the floor.

1.11) PIPING

The satisfactory operation of your boiler depends greatly on the installation of your plumbing. Refer to Figure 4.

In any event, the installation must include:

1. A pressure reducing valve, set at 83 kPa (12 psi), installed on the boiler cold water supply;
2. An expansion tank pressurized to 83 kPa (12 psi), installed on the piping;
3. An automatic air vent, to eliminate trapped air in the boiler;
4. A correctly sized water circulator, installed on the heating loop;
5. Stop valves and threaded unions, installed on the return and supply pipes of the boiler.

Always use quality pipe sealant on all threaded connections and ensure that these connections are well tightened. Avoid flushing the system when the boiler is a replacement for an existing one, to limit oxygen from getting into the system.

CAUTION

To avoid water damage and/or scalding due to relief valve operation, a discharge line must be connected to the valve outlet and run to a drainage area. The discharge line shall be installed in such a way that it will allow for the complete drainage of the valve and discharge line.

1.12) BVSO PERFORMANCE TEST

The purpose of the following test is to check that the electrical outlet on the furnace, designated to the BVSO, is functional.

1. Start up the burner;
2. Remove the three-pole plug from the BVSO outlet on the furnace;
3. The burner must shut-off immediately.

If the test is not in line with the above, call a QUALIFIED SERVICE TECHNICIAN.

1.13) SANITARY HOT WATER HEATING COIL

Before attempting to install a coil, always check the water quality to avoid premature scaling, which quickly renders your installation inefficient. Consult a specialist and have a water treatment system installed, if necessary.

Locate the water inlet with the marking “IN”. We strongly recommend the use of a thermostatic mixing valve to achieve safe and optimal operation from the installation.

1.14) THERMOSTAT

The thermostat must be mounted on an inside wall, approximately 1.5 m (5') above the floor. The location should be such that the thermostat is not subjected to air currants and/or exposed to direct sunlight.

1.15) DRAFT REGULATOR

For chimney venting, a barometric draft regulator must be installed on the connecting pipe between the chimney and the boiler. It must be located in an easily serviceable location. Please refer to the installation instructions supplied with it.

PART 2
OPERATION

We recommend that a qualified service technician start-up and service your boiler. Ensure that the boiler and the system are always full of water and that all air has been bled before starting the burner.

2.1) FUEL

Use only No. 2 fuel oil. Never attempt to use a heavier fuel oil, gasoline, motor oil or any other sort of fuel with your boiler.

2.2) START UP

1. Make sure that the tank contains fuel oil and that the fuel and water valves are open;
2. The main power switch must be “OFF”;
3. Set the Limit Control to the desired temperature, for example 82° C (180° F);
4. Install a 0 - 1400 kPa (200 psi) pressure gage on the oil pump. The use of a suction gage may also be appropriate at the oil pump inlet, if suction of over 20.7 kPa (3 psi) may be encountered;
5. Pre-adjust the burner according to the specifications of Tables 2, 3 or 4. These specifications should only be used as a reference for initial start-up. Refer to the manual provided with the burner for further information on adjustments;
6. Turn the main switch “ON” and start the burner by setting the thermostat to its maximum;
7. Air can be bled from oil lines through the bleed port on the oil pump. If there is no ignition and the burner combustion relay goes into safety mode, see Section 2.3 below;
8. Adjust the oil pressure to the specified value in Tables 2, 3 or 4;
9. Adjust the chimney draft as specified in Table 1. Take this reading midway between the draft regulator and the outlet of the boiler;
10. Adjust the burner air band(s) for a smoke scale reading of 0 on the Bacharach scale;
11. Analyse the combustion gases with an appropriate instrument and set the burner accordingly.

Note: If a burner cabinet is used, ensure that all tests are done with this cabinet in place. Do not forget to tighten the adjustment screws once the burner is adjusted, before putting the burner cabinet back permanently.

12. Check the correct operation of the temperature controls and the burner combustion relay;
13. Adjust the limits and the thermostat to the desired set points. Be sure to avoid operating settings which will result in the boiler water temperature going below 60°C (140°F).

2.3) RESTARTING AFTER IGNITION FAILURE

1. Check the oil level in the fuel tank;
2. Make sure the fuel supply valve is open;
3. Make sure the oil filter is not clogged;
4. Check the electrical circuit (fuse or breaker);
5. Check the burner electrode settings. Refer to the burner instruction manual;
6. Check if the thermostat is calling for heat;
7. Check for air in the oil pump suction line.

If after following these steps and pressing the red Burner Reset Button, the burner still does not fire, call a qualified service technician. Never attempt to re-start the burner if excess fuel oil or fumes have accumulated in the combustion chamber.

2.4) SUMMER SEASON

Make sure the fuel oil valve is closed when the boiler is not in use for a long period of time.

2.5) START-UP AT THE BEGINNING OF THE HEATING SEASON

1. Clean the chimney, the connecting flue pipes and the boiler. Follow the steps in Section 3.6);
2. Replace the oil filter;
3. Have the burner electrodes cleaned along with the burner retention head and change the nozzle;
4. Check the operation of the high temperature Limit Control;
5. Check the operation of the circulating pump.

PART 3
MAINTENANCE

3.1) MAINTENANCE

The area around the boiler must be kept free of combustibles, excessive dust and humidity, and highly flammable products at all times. Fresh air openings to the boiler and the boiler room must be kept clear. Repair any water and oil leaks without delay.

3.2) NOZZLE

A dirty or clogged nozzle can prevent ignition or cause odours. If this is the case, it must be replaced.

3.3) FUEL TANK

Regularly check the level in the fuel tank. Should the tank run dry, the fuel lines will have to be bled before restarting the burner.

3.4) OIL FILTER

Replace the oil filter at the beginning of each heating season.

3.5) BURNER AND CIRCULATING PUMP MOTORS

Motors should be lubricated at least once a year (except permanently lubricated motors), with 2 to 3 drops of SAE 20 detergent-free oil.

3.6) CLEANING THE BOILER

1. Turn the main power switch “OFF” before cleaning;
2. Remove and clean the connecting flue pipe, sweep and check the chimney;

CAUTION

The boiler being equipped with a sound trap, make sure not to damage the acoustical material when cleaning the boiler. The use of a flexible cleaning brush is strongly recommended.

3. Remove the smoke box and the fire tube baffles and clean the fire tubes, with the help of a 5 cm (2") diameter steel brush.
4. Remove the burner and clean the combustion chamber. Take care to not damage the ceramic bottom insulation;
5. Examine the cleaned surfaces for corrosion and correct the cause, as needed;
6. Re-install all components in their original positions and re-adjust the unit.

3.7) BLOCKED VENT SHUT-OFF (BVSO) CLEANING

For continued safe operation, the Blocked Vent Shut-Off System (BVSO) is required to be inspected and maintained annually by a qualified service technician.

1. **Disconnect power to the appliance.**
2. Remove the two screws holding on the BVSO assembly cover.
3. Remove the cover.
4. Remove the two screws holding the control box to the heat transfer tube assembly. Sliding the control box in the appropriate direction will unlock it from the heat transfer tube assembly;
5. Carefully remove any build-up from the thermal switch surface;

CAUTION

Do not dent or scratch the surface of the thermal switch. If the thermal switch is damaged, replacement is required.

6. Clear and remove any build-up or obstruction inside the heat transfer tube.
7. Re-mount, lock and fasten the control box with the 2 screws removed in step 4;
8. Re-attach the assembly cover with the screws removed in step 2.
9. Re-establish power to the appliance.

3.8) BOILER PURGE

It is recommended to purge the boiler for about 1 minute at least once a year, to evacuate sludge and sediment that has accumulated at the bottom of the boiler. Proceed as follows:

1. Let the boiler cool down;
2. Hook-up a garden hose to the drain valve have a bucket ready;
3. Open the valve and drain the water into the bucket until it comes out clean.

3.9) SPARE PARTS

It is always recommended to replace a defective part with a genuine part, available from your supplier.

3.10) TROUBLESHOOTING

Note: It is normal to have to wait several hours after a cold start, before the house is well heated, because of the thermal inertia of the building.

PART 4
INFORMATION

Model: _____ Serial number: _____

Installation date of the boiler: _____

Service telephone # - Day: _____ Night : _____

Dealer name and address : _____

_____

_____

START-UP TEST RESULTS

Nozzle: _____ Pressure : _____ lb/in^2

Burner adjustments : Primary air _____

Fine air _____

Draw Assembly _____

CO_2 : _____ % Smoke scale : _____ (Bacharach)

Gross flue temperature: _____ °F

Ambient temperature: _____ °F

Chimney draft: _____ " W.C.

Overfire draft : _____ " W.C.

Test performed by : _____

TABLE 2
Technical specifications HMR

Beckett Burner AFG-F	**HMR-80-B**	**HMR-92-B**	**HMR-103-B**	**HMR-121-B**
Capacity (BTU/h)	79000	90000	101000	116000
Input (USGPH)	0.65	0.75	0.85	1.00
Retention head	F0	F3	F3	F3
LFRB*	Yes	Yes	Yes	No
Nozzle (Delavan)	0.65-80W	0.75-80W	0.85-80W	1.00-80A
Pressure (PSI)	100	100	100	100
Insertion tube (in.)	2 7/8	2 7/8	2 7/8	2 7/8
Adjustment main air band	0	0	0	1
Adjustment air shutter	8	9	9	9
AFUE %	84	83,5	80,9	80,6
Riello burner 40-F3	**HMR-80-R**	**HMR-92-R**	**HMR-103-R**	**N/A**
Capacity (BTU/h)	79000	91000	100000	-
Input (USGPH)	0.65	0.75	0.85	-
Nozzle (Delavan)	0.60-80A	0.65-70B	0.75-70B	-
Pressure (PSI)	120	135	130	-
Insertion tube (in.)	3 9/16	3 9/16	3 9/16	-
Adjtusment air shutter	3.8	4.1	6.1	-
Adjustment turbulator	0	0	0	-
AFUE %	84,9	84,4	81,8	-

* LFRB = Low Firing Rate Baffle (refer to the burner manual)

TABLE 3
Technical specifications HMT

Beckett Burner AFG-F (With chimney)	**HMT-12-B**	**HMT-14-B**	**HMT-16-B**	**HMT-18-B**
Capacity (BTU/h)	118000	141000	158000	175000
Input (USGPH)	1.00	1.20	1.35	1.50
Retention head	F6	F6	F6	F6
LFRB*	No	No	No	No
Nozzle (Delavan)	1.00-70A	1.20-70A	1.35-70A	1.50-70A
Pressure (PSI)	100	100	100	100
Insertion tube (in.)	2 7/8	2 7/8	2 7/8	2 7/8
Adjustment main air band	0	1	1	2
Adjustment air shutter	7	5	6	5
AFUE %	82,1	82,4	81,6	80,9
Riello Burner 40-F5 (With chimney)	**HMT-12-R**	**HMT-14-R**	**HMT-16-R**	**HMT-18-R**
Capacity (BTU/h)	120000	142000	159000	175000
Input (USGPH)	1.00	1.20	1.35	1.50
Nozzle (Delavan)	0.85-70B	1.00-70B	1.10-70B	1.25-70B
Pressure (PSI)	140	145	150	145
Insertion tube (in.)	3 9/16	3 9/16	3 9/16	3 9/16
Adjustment air shutter	2,5	2,75	3,5	4,5
Adjustment turbulator	0	1	2	3
AFUE %	85.7‡	84,6	83,4	82,4
Riello Burner 40-BF5 (Sealed combustion)	**HMT-12-R**	**HMT-14-R**	**HMT-16-R**	**N/A**
Capacity (BTU/h)	120000	142000	159000	-
Input (USGPH)	1.00	1.20	1.35	-
Nozzle (Delavan)	0.85-80B	1.00-80B	1.10-80B	-
Pressure (PSI)	140	145	150	-
Insertion tube (in.)	3 9/16	3 9/16	3 9/16	-
Adjustment air shutter	2	2	3	-
Adjustment turbulator	3	5	5	-
AFUE %	85.7‡	84,6	83,4	-

*** LFRB = Low Firing Rate Baffle (refer to the burner manual)**

‡ = ENERGY STAR

TABLE 4
Technical specifications HM2

Beckett Burner AFG-V1	**HM-185-B**	**HM-212-B**	**HM-240-B**	**HM-266-B**	**HM-293-B**
Capacity (BTU/h)	185000	215000	243000	270000	296000
Input (USGPH)	1.50	1.75	2.00	2.25	2.50
Retention head	MD-V1	MD-V1	MD-V1	MD-V1	MD-V1
LFRB*	No	No	No	No	No
Nozzle (Delavan)	1.50-70B	1.75-70B	2.00-70B	2.25-70B	2.50-70B
Pressure (PSI)	100	100	100	100	100
Insertion tube (in.)	2 7/8	2 7/8	2 7/8	2 7/8	2 7/8
Adjustment main air band	6	7	4	6	5
Adjustment air shutter	4	4	3	4	4
Head adjustment V1	1	2	3	5	6
Riello Burner 40-F10	**HM-185-R**	**HM-212-R**	**HM-240-R**	**HM-266-R**	**HM-293-R**
Capacity (BTU/h)	185000	215000	243000	270000	296000
Input (USGPH)	1,50	1,75	2,00	2,25	2,50
Nozzle (Delavan)	1.25-60B	1.50-45B	1.65-45B	1.75-45B	2.25-60B
Pressure (PSI)	145	135	145	165	125
Insertion tube (in.)	3 1/8	3 1/8	3 1/8	3 1/8	3 1/8
Adjustment air shutter	3,4	4,5	3,4	5,5	4,5
Adjustment turbulator	0,0	1,0	2,0	3,0	4,0

FIGURE 1
HMR Boiler

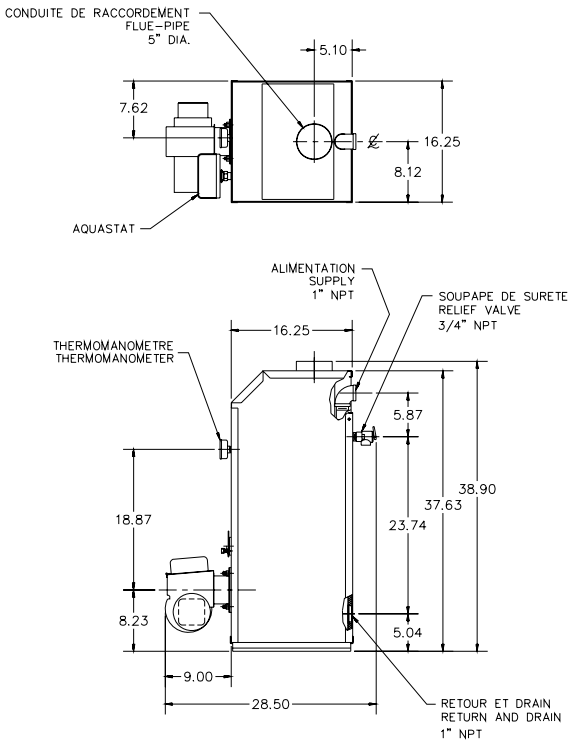


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FIGURE 2
HMT boiler with or without coil

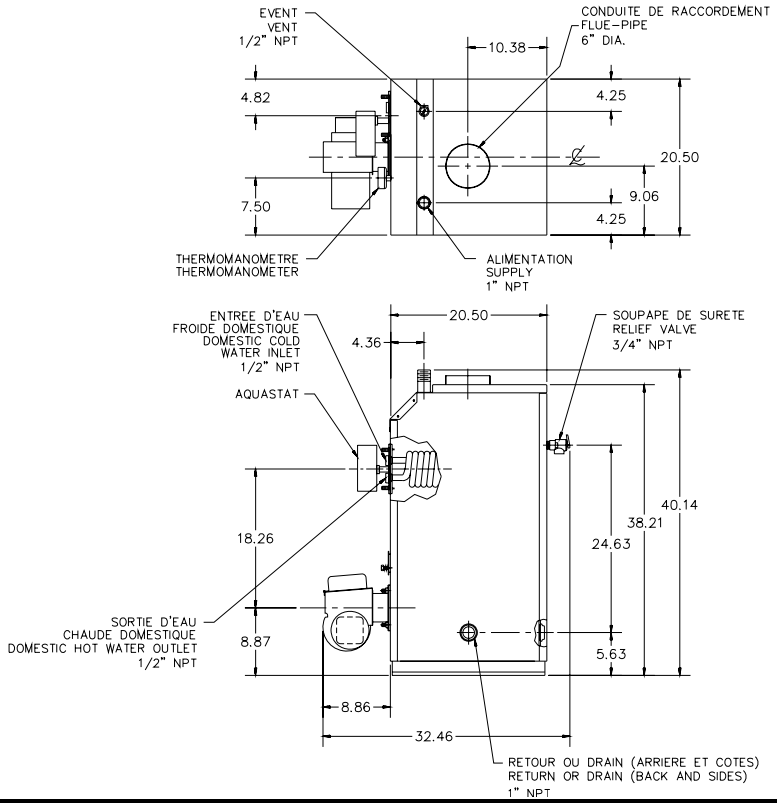

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FIGURE 3
HM2 boiler with or without coil

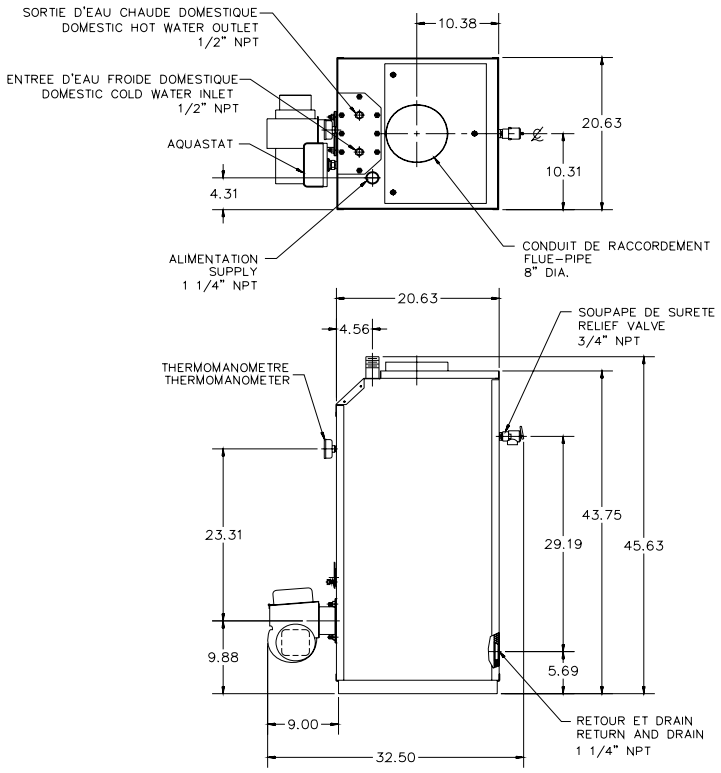

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FIGURE 4
General piping installation diagram

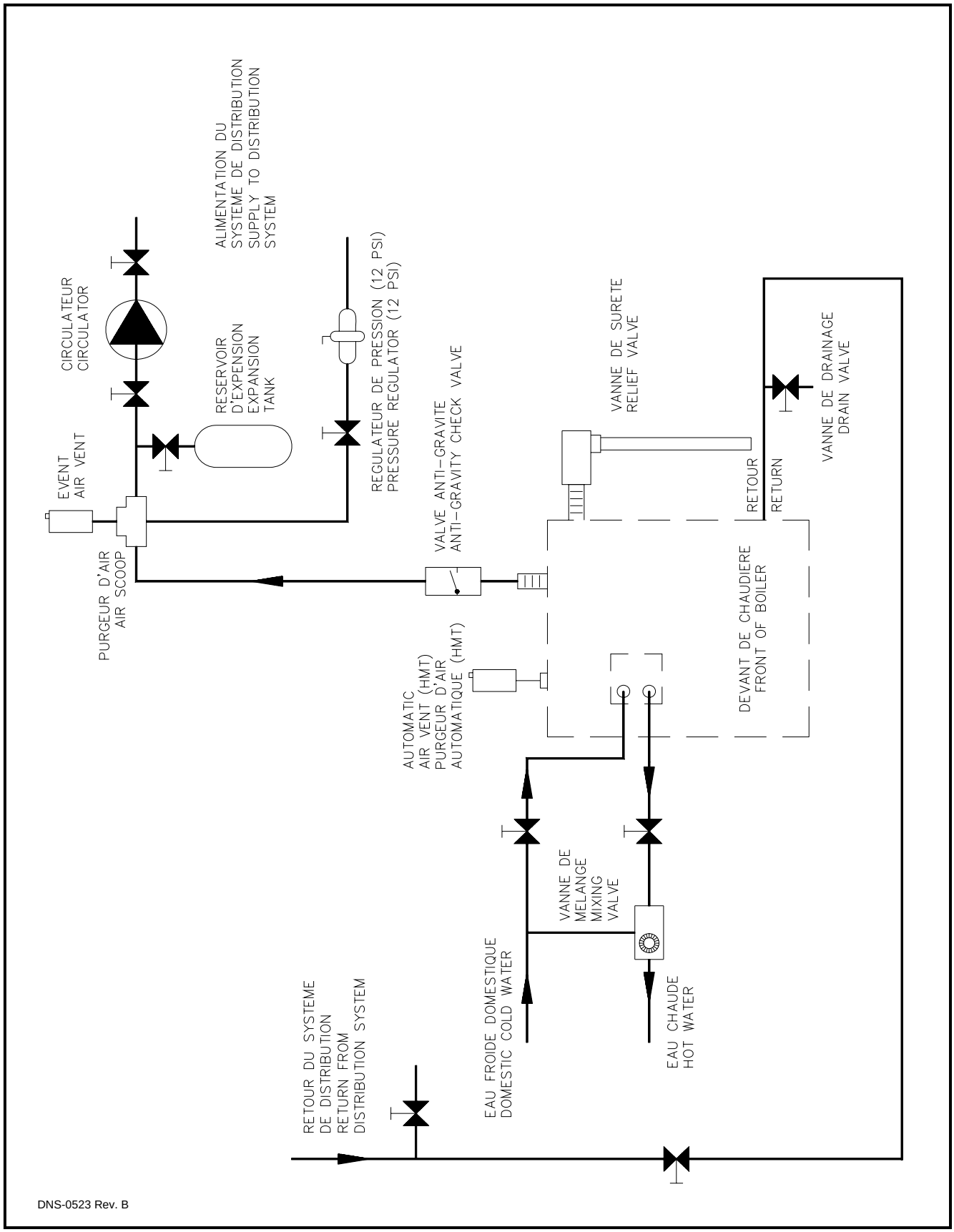
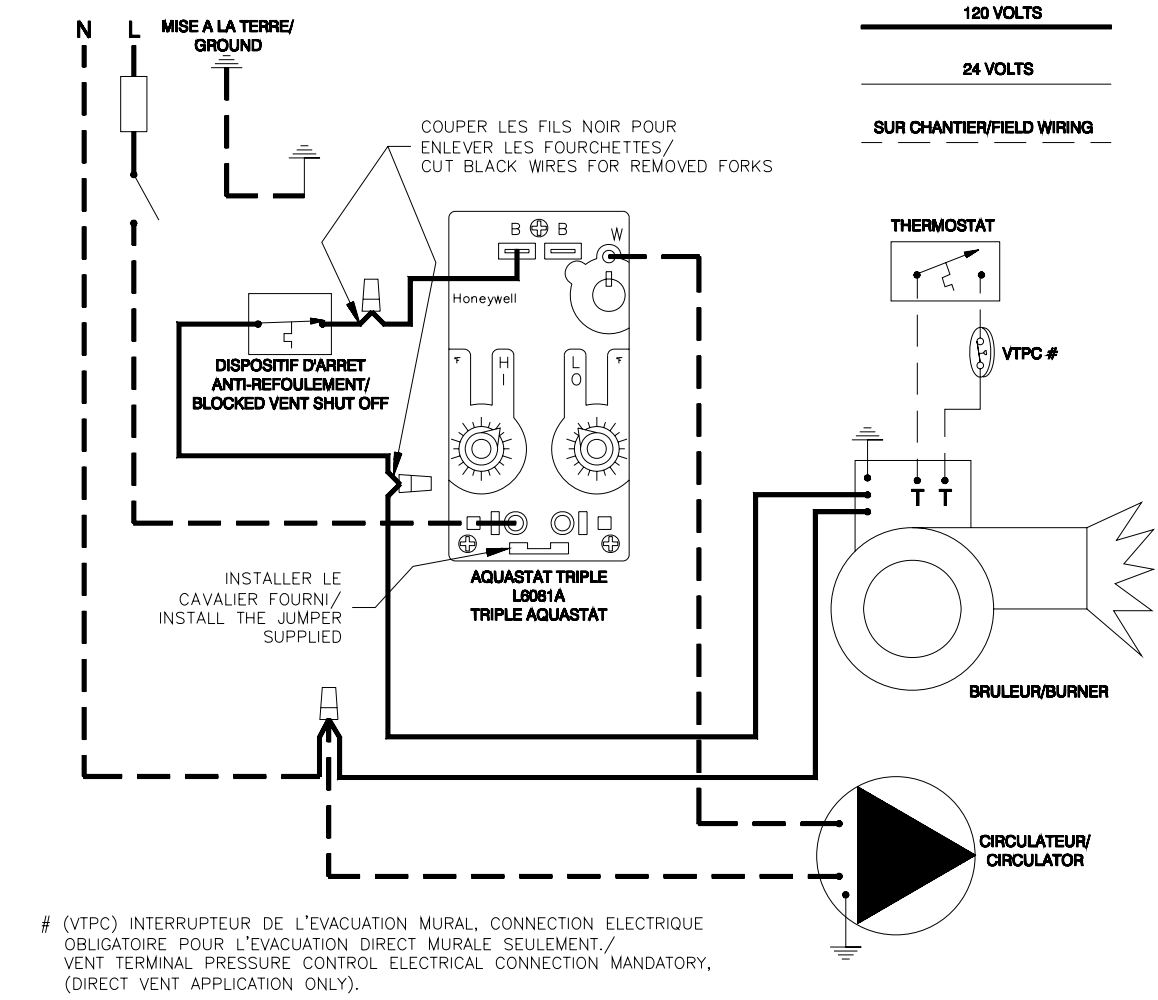


FIGURE 5.1
Typical connection without sanitary water coil

Control used:

"Triple action" temperature control - Honeywell # L6081A or
White Rodgers # 11C61 (Aquastat Triple, Hi-Lo/Circ)



Operation and typical settings

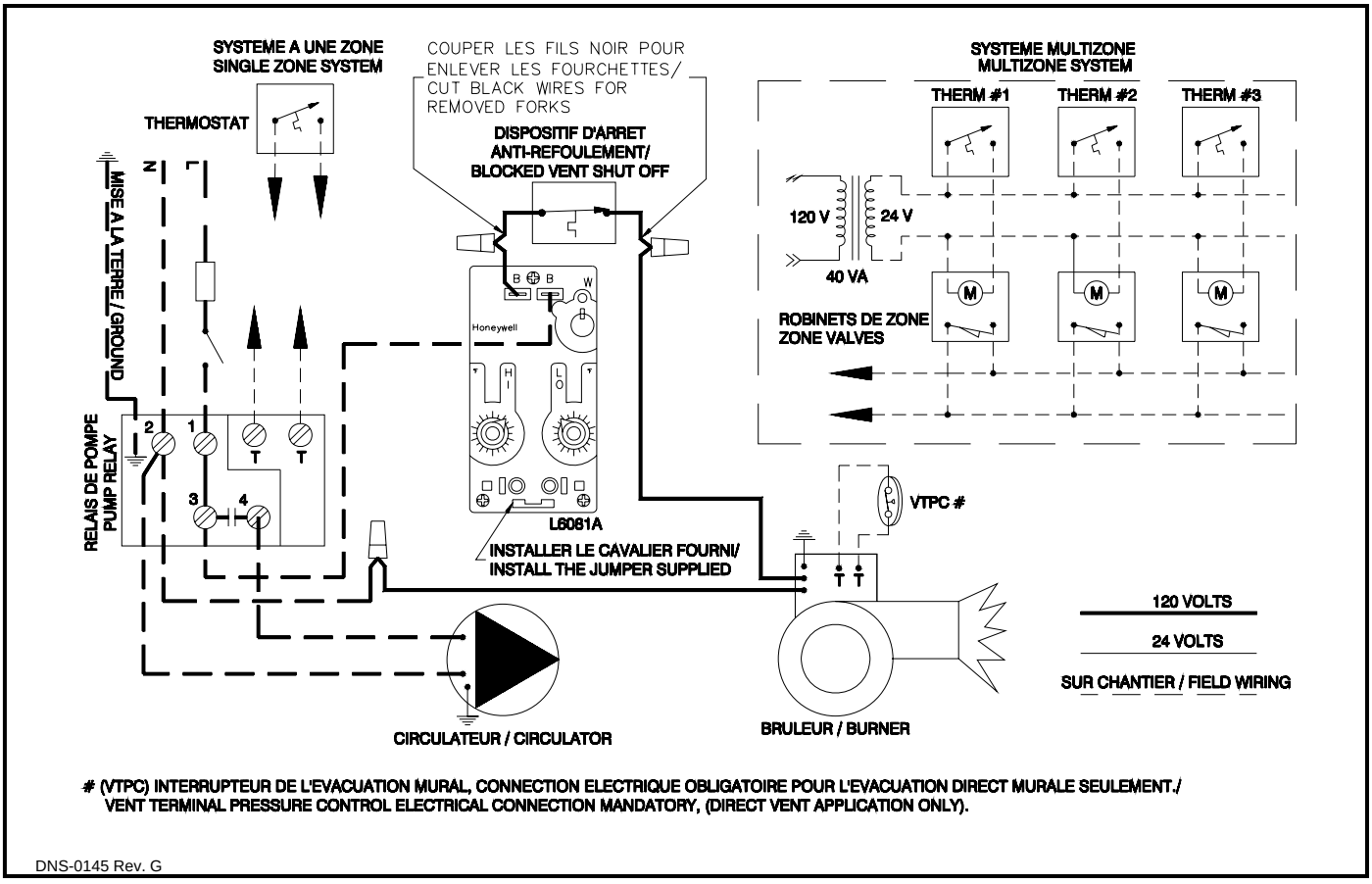
Operation:							
Burner	Stop	Thermostat opened -or- "Hi" contact opened					
	Start	Thermostat closed -and- "Hi" contact closed					
Circulator	Stop	"Circ" contact opened					
	Start	"Circ" contact closed					
Settings:							
"Hi"				"Lo / Circ"			
Set		Diff.		Set		Diff.	
°F	°C	°F	°C	°F	°C	°F	°C
180	82	10	5.6	140	60	10	5.6

Maximum High-Limit setting = 210°F

FIGURE 5.2
Typical connection for system with finned tube radiators and without sanitary water coil

Control used:

- "Triple action" temperature control -Honeywell # L6081A or White Rodgers # 11C61 (Aquastat Triple, Hi-Lo/Circ)
- Pump relay Honeywell # RA89A or White Rodgers # 809A



Operation and typical settings

Operation: (the boiler is maintained warm)		
Burner	Stop	"Lo" contact opened
	Start	"Lo" contact close
Circulator	Stop	Thermostat opened -or- All zone valves closed
	Start	Thermostat closed -or- One zone valves opened

Settings:

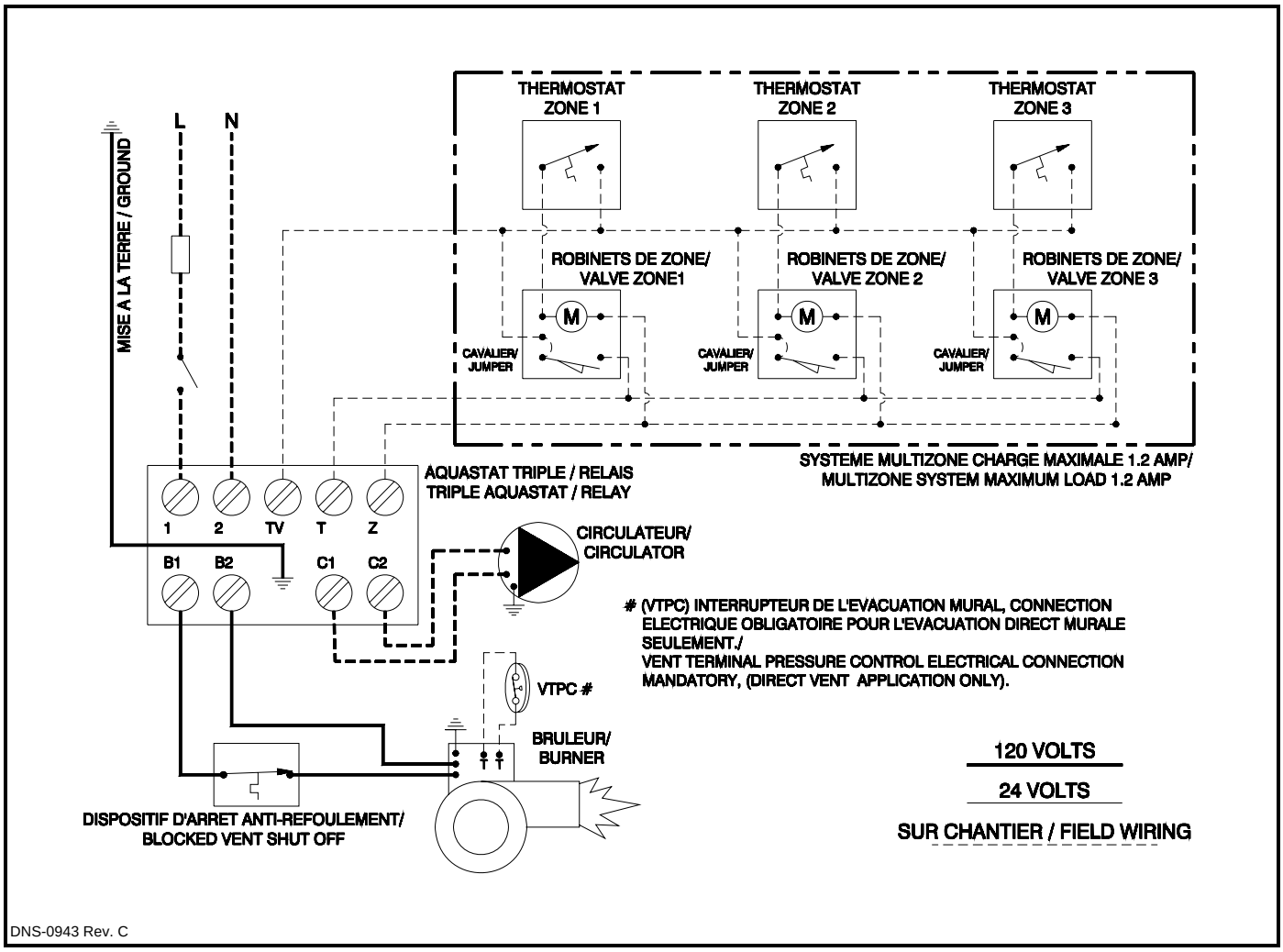
"Hi"				"Lo / Circ"			
Set		Diff.		Set		Diff.	
°F	°C	°F	°C	°F	°C	°F	°C
200	93	10	5.6	180	82	10	5.6

Maximum High-Limit setting = 210°F

FIGURE 5.3
Typical connection with or without sanitary water coil

Control used:

"Triple relay Multizone" temperature control Honeywell # L8124L1029B



Operation and typical settings

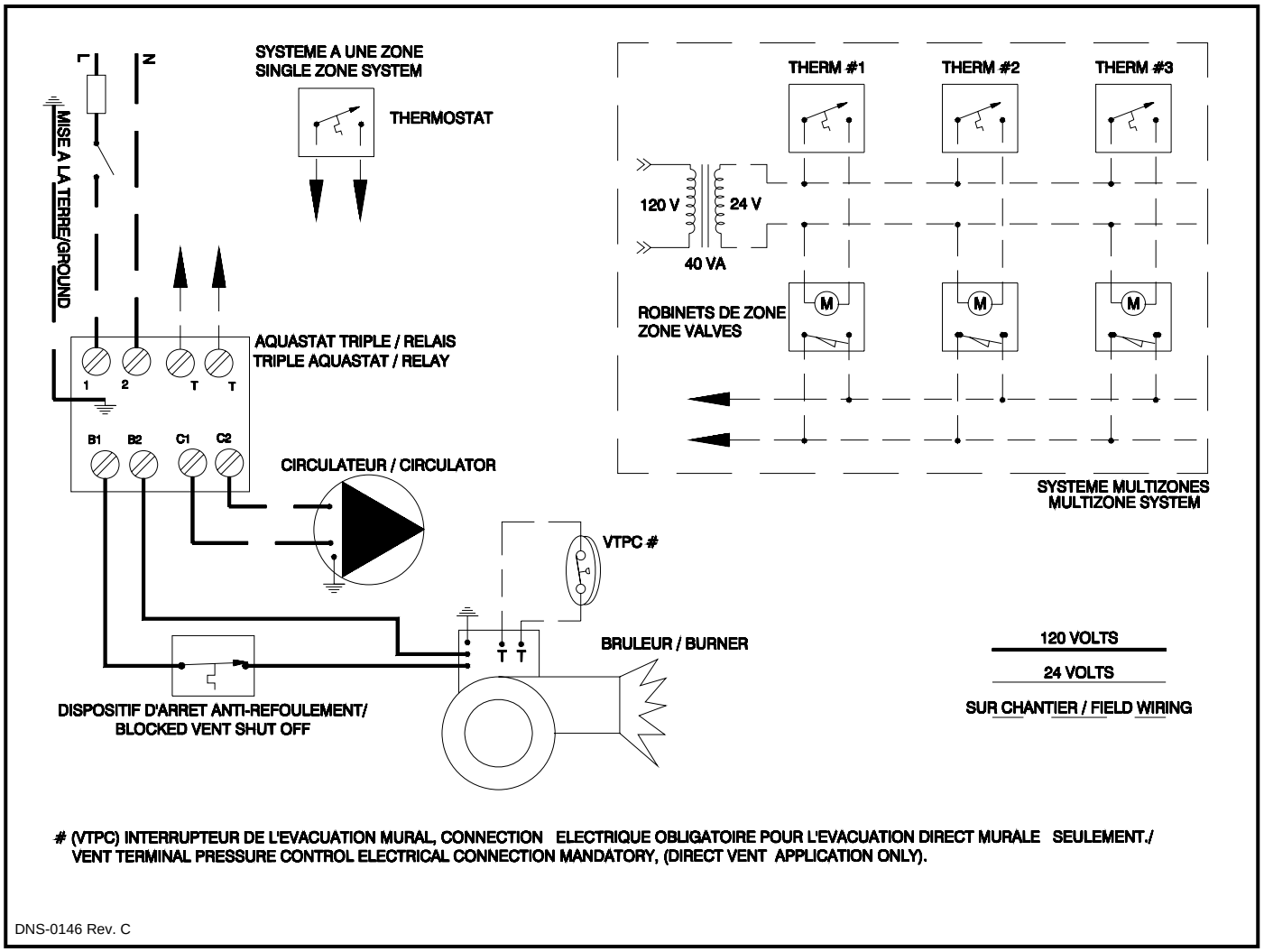
Operation:							
Burner	Stop	"Hi" contact opened -or- if Thermostat opened, "Lo" contact opened					
	Start	"Hi" contact closed and Therm. closed -or- if Therm. opened, "Lo" contact closed					
Circulator	Stop	Thermostat opened -or- "Circ" contact opened					
	Start	Thermostat closed -and- "Circ" conctact closed					
Typical settings with coil:							
"Hi"				"Lo"			
Set		Diff.		Set		Diff.	
°F	°C	°F	°C	°F	°C	°F	°C
200	93	10	5.6	180	82	10	5.6
Typical settings without coil :							
See "Typical settings without coil" in table on page 18							

Maximum High-Limit setting = 210°F

FIGURE 5.4
Typical connection with or without sanitary water coil

Control used:

Triple relay temperature control Honeywell # L8124L1102B



Operation and typical settings

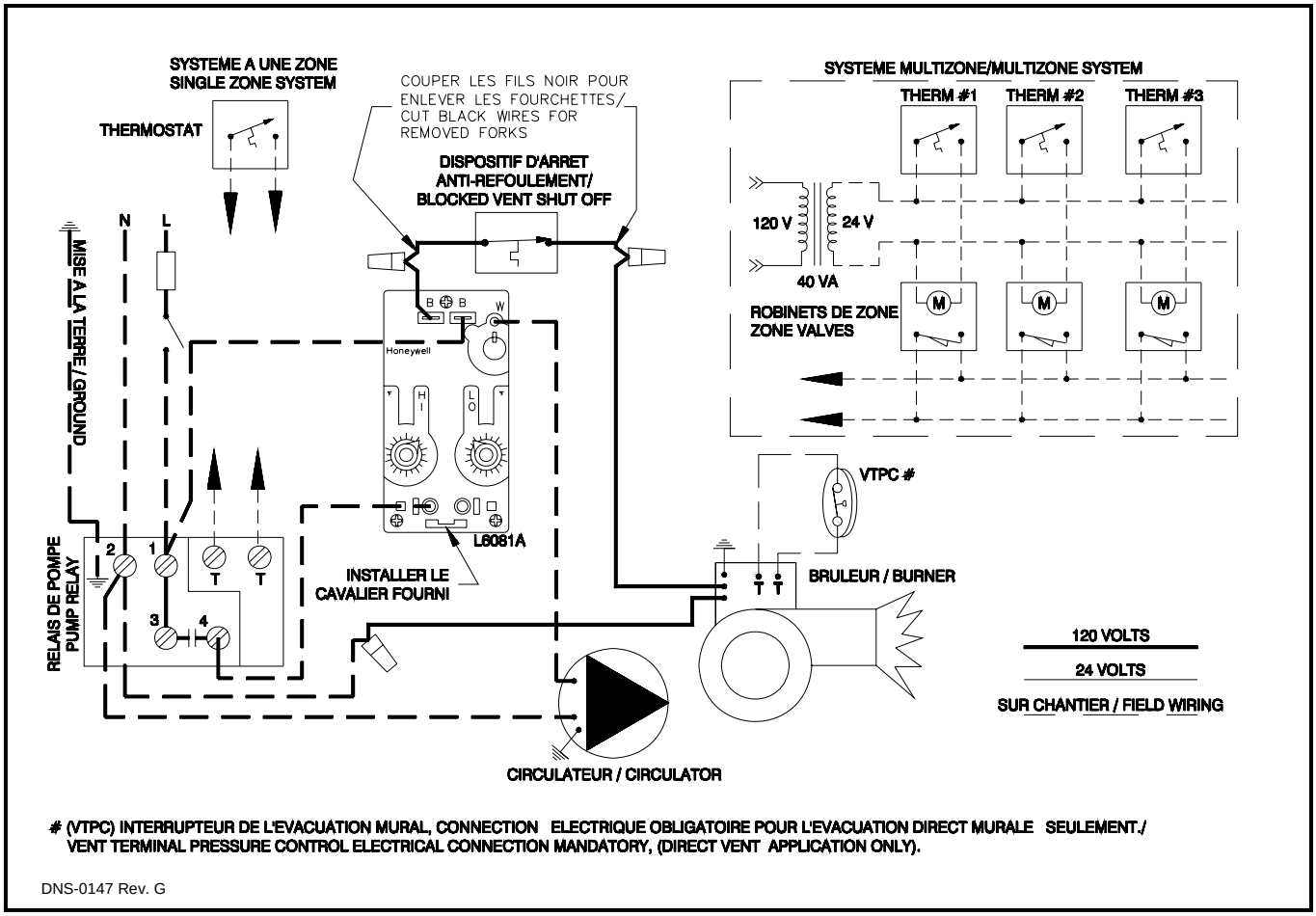
Operation:								
Burner	Stop	"Hi" contact opened -or- if Thermostat opened, "Lo" contact opened						
	Start	"Hi" contact closed and Therm. closed -or- if Therm. opened, "Lo" contact closed						
Circulator	Stop	Thermostat opened -or- "Circ" contact opened						
	Start	Thermostat closed -and- "Circ" conctact closed						
Typical settings with coil:								
"Hi"				"Lo"				
Set		Diff.		Set		Diff.		
°F	°C	°F	°C	°F	°C	°F	°C	
200	93	10	5.6	180	82	10	5.6	
Typical settings without coil :								
See "Typical settings without coil" in table on page 18								

Maximum High-Limit setting = 210°F

FIGURE 5.5
Typical connection with or without sanitary water coil

Control used:

- "Triple action" temperature control Honeywell # L6081A or White Rodgers # 11C61 (Aquastat Triple, Hi-Lo/Circ)
- Pump relay Honeywell # RA89A or White Rodgers # 809A

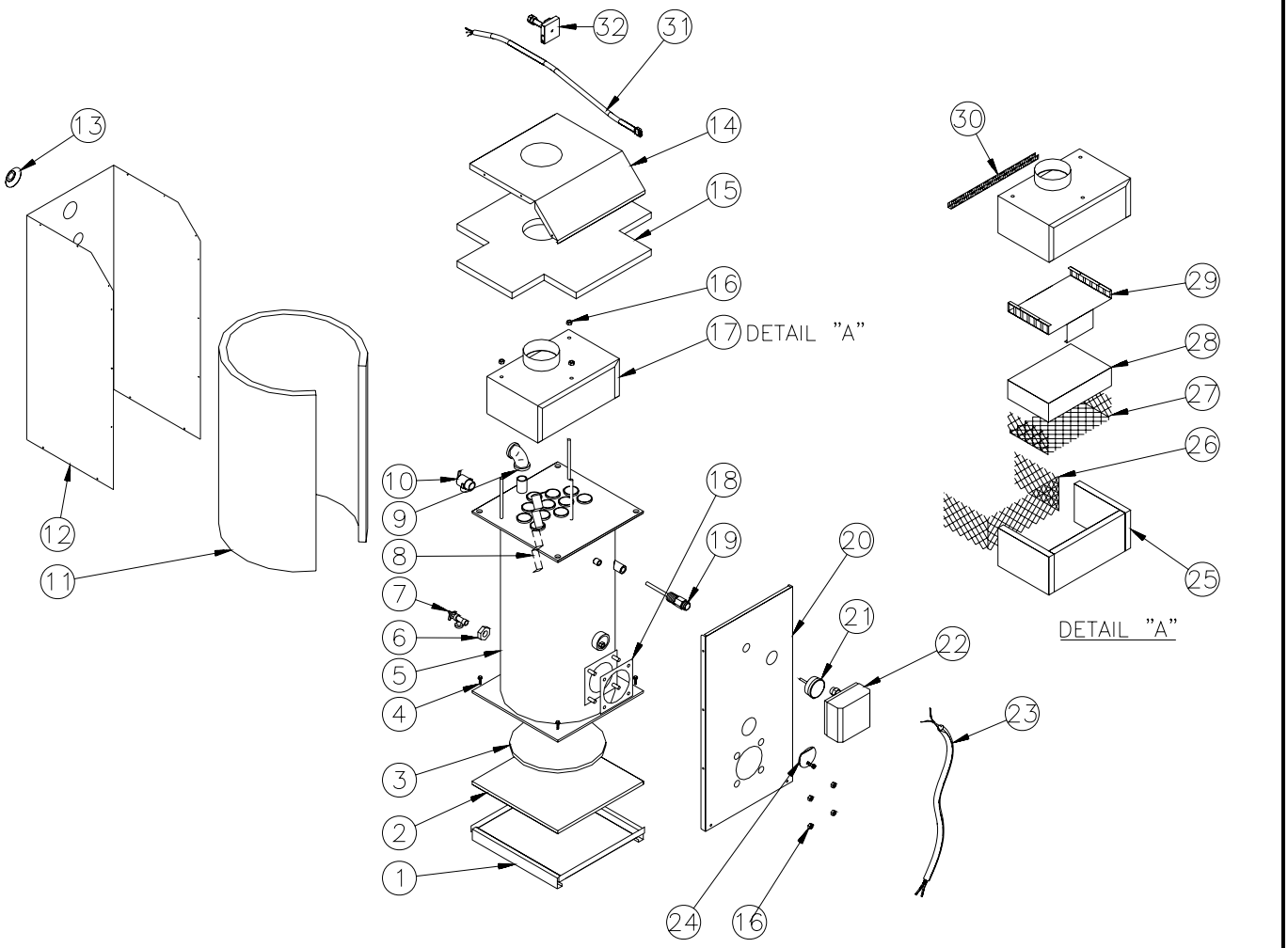


Operation and typical settings

Operation:							
Burner	Stop	Hi" contact opened -ou- if Thermostat opened, "Lo" contact opened					
	Start	"Hi" contact closed and Therm. closed -or- if Therm. opened, "Lo" contact closed					
Circulator	Stop	Thermostat opened -or- "Circ" contact opened					
	Start	Thermostat closed -and- "Circ" contact closed					
Typical settings without coil:							
"Hi"				"Lo / Circ"			
Set		Diff.		Set		Diff.	
°F	°C	°F	°C	°F	°C	°F	°C
180	82	10	5.6	140	60	10	5.6
Typical settings with coil :							
See "Typical settings with coil" in table on page 16							

Maximum High-Limit setting = 210°F

PARTS LIST
Model : HMR (HM-080 @ HM-103)

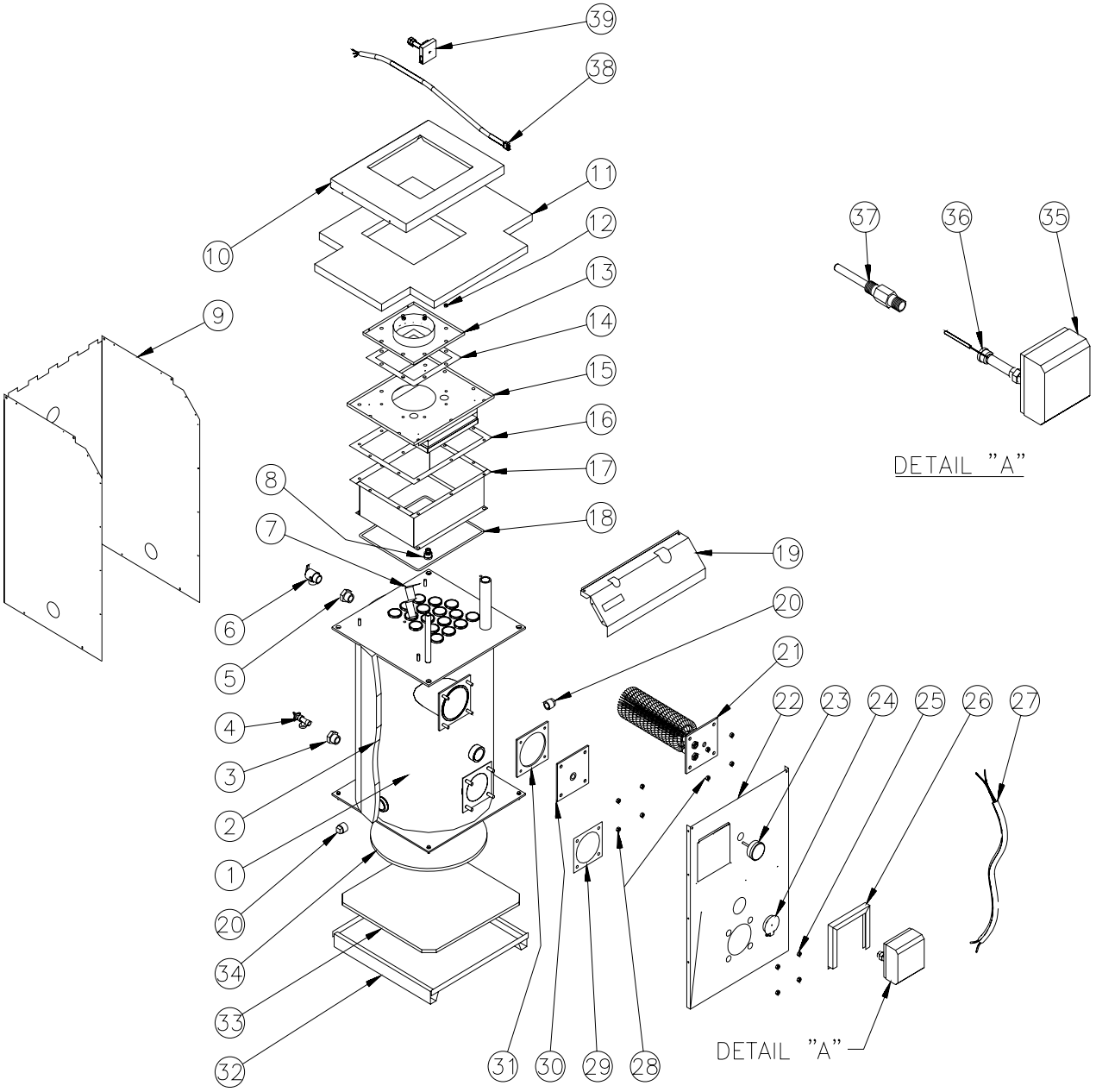


B50019B

PARTS LIST
Model : HMR (HM-080 @ HM-121)

ITEM	PART #	DESCRIPTION
1	B00472-01	FLOOR
2	B00619-01	FLOOR INSULATION
3	B00618-01	COMBUSTION CHAMBER BOTTOM INSULATION
4	F03F004	FLOOR SCREW (Quantity: 4)
5	B00909	HEAT EXCHANGER
6	G08F004	REDUCER BUSHING 1" NPT x 1/2" NPT
7	G11Z001	DRAIN FAUCET 1/2"NPT
8	B00864-02	FLUE BAFFLE (Quantity: 11)
9	G04F002	OUTLET PIPE FITTING
10	G11F012	RELIEF VALVE 30 PSI 3/4" x 3/4"
11	B01651	HEAT EXCHANGER OUTSIDE INSULATION
12	B02904	"U" SHAPED CASING
13	G14G001	FLANGE 2-7/8" OD 1" ID LDPE WHITE
14	B00929	TOP PANEL (Without well)
15	B00701-01	TOP INSULATION
16	F07F011	HEX NUT 3/8"-16NC ZINC (Quantity: 7)
17	B00946	SOUND TRAP ASSEMBLY (with shield & insulation)
18	B00419	GASKET, BURNER
19	R02J003	WELL 3/4" NPT
20	B00927	FRONT PANEL
21	R02L001	TRIDICATOR 0-75 PSI 1/4" NPT
22A	R02H005	TRIPLE ACTION AQUASTAT L6081A
22B	R02H006	TRIPLE ACTION AQUASTAT MULTIZONE L8124L
23	B00964	ELECTRICAL KIT
24A	K02014	OBSERVATION DOOR KIT (before 99/09)
24B	B01842	OBSERVATION DOOR ASSEMBLY (after 99/09)
25	K08006	SOUND TRAP INSULATION KIT
26	B00834-09	SOUND TRAP INSULATION SHIELD
27	B00834-10	SOUND TRAP BAFFLE INSULATION SHIELD
28	B00621-24	SOUND TRAP BAFFLE INSULATION
29	B00892	SOUND TRAP BAFFLE
30	B00702-12	GASKET, SOUND TRAP (25 foot roll)
31	B03029	ELECTRICAL KIT, BVSO
32	Z06G001	BLOCKED VENT SHUT-OFF BVSO-225

PARTS LIST
Model : HMT (HMT-12 @ HMT-18) S/N greater than D010408972



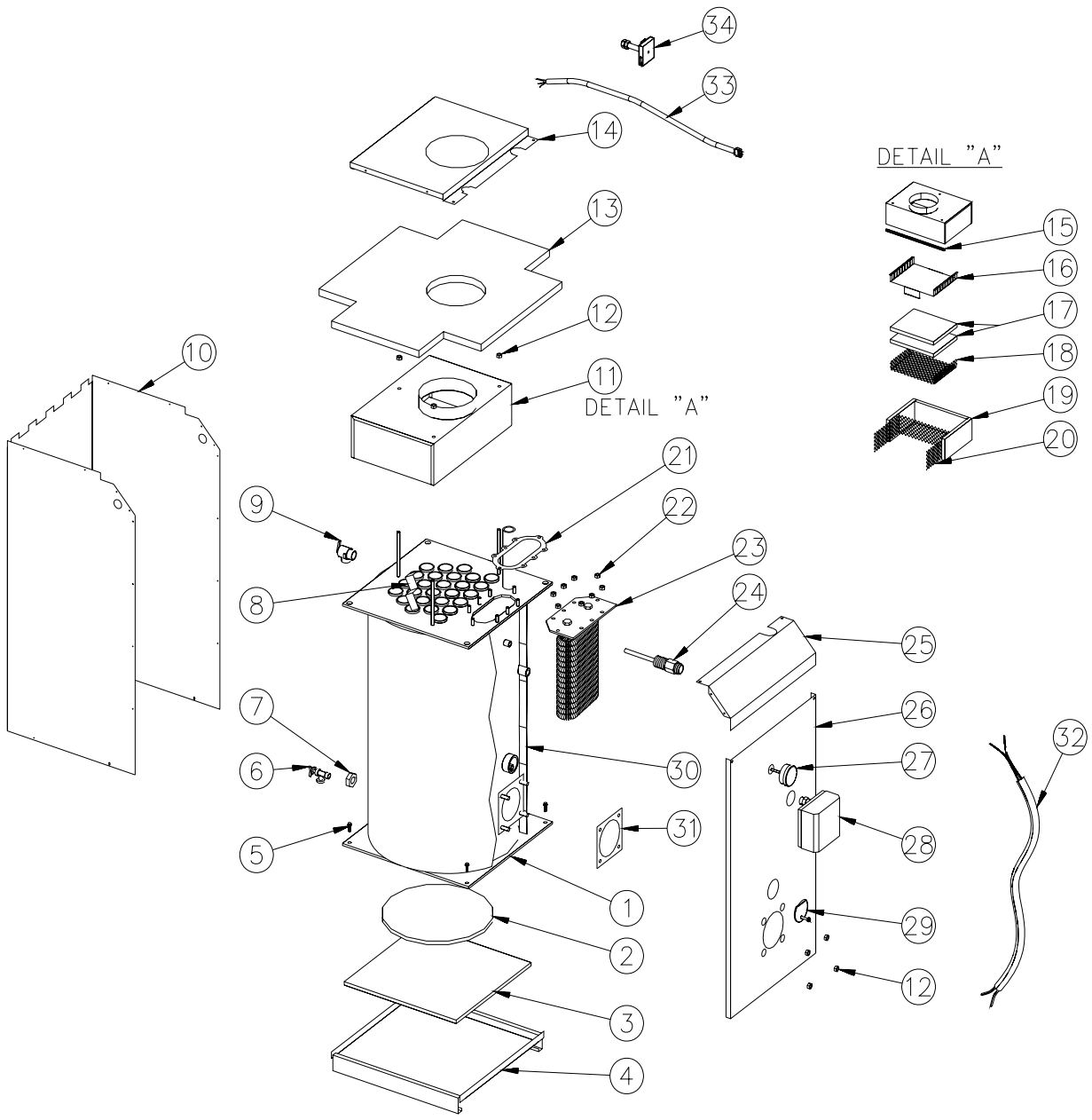
B50020B

PARTS LIST
Model : HMT (HMT-12 @ HMT-18) S/N greater than D010408972

ITEM	PART #	DESCRIPTION
1	B02349-01	HEAT EXCHANGER (Without coil)
2	B01910	HEAT EXCHANGER OUTER INSULATION
3	G08F004	REDUCER BUSHING 1" x 1/2" BLACK
4	G11Z001	DRAIN FAUCET 1/2"
5	G01J002	NIPPLE STD 3/4" NPT x 2" BLACK
6	G11F012	RELIEF VALVE 30 PSI 3/4" x 3/4"
7	B00864-02	FLUE BAFFLE (Quantity: 17)
8	G03J011	REDUCER COUPLING 1/2"NPT @ 1/8" NPT STEEL
9	B02546	CASING
10	B02342	REAR TOP PANEL ASSEMBLY
11	B01938	TOP INSULATION
12	F07O001	HEXAGONAL FLANGE NUT 3/8"-16NC BRASS
13	B01747	SMOKE OUTLET ASSEMBLY
14	B00205	OUTLET COVER GASKET
15	B01955	SOUND TRAP ASSEMBLY
16	B01937	GASKET, SOUND TRAP
17	B01954	SOUND TRAP BOX ASSEMBLY
18	J06L001	SEAL STRIP 1/2" x 1/8" (25 foot roll)
19	B02345	FRONT TOP PANEL
20	G06F003	SQAURE HEAD PLUG 1" NPT BLACK
21A	K14007	COIL, 5 USGPM 1/2"NPT SQUARE
21B	K14008	COIL, 5 USGPM 1-1/4" NPT SQUARE
22	B02340	FRONT PANEL ASSEMBLY
23	R02L001	TRIDICATOR 0-75 PSI 1/4" NPT
24	B02111	OBSERVATION DOOR ASSEMBLY
25	F07F011	HEX NUT 3/8"-16NC ZINC
26	B01634	COIL FLANGE COVER PANEL
27	B00964	ELECTRICAL KIT, BURNER
28	F07F021	HEXAGONAL NUT 7/16"-20NF ZINC (For coil cover)
29	B00419	BURNER GASKET
30	B20090	COIL COVER ASSEMBLY
31	B20060	COIL GASKET
32	B00472-03	FLOOR
33	B00619-03	FLOOR INSULATION
34	B00618-04	COMBUSTION CHAMBER BOTTOM INSULATION
35A	R02H005	TRIPLE ACTION AQUASTAT L6081A
35B	R02H006	TRIPLE ACTION AQUASTAT MULTIZONE L8124L
36	R02J006	WELL PACKING NUT (Use with coil)
37	R02J001	WELL 1/2" NPT (Use without coil)
38	B03029-01	BVSO ELECTRICAL KIT
39	Z06G001	BLOCKED VENT SHUT-OFF BVSO-225

L50020B

PARTS LIST
Model : HM2 (HM-185 @ HM-293) S/N greater than D010408972



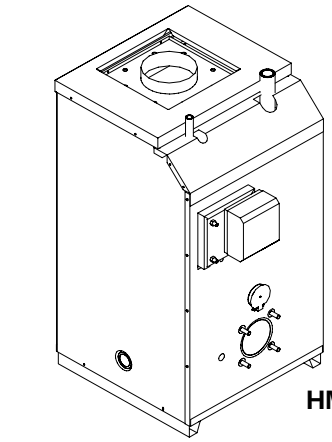
B50021B

PARTS LIST
Model : HM2 (HM-185 @ HM-293) S/N greater than D010408972

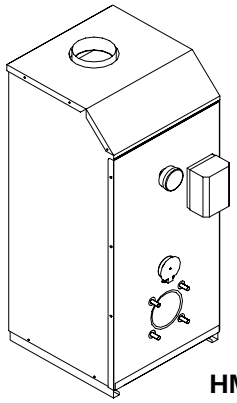
ITEM	PART #	DESCRIPTION
1	B00989	HEAT EXCHANGER
2	B00618-04	COMBUSTION CHAMBER BOTTOM INSULATION
3	B00619-03	FLOOR INSULATION
4	B00472-03	FLOOR
5	F03F004	FLOOR SCREW (Quantity: 4)
6	G11Z001	DRAIN FAUCET 1/2" NPT
7	G08F006	REDUCER BUSHING 1-1/4" NPT x 1/2" BLACK
8	B00864-02	FLUE BAFFLE (Quantity: 26)
9	G11F012	RELIEF VALVE 30 PSI 3/4" x 3/4"
10	B02918	"U" SHAPED CASING
11	B00945	SOUND TRAP ASSEMBLY (Insulation and shield included)
12	F07F011	HEX NUT 3/8"-16NC ZINC (Quantity: 7)
13	B00808-01	TOP INSULATION
14	B01917-01	REAR TOP PANEL ASSEMBLY
15	B00702-11	GASKETY, SOUND TRAP
16	B00893	SOUND TRAP BAFFLE
17	B00621-21	INSULATION (Quantity: 2)
18	B00834-08	SOUND TRAP INSULATION SHIELD
19	K08012	SOUND TRAP INSULATION KIT
20	B00834-07	SOUND TRAP INSULATION
21	A00083	GASKET, VERTICAL COIL
22	F07O001	HEX NUT 3/8"-16NC BRASS
23A	K02019	COIL KIT (optional)
23B	K14023	COIL COVER (Items 21& 22 included)
24A	R02J003	WELL, 3/4" NPT (serial # < 124000)
24B	R02J001	WELL, 1/2" NPT (serial # > 124000)
25	B00910	FRONT TOP PANEL
26	B00904	FRONT PANEL
27	R02L001	TRIDICATOR 0-75 PSI 1/4" NPT
28A	R02H005	TRIPLE ACTION AQUASTAT L6081A
28B	R02H006	TRIPLE ACTION AQUASTAT, MULTIZONE L8124L
29A	K02014	OBSERVATION DOOR KIT (before 99/09)
29B	B01842	OBSERVATION DOOR ASSEMBLY (after 99/09)
30	B01476	INSULATION, CASING
31	B00419	BURNER FLANGE GASKET
32	B00964	ELECTRICAL KIT, BURNER
33	B03029-01	ELECTRICAL KIT, BVSO
34	Z06G001	BLOCKED VENT SHUT-OFF BVSO-225

Guide d'installation et manuel du propriétaire

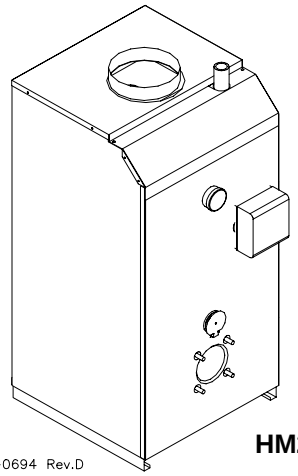
CHAUDIÈRE À EAU CHAUDE AU MAZOUT



HMT



HMR



HM2

DNS–0694 Rev.D

Modèles :

HMR
HMT
HM2

<u>INSTALLATEUR / TECHNICIEN</u> :

UTILISER LES RENSEIGNEMENTS DANS CE MANUEL POUR L'INSTALLATION ET L'ENTRETIEN DE L'APPAREIL ET GARDER LE DOCUMENT PRÈS DE L'UNITÉ POUR RÉFÉRENCES ULTÉRIEURES.

<u>PROPRIÉTAIRE :</u>

S.V.P. GARDEZ CE MANUEL PRÈS DE L'UNITÉ POUR RÉFÉRENCES ULTÉRIEURES.

<u>Attention</u> : Ne pas altérer votre unité ou ses contrôles. Appeler un technicien qualifié.

Fabriqué par :

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X40019 Rev. AB

SECTION 1
INSTALLATION

1.1) LIBELLE DE SÉCURITÉ ET SIGNALISATION

DANGER, MISE EN GARDE ET AVERTISSEMENT

Comprenez bien la portée des mots suivant : **DANGER, MISE EN GARDE** ou **AVERTISSEMENT**. Ces mots sont associés aux symboles de sécurité. Vous les retrouverez dans le manuel de la façon suivante :

⚠ DANGER

Le mot **DANGER** indique les plus graves dangers, ceux qui **provoqueront** la mort ou des dommages corporels et/ou matériels sérieux.

⚠ MISE EN GARDE

L'expression MISE EN GARDE signifie un danger qui peut entraîner la mort ou des dommages corporels et/ou matériels.

AVERTISSEMENT

Quant au mot **AVERTISSEMENT**, il est utilisé pour indiquer les pratiques dangereuses qui **peuvent** provoquer des dommages corporels et/ou matériels mineurs.

Nous recommandons que votre chaudière soit installée par un technicien qualifié et responsable.

⚠ MISE EN GARDE

- Cette chaudière a été conçue pour vous assurer confort, économie, fiabilité et durabilité pour de nombreuses années. Cependant, les performances envisagées ne pourront être obtenues que dans la mesure où l'installation, la mise en marche et l'entretien de votre unité auront été faits correctement et en conformité avec les instructions contenues dans ce manuel.
- Si l'échangeur de chaleur subit de la corrosion produit par la présence continuelle d'air ou d'oxygène dans l'eau occasionnée par : un changement d'eau, un mauvais design du système de distribution ou par l'utilisation d'un tuyau de plastique sans barrière d'oxygène, la garantie de la chaudière n'est pas valide.
- Le brûleur au mazout fourni avec cette chaudière, est conçu pour brûler du mazout No. 2 (huile à fournaise). N'utiliser jamais de l'huile usée ou toutes autres huiles contenant de l'essence.
- S'assurer que l'unité et le système soient remplis d'eau et exempts d'air avant de mettre le brûleur en marche.
- S'assurer que le brûleur ne sera pas opéré au-delà de la capacité indiquée sur la plaque d'identification de la chaudière.
- Ne jamais tenter de mettre en marche le brûleur lorsqu'un excès de mazout s'est accumulé dans la chambre à combustion, lorsque cette dernière est surchauffée ou lorsqu'elle est remplie de vapeur d'huile.
- Lors d'un arrêt prolongé, fermer tous les robinets d'alimentation de mazout.
- Ne jamais accumuler de déchets ou de matériaux combustibles à proximité de la chaudière.
- Ne jamais brûler de déchets ou de papier dans votre chaudière.
- NE JAMAIS TENTER DE MODIFIER VOTRE UNITÉ OU SES CONTRÔLES.

1.2) PRÉSENTATION DES DIFFÉRENTS MODÈLES

Il est très important de consulter les figures 1 à 3 pour reconnaître les caractéristiques propres à chacune des chaudières à eau chaude de la gamme “HMR - HMT – HM2 ”.

Figure 1: Chaudière “HMR” sans serpentin et avec tuyau à fumée de 13 cm (5"). Modèles identifiés HMR-080, HMR-092 et HMR-103. Disponible avec brûleurs Beckett et Riello.

Figure 2: Chaudière “HMT” avec ou sans serpentin et avec tuyau à fumée de 15 cm (6"). Modèles identifiés HMT12, HMT14, HMT16 et HMT18. Disponible avec brûleurs Beckett, Riello et avec système de combustion scellé de modèle VTK.

Figure 3: Chaudière “HM2” avec ou sans serpentin et avec tuyau à fumée de 20 cm (8"). Modèles identifiés HM-185, HM-212, HM-240, HM-266 et HM-293. Disponible avec brûleur Beckett et Riello.

Chacune de ces chaudières possèdent ses propres caractéristiques : localisation des tuyaux d'entrée et de sortie, du serpentin, de la soupape de sûreté, du thermomanomètre, diamètre du tuyau à fumée, etc.

1.3) RÉCEPTION

Inspecter soigneusement l’appareil au moment de la réception afin de vous assurer qu’il n'a pas été endommagé au cours du transport. Toutes réclamations pour dommage ou matériel manquant doivent être faites à la compagnie de transport.

1.4) INSTALLATION

L'installation de votre unité doit se faire en respectant les règlements des autorités compétentes. Voir le code d'installation CSA B139.

1.4.1) Emplacement

Votre chaudière doit être installée le plus près possible de la cheminée et dans un endroit propre et sec. Ces chaudières ne sont pas approuvées pour installation sur plancher combustible.

L’unité doit être installée dans un endroit où la température de l’air ambiant est supérieure à 15°C (60°F).

1.4.2) Normes de dégagement

Les normes de dégagement suivantes doivent être respectées par rapport aux surfaces combustibles :

Dessus :	22.86 cm (9")
Tuyau à fumée :	22.86 cm (9")
Premier coté :	7.62 cm (3")
Autre coté :	0.60 m (24")
Avant (à partir du cabinet) :	0.60 m (24")
Arrière :	7.62 cm (3")

1.5) CÂBLAGES

L’alimentation électrique à la chaudière doit provenir d’un circuit protégé de 15 ampères à 120 Vac. L'installateur doit raccorder la chaudière selon le schéma électrique approprié. Référer aux schémas de câblage typiques, figures 6.1 à 6.5. Tout le câblage doit se faire en respectant les règlements des autorités compétentes et le “Code Canadien de l’Électricité - CSA C22.1 / Partie I”

AVERTISSEMENT

Toujours choisir le mode de câblage en fonction du système de distribution et de l'utilisation ou non d’un serpentin d'eau chaude sanitaire.

Les chaudières “HMR-HMT-HM2” avec voie de contournement intégrée sont conçues pour être installées sur tout les types de systèmes de distribution munis de pompe circulatoire, tel que convecteurs à ailettes ou radiateurs de fonte. Référer à la figure 4 pour visualiser les types d'installations. La voie de contournement intégrée permet de stabiliser l'augmentation de la température entre le retour et la sortie d'eau de la chaudière à approximativement Δ11°C (Δ20°F), peu importe la température de retour d'eau de la chaudière. De plus, la voie de contournement intégrée permet d'assurer le bon fonctionnement de la chaudière sans condensation en utilisant le contact de circulation disponible sur le limiteur de température de la chaudière.

Ainsi, les chocs thermiques sont éliminés dans la tuyauterie de distribution, les temps d'arrêt de la pompe sont réduits et il en résulte un meilleur contrôle et une homogénéisation de la température de l'eau dans le système.

Si plus d'une pompe circulatoire est utilisée, nous recommandons l'utilisation du contrôle de circulation modèle “RC-02“.

1.6) ALIMENTATION EN MAZOUT

L'installation du réservoir et de la tuyauterie de mazout doit être conforme aux réglementations et codes locaux. Le brûleur peut être installé avec un système à un tube lorsque le niveau de mazout du réservoir est toujours supérieur au niveau du brûleur. Le raccordement d’un réservoir de mazout hors-terre extérieur devrait idéalement se faire avec un système à un tube de dimension nominale de 1.3 cm (1/2") de diamètre, en prévoyant l’installation du filtre à mazout et d’un minimum de 3 m (10') de tuyau à l’intérieur, pour permettre au mazout de se réchauffer avant d’atteindre le brûleur lors des périodes de grands froids. Les pompes au mazout sont configurées pour des systèmes à 1 ligne. Ajouter l’orifice de dérivation, lorsque nécessaire, pour un système à 2 lignes (référer aux instructions du fabriquant de la pompe).

L’installation doit obligatoirement comporter un filtre à mazout et un robinet d’arrêt. S’assurer qu'il n'y ait aucune fuite ou obstruction dans le système de tuyauterie. Les conduites de mazout ne doivent comporter aucun joint d’accouplement. Ne pas utiliser de raccords à compression. Pour les systèmes à 2 tubes, il est recommandé que les conduites d'aspiration et de retour soient de même diamètre et atteignent la même profondeur dans le réservoir. Pour plus de renseignements, consulter le manuel d'installation du brûleur.

Au début de chaque saison de chauffage ou chaque année, vérifier le système de distribution de mazout au complet pour la présence de fuite.

TABLEAU 1
Tirage de la cheminée

Modèle	Dimension de cheminée		Tuyau de raccordement	Tirage recommandé
	Minimum	Maximum		
HMR	12.70 cm (5")	15.24 cm (6")	12.70 cm (5")	8.71Pa (0.035")
HMT	12.70 cm (5")	15.24 cm (6")	15.24 cm (6")	8.71Pa (0.035")
HM2	17.78 cm (7")	20.32 cm (8")	20.32 cm (8")	12.44Pa (0.050")

1.7) CHEMINÉE

1.7.1) Tirage de la cheminée

La cheminée de votre unité doit avoir un tirage suffisant pour assurer un fonctionnement sécuritaire et adéquat.

1.7.2) Installation

Le tuyau de raccordement ne doit pas excéder le diamètre de la cheminée et ses courses horizontales doivent avoir une inclinaison ascendante de 2 cm par 1 m (1/4" par 1') vers la cheminée. L'emploi d'un registre de tirage (damper) dans le tuyau de raccordement est prohibé. Si 2 tuyaux de raccordement ou plus sont reliés à la cheminée, celle-ci devra avoir la même section que la somme des sections des tuyaux de branchement. L'utilisation du régulateur barométrique de tirage est obligatoire. Son omission est une condition suffisante pour justifier l'annulation de la garantie de l'unité.

AVERTISSEMENT

Noter que l'installation d'une chaudière efficace peut provoquer de la condensation sur les parois internes d'une cheminée à 3 faces extérieures. Si tel est le cas, un revêtement intérieur de cheminée ou l'installation d'un système d'évacuation murale "SMH" devrait être envisagé.

1.7.3) Évacuation murale

Les chaudières "HMR-HMT-HM2" sont approuvées avec le système d'évacuation murale des gaz de combustion "SMH". La chaudière HMT est aussi approuvée avec le système de combustion scellée VTK. **Si un tel système est requis, consulter le manuel d'installation fourni avec celui-ci.**

1.8) DISPOSITIF D'ARRÊT ANTI-REFOULEMENT (BVSO) Pour évacuation par cheminée

⚠ MISE EN GARDE

Le dispositif doit obligatoirement être installé par un technicien qualifié.

Le dispositif est conçu pour détecter une mauvaise évacuation des gaz de combustion lorsque le tuyau d'évacuation est bouché. Lors d'une anomalie au niveau de l'évacuation, le refoulement des produits de combustion à l'interrupteur thermique permet l'arrêt du brûleur au mazout. Le dispositif requière une remise en fonction manuelle.

Pour l'installation et le câblage électrique veuillez-vous référer aux diagrammes électriques de l'unité et aux instructions détaillées fourni avec le Dispositif d'arrêt anti-refoulement. Pour que le câblage électrique fourni avec l'unité soit suffisamment long, il est important que le dispositif d'arrêt soit installé entre la sortie d'évacuation de l'unité et le régulateur de tirage tel qu'indiqué sur les instructions fournies avec le dispositif d'arrêt anti-refoulement.

Le dispositif d'arrêt doit aussi faire l'objet d'un entretien annuel. Référer aux instructions fournies avec le dispositif ainsi que la section 3 de ce manuel pour plus de détails.

AVERTISSEMENT

Un système d'évacuation fonctionnant en pression positive (combustion scellée ou évacuation directe) NE DOIT PAS utiliser le BVSO. Suivre les instructions fournies avec le système d'évacuation.

1.9) RENSEIGNEMENTS RELATIFS AU BRÛLEUR

Le brûleur est expédié dans une boîte séparée de votre chaudière. Procéder selon les étapes suivantes :

1. Vérifier le numéro de modèle inscrit sur la boîte du brûleur afin qu'il corresponde à celui indiqué sur la plaque d'identification de votre chaudière ;
2. Sortir le brûleur de sa boîte ;
3. Vérifier l'ajustement des électrodes d'allumage ;
4. Installer le brûleur sur la chaudière avec les écrous déjà en place sur les goujons. Ne pas oublier de poser le joint d'étanchéité ignifuge fourni avec le brûleur. Dans le cas des brûleurs Riello avec bride ajustable, s'assurer que le bout de la tuyère soit à égalité avec la paroi interne de la chambre à combustion ;
5. Raccorder le(s) tuyau(x) de mazout à la pompe du brûleur ;
6. Faire le raccordement électrique selon le schéma approprié. Voir paragraphe 1.5.

AVERTISSEMENT

Si le relais de combustion installé sur le brûleur est de la série R7184 de Honeywell : NE JAMAIS utiliser la fonction d'allumage/ignition interrompu.

1.10) SOURCE D'AIR DE COMBUSTION

Le bon fonctionnement de tout système de chauffage au mazout dépend d'une alimentation d'air adéquate et fonctionnelle. Si votre chaudière est installée dans un espace restreint, pratiquer 2 ouvertures d'aération dans la pièce ou se trouve la chaudière. Ces ouvertures doivent avoir chacune 240 cm^2/l de mazout à brûler par heure (1 pi^2 par gallon US). L'une doit être localisée près du plancher et l'autre du plafond.

1.11) TUYAUTERIE

Le bon fonctionnement de votre système à l'eau chaude dépend pertinemment de votre installation de plomberie. Consulter la figure 4.

Dans tous les cas, votre installation doit comprendre :

1. Un régulateur de pression ajusté à 83 kPa (12 lb/po^2), installé sur l'entrée d'eau de la chaudière ;
2. Un réservoir d'expansion pressurisé à 83 kPa (12 lb/po^2), présent sur la tuyauterie ;
3. Un purgeur d'air automatique, afin d'éliminer l'air qui sera emprisonné dans la chaudière ;
4. Une pompe circulatoire de capacité suffisante, installée sur la boucle du circuit de chauffage ;
5. Des robinets d'arrêt et accouplements vissés, installés sur les tuyaux de retour et de sortie de la chaudière.

Utiliser toujours un scellant à tuyau de qualité pour tout les raccordements filetés et s'assurer qu'ils soient bien serrés. Lors du remplacement d'une chaudière, on devra éviter de remplacer l'eau du système, afin d'introduire le moins d'oxygène possible.

AVERTISSEMENT

Pour éviter que le fonctionnement de la soupape entraîne des dommages à la propriété ou des brûlures, une conduite d'écoulement doit être raccordée à la soupape et dirigée vers un réceptacle approprié. La conduite d'écoulement doit être installée de façon à permettre l'évacuation complète aussi bien de la soupape que du trop plein d'eau.

1.12) VÉRIFCATION DU DISPOSITIF D'ARRÊT ANTI-REFOULEMENT

Cette vérification sert à valider le bon fonctionnement de la prise BVSO sur l'unité de chauffage seulement.

1. Faire fonctionner le brûleur ;
2. Débrancher la prise à 3 pôles identifiée BVSO sur l'unité ;
3. Le brûleur doit s'arrêter immédiatement.

Si le fonctionnement n'est pas conforme, APPELER UN TECHNICIEN QUALIFIÉ

1.13) SERPENTIN D'EAU CHAUDE SANITAIRE

Avant d'installer un serpentin, toujours s'assurer de la dureté de l'eau pour éviter une accumulation de tartre prématurée, rendant votre installation inefficace. Consulter un spécialiste et installer un adoucisseur au besoin.

Localiser l'entrée d'eau par l'indication "IN". Nous recommandons l'utilisation d'une soupape de mélange thermostatique afin d'obtenir le rendement optimum et sécuritaire de votre installation.

1.14) THERMOSTAT

Le thermostat doit être fixé à environ 1,5 m (5') du sol sur un mur intérieur d'une pièce située à l'étage principal. L'installation doit se faire ou le thermostat peut enregistrer les variations de température sans toutefois être affecté par les courants d'air et les rayons du soleil.

1.15) RÉGULATEUR DE TIRAGE

Pour une installation utilisant une cheminée, un régulateur de tirage barométrique doit être installé sur le tuyau de raccordement entre la chaudière et la cheminée. Il doit être facile d'accès. Consulter les instructions d'installations fournies avec celui-ci.

SECTION 2
OPÉRATION

Nous recommandons que l'entretien et la mise en marche de votre chaudière soient effectués par un technicien qualifié et responsable. S'assurer que le système et la chaudière soient remplis d'eau et que tout l'air a été évacué du système avant de démarrer le brûleur.

Note : Si votre brûleur est muni d'un cabinet de brûleur, faire tous les tests de combustion avec ce cabinet en place. Ne pas oublier de bien serrer les vis des ajustements du brûleur avant de remettre le cabinet de brûleur en place définitivement.

2.1) COMBUSTIBLE

Utiliser uniquement du mazout No. 2. Ne jamais utiliser de mazout plus lourd, d'essence, d'huile à moteur ou tout autre type de combustible.

2.2) MISE EN MARCHE

1. S'assurer que le réservoir contient du mazout et que les robinets de mazout et d'eau soient ouverts ;
2. L'interrupteur d'alimentation électrique doit être en position "hors-service" (OFF) ;
3. Régler le point de consigne du limiteur de température d'opération de la chaudière à la température désirée, exemple 82°C (180°F) ;
4. Installer un manomètre 0 - 1400 kPa (0 - 200 lb/po^2) sur la prise appropriée de la pompe à mazout. Un manomètre de succion peut aussi être utilisé à l'entrée de la pompe à mazout, si on suspecte une succion supérieure à 20.7 kPa (3 lb/po^2) ;
5. Pré-ajuster le brûleur selon les spécifications des tableaux 2, 3 ou 4. Ces spécifications servent uniquement de référence pour la mise en marche initiale. Se référer au manuel fourni avec votre brûleur pour identifier correctement les ajustements concernés ;
6. Mettre l'interrupteur d'alimentation électrique en position "en service" (ON) et initier le brûleur en ajustant le thermostat au maximum ;
7. Éliminer l'air des conduites de mazout par l'orifice de purge sur la pompe à mazout. Si l'allumage ne se fait pas et que le contrôle de combustion tombe en mode sécurité, consulter le paragraphe 2.3) ;
8. Ajuster la pression de mazout à la valeur appropriée inscrite aux tableaux 2, 3 ou 4;
9. Ajuster le tirage de la cheminée tel que spécifié au tableau 1, Prendre cette mesure sur le tuyau de raccordement entre la chaudière et le régulateur de tirage ;
10. Ajuster la (les) bande (s) d'entrée d'air du brûleur pour obtenir un indice de fumée de 0 à l'échelle Bacharach ;
11. Procéder à l'analyse des produits de combustion à l'aide d'un instrument dédié à cette fin et ajuster le brûleur en conséquence.
12. Vérifier le fonctionnement des limiteurs de température et du contrôle de combustion du brûleur ;
13. Régler les limiteurs et le thermostat aux valeurs désirées, sans toutefois résulter au maintien de la température de l'eau de la chaudière à un niveau inférieur à 60°C (140°F).

2.3) REDÉMARRAGE APRÈS UNE PANNE D'ALLUMAGE

1. Vérifier le niveau de mazout dans le réservoir ;
2. Vérifier si le robinet d'admission de mazout est bien ouvert ;
3. Vérifier le filtre à mazout pour un blocage possible ;
4. Vérifier le circuit d'alimentation électrique (fusible ou disjoncteur);
5. Vérifier l'ajustement des électrodes du brûleur. Consulter la brochure de celui-ci ;
6. S'assurer que le thermostat est en demande ;
7. Vérifier la présence d'air dans le conduit d'aspiration de la pompe à mazout du brûleur.

Si après avoir suivi ces étapes et avoir appuyé sur le bouton rouge de réarmement du contrôle de combustion du brûleur, ce dernier refuse toujours de démarrer, appeler un technicien qualifié. N'essayer jamais de remettre en marche le brûleur s'il y a un excès de mazout ou de vapeur dans la chambre à combustion.

2.4) PÉRIODE ESTIVALE

S'assurer que la soupape d'admission du mazout est fermée lorsque l'unité n'est pas en service pour une longue période.

2.5) MISE EN MARCHE AU DÉBUT DE LA SAISON DE CHAUFFAGE

1. Nettoyer la cheminée, le tuyau de raccordement et la chaudière. Suivre la procédure du paragraphe 3.6 (section 3) ;
2. Remplacer le filtre à mazout ;
3. Nettoyer les électrodes du brûleur ainsi que la tête de rétention de celui-ci et changer le gicleur ;
4. Vérifier le fonctionnement du limiteur de haute température ;
5. Vérifier l'état de la pompe circulatoire.

SECTION 3
ENTRETIEN

3.1) ENTRETIEN

Maintenir en tout temps les environs immédiats de la chaudière, libres de tous matériaux combustibles de poussière excessive, d'humidité excessive et de produits hautement inflammables. Maintenir dégagées les ouvertures d'alimentation d'air à la chaudière et à la chaufferie. Réparer toutes fuites d'eau ou de mazout dès leur apparition.

3.2) GICLEUR

Si le gicleur se salit ou se bouche durant la saison, il y aura une odeur de mazout ou même absence d'allumage. Dans ce cas, il doit être remplacé.

3.3) RÉSERVOIR

Vérifier régulièrement le niveau de mazout dans le réservoir et les fuites de mazout aux points de raccordement. Si, par mégarde, le réservoir se vidait complètement, l'air devra être évacué des conduits de mazout avant de redémarrer le brûleur.

3.4) FILTRE À MAZOUT

Remplacer le filtre à mazout au début de la saison de chauffage.

3.5) MOTEURS DU BRÛLEUR ET DE LA POMPE CIRCULATOIRE

Lubrifier les moteurs (sauf dans le cas des moteurs lubrifiés à vie) au moins une fois durant la saison de chauffage avec 2 à 3 gouttes d'huile non-détergente de grade SAE 20, introduite aux endroits appropriés.

3.6) NETTOYAGE DE L'UNITÉ

1. Mettre l'interrupteur électrique en position "hors-service" (OFF) avant d'entreprendre tous travaux ;
2. Retirer le conduit à fumée de la chaudière, le nettoyer et vérifier l'état de la cheminée ;
3. Retirer la boîte à fumée et les déflecteurs et, à l'aide d'une brosse métallique de 5 cm (2'') de diamètre, nettoyer les tubes de la chaudière ;

AVERTISSEMENT

La boîte à fumée de la chaudière est munie d'un piège à son. Prendre soin de ne pas endommager l'isolation acoustique en nettoyant l'unité. L'utilisation d'une brosse souple est fortement recommandée.

4. Retirer le brûleur et nettoyer la chambre à combustion. Prendre soin de ne pas endommager le fond de céramique ;
5. Vérifier la présence de corrosion sur les surfaces d'échange et corriger la cause au besoin ;
6. Remonter toutes les composantes selon leurs positions originales et réajuster l'unité.

3.7) NETTOYAGE DU DISPOSITIF D'ARRÊT ANTI-REFOULEMENT (BVSO)

Pour un fonctionnement continu et sûr, le dispositif d'arrêt doit être inspecté et entretenu chaque année par une agence qualifiée.

1. **Couper l'alimentation électrique à l'unité** ;
2. Dévisser les deux vis qui fixent le couvercle du dispositif d'arrêt.
3. Enlever le couvercle ;
4. Enlever les deux vis supportant l'interrupteur thermique sur l'assemblage ;
5. Enlever les deux vis qui maintiennent le boîtier de commande à l'ensemble du tube de transfert de chaleur. En glissant le boîtier de commande dans la bonne direction, le tube de transfert de chaleur se détachera.

AVERTISSEMENT

Ne pas érafler ou égratigner la surface de l'interrupteur thermique. Un interrupteur thermique endommagé doit être remplacé.

6. Nettoyer et enlever toute accumulation de saleté ou obstruction de l'intérieur du tube de transfert de chaleur;
7. Remonter, verrouiller et refixer le boîtier de commande à l'aide des 2 vis qui avaient été enlevées à l'étape 4 ;
8. Remettre en place le couvercle de l'ensemble et fixer avec les vis enlevées à l'étape 2 ;
9. Remettre l'alimentation électrique.

3.8) PURGE DE LA CHAUDIÈRE

Il est recommandé de procéder à une purge d'environ 1 minute au moins une fois par année, afin d'éliminer les sédiments et boues qui peuvent s'accumuler au fond de la chaudière.

Procédure :

1. Laisser refroidir la chaudière ;
2. A l'aide d'un boyau d'arrosage, diriger la purge vers un seau ;
3. Ouvrir le robinet de purge jusqu'à ce que l'eau soit claire.

3.9) PIÈCES DE REMPLACEMENT

Il est recommandé de toujours remplacer une composante défectueuse par une pièce d'origine, disponible chez votre distributeur.

3.10) RECHERCHE DES PANNES

Note : Lors d'un départ à froid, il est normal d'attendre quelques heures avant que la maison soit totalement réchauffée, à cause de l'inertie thermique de la bâtisse.

SECTION 4

INFORMATION

Modèle : _____ Numéro de série : _____

Date d'installation de la chaudière : _____

Nos tél. service – Jour : _____ Soir : _____

Nom et adresse du technicien de service : _____

_____

_____

RÉSULTAT DU TEST DE MISE EN MARCHE

Gicleur : _____ Pression : _____ lb/po^2

Ajustements du brûleur : Bande principale _____

Bande fine _____

Position de la tête _____

CO_2 : _____ % fumée : Indice de _____ (Bacharach)

Température des gaz à la sortie de l'unité : _____ °F

Température ambiante : _____ °F

Tirage dans la cheminée : _____ " W.C.

Tirage au dessus du feu : _____ " W.C.

Examiné par : _____

TABLEAU 2
Spécifications techniques HMR

Bruleur Beckett AFG-F	HMR-80-B	HMR-92-B	HMR-103-B	HMR-121-B
Capacité (BTU/h)	79000	90000	101000	116000
Entrée (USGPH)	0.65	0.75	0.85	1.00
Tête de rétention	F0	F3	F3	F3
LFRB*	Oui	Oui	Oui	Non
Gicleur (Delavan)	0.65-80W	0.75-80W	0.85-80W	1.00-80A
Pression (PSI)	100	100	100	100
Tube d'insertion (po.)	2 7/8	2 7/8	2 7/8	2 7/8
Ajustement bande d'air prinipale	0	0	0	1
Ajustement obturateur d'air	8	9	9	9
AFUE %	84	83.5	80.9	80.6
Bruleur Riello 40-F3	**HMR-80-R**	**HMR-92-R**	**HMR-103-R**	**N/A**
Capacité (BTU/h)	79000	91000	100000	-
Entrée (USGPH)	0.65	0.75	0.85	-
Gicleur (Delavan)	0.60-80A	0.65-70B	0.75-70B	-
Pression (PSI)	120	135	130	-
Tube d'insertion (po.)	3 9/16	3 9/16	3 9/16	-
Ajustement obturateur d'air	3.8	4.1	6.1	-
Réglage du turbulateur	0	0	0	-
AFUE %	84.9	84.4	81.8	-

* LFRB = Déflecteur de bas régime (Voir manuel du brûleur)

TABLEAU 3
Spécifications techniques HMT

Bruleur Beckett AFG-F (Avec cheminée)	HMT-12-B	HMT-14-B	HMT-16-B	HMT-18-B
Capacité (BTU/h)	118000	141000	158000	175000
Entrée (USGPH)	1.00	1.20	1.35	1.50
Tête de rétention	F6	F6	F6	F6
LFRB*	Non	Non	Non	Non
Gicleur (Delavan)	1.00-70A	1.20-70A	1.35-70A	1.50-70A
Pression (PSI)	100	100	100	100
Tube d'insertion (po.)	2 7/8	2 7/8	2 7/8	2 7/8
Ajustement bande d'air prinipale	0	1	1	2
Ajustement obturateur d'air	7	5	6	5
AFUE %	82,1	82,4	81,6	80,9
Bruleur Riello 40-F5 (Avec Cheminée)	**HMT-12-R**	**HMT-14-R**	**HMT-16-R**	**HMT-18-R**
Capacité (BTU/h)	120000	142000	159000	175000
Entrée (USGPH)	1.00	1.20	1.35	1.50
Gicleur (Delavan)	0.85-70B	1.00-70B	1.10-70B	1.25-70B
Pression (PSI)	140	145	150	145
Tube d'insertion (po.)	3 9/16	3 9/16	3 9/16	3 9/16
Ajustement obturateur d'air	2,5	2,75	3,5	4,5
Réglage du turbulateur	0	1	2	3
AFUE %	85.7‡	84,6	83,4	82,4
Bruleur Riello 40-BF5 (Combustion Scellée)	**HMT-12-R**	**HMT-14-R**	**HMT-16-R**	**N/A**
Capacité (BTU/h)	120000	142000	159000	-
Entrée (USGPH)	1.00	1.20	1.35	-
Gicleur (Delavan)	0.85-80B	1.00-80B	1.10-80B	-
Pression (PSI)	140	145	150	-
Tube d'insertion (po.)	3 9/16	3 9/16	3 9/16	-
Ajustement obturateur d'air	2	2	3	-
Réglage du turbulateur	3	5	5	-
AFUE %	85.7‡	84,6	83,4	-

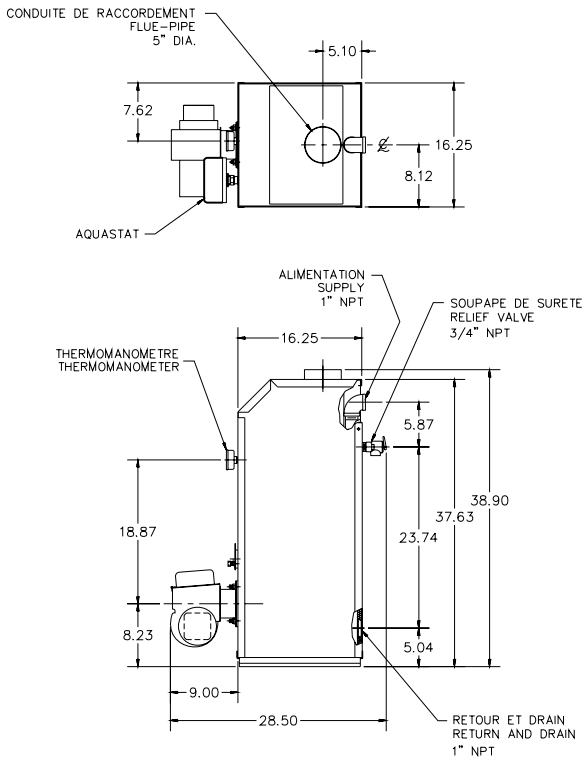
* LFRB = Déflecteur de bas régime (Voir manuel du brûleur)

‡ = ENERGY STAR

TABLEAU 4
Spécifications techniques HM2

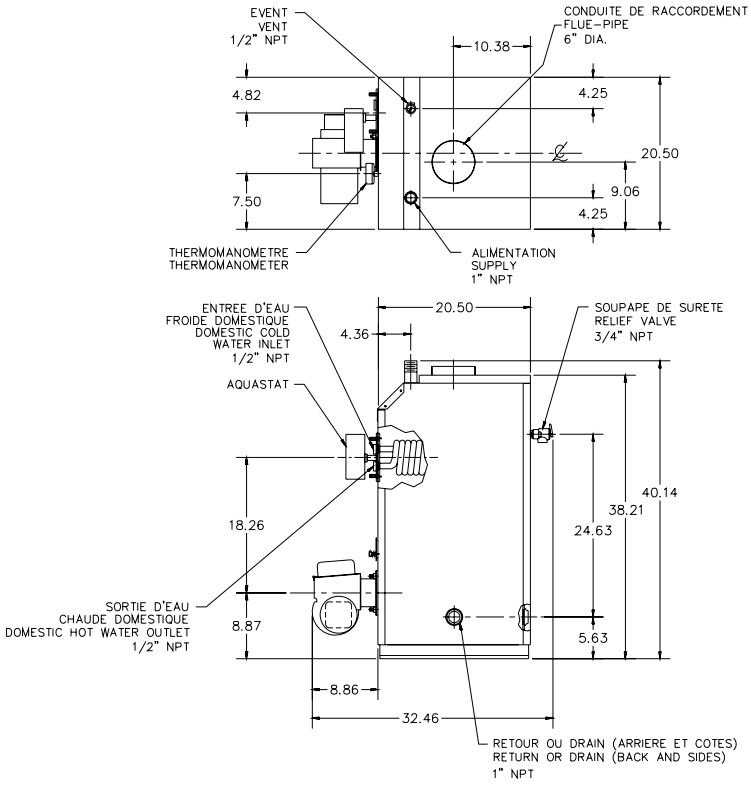
Bruleur Beckett AFG-V1	HM-185-B	HM-212-B	HM-240-B	HM-266-B	HM-293-B
Capacité (BTU/h)	185000	215000	243000	270000	296000
Entrée (USGPH)	1.50	1.75	2.00	2.25	2.50
Tête de rétention	MD-V1	MD-V1	MD-V1	MD-V1	MD-V1
LFRB*	Non	Non	Non	Non	Non
Gicleur (Delavan)	1.50-70B	1.75-70B	2.00-70B	2.25-70B	2.50-70B
Pression (PSI)	100	100	100	100	100
Tube d'insertion (po.)	2 7/8	2 7/8	2 7/8	2 7/8	2 7/8
Ajustement bande d'air prinipale	6	7	4	6	5
Ajustement obturateur d'air	4	4	3	4	4
Ajustement Tête V1	1	2	3	5	6
Bruleur Riello 40-F10	**HM-185-R**	**HM-212-R**	**HM-240-R**	**HM-266-R**	**HM-293-R**
Capacité (BTU/h)	185000	215000	243000	270000	296000
Entrée (USGPH)	1,50	1,75	2,00	2,25	2,50
Gicleur (Delavan)	1.25-60B	1.50-45B	1.65-45B	1.75-45B	2.25-60B
Pression (PSI)	145	135	145	165	125
Tube d'insertion (po.)	3 1/8	3 1/8	3 1/8	3 1/8	3 1/8
Ajustement obturateur d'air	3,4	4,5	3,4	5,5	4,5
Réglage du turbulateur	0,0	1,0	2,0	3,0	4,0

FIGURE 1
Chaudière HMR



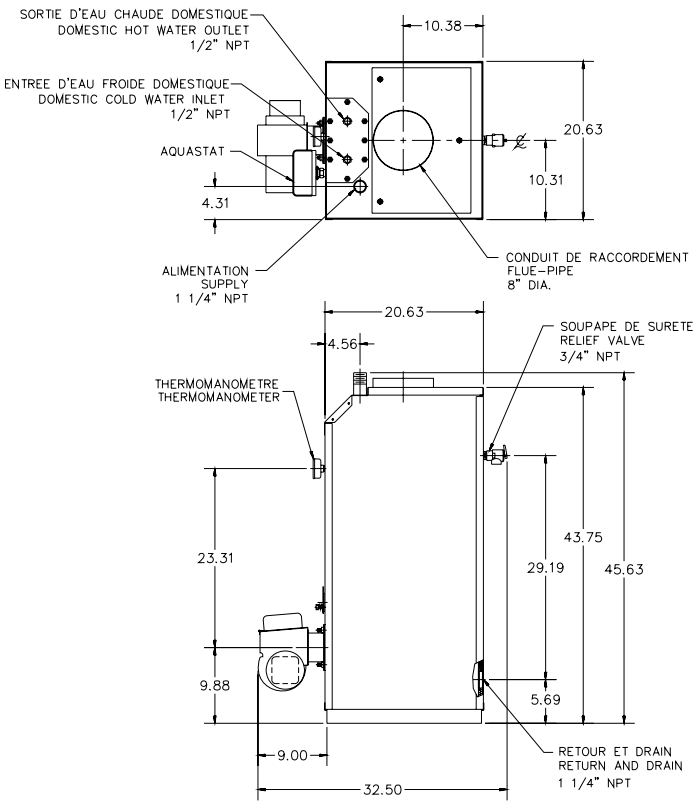
DNS-0317 Rév. B

FIGURE 2
Chaudière HMT avec ou sans serpentin



DNS-0321 Rév. C

FIGURE 3
Chaudière HM2 avec ou sans serpentin



DNS-0320 Rév. B

FIGURE 4

Schéma typique recommandé d'un installation général de la tuyauterie

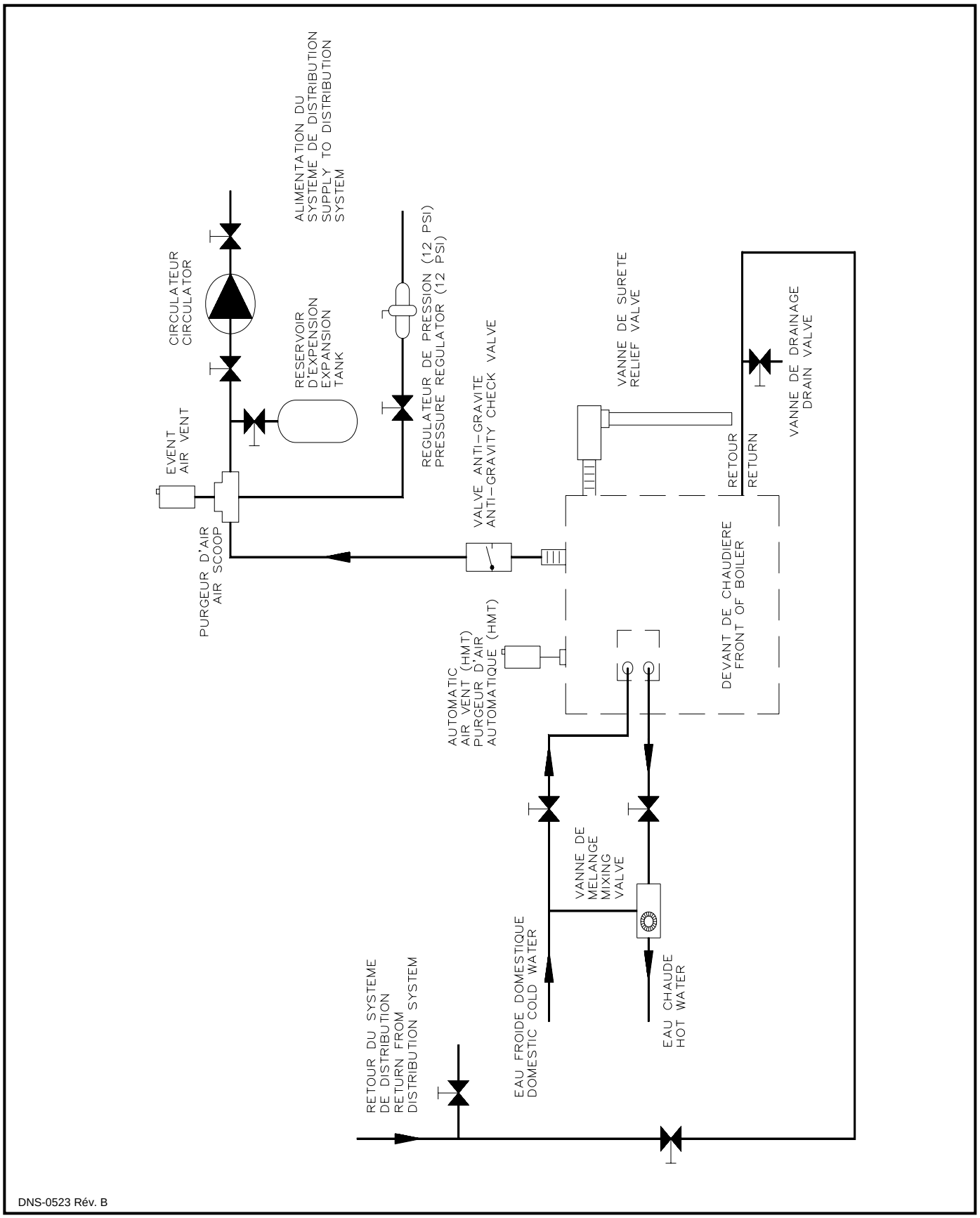
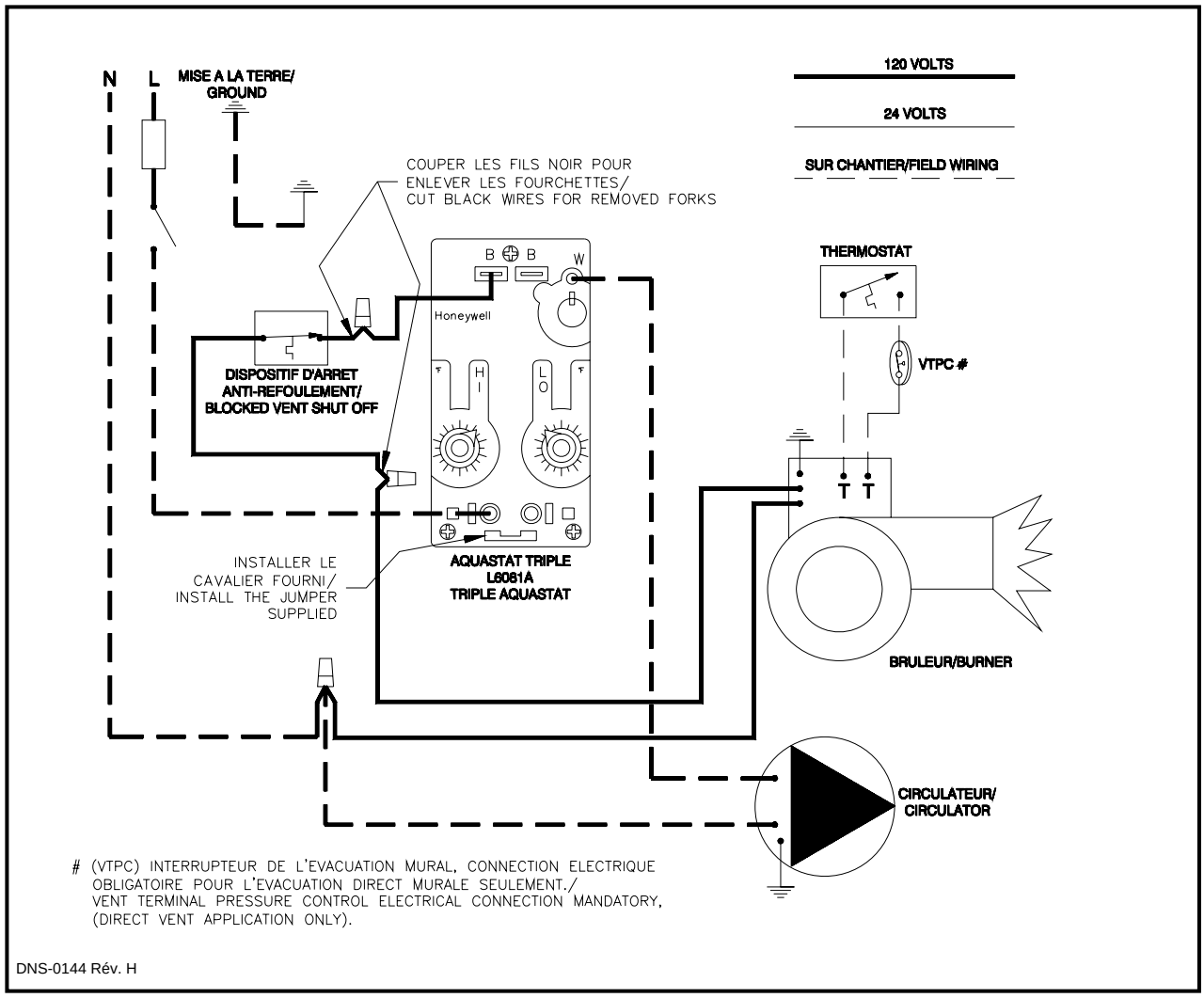


FIGURE 5.1
Raccordement typique sans serpentin d'eau sanitaire

Contrôleur utilisé:

Limiteur de température à "triple action" Honeywell # L6081A
ou White Rodgers # 11C61 (Aquastat Triple, Hi-Lo/Circ)



Fonctionnement et ajustements typiques

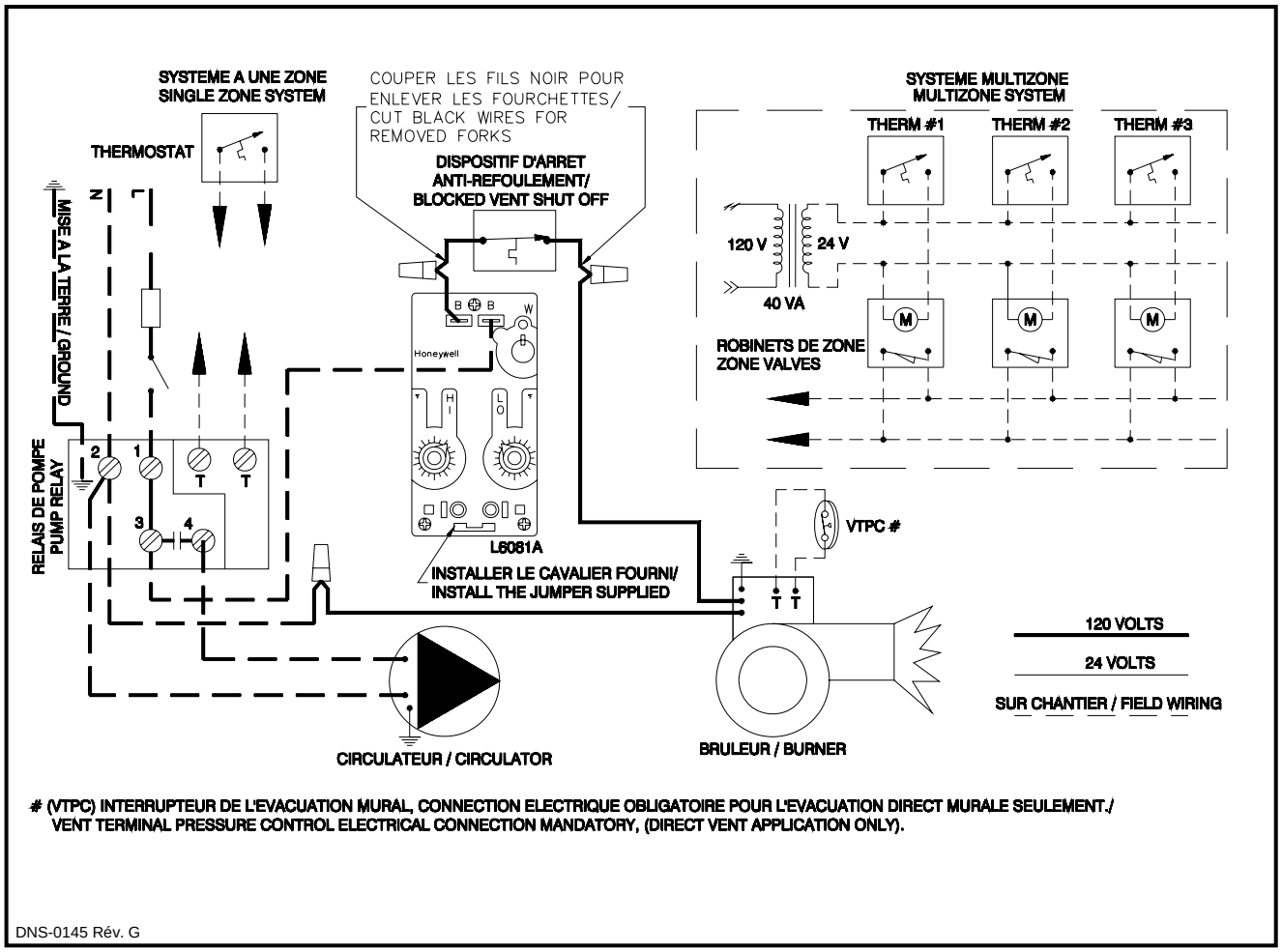
Fonctionnement :							
Brûleur	Arrêt	Thermostat ouvert -ou- Contact "Hi" ouvert					
	Départ	Thermostat fermé -et- Contact "Hi" fermé					
Circulateur	Arrêt	Contact "Circ" ouvert					
	Départ	Contact "Circ" fermé					
Ajustements :							
"Hi"				"Lo / Circ"			
Consigne		Diff.		Consigne		Diff.	
°F	°C	°F	°C	°F	°C	°F	°C
180	82	10	5.6	140	60	10	5.6

Ajustement maximum de la Haute Limite = 210°F

FIGURE 5.2
Raccordement typique sur système avec convecteurs à ailettes et sans serpentin d'eau sanitaire

Contrôleur utilisé:

- Limiteur de température à "triple action" Honeywell # L6081A
  ou White Rodgers # 11C61 (Aquastat Triple, Hi-Lo/Circ)
- Relais de pompe circulatoire Honeywell # RA89A ou
  White Rodgers # 809A



Fonctionnement et ajustements typiques

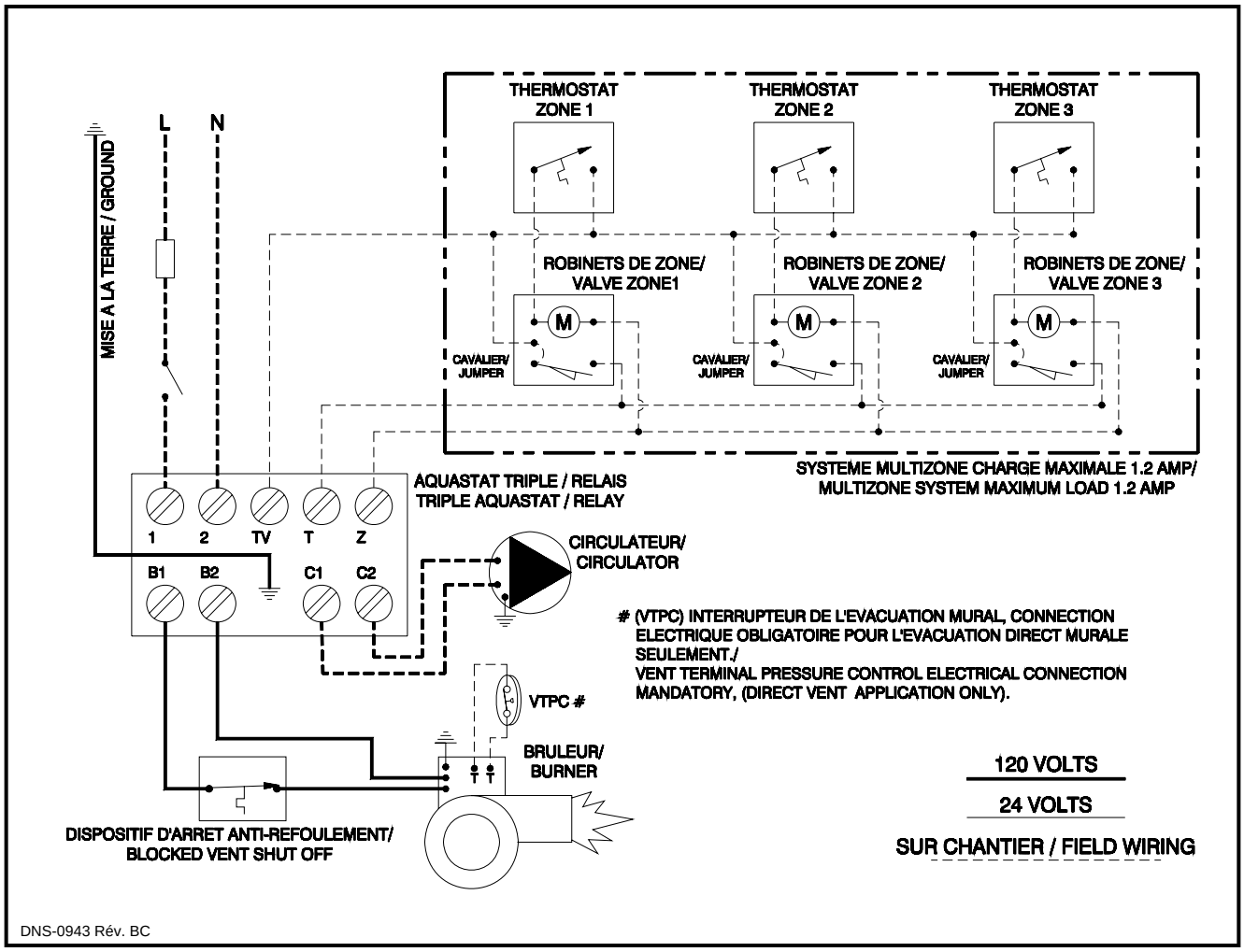
Fonctionnement : (la chaudière est maintenue chaude)							
Brûleur	Arrêt	Contact "Lo" ouvert					
	Départ	Contact "Lo" fermé					
Circulateur	Arrêt	Thermostat ouvert -ou- Tous les robinets de zone fermés					
	Départ	Thermostat fermé -et- Un des robinets de zone ouvert					
Ajustements :							
"Hi"				"Lo / Circ"			
Consigne		Diff.		Consigne		Diff.	
°F	°C	°F	°C	°F	°C	°F	°C
200	93	10	5.6	180	82	10	5.6

Ajustement maximum de la Haute Limite = 210°F

FIGURE 5.3
Raccordement typique avec ou sans serpentin d'eau sanitaire

Contrôleur utilisé:

Limiteur de température à triple relais "Multizone" Honeywell # L8124L1029B



Fonctionnement :		
Brûleur	Arrêt	Contact "Hi" ouvert -ou- si Thermostat ouvert, contact "Lo" ouvert
	Départ	Contact "Hi" fermé et therm. fermé -ou- si Therm. ouvert, contact "Lo" fermé
Circulateur	Arrêt	Thermostat ouvert -ou- Contact "Circ" ouvert
	Départ	Thermostat fermé -et- Contact "Circ" fermé

Ajustements typiques avec serpentin :

"Hi"				"Lo"			
Consigne		Diff.		Consigne		Diff.	
°F	°C	°F	°C	°F	°C	°F	°C
200	93	10	5.6	180	82	10	5.6

Ajustements typiques sans serpentin :

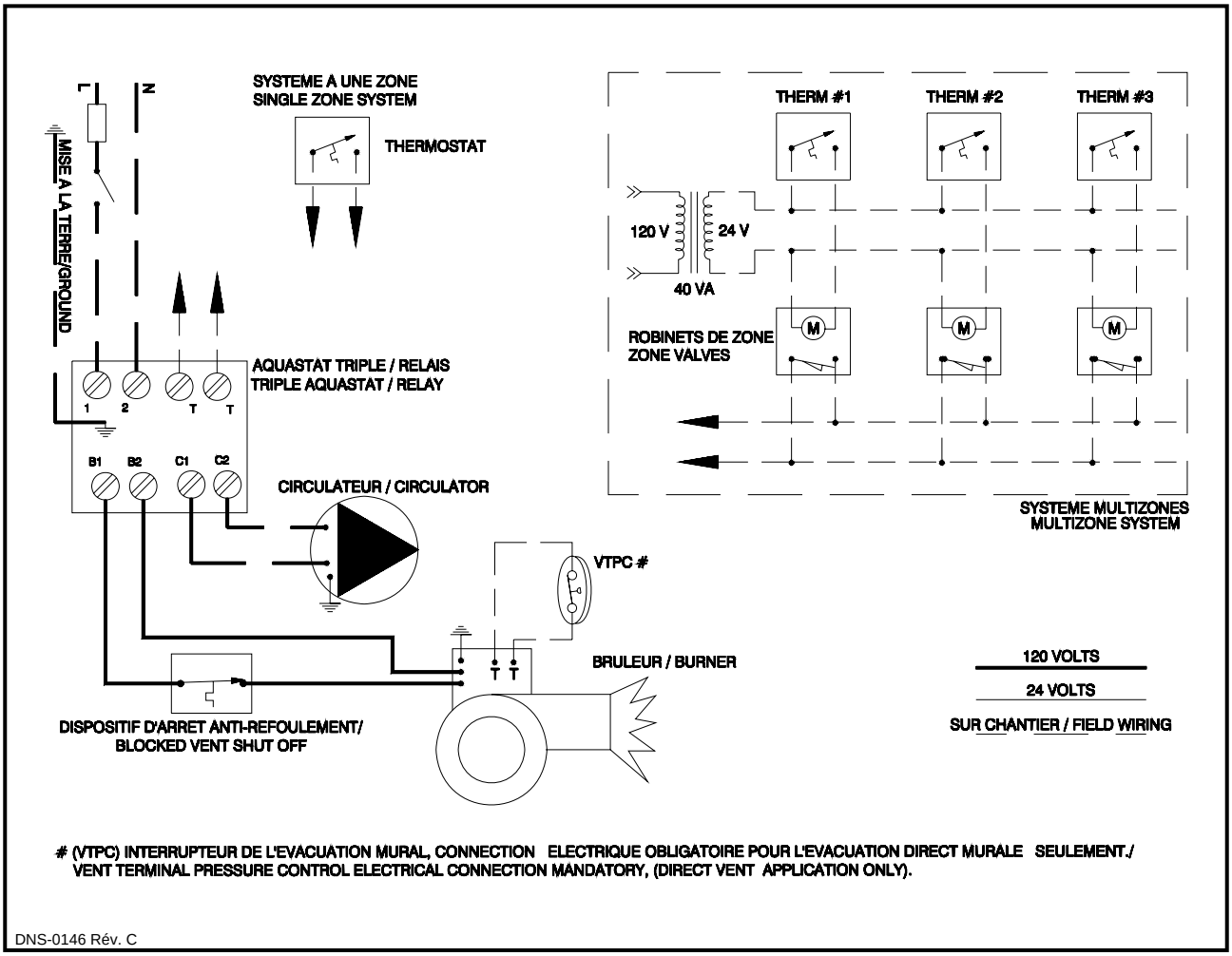
Voir "Ajustements typiques sans serpentin" du tableau de la page 18

Ajustement maximum de la Haute Limite = 210°F

FIGURE 5.4
Raccordement typique avec ou sans serpentin d'eau sanitaire

Contrôleur utilisé:

Limiteur de température à triple relais Honeywell # L8124C1102B



Fonctionnement et ajustements typiques

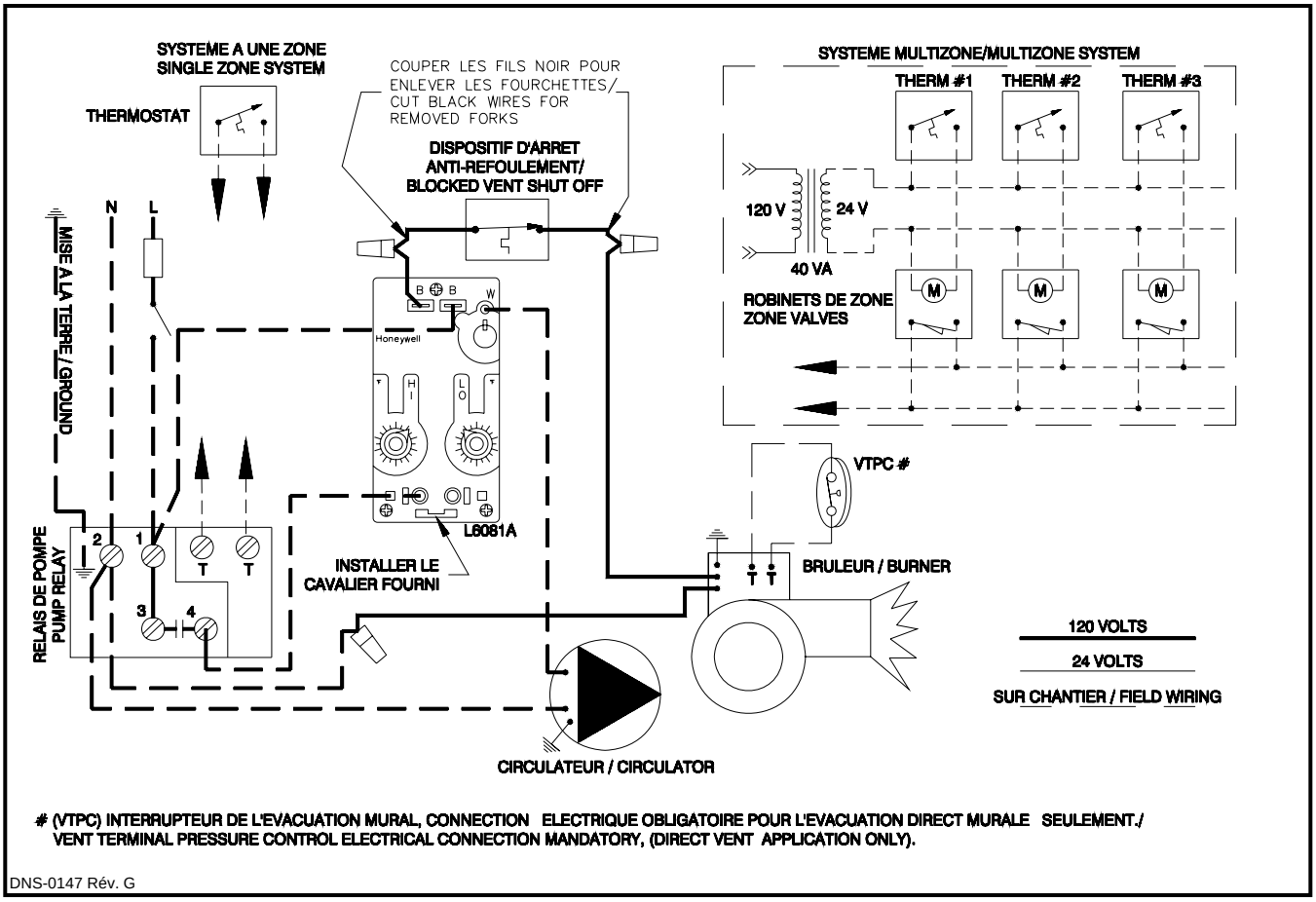
Fonctionnement :							
Brûleur	Arrêt	Contact "Hi" ouvert -ou- si Thermostat ouvert, contact "Lo" ouvert					
	Départ	Contact "Hi" fermé et therm. fermé -ou- si Therm. ouvert, contact "Lo" fermé					
Circulateur	Arrêt	Thermostat ouvert -ou- Contact "Circ" ouvert					
	Départ	Thermostat fermé -et- Contact "Circ" fermé					
Ajustements typiques avec serpentin :							
"Hi"				"Lo"			
Consigne		Diff.		Consigne		Diff.	
°F	°C	°F	°C	°F	°C	°F	°C
200	93	10	5.6	180	82	10	5.6
Ajustements typiques sans serpentin :							
Voir "Ajustements typiques sans serpentin" du tableau de la page 18							

Ajustement maximum de la Haute Limite = 210°F

FIGURE 5.5
Raccordement typique avec ou sans serpentin d'eau sanitaire

Contrôleur utilisé:

- Limiteur de température à "triple action" Honeywell # L6081A ou White Rodgers # 11C61 (Aquastat Triple, Hi-Lo/Circ)
- Relais de pompe circulatoire Honeywell # RA89A ou White Rodgers # 809A

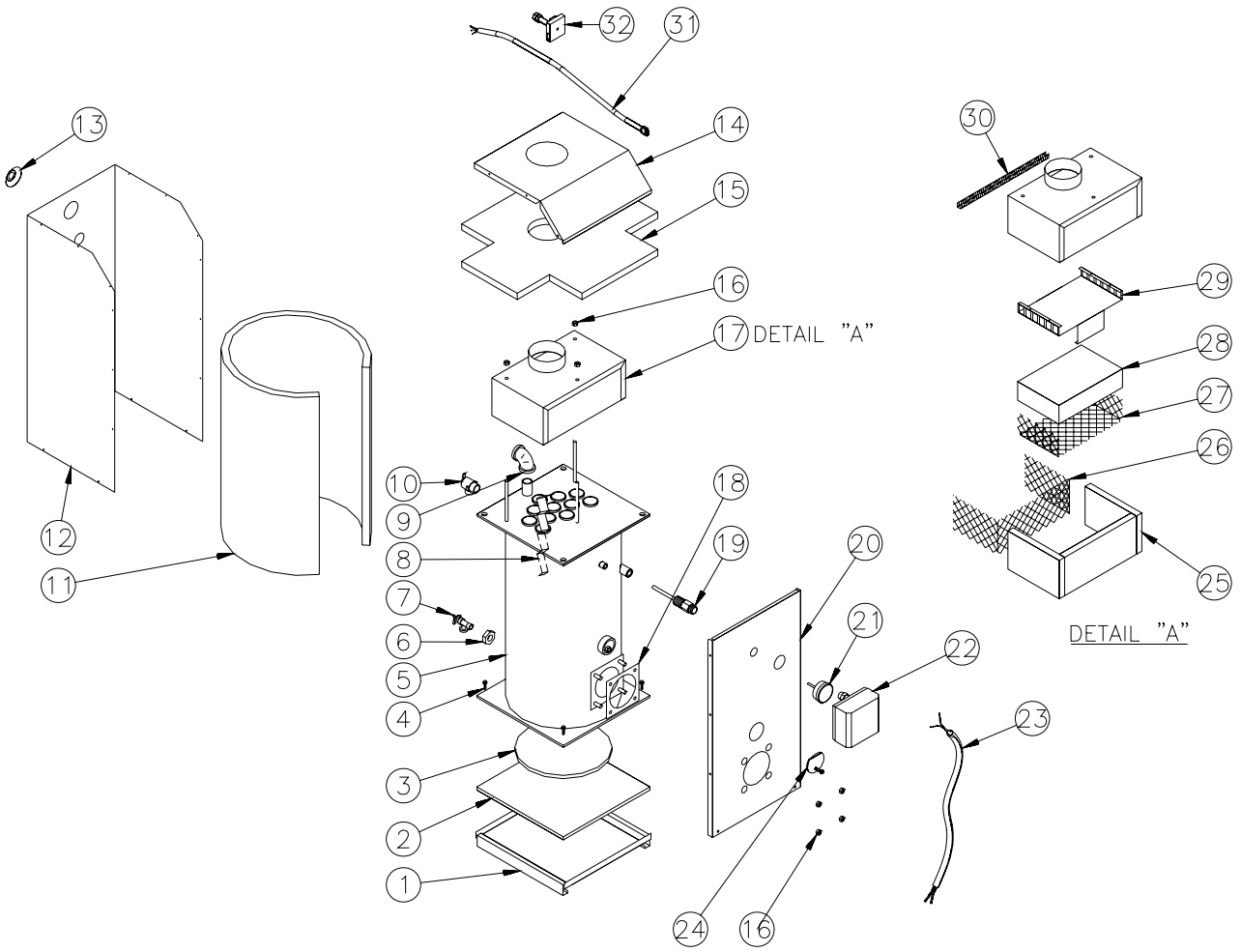


Fonctionnement et ajustements typiques

Fonctionnement :							
Brûleur	Arrêt	Contact "Hi" ouvert -ou- si Thermostat ouvert, contact "Lo" ouvert					
	Départ	Contact "Hi" fermé et therm. fermé -ou- si Therm. ouvert, contact "Lo" fermé					
Circulateur	Arrêt	Thermostat ouvert -ou- Contact "Circ" ouvert					
	Départ	Thermostat fermé -et- Contact "Circ" fermé					
Ajustements typiques sans serpentin :							
"Hi"				"Lo / Circ"			
Consigne		Diff.		Consigne		Diff.	
°F	°C	°F	°C	°F	°C	°F	°C
180	82	10	5.6	140	60	10	5.6
Ajustements typiques avec serpentin :							
Voir "Ajustements typiques avec serpentin" du tableau de la page 16							

Ajustement maximum de la Haute Limite = 210°F

LISTE DE PIÈCES
Modèle : HMR (HM-080 @ HM-103)



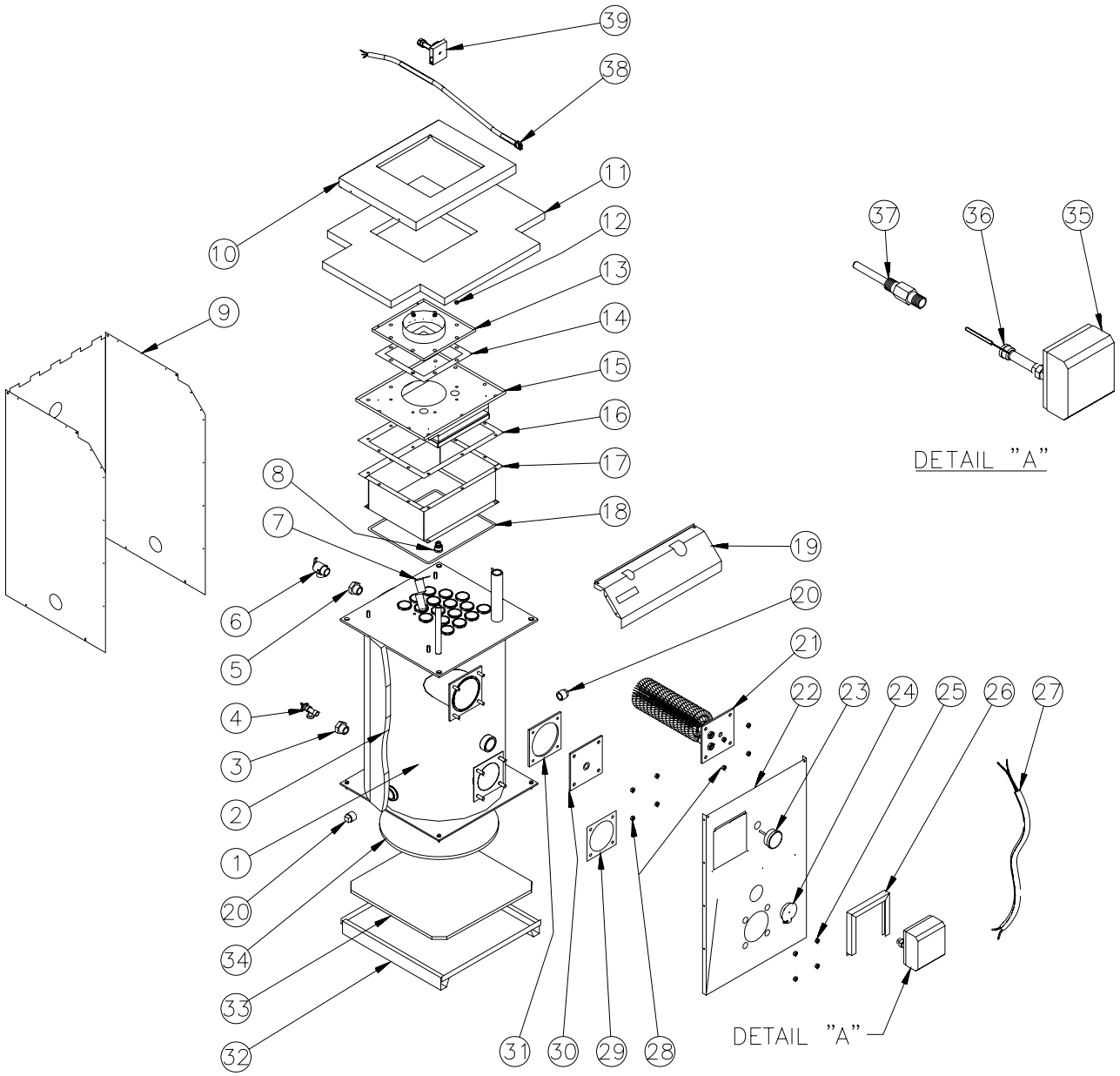
B50019B

LISTE DE PIÈCES
Modèle : HMR (HM-080 @ HM-103)

ITEM	No. DESSIN	DESCRIPTION
1	B00472-01	PLANCHER
2	B00619-01	ISOLATION PLANCHER
3	B00618-01	ISOLATION DE FOND DE CHAMBRE A COMBUSTION
4	F03F004	VIS A PLANCHER (Quantité : 4)
5	B00909	ASS CHAUDIERE EAU CHAUDE
6	G08F004	DOUILLE REDUCTRICE 1"NPT x 1/2"NPT
7	G11Z001	ROBINET DE PURGE 1/2"NPT
8	B00864-02	DEFLECTEUR (Quantité : 11)
9	G04F002	COUDE 90°FEM-FEM 1"NPT
10	G11F012	VALVE SURPRESSION 30 PSI 3/4" x 3/4"
11	B01651	ISOLATION CHAUDIERE EAU CHAUDE
12	B02904	CABINET EN U
13	G14G001	GARNITURE 2-7/8"OD 1"ID LDPE BLANC
14	B00929	PANNEAU DESSUS (Sans puit de sonde)
15	B00701-01	ISOLATION DE DESSUS
16	F07F011	ECROU HEXAGONAL 3/8"-16NC ZINC (Quantité : 7)
17	B00946	ASS PIEGE A SON COMPLET (avec protecteur et isolation)
18	B00419	GARNITURE BRIDE DE BRULEUR
19	R02J003	PUITS IMMERSION 3/4"NPT
20	B00927	PANNEAU AVANT
21	R02L001	THERMOMANOMETRE 0-75 PSI 1/4" NPT
22A	R02H005	AQUASTAT TRIPLE ACTION L6081A
22B	R02H006	AQUASTAT TRIPLE RELAIS MULTIZONE L8124L
23	B00964	KIT ELECTRIQUE
24A	K02014	ENSEMBLE DE PORTE D'OBSERVATION (avant 99/09)
24B	B01842	ASS DE PORTE D'OBSERVATION (apres 99/09)
25	K08006	ENSEMBLE D'ISOLATION DE PIEGE A SON
26	B00834-09	GRILLAGE, PIEGE A SON
27	B00834-10	GRILLAGE, PIEGE A SON
28	B00621-24	ISOLATION
29	B00892	DEFLECTEUR DU PIEGE A SON
30	B00702-12	GARNITURE BOITE A FUMEE (rouleau de 25 pieds)
31	B03029	KIT ELECTRIQUE BVSO
32	Z06G001	DISPOSITIF D'ARRET BVSO-225

L50019B

LISTE DE PIÈCES
Modèle : HMT (HMT-12 @ HMT-18) S/N plus grand que D010408972



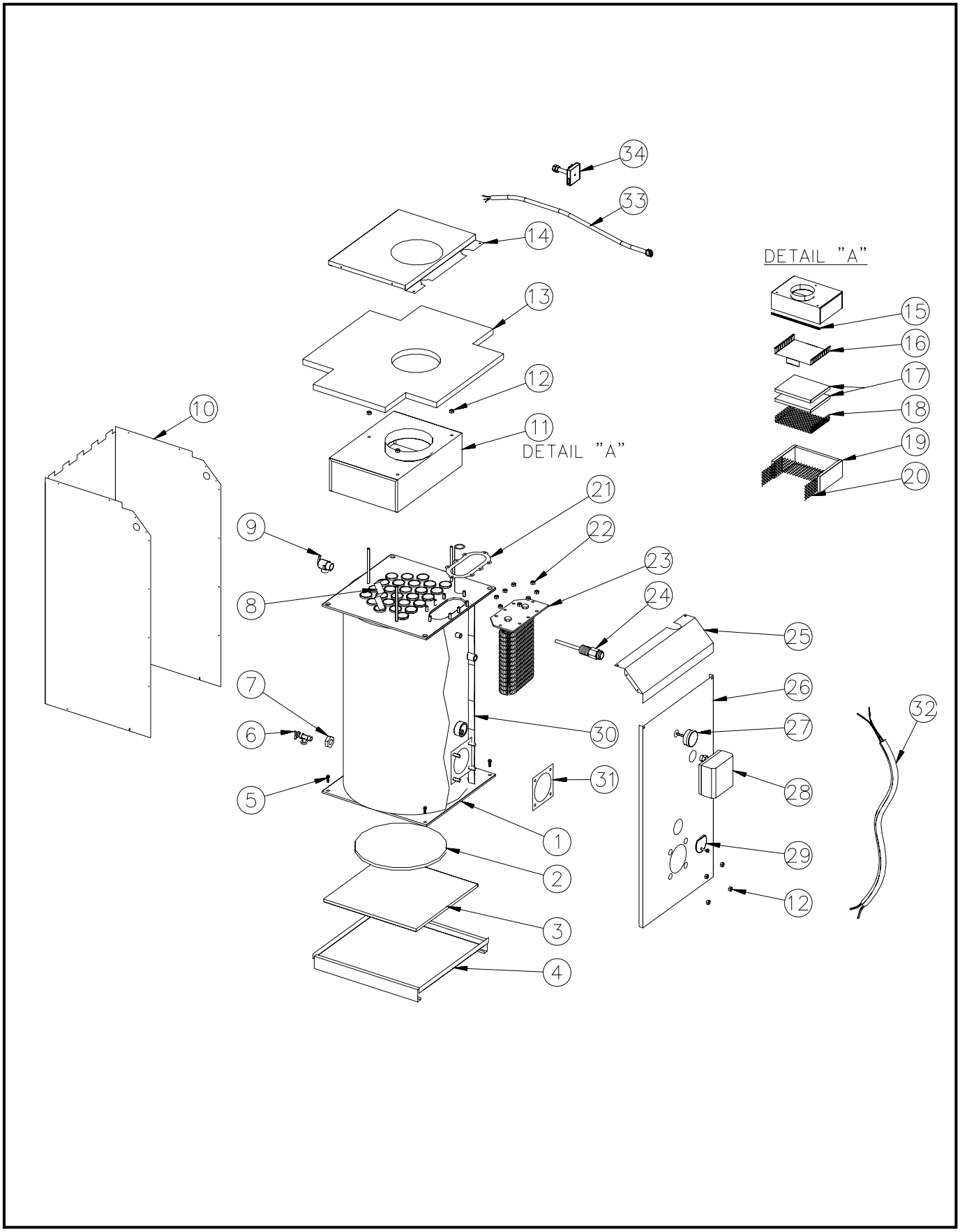
B50020B

LISTE DE PIÈCES
Modèle : HMT (HMT-12 @ HMT-18) S/N plus grand que D010408972

ITEM	No. DESSIN	DESCRIPTION
1	B02349-01	ASS CHAUDIERE EAU CHAUDE (sans serpentin)
2	B01910	ISOLATION CABINET
3	G08F004	DOUILLE REDUCTRICE 1" x 1/2" NOIR
4	G11Z001	ROBINET DE PURGE 1/2"
5	G01J002	MAMELON STD 3/4"NPT x 2" NOIR
6	G11F012	VALVE SURPRESSION 30 PSI 3/4" x 3/4"
7	B00864-02	DEFLECTEUR (Quantité : 17)
8	G03J011	MANCHON 1/2" NPT @ 1/8" NPT ACIER
9	B02546	CABINET
10	B02342	ASS PANNEAU DESSUS ARRIERE
11	B01938	ISOLATION DE DESSUS
12	F07O001	ECROU HEXAGONAL A BRIDE 3/8"-16NC LAITON
13	B01747	CONDUIT DE RACCORDEMENT
14	B00205	GARNITURE COUVERCLE CONDUIT DE RACCORDEMENT
15	B01955	ASS PIEGE A SON
16	B01937	GARNITURE DE PIEGE A SON
17	B01954	ASS BOITE PIEGE A SON
18	J06L001	BANDE SCELLANTE 1/2" x 1/8" (25 pieds)
19	B02345	PANNEAU HAUT AVANT
20	G06F003	BOUCHON MALE 4 PANS 1"NPT NOIR
21A	K14007	SERPENTIN 5 GUSPM 1/2"NPT
21B	K14008	SERPENTIN 5 GUSPM 1-1/4"NPT
22	B02340	ASS PANNEAU AVANT
23	R02L001	THERMOMANOMETRE 0-75PSI 1/4"NPT
24	B02111	ASS PORTE D'OBSERVATION
25	F07F011	ECROU HEXAGONAL 3/8"-16NC ZINC
26	B01634	CACHE SERPENTIN
27	B00964	KIT ELECTRIQUE, BRULEUR
28	F07F021	ECROU HEXAGONAL 7/16"-20NF ZINC (pour couvercle serpantin)
29	B00419	GARNITURE BRIDE DE BRULEUR
30	B20090	ASS COUVERCLE SERPENTIN
31	B20060	GARNITURE, BRIDE DE SERPENTIN
32	B00472-03	PLANCHER
33	B00619-03	ISOLATION PLANCHER
34	B00618-04	ISOLATION DE FOND DE CHAMBRE A COMBUSTION
35A	R02H005	AQUASTAT TRIPLE ACTION L6081A
35B	R02H006	AQUASTAT TRIPLE RELAIS MULTIZONE L8124L
36	R02J006	PUITS ECROU PRESSE GARNITURE (Utiliser avec serpentin)
37	R02J001	PUITS IMMERSION 1/2" NPT (Utiliser sans serpentin)
38	B03029-01	KIT ELECTRIQUE BVSO
39	Z06G001	DISPOSITIF D'ARRET BVSO-225

L50020B

LISTE DE PIÈCES
Modèle : HM2 (HM-185 @ HM-293) S/N plus grand que D010408972



B50021B

LISTE DE PIÈCES
Modèle : HM2 (HM-185 @ HM-293) S/N plus grand que D010408972

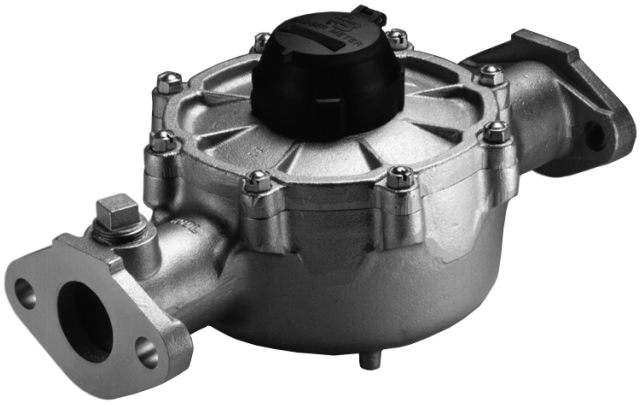
ITEM	No. DESSIN	DESCRIPTION
1	B00989	ASS CHAUDIERE EAU CHAUDE
2	B00618-04	ISOLATION DE FOND DE CHAMBRE A COMBUSTION
3	B00619-03	ISOLATON PLANCHER
4	B00472-03	PLANCHER
5	F03F004	VIS A PLANCHER (Quantité : 4)
6	G11Z001	ROBINET DE PURGE 1/2"NPT
7	G08F006	DOUILLE REDUCT 1-1/4" x 1/2" NOIR
8	B00864-02	DEFLECTEUR (Quantité par unité : 26)
9	G11F012	VALVE SURPRESSION 30 PSI 3/4" x 3/4"
10	B02918	CABINET EN U
11	B00945	ASS PIEGE A SON COMPLET (Isolation et protecteur inclus)
12	F07F011	ECROU HEXAGONAL 3/8"-16NC ZINC (Quantité : 7)
13	B00808-01	ISOLATION DU DESSUS
14	B01917-01	ASS PANNEAU DESSUS ARRIERE
15	B00702-11	GARNITURE CONDUIT DE RACCORDEMENT
16	B00893	DEFLECTEUR PIEGE A SON
17	B00621-21	ISOLATION (Quantité : 2)
18	B00834-08	GRILLAGE, PIEGE A SON
19	K08012	ENSEMBLE D'ISOLATION DE PIEGE A SON
20	B00834-07	GRILLAGE, PIEGE A SON
21	A00083	GARNITURE, SERPENTIN VERTICAL
22	F07O001	ECROU HEXAGONAL 3/8"-16NC LAITON
23A	K02019	ASS SERPENTIN (Optionnel)
23B	K14023	COUVERCLE DE SERPENTIN (Item 21& 22 inclus)
24A	R02J003	PUITS IMMERSION 3/4"NPT (no. de serie < 124000)
24B	R02J001	PUITS IMMERSION 1/2"NPT (no. de serie > 124000)
25	B00910	PANNEAU HAUT AVANT
26	B00904	PANNEAU AVANT
27	R02L001	THERMOMANOMETRE 0-75PSI 1/4"NPT
28A	R02H005	AQ TRIPLE ACTION L6081A
28B	R02H006	AQ TRIPLE RELAIS MULTIZONE L8124L
29A	K02014	ENSEMBLE DE PORTE D'OBSERVATION (avant 99/09)
29B	B01842	ASS DE PORTE D'OBSERVATION (apres 99/09)
30	B01476	ISOLATION CABINET
31	B00419	GARNITURE BRIDE DE BRULEUR
32	B00964	KIT ELECTRIQUE, BRULEUR
33	B03029-01	KIT ELECTRIQUE BVSO
34	Z06G001	DISPOSITIF D'ARRET BVSO-225

L50021B

Size 2" (DN 50mm) Recordall® Cold Water Top Load Bronze Disc Meter

BadgerMeter
Utility Division

TECHNICAL BRIEF



Model 170 shown with optional 1" Test Plug

SPECIFICATIONS

Typical Operating Range (100% ± 1.5%)	2½-170 GPM (9.5 to 645 l/m)
Low Flow (Min. 95%)	1½ GPM (5.7 l/m)
Maximum Continuous Operation	100 GPM (380 l/m)
Pressure Loss at Maximum Continuous Operation	3.3 PSI at 100 GPM (.23 bar at 380 l/m)
Maximum Operating Temperature	80°F (26°C)
Maximum Operating Pressure	150 PSI (10 bar)
Measuring Element	Nutating disc, positive displacement
Register Type	Straight reading, permanently sealed magnetic drive standard. Remote reading or Automatic Meter Reading units optional.
Registration	100 Gallons, 10 Cubic Feet, 1 m^3
Register Capacity	100,000,000 Gallons, 10,000,000 Cubic Feet, 1,000,000 m^3. 6 odometer wheels.
Meter Connections	2" AWWA two bolt elliptical flange, drilled, or 2" - 11 1/2 NPT internal pipe threads.
Optional Test Plug	1" NPT test plug (TP) available on elliptical long and short versions.

MATERIALS

Meter Housing	Cast Bronze
Housing Top Plate	Cast Bronze
Measuring Chamber	Thermoplastic
Disc	Thermoplastic
Trim	Stainless Steel/Bronze
Strainer	Thermoplastic
Disc Spindle	Stainless Steel
Magnet	Ceramic
Magnet Spindle	Stainless Steel
Register Lid and Box	Thermoplastic or Bronze
Generator Housing	Thermoplastic

DESCRIPTION

APPLICATIONS: For use in measurement of potable cold water in residential, commercial and industrial services where flow is in one direction only.

OPERATION: Water flows through the meter's strainer and into the measuring chamber where it causes the disc to nutate. The disc, which moves freely, nutates on its own ball, guided by a thrust roller. A drive magnet transmits the motion of the disc to a follower magnet located within the permanently-sealed register. The follower magnet is connected to the register gear train. The gear train reduces the disc nutations into volume totalization units displayed on the register dial face.

OPERATING PERFORMANCE: The Badger Recordall Disc meters meet or exceed registration accuracy for the low flow rates (95%), normal operating flow rates (100 ± 1.5%), and maximum continuous operation flow rates as specifically stated by AWWA Standard C700.

CONSTRUCTION: Badger Recordall Disc meter construction, which complies with ANSI/AWWA standard C700, consists of three basic components: bronze meter housing, measuring chamber, and permanently, sealed register. A corrosion-resistant thermoplastic material is used for the measuring chamber.

To simplify maintenance, the register, measuring chamber, and strainer can be replaced without removing the meter housing from the installation. No change gears are required for accuracy calibration. Interchangeability of parts among like-sized meters also minimizes spare parts inventory investment. The built-in strainer has an effective straining area of twice the inlet size.

MAGNETIC DRIVE: Direct magnetic drive, through the use of high-strength magnets, provides positive, reliable and dependable register coupling for straight-reading, remote or automatic meter reading options.

SEALED REGISTER: The standard register consists of a straight-reading, odometer-type totalization display, 360° test circle with center sweep hand and flow finder to detect leaks. Register gearing consists of self-lubricating thermoplastic gears to minimize friction and provides long life. Permanently sealed; dirt, moisture, tampering and lens fogging problems are eliminated. Multi-position register simplifies meter installation and reading. Generator-type remote reading and automatic meter reading systems are available for all Recordall Disc meters. (See back of sheet for additional information.) All reading options are removable from the meter without disrupting water service.

TAMPER-PROOF FEATURES: Customer removal of the register to obtain free water can be prevented when the optional tamper detection seal wire screw/or Torx® tamper seal resistant screw is added to the meter. Both can be installed at the meter site or at the factory.

MAINTENANCE: Badger Recordall Disc meters are designed and manufactured to provide long-term service with minimal maintenance. When maintenance is required, it can be performed easily either at the meter installation or at any other convenient location. As an alternative to repair by the utility, Badger offers various maintenance and meter component exchange programs to fit the needs of the utility.

CONNECTIONS: Tailpieces/Flanges for installations of meters on various pipe types and sizes, including misaligned pipes, are available as an option.

Remote/Automatic Meter Reading Systems

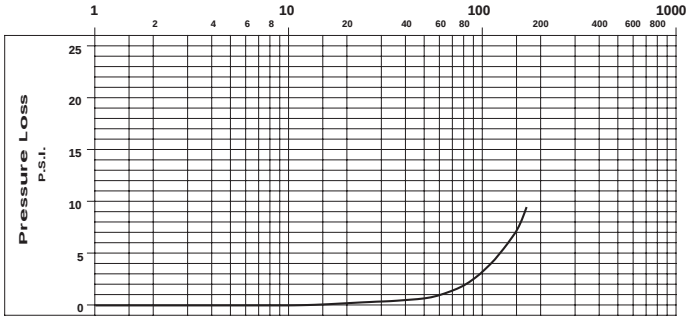
Remote Reading

The Badger ROM system generates and transmits an electrical pulse up to 5000 feet from the meter to a remote totalizer register without use of external power. See reference chart ROM-I-3. The generator which incorporates test circle and odometer-type totalizer is submersible. The remote register design permits resetting to any desired reading in the field and can be sealed to prevent tampering. See Bulletin ROM-T-5 for detail.

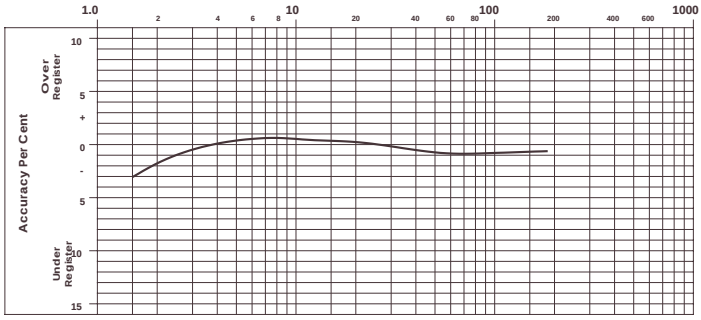
AMR

The TRACE® radio frequency system or the ACCESSplus® telephone system easily integrate with all Recordall Disc meters. Both technologies provide an efficient meter data retrieval and information management system. The TRACE Transponder and ACCESSplus Remote Module connect to the High Resolution Transmitter register assembly. Complete turnkey systems, including hardware and software, are available to provide a wide range of meter reading information.

PRESSURE LOSS CHART



ACCURACY CHART

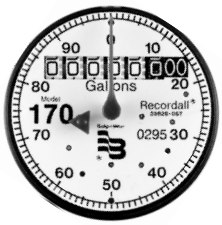


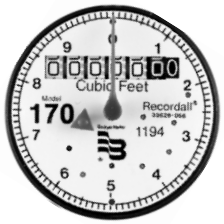
METER SIZE	METER MODEL	A LAYING LENGTH	B HEIGHT REG.	C HEIGHT GEN./HRT	D CENTERLINE BASE	WIDTH	APPROX. SHIPPING WEIGHT
2" (50mm)	170 EL, Hex. 170 EL, TP	15 1/4" (387mm)	8" (203mm)	9 3/8" (238mm)	2 7/8" (73mm)	9 1/2" (241mm)	30 lb. (13.6kg)
2" (50mm)	170 ELL, 170 ELL, TP	17" (432mm)	8" (203mm)	9 3/8" (238mm)	2 7/8" (73mm)	9 1/2" (241mm)	30 lb. (13.6kg)

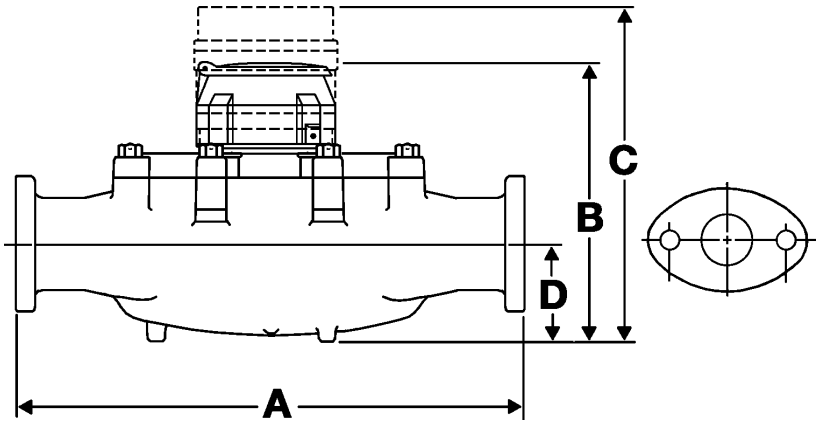
EL = Elliptical ELL = Elliptical Long Hex = Hexagon, 2" - 11 1/2 NPT Thread TP=Test Plug 1"

Sweep Hand Registration

MODEL	GALLON	CU.FT.	CU. METER
M170	100	10	1







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P.O. Box 23099
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(414) 355-0400 / (800) 876-3837
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17103 Preston Road, Suite 175
Dallas, TX 75248-1332
(972) 248-7557 / (800) 235-7590
Fax: (972) 248-4332

Western Region
5575 DTC Parkway, Suite 260
Englewood, CO 80111-3016
(303) 771-4666 / (800) 656-3837
Fax: (303) 771-6655

BadgerMeter,Inc. Utility Division
P.O. Box 23099, Milwaukee, WI 53223-0099
Fax: (414) 371-5980
An independently owned American company.

AIRCOM TECHNOLOGIES inc.

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MANUEL D'OPÉRATION ET DE MAINTENANCE

GROUPE AIRCOM

AVEC SURPRESSEUR À DÉPLACEMENT POSITIF

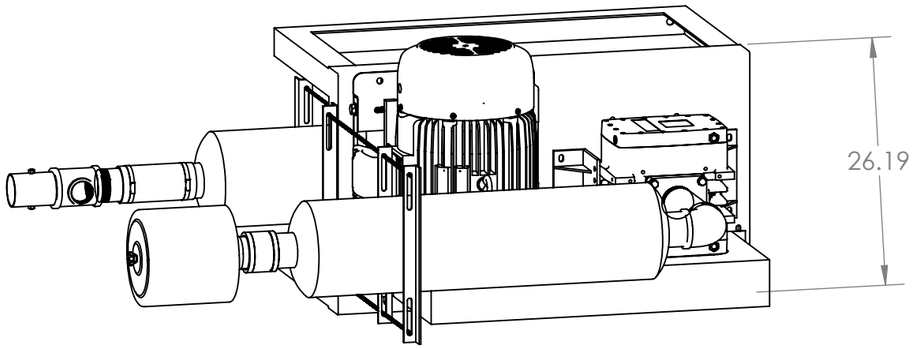
SUTORBILT

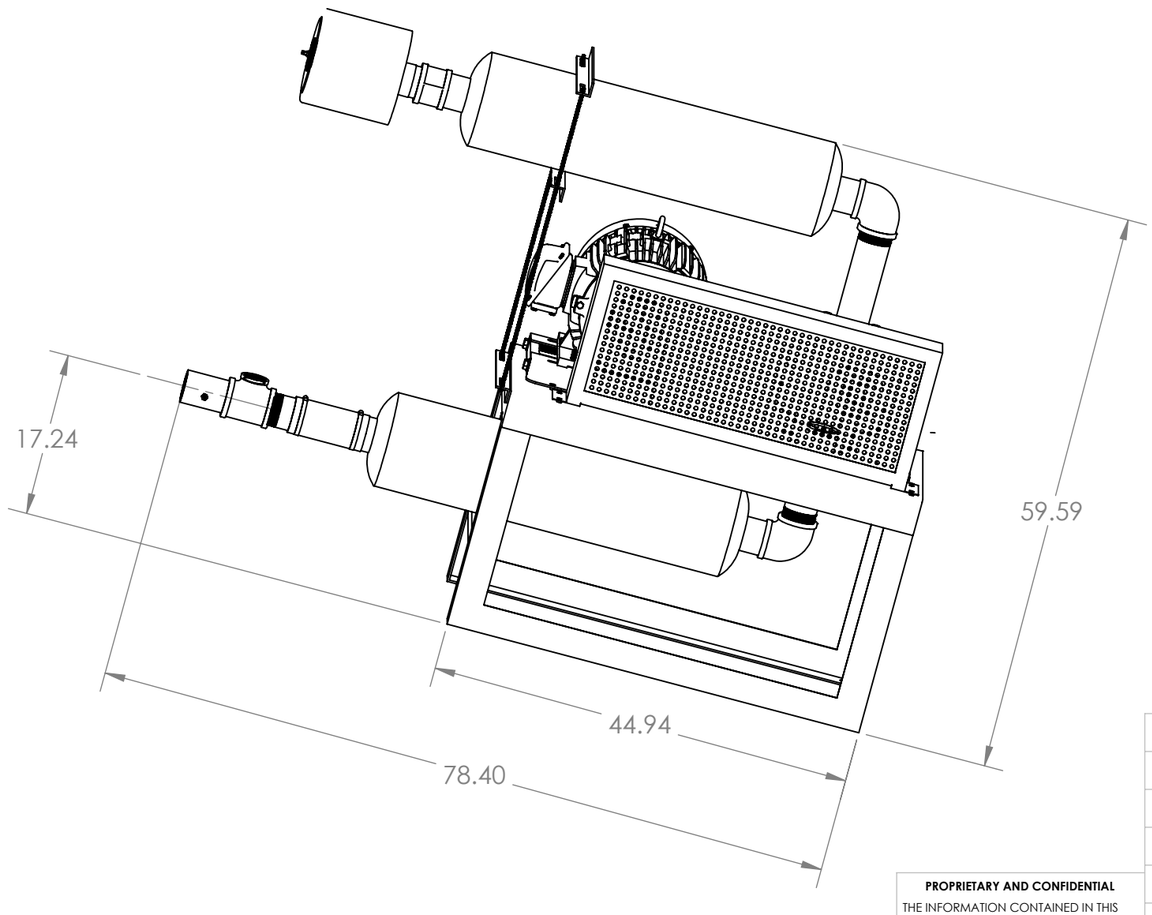
VOTRE RÉFÉRENCE: PO # 14010

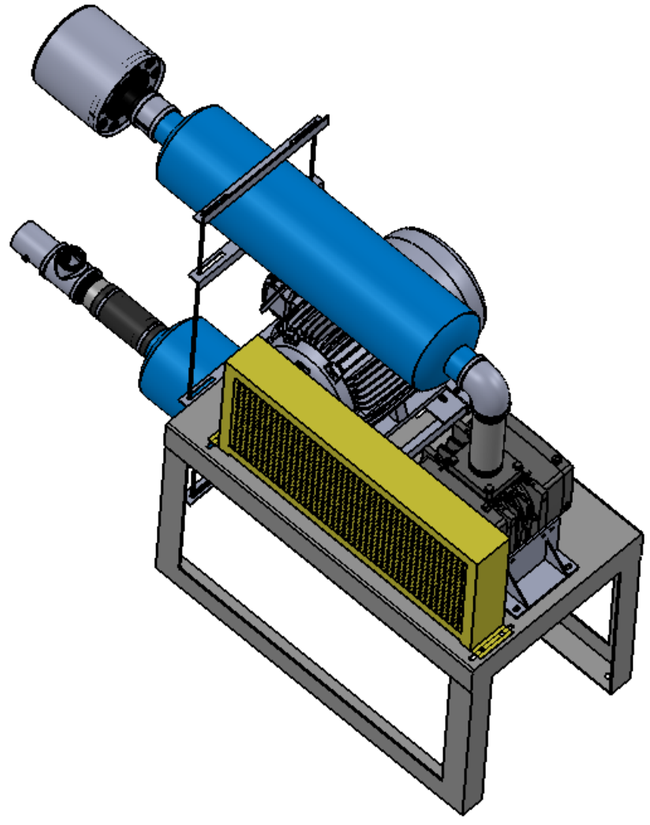
NOTRE RÉFÉRENCE: 221541

TABLE DES MATIÈRES

ITEM







		UNLESS OTHERWISE SPECIFIED:
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±
		INTERPRET GEOMETRIC TOLERANCING PER:
		MATERIAL
NEXT ASSY	USED ON	FINISH
APPLICATION		DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	Frederik K.	24/08/2015
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

AIRCOM TECHNOLOGIES Inc.

TITLE:

Package Heliflow 406 - 30 HP

SIZE	DWG. NO.	REV
B	0898	0

SCALE: 1:32	WEIGHT:	SHEET 1 OF 1

AIRCOM TECHNOLOGIES inc.

PERFORMANCE

Débit: 200 scfm; Pression de sortie: 14.5 psig.

LISTE DE FOURNITURE

1 **Groupe surpresseur Aircom comprenant:**

Éléments pré-assemblés:

1 Surpresseur Heliflow, HF406, RHBD, CW
2 Pieds pour Heliflow Edmonton
1 Base surélevée
1 Moteur, 30 HP, TEXP, 3600 rpm, 284TS, 575V
1 Base moteur, double ajustement, 284T
1 Entraînement poulies et courroies, 25 HP
1 Garde, accouplement poulie et courroie
1 Filtre silencieux, 3" NPT, c/a élément en papier
1 Silencieux de sortie, 3" MPT, entrée droite, haute efficacité
1 Assemblage groupe-surpresseur
1 Quincallerie pour assemblage

Éléments expédiés séparément (à être assemblés par autres):

1 Manchons de caoutchouc 3" PIPE
1 Collet de serrage 3" pipe
4 Plot anti-vibration
1 Soupape de sûreté à poids, pression, 2" - 3 psig
24 Disques, 0.5 psig/ ch pour PRV 2"
1 Tuyauterie pour supporter la soupape de sûreté
1 Clapet anti-retour, 3" NPT', siège en EPDM
1 Manomètre Winter's, 2.1/2" x1/4" NPT, -30" HG
1 Vanne d'isolement pour manomètre
1 Huile synthétique, AEON PD, 1L, pour démarrage

Options:

1 Ensemble silencieux d'entrée 3" horizontal et support

HeliFlow HF Series Model 406

Price:

Click to enter price

Project Specifications

Corrected Values	Original Units	English Units	Metric Units
Barometer	14.696 PSIA	14.696 PSIA	1.013 bar a
Elevation	0 ALTI-FT	0 ALTI-FT	0 alti-m
Inlet Pressure	0 PSIG	0 PSIG	0 bar g
Inlet Temp.	68 °F	68 °F	20 °C
Inlet Flow	300 SCFM	300 ICFM	510 m³/h
Dis. Pressure	14.5 PSIG	14.5 PSIG	1 bar g
Rel. Humidity	36 %	36 %	36 %
Delta Pressure	15 PSI	15 PSI	1.034 bar

Measured Values	Plot Units	English Units	Metric Units
Blower Speed	3557 RPM	3557 RPM	3557 RPM
% of Max Speed	89 %	89 %	89 %
Blower Power**	30.3 HP	30.3 HP	22.6 kw
Efficiency	49.3 %	49.3 %	49.3 %
Discharge Temp.	297 °F	297 °F	147 °C
Estimated Noise	89 db	89 db	89 db

**Drive losses not included

Physical:

Weight	146 lbs.
Gear Diameter	4 in.
Case Length	5.50 in.
Port Size	3 in.
WR²	N/A lb-ft²
Configuration	Horizontal

Performance:

Max Delta P	15 PSI
Max Temp	350 °F
Max speed	4000 rpm
Min speed	955 rpm
Max Case Pressure	25 PSIG
Max Delta T	250 °F
Max T	350 °F

Gas Parameters	English Units	Metric Units
Molecular Weight	28.88 lbm/lbmol	28.88 kg/kgmol
R Value	53.52 ft.lbf/lbm.R	0.29 kJ/kg.K
Density	0.073 lbm/ft³	1.175 kg/m³
Sp. Heat @ Const. P	0.24 BTU/lbm.R	1.01 kJ/kg.K
Ratio of Sp. Heats	1.4	1.4
Saturated Vapor Pres.	0.3388 PSIA	0.023 bar a
Partial Pres. of Gas	14.574 PSIA	1.005 bar a
Partial Pres. of Vapor	0.122 PSIA	0.0083 bar a
Reference Pressure	14.696 PSIA	1.013 bar a
Reference Temperature	68 °F	0 °C
Reference Rel. Humid.	36 %	0 %

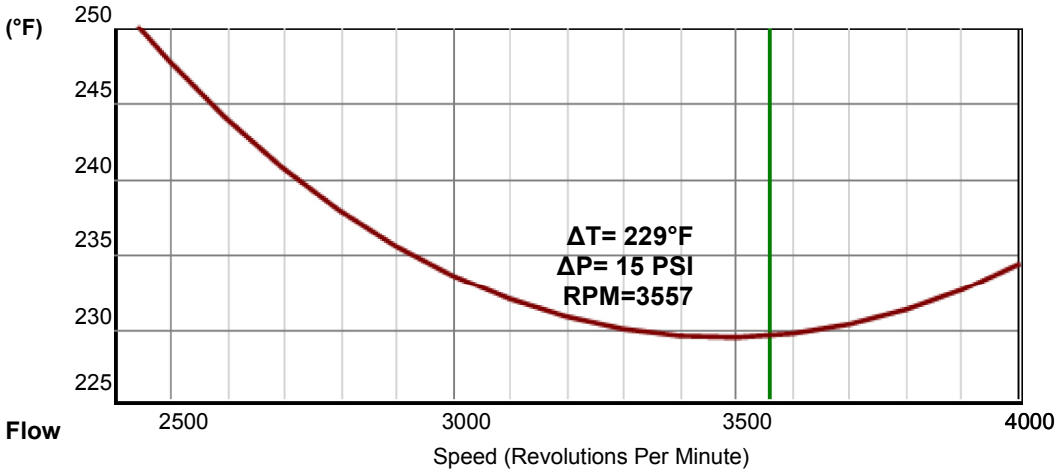
Gas mix: % by volume

Air 100 %

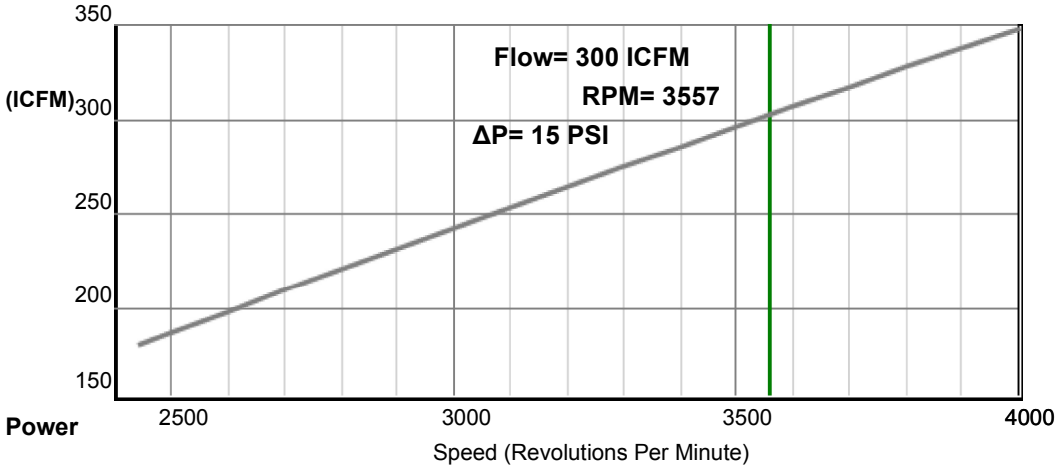
Gardner Denver Inc. QuickPik Version 1.0.10 Tue Aug 18 11:22:56 EDT 2015

Performance Information - HeliFlow HF Series Model 406

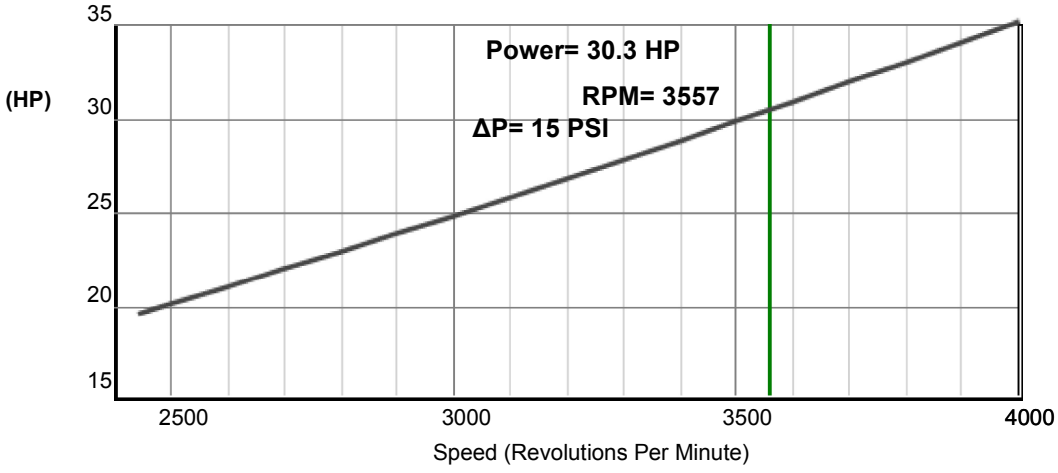
Temperature Rise



Flow



Power



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www.maskapulleys.com
www.pouliesmaska.com

Poulies Maska Inc.
180,Boul. Gagnon
Ste-Claire, Qc
G0R 2V0
(418) 883-3322
(418) 883-5015
sales@maskapulleys.com

Project #

BEST MANAGED PRIVATE COMPANIES

Selection Parameter

Driver	Driven
Rpm: 3545	**Rpm Minimum** 3450
Power: 30.00 hp	**Rpm Maximum** 3664
Shaft diameter :	**Shaft diameter:**
1.6250 Inch	1.2500 Inch

Pitch Diameter Limits

	Minimum	Maximum
Driver	0.50	71.00
Driven	0.50	71.00

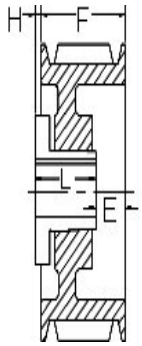
Service Factor: 1.3
Center Distance Minimum: 23.00
(Inch) Maximum: 24.00

Max. Hub Load: 9999
Min. Nbr of Grooves: 1
Max. Nbr of Grooves: 15
Min. Rim Speed (FPM): 900
Max. Rim Speed (FPM): 9500
Belts: A, AX, B, BX, C, CX, 3V, 3VX, 5V, 5VX, 8V,

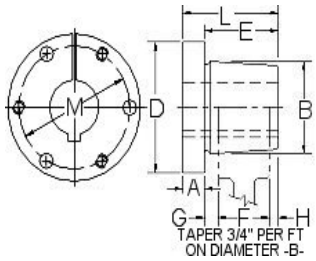
Actual Drive Values:

Rpm Driven: 3545 **Center Distance:** 23.4 in. **Deflection (in):0.36** ***Deflection Force (lbs):6.9** ***Hub Loads (lbs):261**
Service Factor: 2.08 **Power/Belts:** 31.2 hp **Non-Standard Drive (Over 6500 FPM)**

Driver

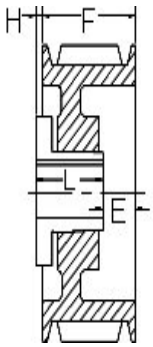


Driver Sheave: 2-5V7.1
Weight: 10.55 Lb
P.D.:7.1
D.D.:7
Price: 120.00$
Datum Diameter: 7
E: 3/16
F: 1 11/16
H: 3/8
L: 1 7/8
O.D.: 7.1

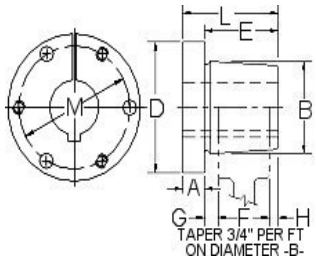


Driver Bushing: SKX1-5/8
Weight: 2.75 Lb
Price: 26.80$
A: 1/2
B: 2 13/16
D: 3 7/8
E: 1 3/8
F: 1 1/4
G: 5/16
H: -3/16
Keyseat: 3/8 x 3/16
L: 1 7/8
M: 3 5/16

Driven



Driven Sheave: 2-5V7.1
Weight: 10.55 Lb
P.D.:7.1
D.D.:7
Price: 120.00$
Datum Diameter: 7
E: 3/16
F: 1 11/16
H: 3/8
L: 1 7/8
O.D.: 7.1



Driven Bushing: SKX1-1/4
Weight: 3.15 Lb
Price: 26.80$
A: 1/2
B: 2 13/16
D: 3 7/8
E: 1 3/8
F: 1 1/4
G: 5/16
H: -3/16
Keyseat: 1/4 x 1/8
L: 1 7/8
M: 3 5/16

Version 2.6.2

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Project #

BEST MANAGED PRIVATE COMPANIES

Selection Parameter

Driver	Driven
Rpm: 3545	**Rpm Minimum** 3450
Power: 30.00 hp	**Rpm Maximum** 3664
Shaft diameter :	**Shaft diameter:**
1.6250 Inch	1.2500 Inch

Pitch Diameter Limits

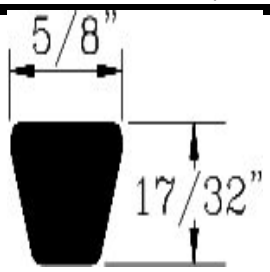
	Minimum	Maximum
Driver	0.50	71.00
Driven	0.50	71.00

Service Factor: 1.3
Center Distance Minimum: 23.00
(Inch) Maximum: 24.00

Max. Hub Load: 9999
Min. Nbr of Grooves: 1
Max. Nbr of Grooves: 15
Min. Rim Speed (FPM): 900
Max. Rim Speed (FPM): 9500
Belts: A, AX, B, BX, C, CX, 3V, 3VX, 5V, 5VX, 8V,

Actual Drive Values:

Rpm Driven: 3545 **Center Distance:** 23.4 in. **Deflection (in):0.36** ***Deflection Force (lbs):6.9** ***Hub Loads (lbs):261**
Service Factor: 2.08 **Power/Belts:** 31.2 hp **Non-Standard Drive (Over 6500 FPM)**



Belts: VB5VX690
Weight: 0.8 Lb
Qty: 2
Price: 18.53$

*Deflection Force (lbs):6.9
Deflection (in):0.36
*Hub Loads (lbs):261
Note: This Hub Loads value is calculated after 24 hours of utilisation.
(*These values are calculated with a service factor equal to 1.0)

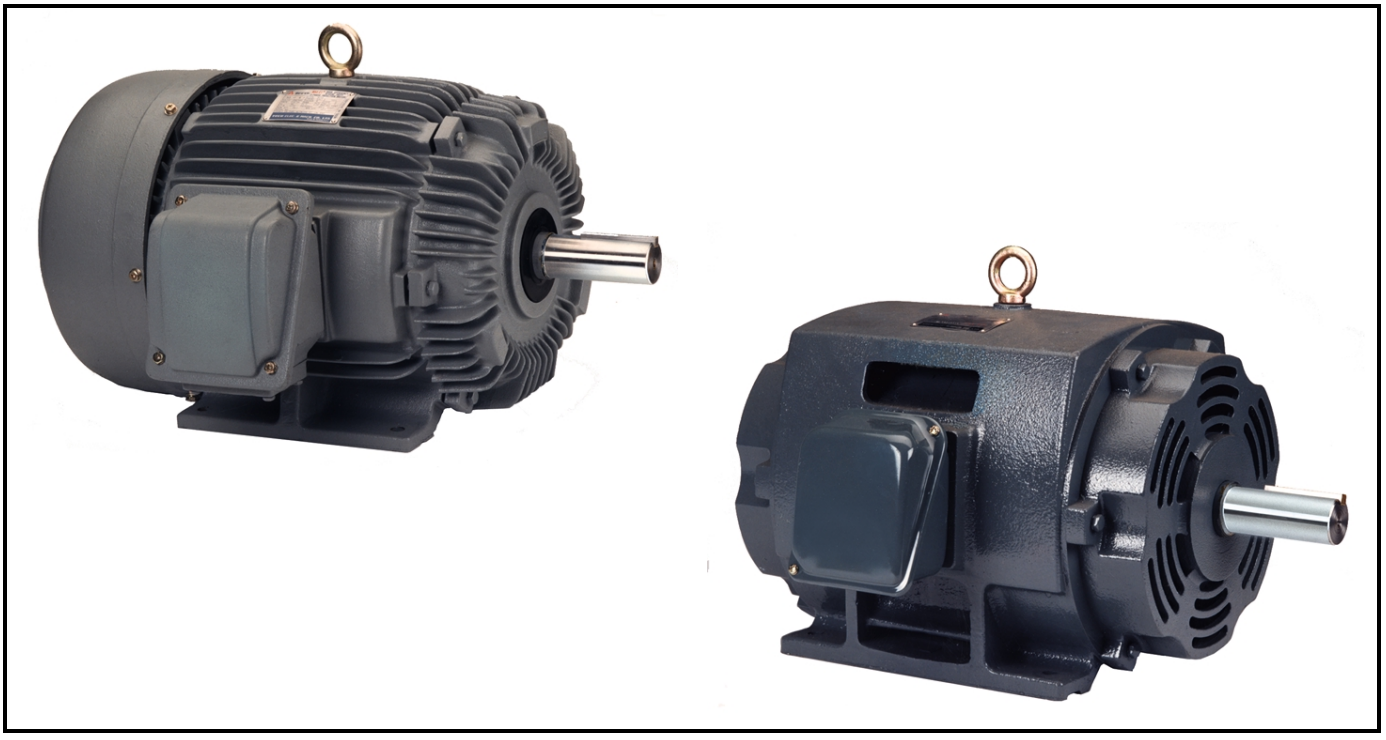
Version 2.6.2

TECO Westinghouse

MOTORS (CANADA) INC.

INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR THREE PHASE INDUCTION MOTORS

Frames 143T - 449T



18060 -109 Ave Edmonton, AB T5S 2K2
Phone: 800-661-4023 780-444-8933 Fax: 888-873-8964

RECEIVING

1. Check nameplate data.
2. Check whether any damage has occurred during transportation.
3. After removal of shaft clamp, turn shaft by hand to check that it turns freely.
4. If motor is to be reshipped (alone or installed to another piece of equipment) the shaft must again be clamped to prevent axial movement.
   Note: Remove the bearing clamp before turning the shaft on 284T-449T frame motors.

WARNING
THE FOLLOWING SAFETY PRECAUTIONS MUST BE OBSERVED:

1. Electric rotating machinery and high voltage can cause serious or fatal injury if improperly installed, operated or maintained. Responsible personnel should be familiarized with NEMA MG2; Safety Standards for Construction and Guide Selection. Installation and Use of Electric Motors and Generators; National Electric Code and all local safety requirements.
2. When servicing, all power sources to the motor and to the accessory devices should be de-energized and disconnected and all rotating parts should be at standstill.
3. Lifting means, when supplied, are intended for lifting the motor only. When two lifting devices are supplied with the motor a dual chain must be used.
4. Suitable protection must be used when working near machinery with high noise levels.
5. Safeguard or protective devices must not be by-passed or rendered inoperative.
6. The frame of this machine must be grounded in accordance with the National Electric Code and applicable local codes.
7. A suitable enclosure should be provided to prevent access to the motor by other than authorized personnel. Extra caution should be observed around motors that are automatically or have automatic re-setting relays as they may restart unexpectedly.
8. Shaft key must be fully captive or removed before motor is started.
9. Provide proper safeguards for personnel against possible failure of motor-mounted brake, particularly on applications involving overhauling loads.
10. Explosion proof motors are constructed to comply with the label service procedure manual, repair of these motors must be made by TECO-Westinghouse or CSA/UL Listed service center in order to maintain CSA/UL Listing.

LOCATION

1. Drip-proof motors are intended for use where atmosphere is relatively clean, dry, well ventilated and non-corrosive.
2. Totally enclosed motors may be installed where dirt, moisture, or dust are present and in outdoor locations.
3. Explosion-proof motors are built for use in hazardous locations as indicated by Underwriters label on the motor.
4. Chemical duty enclosed motors are designed for installation in high corrosion or excessive moisture locations.
   Note: in all cases, no surrounding structure should obstruct normal flow or ventilating air through or over the motor.

MOUNTING

1. Mount motor securely on a firm, flat base. All ball bearing normal thrust motors up to and including 256T frame size may be side-wall or ceiling mounted; all others check nearest TECO-Westinghouse office for mounting recommendations.
2. Align motor accurately, using a flexible coupling if possible. For drive recommendations, consult with drive or equipment manufacturer, or TECO-Westinghouse.
3. Mounting bolts must be carefully tightened to prevent changes in alignment and possible damage to the equipment. The recommended tightening torque s for medium carbon steel bolts, identified by three radial lines at 120 degrees on the head, are:

Bolt Size	Recommended Torque (Ft-lb.)	
	Minimum	Maximum
2/8	25	37
1/2	60	90
5/8	120	180
3/4	210	320

4. V-belts Sheave Pitch Diameters should not be less than those shown in Table 1 (NEMA recommended values)
5. Tighten belts only enough to prevent slippage. Belt speed should not exceed 5000 ft. per min.

TABLE 1. V-Belt Sheave Pitch Diameters (MG1-14.42)

Frame Number	Horsepower at Synchronous Speed, RPM				V-Belt Sheave			
					Conventional A, B, C, D AND E		Narrow 3V, 5V, AND 8V	
	3600	1800	1200	900	Minimum Pitch Diameter Inches	*Maximum Width Inches	Minimum Outside Diameter Inches	**Maximum Width Inches
143T	1.5	1	.75	.5	2.2	4.25	2.2	2.25
145T	2-3	1.5-2	1	.75	2.4	4.25	2.4	2.25
182T	3	3	1.5	1	2.4	5.25	2.4	2.75
182T	5				2.6	5.25	2.4	2.75
184T			2	1.5	2.4	5.25	2.4	2.75
184T	5				2.6	5.25	2.4	2.75
184T	7.5	5			3.0	5.25	3.0	2.75
213T	7.5-10	7.5	3	2	3.0	6.5	3.0	3.375
215T	10		5	3	3.0	6.5	3.0	3.375
215T	15	10			3.8	6.5	3.8	3.375
254T	15		7.5	5	3.8	7.75	3.8	4
254T	20	15			4.4	7.75	4.4	4
256T	20-25		10	7.5	4.4	7.75	4.4	4
256T		20			4.6	7.75	4.4	4
284T			15	10	4.6	9	4.4	4.625
284T		25			5.0	9	4.4	4.625
286T		30	20	15	5.4	9	5.2	4.625

TABLE 1. V-Belt Sheave Pitch Diameters (MG1-14.42)

Frame Number	Horsepower at Synchronous Speed, RPM				V-Belt Sheave			
					Conventional A, B, C, D AND E		Narrow 3V, 5V, AND 8V	
	3600	1800	1200	900	Minimum Pitch Diameter Inches	*Maximum Width Inches	Minimum Outside Diameter Inches	**Maximum Width Inches
324T		40	25	20	6.0	10.25	6.0	5.25
326T		50	30	25	6.8	10.25	6.8	5.25
364T			40	30	6.8	11.5	6.8	5
364T		60			7.4	11.5	7.4	5.785
365T			50	40	8.2	11.5	8.2	5.785
365T		75			9.0	11.5	8.6	5.785
404T			60		9.0	14.25	8.0	7.25
404T				50	9.0	14.25	8.4	7.25
404T		100			10.0	14.25	8.6	7.25
405T			75	60	10.0	14.25	10.0	7.25
405T		100			10.0	14.25	8.6	7.25
405T		125			11.5	14.25	10.5	7.25
444T			100		11.0	16.75	10.0	8.5
444T				75	10.5	16.75	9.5	8.5
444T		125			11.0	16.75	9.5	8.5
444T		150				16.75	10.5	8.5
445T			125		12.5	16.75	12.0	8.5
445T				100	12.5	16.75	12.0	8.5
445T		150				16.75	10.5	8.5

*Max. Sheave width = 2(N-W) - .25

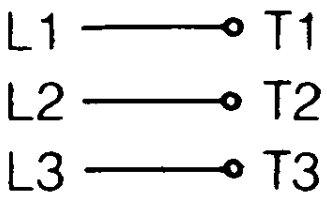
**Max Sheave width = N-W

***Sheave ratios grater than 5:1 and center-to-center distance less than the diameter of the large sheave should be referred to TECO-Westinghouse.

POWER SUPPLY & CONNECTIONS

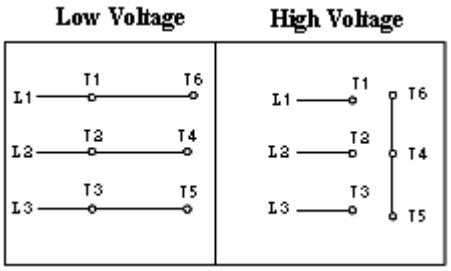
1. Wiring of motor and control, overload protection and grounding should be in accordance with National Electrical Code and all local safety requirements.
2. Nameplate voltage and frequency should agree with power supply. Motor will operate satisfactorily on line voltage within –10% of nameplate voltage; or frequency with –5% and with a combined variation not to exceed –10%. 230-volt motors can be used on 208-volt network systems, but with slightly modified performance characteristics as shown on the nameplate.
3. Dual voltage and single voltage motors can be connected for the desired voltage by following connection diagram shown on the nameplate or inside of the conduit box.
4. All Explosion Proof motors have Temperature Limiting Devices in the motor enclosure to prevent excessive external surface temperature of the motor in accordance with CSA/UL standards. Terminals of thermal protectors (P1 & P2) should be connected to the motor control equipment, according to the connection diagram inside of the conduit box.
5. Standard connection diagram for three phase, not thermally protected, dual rotation motors are shown in diagrams A through E.
   (Note: To change rotation, interchange any two line leads)

A. 3 Lead, Single Voltage

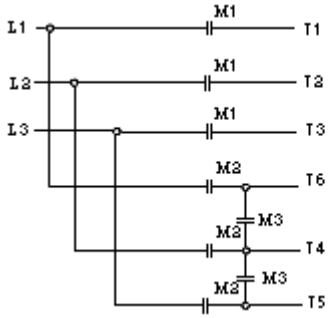


B. 6 Lead, Dual Voltage & Voltage Ration 1 to 3

B-1 Across the Line Start & Run



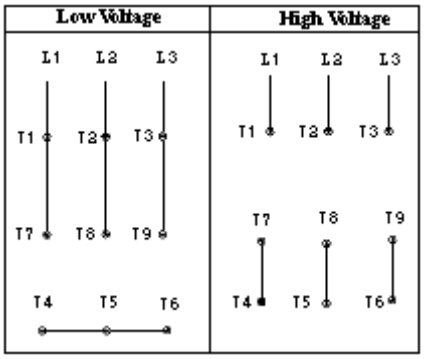
B-2 Wye Start & Delta Run
(Low Voltage only)



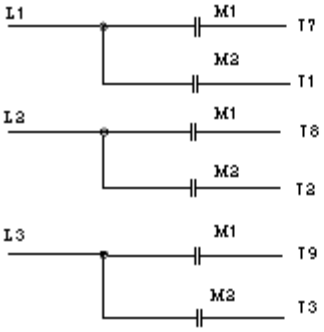
	START	RUN
M1	CLOSE	CLOSE
M2	OPEN	CLOSE
M3	CLOSE	OPEN

C. 9 Leads; Dual Voltage & Voltage Ratio 1 to 2, Wye Connected

C-1 Across the Line Start & Run



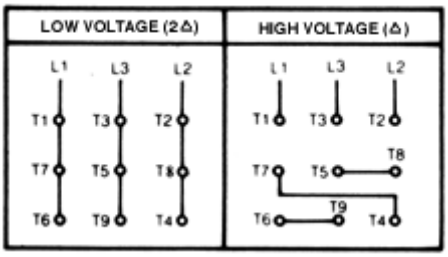
C-2 Part Winding Start
(Low Voltage only)



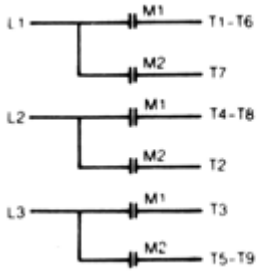
	START	RUN
M1	CLOSE	CLOSE
M2	OPEN	CLOSE
Tie Together	(T4-T5-T6)	

D. 9 Leads; Dual Voltage & Voltage Ration 1 to 2, Delta Connected

D-1 Across the Line Start & Run



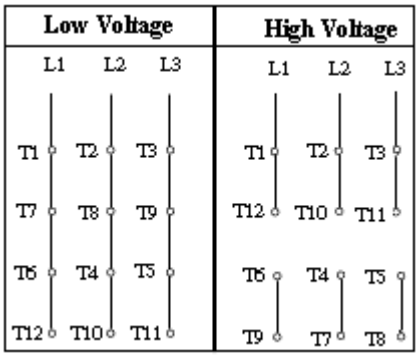
D-2 Part Winding Start
(Low Voltage only)



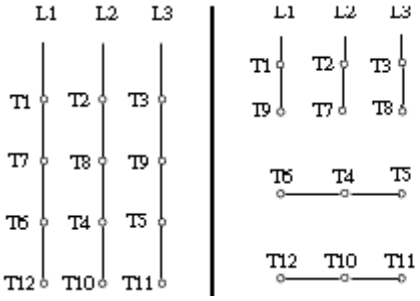
	START	RUN
M1	CLOSE	CLOSE
M2	OPEN	CLOSE

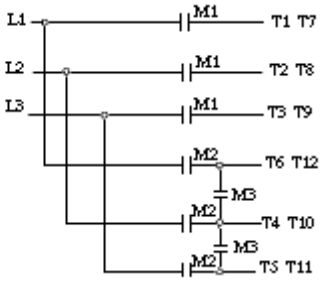
E. 12 Leads, Dual Voltage

E-1 Across the Line Start & Run



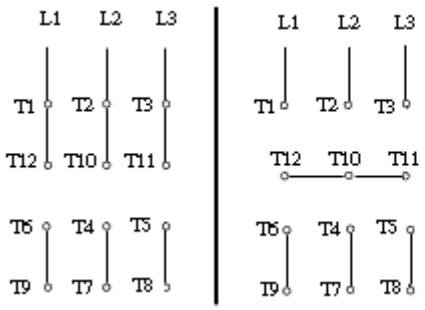
E-2-1 Wye Start & Delta Run (Low Voltage only)

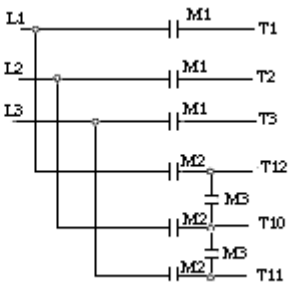




	START	RUN
M1	CLOSE	CLOSE
M2	OPEN	CLOSE
M3	CLOSE	OPEN

E-2-2 Wye Start & Delta Run (High Voltage only)

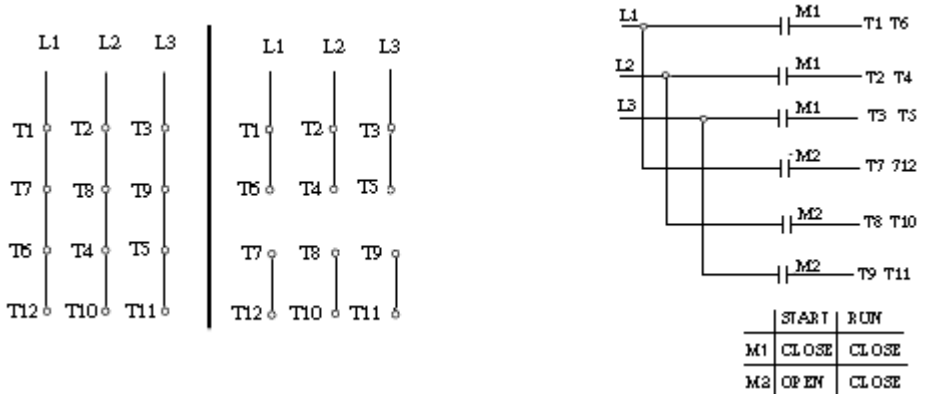




	START	RUN
M1	CLOSE	CLOSE
M2	OPEN	CLOSE
M3	CLOSE	OPEN

Tie Together (T4-T7); (T5-T8); (T6-T9)

E-3 Part Winding Start (Low Voltage only)



*Important: For Part Winding Start, M2 contactor should be closed within two (2) seconds after M1 contactor is closed.
Only 4 pole and above (e.g., 6P, 8P) motors are satisfactory for Part Winding Start at low voltage.

START UP

1. Disconnect load and start motor. Check direction of rotation. If rotation must be changed, ALLOW THE MOTOR TO STOP COMPLETLEY. Interchange any two leads of a three-phase motor.
2. Connect load. The motor should start quickly and run smoothly. If no, shut power off at once. Recheck the assembly including all connections before restarting.
3. If excessive vibration is noted, check for loose mounting bolts too flexible motor support structure or transmitted vibration from adjacent machinery. Periodic vibration checks should be made; foundations often settle.
4. Operate under load for short period of time and check operating current against nameplate.

TESTING

If the motor has been in storage for an extensive period or has been subjected to adverse moisture conditions, it is best to check the insulation resistance of the stator winding with a megometer. Depending on the length and conditions of storage it may be necessary to regrease or change rusted bearings.
If the resistance is lower than one megohm the windings should be dried in one of the following two ways:

1. Bake in oven at temperatures not exceeding 90ºC (194ºF) until insulation resistance becomes constant.
2. With rotor locked, apply low voltage and gradually increase the current through windings until temperature measured with a thermometer reaches 90ºC (194ºF). Do not exceed this temperature.

MAINTENANCE

INSPECTION

Inspect motor at regular intervals. Keep motor clean and ventilation openings clear.

LUBRICATION

1. Frame 143T-256T: Double shielded and pre-lubricated ball-bearing motors without grease fittings and don't need relubrication, except on Advantage Plus products which have regreasable features.
2. Frames 280TS, 320-449T(TS): Motors having grease fittings and grease discharge devices at brackets. Motors are shipped with grease for initial running. It is necessary to relubricate anti-friction bearing motors periodically, depending on size and type of service. See Table 2 to provide maximum bearing life. Excessive or too frequent lubrication may damage the motor.

TABLE 2

Horsepower	Standard Conditions	Severe Conditions	Extreme Conditions
1 Thru 30 Hp, 1800 rpm and below	7 years	3 years	180 days
40 Thru 75 Hp, 1800 rpm and below	210 days	70 days	30 days
100 Thru 150 Hp, 1800 rpm and below	90 days	30 days	15 days
1 Thru 20 Hp, 3600 rpm	5 years	2 years	90 days
25 Thru 75 Hp, 3600 rpm	180 days	60 days	30 days
100 Thru 150 Hp, 3600 rpm	90 days	30 days	15 days

Note:

A. Standard conditions: 8 hours operation per day, normal or light loading, clear and 40ºC ambient conditions.
B. Severe conditions: 24-hour operation per day or light shock loading, vibration or in dirty or dusty conditions.
C. Extreme conditions: With heavy shock loading or vibration or dusty conditions.
D. For double shielded bearings, above data (lubrication frequency) means that the bearing must be replaced.

3. Be sure fittings are clean and free from dirt. Using a low-pressure grease gun, pump in the recommended grease until new grease appears at grease discharge hole.
4. Use ExxonMobil Polyrex EM grease or equivalent polyurea based grease unless special grease is specified on the nameplate.
5. If relubrication is to be performed with the motor running, stay clear of rotating parts. After regreasing, allow the motor to run for ten to thirty minutes.

RENEWAL PARTS

1. Use only genuine TECO-Westinghouse renewal parts or as recommended by TECO-Westinghouse.
2. When you order renewal parts please specify complete information to TECO-Westinghouse office/agent such as type, frame no., poles, horsepower, voltage, series no., quantity, etc.

FOR FURTHER INFORMATION PLEASE CONTACT

TECO-WESTINGHOUSE MOTORS (CANADA) INC.

GARDNER DENVER
HeliFlow™

PARTS LIST OPERATING AND SERVICE MANUAL

HELIFLOW

INDUSTRIAL SERIES BLOWERS

4” GEAR DIAMETER

Models
HYCL_BA
HYCM_BA

HF-7-600
Version 02
April 24, 2007

MAINTAIN BLOWER RELIABILITY AND PERFORMANCE WITH GENUINE GARDNER DENVER PARTS AND SUPPORT SERVICES

Factory genuine parts, manufactured to design tolerances, are developed for optimum dependability - - - specifically for your blower. Design and material innovations are born from years of experience with hundreds of different blower applications. When you specify factory genuine parts you are assured of receiving parts that incorporate the most current design advancements manufactured in our state-of-the-art blower factory under exacting quality standards.

Your AUTHORIZED DISTRIBUTOR offers all the backup you require. A worldwide network of authorized distributors provides the finest product support in the blower industry.

Your AUTHORIZED DISTRIBUTOR can support your blower investment with these services:

1. Trained parts technical representatives to assist you in selecting the correct replacement parts.

2. Complete inventory of new machines and new, genuine factory parts.

3. A full line of factory tested AEON™ PD blower lubricants specifically formulated for optimum performance in all blowers.

4. Authorized distributor service technicians are factory-trained and skilled in blower maintenance and repair. They are ready to respond and assist you by providing fast, expert maintenance and repair service.

INSTRUCTIONS FOR DETERMINING BLOWER CONFIGURATION

1. Face the blower drive shaft.
2. In a **VERTICAL** configuration, air flow is horizontal.
3. In a **HORIZONTAL** configuration, air flow is vertical.
4. In a vertical configuration, a **BOTTOM HAND** exists when the drive shaft is below the horizontal center line of the blower. A TOP HAND exits when the drive shaft is above the horizontal center line of the blower.
5. In a horizontal configuration, a **RIGHT HAND** exists when the drive shaft is to the right of the vertical center line of the blower. A **LEFT HAND** exists when the drive shaft is to the left of the vertical center line of the blower.

INSTRUCTIONS FOR ORDERING REPAIR PARTS

For pricing, and ordering information contact your nearest AUTHORIZED FACTORY DISTRIBUTOR. When ordering parts, specify Blower **MODEL** and **SERIAL NUMBER** (see nameplate on unit).

Rely upon the knowledge and experience of you AUTHORIZED DISTRIBUTOR and let them assist you in making the proper parts selection for your blower.

For the location of your local authorized Gardner Denver blower distributor refer to the yellow pages of your phone directory, check the Web site at www.gardnerdenver.com or contact:

Gardner Denver Compressor Division
1800 Gardner Expressway
Quincy, IL 62305
Phone: (217) 222-5400
Fax: (217) 221-8780

FOREWORD

Gardner Denver® blowers are the result of advanced engineering and skilled manufacturing. To be assured of receiving maximum service from this machine, the owner must exercise care in its operation and maintenance. This book is written to give the operator and maintenance department essential information for day-to-day operation, maintenance and adjustment. Careful adherence to these instructions will result in economical operation and minimum downtime.

⚠ DANGER

Danger is used to indicate the presence of a hazard which will cause severe personal injury, death, or substantial property damage if the warning is ignored.

⚠ WARNING

Warning is used to indicate the presence of a hazard which can cause severe personal injury, death, or substantial property damage if the warning is ignored.

⚠ CAUTION

Caution is used to indicate the presence of a hazard which will or can cause minor personal injury or property damage if the warning is ignored.

NOTICE

Notice is used to notify people of installation, operation or maintenance information which is important but not hazard-related.

SAFETY PRECAUTIONS

Safety is everybody's business and is based on your use of good common sense. All situations or circumstances cannot always be predicted and covered by established rules. Therefore, use your past experience, watch out for safety hazards and be cautious. Some general safety precautions are given below:

⚠ DANGER

Failure to observe these notices could result in injury to or death of personnel.

- **Keep fingers and clothing away from blower inlet and discharge ports, revolving belts, sheaves, drive coupling, etc.**
- **Do not use the air discharge from this unit for breathing – not suitable for human consumption.**
- **Do not loosen or remove the oil filler plug, drain plugs, covers the thermostatic mixing valve or break any connections, etc., in the compressor air or oil system until the unit is shut down and the air pressure has been relieved.**
- **Electrical shock can and may be fatal.**
- **Blower unit must be grounded in accordance with the National Electrical Code. A ground jumper equal to the size of the equipment ground conductor must be used to connect the blower motor base to the unit base.**
- **Open main disconnect switch, tag and lockout before working on the control.**
- **Disconnect the blower from its power source, tag and lockout before working on the unit – this machine is automatically controlled and may start at any time.**

⚠ WARNING

Failure to observe these notices could result in damage to equipment.

- **Stop the unit if any repairs or adjustments on or around the blower are required.**
- **Disconnect the blower from its power source, tag and lockout before working on the unit – this machine is automatically controlled and may start at any time.**
- **Do not exceed the rated maximum speed values shown on the nameplate.**
- **Do not operate unit if safety devices are not operating properly. Check periodically. Never bypass safety devices.**

TABLE OF CONTENTS

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LIST OF ILLUSTRATION

GARDNER DENVER HELIFLOW INDUSTRIAL SERIES BLOWERS
MATRIX/MENU

NOTICE TO CUSTOMER – To find the construction options for Your blower unit, FILL IN THE BALANCE OF LETTERS OR NUMBERS FROM YOUR UNIT NAMEPLATE

	H	Y	C			A	A
COLUMN NUMBER:	1	2	3	4	5	6	7

FOLLOW THE LINE DOWN AND OVER FROM EACH SPACE THUS FILLED IN TO FIND THE APPROPRIATE CONSTRUCTION OPTION WITH WHICH YOUR MACHINE IS EQUIPPED.

COLUMN 1 – BASIC DESIGNATOR

COLUMN 2 – PRODUCT FAMILY

COLUMN 3 – GEAR DIAMETER

A.		F.
B.		G.
C.	4”	H.
E.		

COLUMN 4 – CASE LENGTH

L - Low Pressure (HF 408)
M - Medium Pressure (HF 406)

COLUMN 5 – CONFIGURATION

E. Std Blower – Vertical-Bottom Hand-Right Discharged Timed, CCW
F. Std Blower – Vertical-Bottom Hand-Left Discharge Timed, CW
G. Std Blower – Vertical-Top Hand-Right Discharge Timed, CW
H. Std Blower – Vertical-Top Hand-Left Discharge Timed, CCW
J. Std Blower – Horizontal-Right Hand-Bottom Discharge Timed CW
K. Std Blower – Horizontal-Right Hand-Top Discharge Timed CCW
L. Std Blower – Horizontal-Left Hand-Top Discharge Timed CW
M. Std Blower – Horizontal-Left Hand-Bottom Discharge Timed CCW

COLUMN 6 – DESIGN VERSION

COLUMN 7 – ADDITIONAL DESCRIPTION

A. Lip Seal

INTRODUCTION
YOUR KEY TO TROUBLE FREE SERVICE

Thank your for investing in Gardner Denver quality. The Gardner Denver reputation for rugged dependability has been earned by over 50 years of service in demanding, industrial operations where downtime cannot be tolerated and efficient blower performance is expected.

Your Gardner Denver blower is a precision engineered blower that has been carefully manufactured and thoroughly tested at the state-of the-art Gardner Denver Blower Factory in Sedalia, Missouri.

As with other precision machinery, there are several relatively simple installation, operation and maintenance procedures that you must observe to assure optimum blower performance. There is no guesswork in the manufacture of your highly advanced Gardner Denver blower and there must be none in preparing the blower to get the job done in the field.

The purpose of this manual is to help you properly install, operate and maintain your Gardner Denver blower. It is essential that you review all sections of this manual in preparation for installing your blower. Follow the instructions carefully and you will be rewarded with trouble-free Gardner Denver service… year in and year out.

IMPORTANT GARDNER DENVER TELEPHONE NUMBERS

YOUR AUTHORIZED GARDNER DENVER DISTRIBUTION

NAME: _____

TELEPHONE: _____

FAX: _____

CONTACT: _____

THANKS…FOR THE PRIVIEDGE OF SERVING YOU WITH DEPENDABLE GARDNER DENVER QUALITY.

SECTION 1
EQUIPMENT CHECK

Before uncrating, check the packing slip carefully to be sure all the parts have been received. All accessories are listed as separate items on the packing slip, and small important accessories such as relief valves can be overlooked or lost. After every item on the packing slip has been checked off, uncrate carefully. Register a claim with the carrier for lost or damaged equipment.

⚠WARNING

Customers are cautioned to provide adequate protection, warning and safety equipment necessary to protect personnel against hazards involved in installation and operation of this equipment in the system or facility.

STORAGE

Your Gardner Denver Blower was packaged at the factory with adequate protection to permit normal storage for up to six (6) months.

If the unit is to be stored under adverse conditions or for extended periods of time, the following additional measures should be taken to prevent damage.

1. Store the blower in a clean, dry, heated (if possible) area.
2. Make certain inlet and discharge air ports are tightly covered to prevent foreign material from entering the air box.
3. All exposed, non-painted surfaces should be protected against rust and corrosion.
4. Provide adequate protection to avoid accidental mechanical damage.
5. In high humidity or corrosive environments, additional measures may be required to prevent rusting of the blower internal surfaces.
6. To prevent rusting of gears, bearings, etc., the oil reservoirs may be filled with normal operating oil.

⚠CAUTION

Before running the blower, drain the oil and replace to the proper operating level with clean, fresh lubricant.

7. Rotate the blower shaft (10 to 25 turns) monthly during storage. Inspect the blower shaft (near the shaft seal area) monthly and spray with rust inhibitor if needed.
8. For long term storage (over six (6) months), contact Gardner Denver Customer Service for recommendations.

REMOVING PROTECTIVE MATERIALS

The shaft extension is protected with rust inhibitor which can be removed with any standard solvent.

⚠ CAUTION
Follow the safety directions of the solvent manufacturer.

Blower inlet and outlet are temporarily capped to keep out dirt and other contaminants during shipment. These covers must be removed before start-up.

The internal surfaces of all HeliFlow blowers are mist sprayed with a rust preventative to protect the machine during shipment. Remove this film upon initial startup, using any commercial safety solvent. Position the blower so that the inlet and discharge connections are in the vertical position (vertical airflow). On vertically mounted units, it will be necessary to lay the unit on its side supporting the ends of the unit so as not to restrict the portion on the bottom side. Place a shallow pan on the under side of the unit. With the blower disconnected from power, spray the solvent in the top port, rotating the impellers by spinning the shaft manually. Continue this procedure until the unit is visibly clean.

⚠ **WARNING**

Rotating components will cause severe injury in case of personal contact. Keep hands away from blower inlet and discharge ports.

SECTION 2
INSTALLATION

LOCATION

If possible, install the blower in a well lit, clean, dry place with plenty of room for inspection and maintenance.

FOUNDATIONS

For permanent installations we recommend concrete foundations be provided, and the equipment should be grouted to the concrete. It is necessary that a suitable base be used, such as a steel combination base under blower and motor, or a separate sole plate under each. Before grouting, equipment must be leveled, free of all strains, and anchored so no movement will occur during setting of grout. After grout has completely hardened, a recheck is necessary to compensate for shrinkage, etc. If required, add shims under blower feet after final tightening of foundation anchor bolts to remove strain from the blower housing. Where jack screws or wedges are used during grouting, they must be backed off or removed before final tightening of anchor bolts.

Where a concrete foundation is not feasible, care must be taken to insure that equipment is firmly anchored to adequate structural members.

MOUNTING CONFIGURATIONS

The blower flex-mounting design enables horizontal and vertical mounting configurations with top or bottom hand, right or left hand shaft positioning. The units are discharge timed allowing rotation in only one direction (refer to FIGURE 2-1). If converting a blower from vertical bottom hand drive to vertical top hand drive or vice versa, the oil slinger on each end must be moved to the lower rotor.

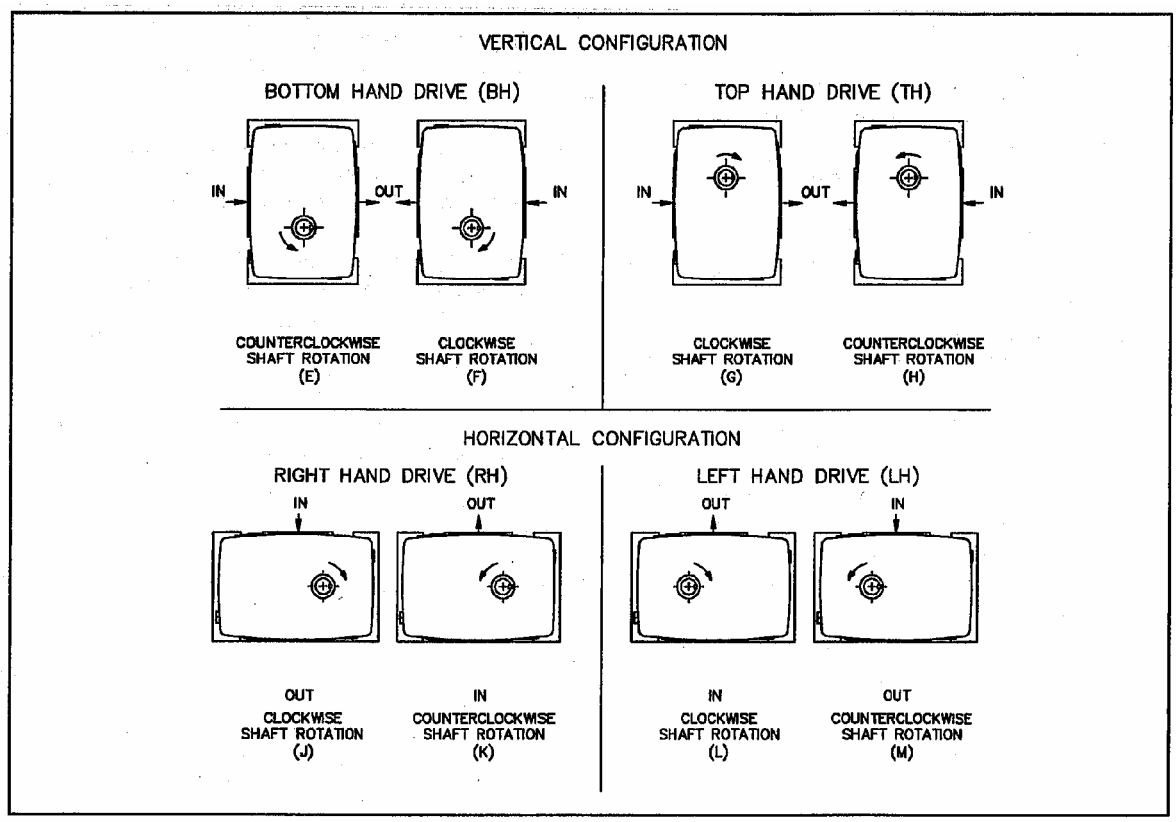


FIGURE 2-1– BLOWER MOUNTING CONFIGURATIONS

NOTICE

When changing mounting configuration, it will be necessary to reposition oil level gauge (H), and drain plug (A). Refer to FIGURE 3-1, page 8, for correct location.

⚠WARNING

For Vertical Models, the oil slinger must be on the lower rotor or blower failure is immediate.

DRIVE INSTALLATION

When selecting a V-belt drive, check to be sure the shaft overhung load limitation is not exceeded. Refer to FIGURE 2-2, page 6, for overhung load calculations and limitations.

Belt drives must be carefully aligned. Motor and blower pulleys must be parallel to each other and in the same plane within 1/32 inch. Belt tension should be carefully adjusted to the belt manufacturer's recommendation using a belt tension gauge. Check tension frequently during the first day of operation.

⚠WARNING

Overtightening belts leads to heavy bearing loads and premature failure.

On the direct connected units, alignment and lubrication of couplings to specifications of the coupling manufacturer is very important. When mounted drives are supplied from the factory, proper alignment has been established before shipment. However, during shipping, handling and installation, it is likely that the alignment has been disturbed and final adjustment must be made before startup.

⚠WARNING

Exceeding overhung load limitations leads to unwarrantable premature bearing failure and shaft breakage.

The location of the sheave on the blower shaft greatly affects the stress in the shaft. The optimum blower sheave positioning is as close as possible to the blower drive cover, not to exceed dimension "C" in Drive Shaft Illustration, FIGURE 2-2, page 6.

The calculated shaft moment must not exceed the maximum allowable moment listed in Maximum Allowable Moment Chart, FIGURE 2-2, page 6. If the calculated shaft moment exceeds the maximum allowable moment:

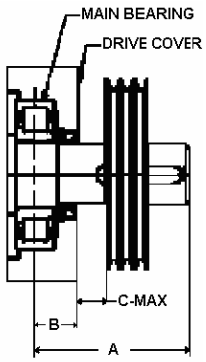
- Increase Sheave Diameters to Reduce Belt Pull
- Use Jackshaft Drive
- Use Direct Coupled or Gearbox Drive

To calculate shaft moment for a given V-Belt Drive Arrangement:

1. Use the formula for Calculation of Belt Pull, FIGURE 2-2, page 6, to calculate belt pull. Refer to Arc of Contact Factor Chart, FIGURE 2-2, page 6.
2. Insert the calculated belt pull into the formula for Calculation of Shaft Moment, FIGURE 2-2, page 6 to arrive at the calculated shaft moment.

Gear Diameter (Inches)	Dimensions (Inches)			Maximum Allowable Moment (LB-IN)
	A	B	C (Max)	
4	4.30	1.46	0.38	1450

MAXIMUM ALLOWABLE MOMENT



DRIVE SHAFT ILLUSTRATION

Z	Ac	Z	Ac	Z	Ac	Z	Ac	Z	Ac	Z	Ac
0.000	1.000	0.250	0.966	0.500	0.926	0.750	0.879	1.000	0.823	1.250	0.751
0.025	0.997	0.275	0.962	0.525	0.922	0.775	0.874	1.025	0.816	1.275	0.742
0.050	0.994	0.300	0.958	0.550	0.917	0.800	0.869	1.050	0.810	1.300	0.734
0.075	0.990	0.325	0.954	0.575	0.913	0.825	0.864	1.075	0.803	1.325	0.725
0.100	0.987	0.350	0.951	0.600	0.908	0.850	0.858	1.100	0.796	1.350	0.716
0.125	0.983	0.375	0.947	0.625	0.904	0.875	0.852	1.125	0.789	1.375	0.706
0.150	0.980	0.400	0.943	0.650	0.899	0.900	0.847	1.150	0.782	1.400	0.697
0.175	0.977	0.425	0.939	0.675	0.894	0.925	0.841	1.175	0.774	1.425	0.687
0.200	0.973	0.450	0.935	0.700	0.889	0.950	0.835	1.200	0.767		
0.225	0.969	0.475	0.930	0.725	0.884	0.975	0.829	1.225	0.759		

ARC OF CONTACT FACTORS

$$\text{Belt Pull} = \left[\frac{2.5 - Ac}{Ac}\right]\left[\frac{125954 \times Hp \times S.F.}{D \times RPM}\right]$$

Key:
- Ac = Arc of Contact Factor (Refer to Arc of Contact Factor Chart above)
- Hp = Blower Horsepower for Operating Conditions
- S.F. = Actual Drive Service Factor
- D = Blower Sheave Pitch Diameter in Inches
- RPM = Blower Sheave Speed

$$Z = \left[\frac{\text{Large Sheave Pitch Diameter (in)} - \text{Small Sheave Pitch Diameter (in)}}{\text{Sheave Center Distance (in)}}\right]$$

CALCULATION OF BELT PULL

$$\text{Shaft Moment (LB-IN)} = \text{Belt Pull} \times \left[B + C + \left(\frac{\text{Sheave Width}}{2}\right)\right]$$

CALCULATION OF SHAFT MOMENT

FIGURE 2-2 – BELT DRIVE OVERHUNG LOAD CALCULATIONS

PIPING

Inlet and discharge connections on all blowers are large enough to handle maximum volume with minimum friction loss. Reducing the pipe diameter on either inlet or discharge will only create additional line loss and increase the overall pressure differential.

Excessive weight of piping and fittings will cause internal misalignment and premature wear. Never allow the blower to carry the weight of the pipe. If possible, a spool or sleeve-type expansion joint should be installed between the unit and the piping. Where a flexible connection is not practical, the weight of the rigid connection must be separately supported. All system piping must be cleaned internally before connecting to the blower.

Gardner Denver blowers are shipped dry from the factory. Do not attempt to operate the blower before following proper lubrication instructions. Permanent damage to the gears, bearings and seals will occur.

SECTION 3
MAINTENANCE

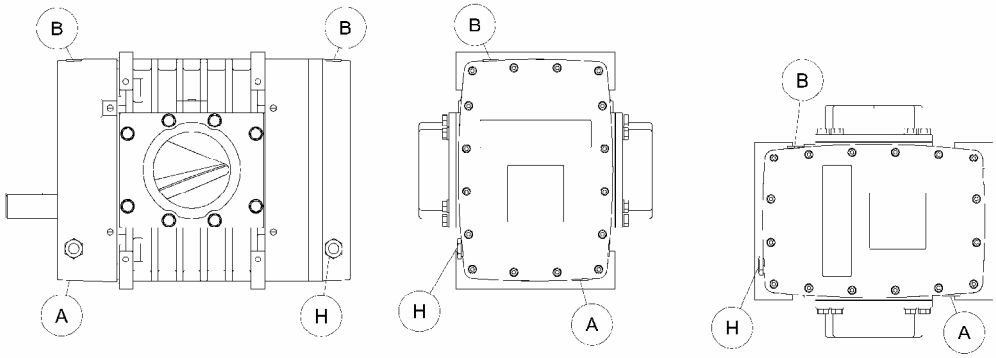


FIGURE 3-1 - LUBRICATION

A. Oil Drain Plug
B. Plug/Oil Fill
H. Oil Level Sight Gauge

GENERAL

Blower efficiency and life depend on the quality of maintenance the blower receives. Maintenance must be done regularly and with care. Clean work space, tools, solvents and wiping rags are necessary to avoid transferring dirt into the unit. Scheduling regular maintenance of the blower will insure long trouble-free service.

LUBRICATION

Gears and bearings are splash lubricated by an oil slinger in each sump. Check the oil level in both sumps daily. Do not operate the blower if the oil level is not in the middle of the sight gauge for each sump when the blower is not running.

FILLING PROCEDURE

Refer to FIGURE 3-1. While the blower is not running remove the plug (B) from each sump. Add oil to each sump until it reaches the middle of each oil level sight gauge (H). Secure the plug (B) in each end.

LUBRICATION SERVICE

Add fresh oil as required to maintain proper level. If premium grade mineral oil is used, the oil should be drained, the gearbox flushed and the oil replaced every 1500 hours or more frequently if inspection so indicates. The oil change period is governed by operating conditions such as load, temperature, dirt, humidity, fumes and the quality of the oil used. The oil drain plug is located at (A). With AEON PD synthetic blower lubricant, perform the above oil-change maintenance after 4500 to 7500 hours.

⚠WARNING

Do not overfill as this will tend to cause excessive heating of the gears and may damage the unit.

RECOMMENDED LUBRICANT

Oil Fill Ports	Vertical	Horizontal
Shaft End	1.0	1.25
Gear End	1.5	2.0

FIGURE 3-2 – APPROXIMATE OIL CAPACITIES (PINTS)

AEON PD is formulated especially for positive displacement blower service to provide maximum blower protection at any temperature. One filling of AEON PD will last a minimum of 4 times longer than a premium mineral oil. Refer to FIGURE 3-3, page 9.

Order AEON PD from your Gardner Denver Distributor.

AEON PD	**1 Quart Bottle**	**Part No. 28G23**
AEON PD	**12 Quart Case**	**Part No. 28G24**

Blower Discharge Temperature		Factory Tested Recommended and Approved Lubricant
° F	° C	AEON PD Synthetic Blower Lubricant One Superior Lubricant For All Operating Temperatures
32°	0°	
100°	38°	
275°	135°	
350°	177°	

FIGURE 3-3 – TEMPERATURE CHART

If not using AEON PD synthetic blower lubricant, use oils with rust and oxidation inhibitors, anti-foam additives and viscosities listed in FIGURE 3-4. Do not use oil that contains EP additives.

Blower Discharge Temperature	Ambient Temperature			
	Less than 10°F	10°F to 32°F**	32°F to 90°F	Greater than 90°F
Less than 32°F (0°C)	ISO 100 ‡	ISO 100 ‡		
32° F to 100° F (0° C to 38°C)	ISO 100 ‡	ISO 100 ‡	ISO 150 ‡	
100° F to 225° F (38° C to 105°C)	ISO 100 ‡	ISO 100 ‡	ISO 150 ‡	ISO 220 ‡
225° F to 300° F (105° C to 149°C)	ISO 150 ‡	ISO 150 ‡	ISO 220 ‡	ISO 220 ‡
Over 300° F (149°C)			*** ‡	*** ‡

* For ambient temperatures less than 10° F, but not less than -20° F, the use of sump heaters, heated enclosures or synthetic lubricant is required.

** For ambient temperatures 10° F to 32° F, the use of oil sump heaters, heated enclosures or synthetic lubricant is recommended.

*** The lubricant viscosity must be 70 SUS minimum at the lubricant operating temperature.

The pour point of the lubricant should be at least 5° to 10° F below the minimum expected ambient temperature.

For continuous operation, where the lubricant temperature exceeds 200° F, synthetic lubricant is recommended.

‡ The recommended operating range for AEON PD Synthetic Lubricant.

FIGURE 3-4 – LUBRICATION RECOMMENDATION

AIR FILTERS AND FILTER SILENCERS

⚠WARNING

Servicing the air filters is one of the most important maintenance operations to be performed to insure long blower life.

Servicing frequency of filter elements is not time predictable. A differential pressure indicator, with a continuous gauge reading, should be installed across the inlet filter. It will tell how much of the service life of the filter element has been used. It will also eliminate both premature filter servicing and premature blower failure due to a plugged filter when the filter pressure drop is used to establish maintenance points.

In all cases refer to the filter manufacturer's service instructions. Due to the many types of filters, it is not practical to give specific instructions covering all models.

NOTICE

No matter what type of filter is used, always make sure all seats, gaskets, clamps and hose connections on the filter and inlet line are absolutely air tight. Each time the filter is serviced, inspect interior of the blower for dirt.

PERIODIC INSPECITIONS

A good maintenance program will provide for periodic inspections of the blower and drive components. The following inspections may prevent major repairs and downtime:

1. Observe the blower for vibration, heating, noise, oil leaks and excessive air leaks.

2. Check for proper operation of the filters, silencers, couplings, drive belts, motor (or power unit), relief valve, check valve, gauges and other controls.

3. Disconnect the drive and turn the blower by hand to check for drag, tight spots, bearing wear and gear backlash. Rotation should be free with no indication of drag or metallic interference.

4. Inspect the interior of the blower through the inlet or discharge port for cleanliness, corrosion and contact of internal parts.

5. Check the tightness of all screws, bolts and nuts.

SECTION 4
OPERATION

Future operating problems can be avoided if proper precautions are observed when the equipment is first put into service.

NOTICE

Machines are shipped without oil in the sumps. Do not operate before adding lubricant.

Before starting under power, the blower should be turned over by hand to make certain there is no binding, or internal contact.

Each size blower has limits on pressure differential, running speed and discharge temperature which must not be exceeded. These limits are shown in the following tabulation. Refer to FIGURE 4-1, page 11.

⚠WARNING

Operating beyond the specified operating limitations will result in damage to the unit.

It is important that the pressures and temperatures are measured directly at the ports of the blower to avoid error that may be caused by intervening pipe runs, fittings, etc.

Relief valves should be used to protect against excessive pressure or vacuum conditions. These valves should be tested at initial startup to be sure they are adjusted to relieve at or below the maximum pressure differential rating of the blower.

NOTICE

Relief valves should be placed as close as possible to the blower inlet or discharge.

In some instances, pressure may be relieved at a lower point than the blower maximum in order to protect the motor or the equipment served by the blower.

Discharge temperature switches are recommended to protect against excessive inlet restriction or inlet temperatures. Check valves in the discharge line on pressure blowers and in the inlet line on vacuum blowers are recommended to protect the blower from motoring backwards when shut down under load.

LIMITATIONS

For information regarding limitations, refer to FIGURE 4-1, below.

MAXIMUM OPERATING LIMITATIONS

SIZE	RPM	PRESSURE PSI	VACUUM IN HG	TEMPERATURE RISE ° F	DISCHARGE TEMPERATURE ° F
HF 408	4000	12	16	250	350
HF 406	4000	15	16	250	350

DO NOT EXCEED THESE LIMITS

NOTICE

Blower speed, line losses, elevation, and increased inlet temperatures will affect the maximum operating limitations.

FIGURE 4-1 – MAXIMUM OPERATING LIMITATIONS

BLOWER STARTUP CHECKLIST

This startup procedure should be followed during the initial installation and after any shutdown periods or after the blower has been worked on or moved to new location. It is suggested that the steps be followed in sequence and checked off (√) in the boxes provided.

- ☐ 1. Check the unit and all piping for foreign material and clean if required.
- ☐ 2. Check the flatness of the feet and the alignment of the drive. Feet that are bolted down in a bind can cause housing distortion and internal rubbing. Misaligned V-drives can cause the impellers to rub against the headplates and cause a reduction in the volumetric efficiency of the unit. Misaligned couplings can ruin bearings.
- ☐ 3. If the blower is V-belt driven, check the belt tension and alignment. Over-tensioned belts create heavy bearing loads which lead to premature failure.
- ☐ 4. Be sure adequate drive guards are in place to protect the operator from severe personal injury from incidental contact.
- ☐ 5. Check the unit for proper lubrication. Proper oil level cannot be over-emphasized. Too little oil will ruin bearings and gears. Too much oil will cause overheating and can ruin gears and cause other damage.
- ☐ 6. With motor electrical power locked out and disconnected, turn the drive shaft by hand to be certain the impellers do not bind.
- ☐ 7. "Jog" the unit with the motor a few times to check that rotation is in the proper direction, and to be certain it turns freely and smoothly.
- ☐ 8. The internal surfaces of all Gardner Denver units are mist sprayed with a rust preventive to protect the machine during the shipping and installation period. This film should be removed upon initial startup.
- ☐ 9. Start the unit and operate 15 minutes at no load. During this time, check for hot spots and other indications of interference.
- ☐ 10. Apply the load and observe the operation of the unit for one hour. Check frequently during the first day of operation.
- ☐ 11. If malfunctions occur, do not continue to operate. Problems such as knocking rotors can cause serious damage if the unit is operated without correction.

SAFETY PRECAUTIONS

1. Do not operate blower with open inlet or outlet port.
2. Do not exceed specified vacuum or pressure limitations.
3. Do not operate above or below recommended blower speed range.
4. Blower is not to be used where non-sparking equipment is specified.
5. Do not operate without belt guard or coupling shield.

⚠WARNING

Do not exceed sheave or coupling manufacturer's rim speed limit.

6. The blower and blower discharge piping may be extremely hot and can cause skin burns on contact.

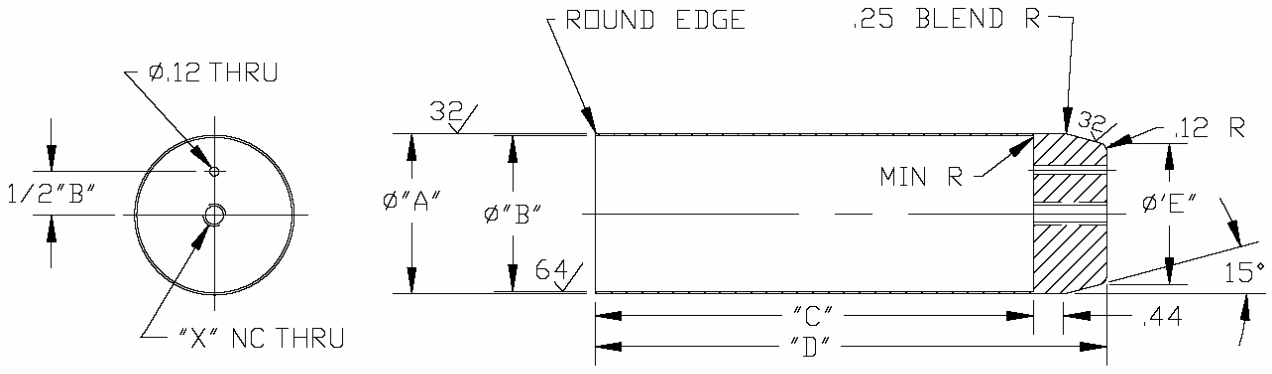
TROUBLE SHOOTING

No matter how well the equipment is designed and manufactured, there may be times when servicing will be required due to normal wear, the need for adjustment, or various external causes. Whenever equipment needs attention, the operator or repairman should be able to locate the cause and correct the trouble quickly. The Trouble Shooting Chart below is provided to assist the mechanic in those respects.

PROBLEM	POSSIBLE CAUSE	SOLUTION
Knocking	1. Unit out of time. 2. Distortion due to improper mounting or pipe strains. 3. Excessive pressure differential. 4. Worn gears. 5. Worn bearings.	1. Retime impellers. 2. Check mounting alignment and relieve pipe strains. 3. Reduce to manufacturer's recommended pressure. Examine relief valve, re-set if necessary. 4. Replace timing gears. 5. Replace bearings.
Excessive blower temperature.	1. Too much oil in gear case. 2. Too low operating speed. 3. Clogged filter or muffler. 4. Excessive pressure differential. 5. Worn impeller clearances. 6. Internal contact.	1. Reduce oil level. 2. Increase blower speed. 3. Remove cause of obstruction. 4. Reduce pressure differential across the blower. 5. Replace impeller. 6. Correct clearances.
Impeller end or tip drag.	1. Insufficient assembled clearances. 2. Case or frame distortion. 3. Excessive operating pressure. 4. Excessive operating temperature.	1. Correct clearances. 2. Check mounting and pipe strain. 3. Remove causes. 4. Remove causes.
Lack of volume.	1. Slipping belts. 2. Worn clearances. 3. Dirty air filter	1. Tighten belts. 2. Re-establish proper clearances. 3. Clean or replace air filter
Excessive bearing or gear wear.	1. Improper lubrication.	1. Correct lubrication level. Replace dirty oil.
Loss of oil.	1. Bearing housing vents plugged. 2. Worn seal.	1. Clean vents. 2. Replace seals.

SECTION 5
SPECIAL TOOLS

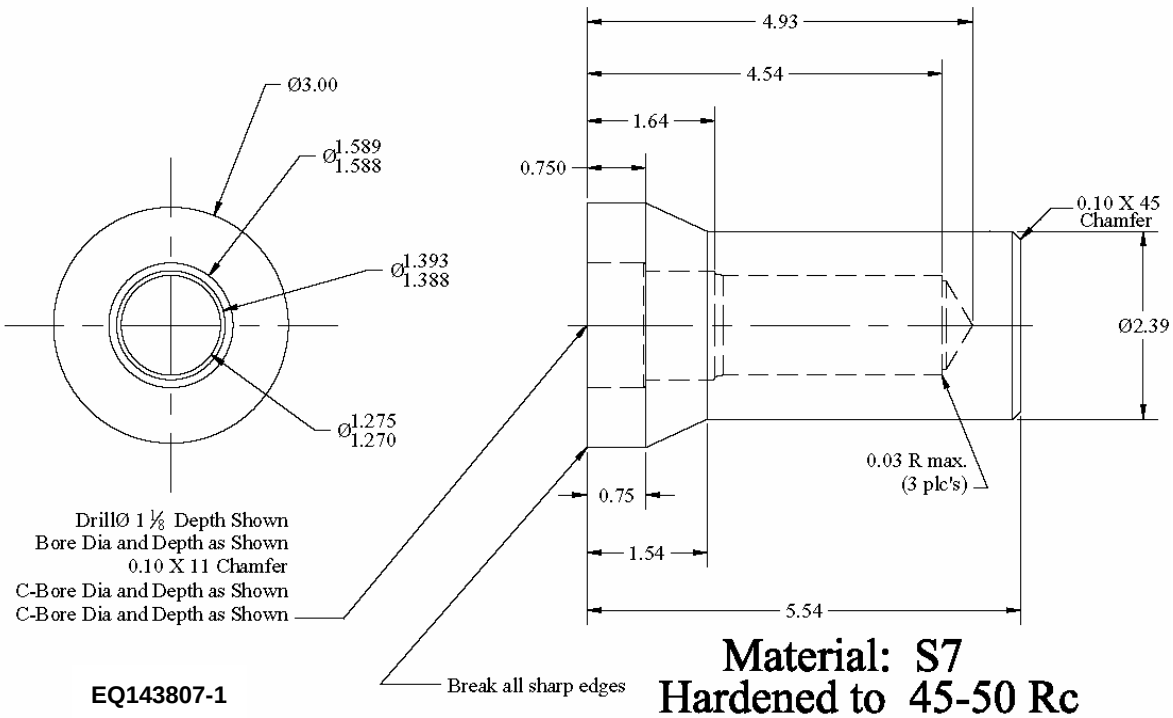
ORDER SPECIAL TOOLS BY PART NUMBER. SEE PAGE 1 FOR ORDERING INSTRUCTIONS.



EQ143096-13

"A" +/-.001	"B" +/-.001	"C"	"D"	"E"	"X"
1.293	1.253	3.25	4.75	0.72	1/4-20

FIGURE 5-1 - SEAL PROTECTION SLEEVE



EQ143807-1

FIGURE 5-2 – BEARING DRIVER

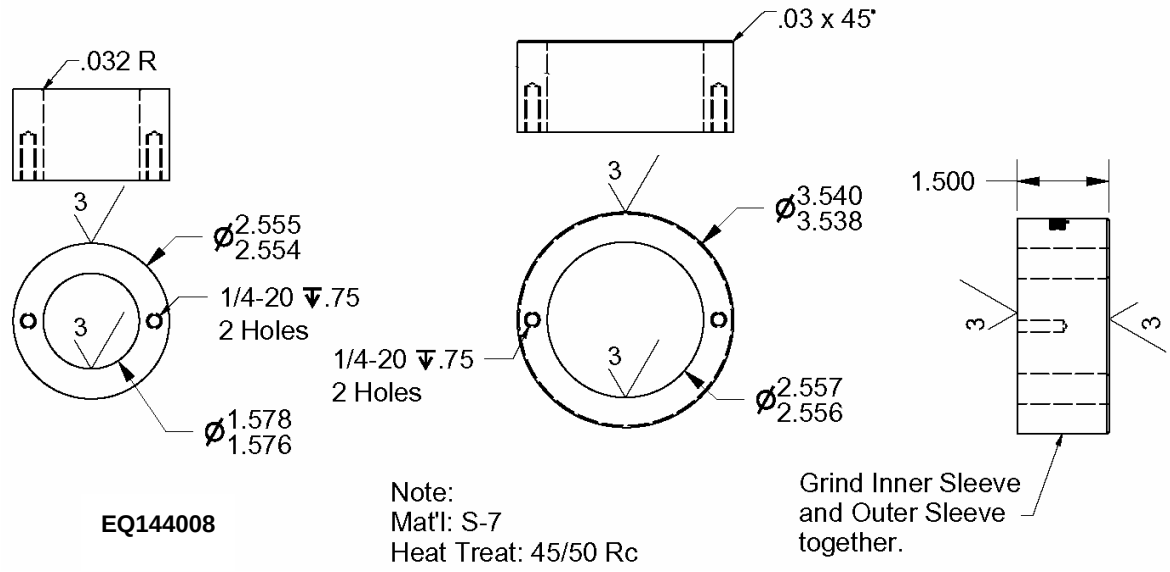


FIGURE 5-3 – FALSE BEARING

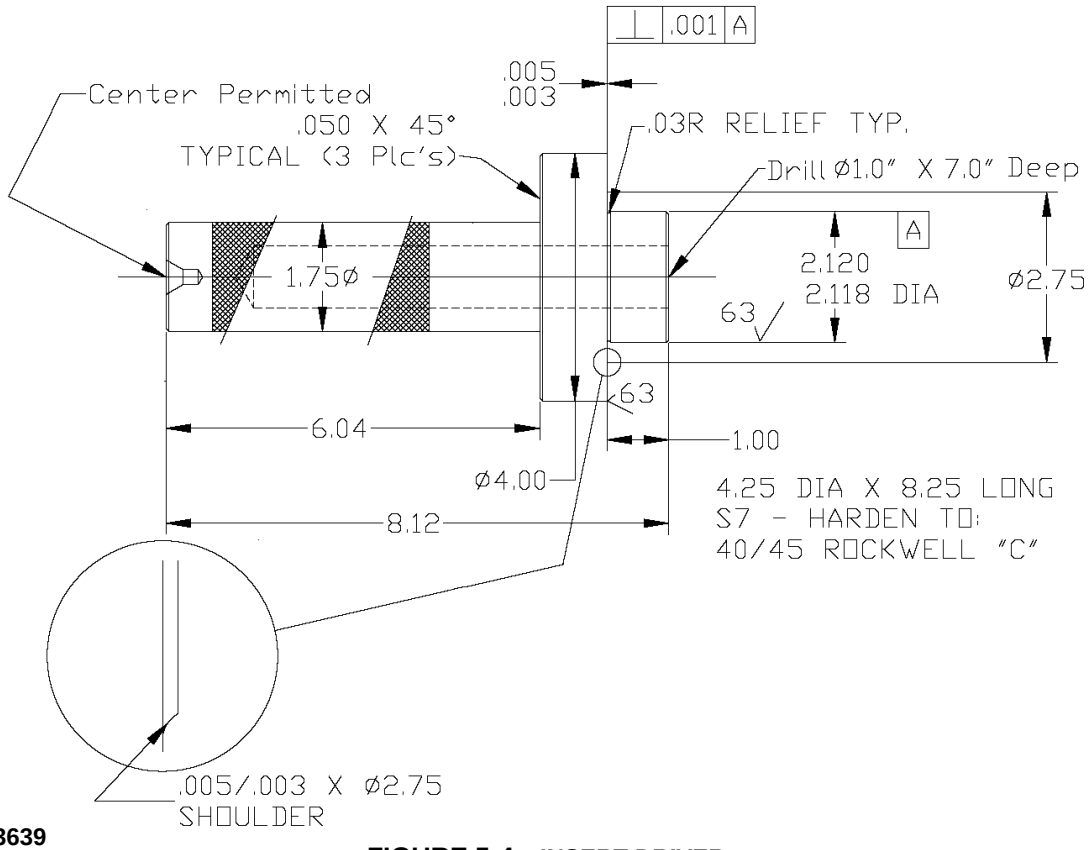
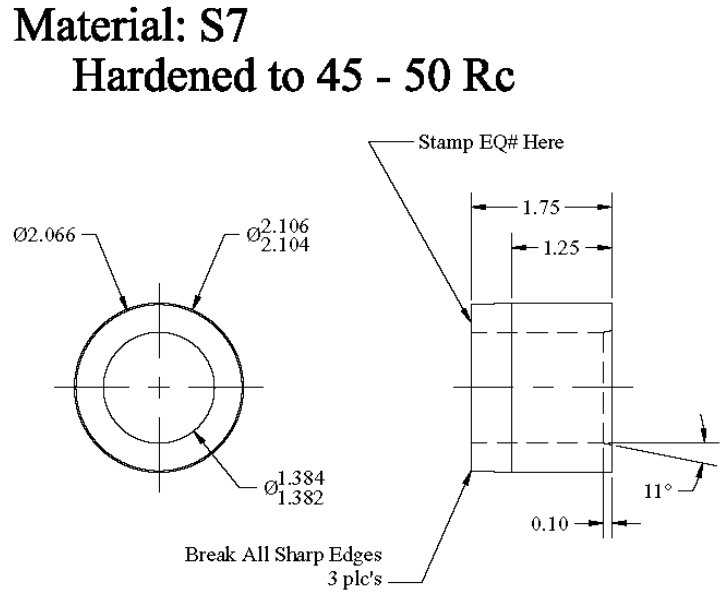
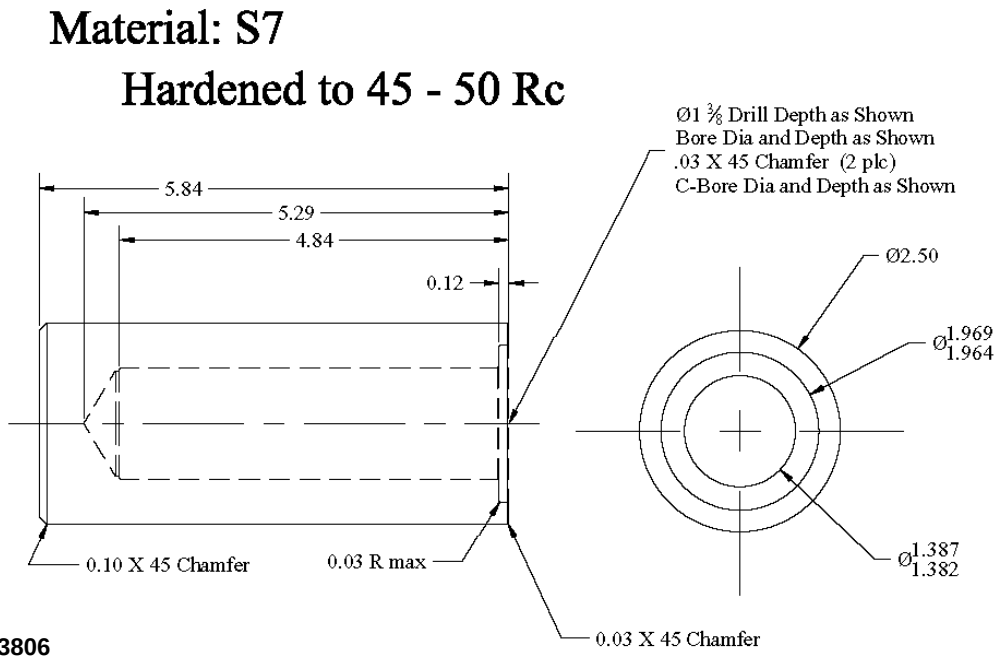


FIGURE 5-4 – INSERT DRIVER



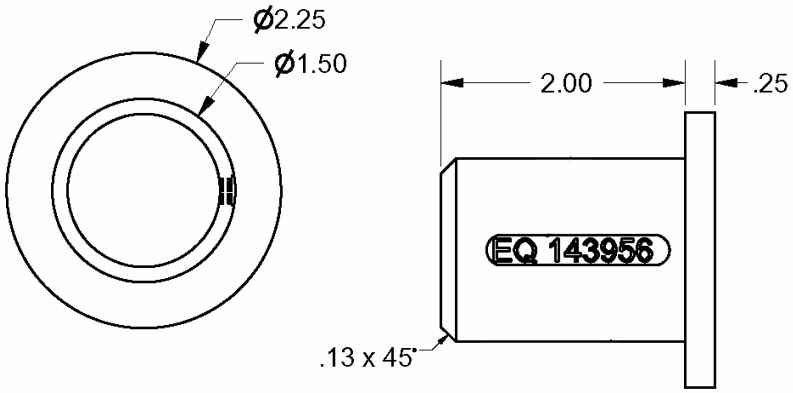
EQ143805

FIGURE 5-5 – ASSEMBLY GUIDE FOR RINGS



EQ143806

FIGURE 5-6 – SLINGER/CARRIER DRIVER



NOTE:
Material: 4140
Heat Treat RC 45/50
Break All Sharp Edges

EQ143956

FIGURE 5-7 – SEAL DRIVER

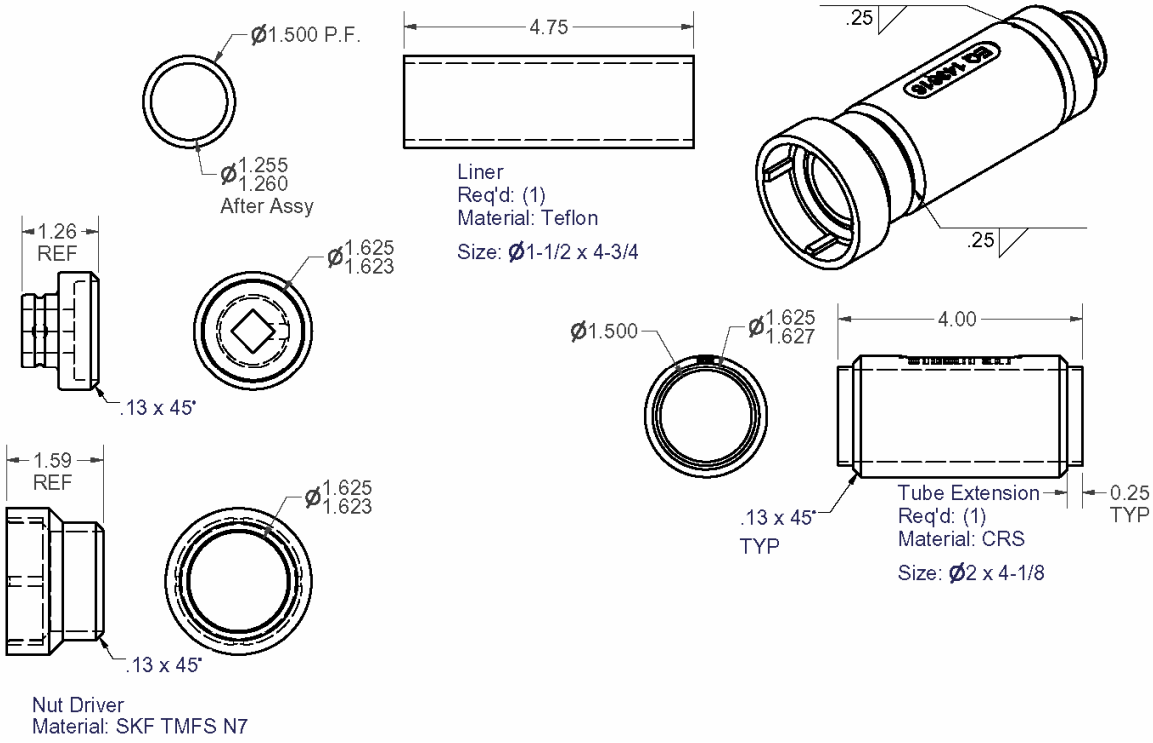


FIGURE 5-8 – NUT DRIVER

EQ143956

SECTION 6
DISASSEMBLY INSTRUCTIONS

1. Remove the screws (46) and lockwashers (48) from the port connectors. Remove the connector (52) and gasket (51) from the inlet and discharge ports.

2. Inspect the interior of the blower for any signs of rotor contact (rotor to rotor, rotor tip to case, rotor end to bearing housing). If there are signs of contact then the various clearances should be measured with feeler gauges prior to any disassembly.

3. Inspect the areas around the drive shaft seal and vent passages in the bearing housing and air cylinder for any signs of oil leaks.

4. Drain the oil from the gear end and drive end sumps by removing their drain plugs (2). A small amount of oil from each sump should be saved in the event that an oil analysis will be required.

5. Remove the screws (5) from the drive end sump cover (29). Remove the sump cover by sliding it off the drive shaft.
6. Inspect the drive shaft in the area of the oil seal for damage and wear. Inspect the oil seal (31).

7. Support the external surface of the drive end sump cover near the oil seal with blocks of wood. Drive the oil seal from the cover using the seal driver tool (EQ143956) and a press or small hammer.

8. Remove the screws (5) from the gear end sump cover (3). Remove the sump cover.

9. Remove the bolt (8), washer (6), and oil slinger (26) from the gear end of its rotor shaft.

10. If it appears the gears can be reused their backlash should be measured. Lock the idler rotor from turning by wedging a shop rag between the tip of a lobe and the air cylinder. Measure the backlash of the gears using a dial indicator and a magnetic base. The backlash should be measured in 3 places (every 1/3 turn).

11. Match mark the gears by making small punch marks on the ends of 2 meshing teeth.

12. Remove the 3 set screws (57) from both gear locking assemblies (56). Note these are located through the unthreaded holes in the outer ring.

13. Remove the 6 capscrews from both gears. Thread 3 of these capscrews into the threaded holes in the outer ring of each locking assembly. Tighten the screws evenly to remove the locking assembly from each gear.

14. Remove the gears (9) from both rotor shafts.

15. Remove the stepped spacer (55) from each rotor shaft.

16. Remove the 4 bearing retaining screws (10) and washers (12) from the air cylinder.

17. Position the blower assembly vertically with the drive end up. Support the gear end of the air cylinder on blocks to protect the ends of the rotor shafts.

18. Remove the locknuts (36) from both of the rotor shafts on the drive end using nut driver tool (EQ143816).

19. Remove the oil slinger (27) from its rotor shaft.

20. Remove the spacer (49) from each rotor shaft.

21. Remove the 6 socket head screws (21) and washers (20) that attach the bearing housing (24) to the air Cylinder (22).

22. Remove the bearing housing from the air cylinder using two 2 jaw pullers. The puller jaws must be narrow enough to fit in the rectangular holes in the bearing bosses. A shaft protector (soft spacer) must be placed over the end of each rotor shaft. Both pullers must be tightened evenly during this process. There are 2 dowel pins that locate the bearing housing relative to the air cylinder. If the bearing housing is tilted during removal these dowel pins may break out of their holes.

23. Remove the 2 seal flingers (34) from their bores in the bearing housing.

24. Remove the ball (14) and roller bearing (35) from their bores in the bearing housing using a ball peen hammer and punch. Exercise care not to damage the bearing bores.

25. Position the blower assembly horizontally.

26. Match mark the rotors by making small punch marks on the ends of meshing lobes.

27. Push the drive rotor (23A) shaft through the air cylinder using a 2 jaw puller. The puller jaws must be narrow enough to fit in the rectangular holes in the bearing boss. A shaft protector (soft spacer) must be placed over the end of the rotor shaft. Remove the drive rotor from the air cylinder.

28. Push the idler rotor (23B) shaft through the air cylinder using a 2 jaw puller. Remove the idler rotor from the air cylinder.

29. Remove the 2 seal flingers (34) from their bores in the air cylinder.

30. Remove the 2 ball bearings (14) from their bores in the air cylinder using a ball peen hammer and punch. Exercise care not to damage the bearing bores.

31. Inspect the 3 piston rings (15) on both ends of both rotors for signs of damage and abnormal wear. Remove the piston rings from each of the 4 ring carriers (33).

32. Inspect the ring carriers for signs of damage and abnormal wear. Normally it is not required to replace the ring carriers.

33. If a ring carrier is damaged it may be removed by heating with a torch. The rotor should be placed in a vertical position and continuously rotated while the ring carrier is being heated. Caution should be used when performing this procedure as the rotor can be damaged by uneven and extreme heating.

34. Inspect the inserts (32) in the 4 bearing bosses (2 in bearing housing and 2 in air cylinder) for signs of damage and abnormal wear. Normally it is not required to replace the inserts.

35. If an insert is damaged it may be removed by using a hydraulic press and suitable driver tool. It must be removed from the air side of the bearing housing or air cylinder.

SECTION 7
ASSEMBLY INSTRUCTIONS

1. Apply a light coating of loctite 620 to the outside diameter of 2 inserts (32). The wide face of the inserts must face the air side of the bearing housing (24). Position the holes in the inserts so that they are located at the 3, 6, 9, and 12 o'clock positions in the bearing housing bore. Support the bearing housing under the bearing bosses. Use a hydraulic press and insert driver tool (EQ143639) to install the inserts into the bearing housing from the air side. After they are installed ensure that the inserts are slightly below or flush with the air surface of the bearing housing.

2. Install 2 inserts into the air cylinder (22) from the air side using the same procedure and tooling as in step 1. Note the air cylinder must be supported by the bearing bosses during this procedure.

3. Apply loctite 620 to both ends of the drive (long) rotor (23A) shaft (on the largest diameter next to the rotor body). Support the rotor in a vertical position.

4. Heat 2 piston ring carriers (33) to 275 degrees F. After heating use a gauss meter to check the ring carriers for magnetism. The magnetic flux density must be less than one gauss. The carriers must be orientated so that their stepped face does not contact the rotor body. Drive the piston ring carriers up against the face of the rotor body at both locations using the Carrier driver tool (EQ143806). After the ring carriers have cooled ensure that they are still tight against the face of the rotor body.

5. Repeat steps 3 and 4 for the idler (short) rotor (23B).

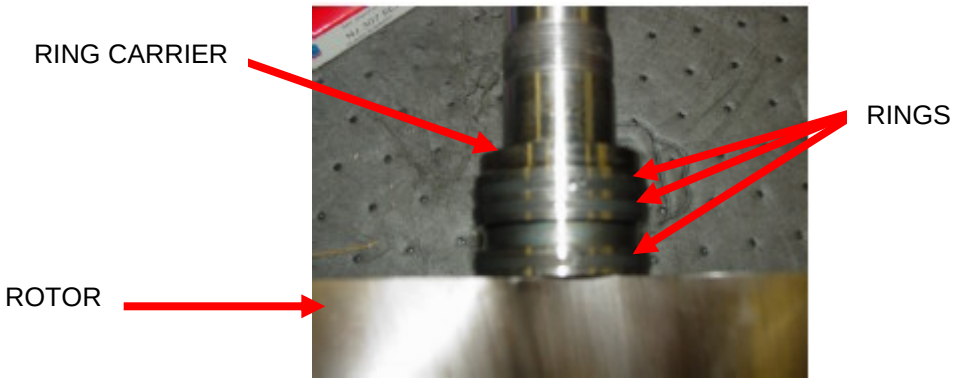


FIGURE 7-1 – INSTALL PISTON RINGS

6. Install the piston rings (15) into the 4 piston ring carriers starting with the ring closest to the rotor body. Ensure that the ring ends are hooked together properly. Offset the gaps in the rings 180 degrees. See Figure 7-1.

7. Position the air cylinder vertically with the gear end on the bottom. Determine the location of the blower discharge port. The discharge port has two feedback slots adjacent to the triangular opening. Refer to the arrows cast into the air cylinder to determine the air flow direction. From the blower model designation determine drive shaft (long rotor) location and the direction it rotates.

8. Apply oil to the inside diameter of the 2 inserts in the gear end of the air cylinder and to the outside diameter of the piston rings on the gear end of both rotors. Place a ring guide tool (EQ143805) on the gear end of both rotor shafts.

9. Install both rotors into the air cylinder. Verify that the long end of the drive rotor is pointing up and that the drive rotor is in the correct bore. Ensure that the rotation of each rotor matches the arrows on the outside of the air cylinder. Ensure that the rotor lobes match the triangular shape of the discharge port. Remove the ring guide tool from each rotor shaft.

10. Measure and record the total rotor to bearing housing end clearance for each rotor. This is accomplished by using a depth micrometer to measure the distance from the top edge of the air cylinder to the top of the rotor lobe while the rotor is held as vertically as possible.

11. Apply oil to the inside diameter of the 2 inserts in the bearing housing and to he outside diameter of the piston rings on the drive end of both rotors. Place a ring guide tool (EQ143805) on the drive end of both rotor shafts.

12. Apply Loctite Gasket Eliminator 515 to the sealing surface of the air cylinder. Use a roller to spread the gasket eliminator to an even coat.

13. Install 2 dowel pins (19) into the drive end of the air cylinder.

14. Install the bearing housing over the shafts of the rotors and onto the air cylinder. There is only one orientation of the bearing housing which will allow the dowel pins to line up with their mating holes. Remove the ring guide tool from each rotor shaft.

15. Attach the bearing housing to the air cylinder using 6 socket head screws (21) and washers (20). The screws should have a nylok insert. Tighten the screws in an alternating pattern starting with the middle ones. Torque the screws to 38 ft-lb in 2 steps.

16. Heat 2 seal flingers (34) to 275 degrees F. After heating use a gauss meter to check the flingers for magnetism. The magnetic flux density must be less than one gauss. Use the flinger drive tool (EQ143806) to drive them into position on the ends of the piston ring carriers of the drive end of both rotors. Be careful not the damage the threads on the rotor shafts. Ensure each flinger is seated against the shoulder on the ring carrier and that it is recessed below the end of the ring carrier.

17. Position the air cylinder vertically with the gear end on the top. Support the cylinder so that the rotor shafts may extend through the bearing bores.

18. Heat 2 seal flingers (34) to 275 degrees F. After heating use a gauss meter to check the flingers for magnetism. The magnetic flux density must be less than one gauss. Use the flinger drive tool to drive them into position on the ends of the piston ring carriers of the gear end of both rotors. Ensure each flinger is seated against the shoulder on the ring carrier and that it is recessed below the end of the ring carrier.

FIGURE 7-2 – MEASURE STEP IN FALSE BEARING

19. Put the false bearing (EQ144008) into the bearing bore for the idler (short) shaft. Screw an eye bolt into the end of the idler rotor and lift the rotor until the ends of the rotor lobes contact the end surface of the air cylinder. Using a depth micrometer measure and record the distance from the top surface of the outer ring of the false bearing to the top surface of the inner ring. The inner ring of the false bearing should be above the outer ring. See FIGURE 7-2.

20. The number measured in step 19 should be .004 - .005“. If it is less than this then shims equal to the difference must be installed on the shaft of that rotor.

21. Lower the rotor and remove the eye bolt. Remove the false bearing. Install the required amount of shims (13) as determined in step 20 onto the idler rotor shaft.

22. Repeat steps 19 through 21 for the drive (long) rotor.

23. Apply oil to the drive and idler rotor bearing bores in the air cylinder.

FIGURE 7-3 – PRESS BEARING ONTO ROTOR SHAFT

24. Place the air cylinder vertically in a hydraulic press with the gear end on top. The bottom of the idler rotor shaft must be in contact with the bed of the press. The bottom of the drive rotor shaft must not be in contact with the bed of the press. The blower air cylinder must be cradled on its sides but must not be restrained in the vertical direction. Place a ball bearing (14) over the rotor shaft with the numbers on the bearing facing up. Press the bearing onto the idler rotor shaft using the hydraulic press and the bearing driver tool (EQ143807-1). See FIGURE 7-3.

25. Repeat step 24 for the drive rotor bearing. In this step the bottom of the drive rotor shaft must be in contact with the bed of the press and the bottom of idler shaft must not be in contact with the bed of the press.

FIGURE 7-4 – INSTALL BEARING RETAINING SCREWS

26. Install the 4 bearing retaining screws (10) and washers (12) into the gear end of the air cylinder. The screws should have a loctite patch. Tighten the screws to 38 ft-lb. See FIGURE 7-4.

27. Position the air cylinder vertically with the drive end on the top.

28. Apply oil to the drive and idler rotor bearing bores in the bearing housing.

29. Place the air cylinder vertically in a hydraulic press with the drive end on top. The bottom of the idler rotor shaft must be in contact with the bed of the press. The bottom of the drive rotor shaft must not be in contact with the bed of the press. The blower air cylinder must be cradled on its sides but must not be restrained in the vertical direction. Place a ball bearing (14) over the rotor shaft with the numbers on the bearing facing up. Press the bearing onto the idler rotor shaft using the hydraulic press and the bearing driver tool.

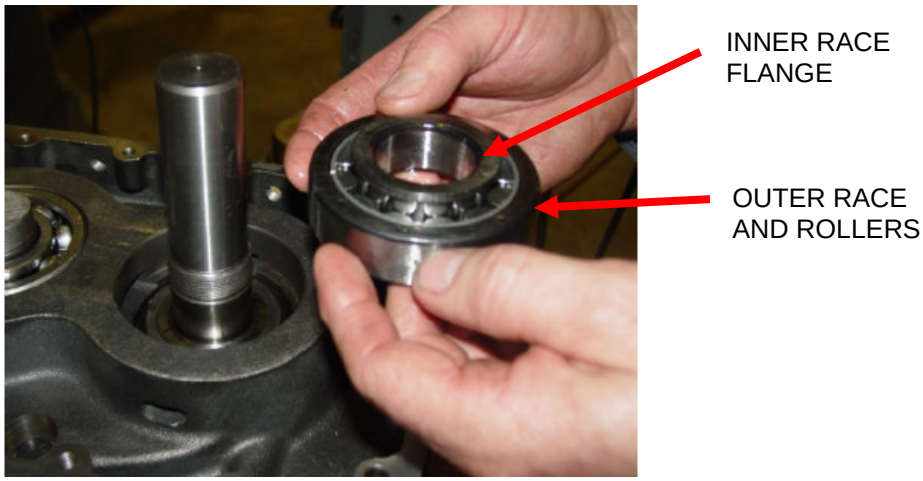


FIGURE 7- 5 – INSTALL ROLLER BEARING

30. Repeat step 29 for the drive rotor bearing with the exception that this bearing is a roller bearing (35). One side of the inner race of this bearing has a flange and one side does not have a flange. The bearing should be installed so that the end of the inner race that does not have a flange is in contact with the ring carrier. In this step the bottom of the drive rotor shaft must be in contact with the bed of the press and the bottom of idler shaft must not be in contact with the bed of the press. The inner race and outer race(and rollers) must be engaged with each other while the bearing is being pressed onto the rotor shaft. See Figure 7-5.

31. Position the air cylinder vertically on a work table with the drive end on the top. Support the cylinder so that the rotor shafts are free to move in the vertical direction.

32. Measure the fixed end (gear end) axial clearance for both rotors. This can be accomplished by inserting feeler gauges between the end of the rotor lobe and the inner surface of the bearing housing. This clearance should be measured and recorded for all 3 lobes on both rotors. Compare these clearances to the requirements on the clearance drawing (301HYC499). Do not proceed with the assembly if these measurements are not equal to or greater than the minimum specified.

33. Position the air cylinder vertically with the gear end on the top. Support the cylinder so that the rotor shafts are free to move in the vertical direction.

34. Repeat step 32 (with gear end on the top) to measure the floating end (drive end) axial clearance.

35. With the gear end on top measure and record the gear end axial clearance for all 3 lobes on both rotors. Note there are no specifications on the clearance drawing for this measurement. This measurement will be used to determine the axial movement of the bearings.

36. Position the air cylinder horizontal.

37. Using feeler gauges measure the clearance between the rotor tips and the air cylinder. This measurement should be taken for the drive and the idler rotor. The first measurement (for both rotors) should be taken on the inlet side of the air cylinder (by going through the inlet port). The second measurement (for both rotors) should be taken on the discharge side of the air cylinder (by going through the discharge port). The clearance should be measured along the entire length of the lobe and for all 3 lobes on both rotors. Record these clearances and verify that they are within the range specified on the clearance drawing.

38. Obtain 2 gear locking assemblies (56). Each locking assembly comes with 9 capscrews. Remove 3 of these screws. The 6 remaining screws should be in a equally spaced pattern. Note these are metric (M6) screws.

39. Clean the inside and outside diameters of both locking assemblies. Clean the inside diameter of 2 gears (9). Clean the outside diameter of the idler and drive rotor shafts. Lightly oil the surfaces that have been cleaned. Note: DO NOT USE MOLYBDENUM DISULFIDE, MOLYKOTE, OR ANY OTHER SIMILAR LUBRICANTS.

40. Install a spacer (55) onto the gear end of both rotor shafts. Note this is a stepped spacer. The narrow end should be in contact with the bearing inner race.

41. Slide a locking assembly into a gear. The slits in the inner ring and in the outer ring must not be in line with each other. Install the gear and locking ring assembly onto the idler rotor shaft.

42. Push the locking assembly firmly up against the shaft spacer and hand tighten the 6 capscrews.

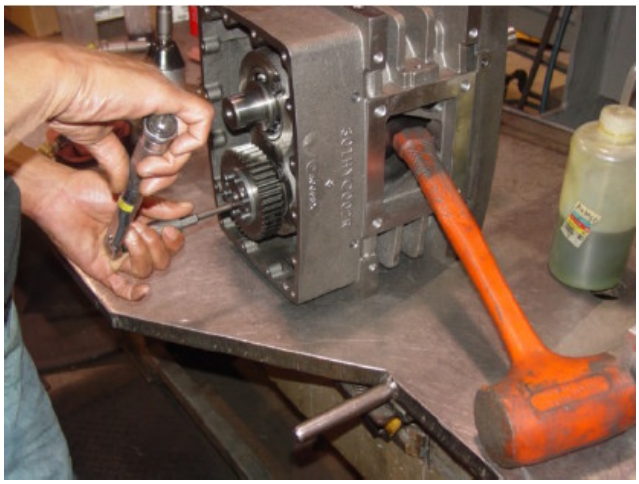


FIGURE 7-6 – TIGHTEN GEAR LOCKING SCREWS

43. Use a torque wrench to tighten the screws to 50 in.lbs in a diametrically opposite sequence. Ensure that none of the screws will turn when 50 in.lbs is applied to them a second time. See FIGURE 7-6.

44. Tighten the screws further to 100 in.lbs in a diametrically opposite sequence. Ensure that none of the screws will turn when 100 in.lbs is applied to them a second time.

45. Tighten the screws to a final torque of 150 in.lbs in a diametrically opposite sequence. Ensure that none of the screws will turn when 150 in.lbs is applied to them a second time.

46. Slide a locking assembly into a gear. The slits in the inner ring and in the outer ring must not be in line with each other. Install the gear and locking ring assembly onto the drive rotor shaft. Note the circular mark on each gear indicates the position of the largest runout. These marks must be 180 degrees apart when the gears are installed.

47. Push the locking assembly firmly up against the shaft spacer and hand tighten the 6 capscrews but leave them loose enough that the gear can be rotated on the shaft.

48. The first step in setting the interlobe clearance is to measure the total clearance between two meshing lobes. This is accomplished by determining the maximum feeler gauge thickness that will fit between the rotor lobes near the pitch diameter. The pitch diameter is just above the transition point from the flank of the lobe profile to the hub diameter. The clearance should be measured along the entire length of the meshing lobes. This measurement should be taken for each of the 3 interlobe meshes. The location of the smallest total interlobe clearance should be marked on the rotor lobes.

49. The total clearance between rotor lobes is to be divided with the larger (open) clearance on the leading side of the drive (long) rotor lobe and the smaller (closed) clearance on the trailing side of the drive rotor lobe. The minimum open clearance and the minimum closed clearance is specified on the clearance drawing (301HYC499). If the actual measured total clearance is larger than the sum of the open minimum and the closed minimum on the clearance drawing then the total clearance should be divided such that 1/3 of it is on the closed side and 2/3 of it is on the open side. Note neither of the actual clearances can ever be less than their minimum specified on the clearance drawing. The leading side of the drive rotor lobe is determined by looking through either the inlet or discharge port and rotating the rotor in the correct direction (as indicated by the arrows cast into the air cylinder). The first drive rotor lobe surface that meshes with an idler (short) rotor lobe is the leading side. As the drive rotor continues to rotate the trailing side of this same lobe will mesh with a different lobe on the idler rotor.

50. Rotate the rotors until the two lobes that have the smallest total interlobe clearance (as determined in step 48) are visible through the discharge port. Lock the idler rotor from turning by wedging a shop rag between the tip of a lobe and the air cylinder. Insert feeler gauges with a thickness equal to the desired closed clearance (as determined in step 49) between the drive rotor lobe trailing surface and the idler rotor lobe. Pull the drive rotor tight against the feeler gauges (drive rotor, feeler gauges, and idler rotor must be tight against each other). While holding the drive rotor tight against the feeler gauges rotate (in the direction that the rotor turns) the gear on the drive rotor until a tooth on it contacts a tooth on the gear on the idler rotor. Hand tighten the 6 capscrews in the drive gear locking assembly.

51. Use a torque wrench to tighten the screws to 50 in.lbs in a diametrically opposite sequence. Ensure that none of the screws will turn when 50 in.lbs is applied to them a second time.

52. Tighten the screws further to 100 in.lbs in a diametrically opposite sequence. Ensure that none of the screws will turn when 100 in.lbs is applied to them a second time.

53. Tighten the screws to a final torque of 150 in.lbs in a diametrically opposite sequence. Ensure that none of the screws will turn when 150 in.lbs is applied to them a second time.

54. Measure and record the interlobe clearance on both (open and closed) side of all 3 drive rotor lobes. Before proceeding with the assembly ensure that all of these clearances are equal to or greater than the minimums specified on the clearance drawing.

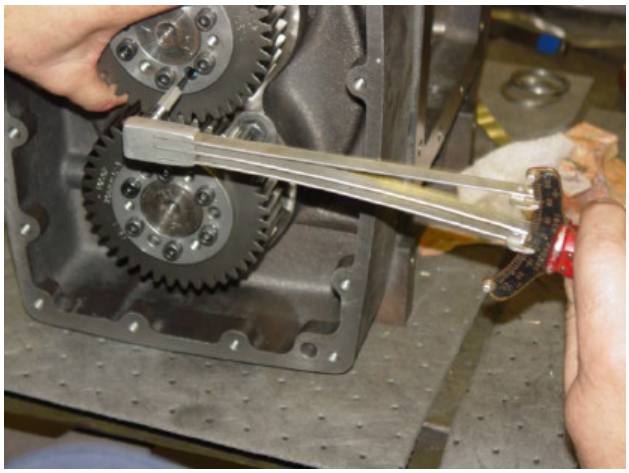


FIGURE 7-7 – TIGHTEN SETSCREWS

55. Apply loctite 243 to 6 set screws (57) {M6 x 12mm}. Install 3 of these screws into each of the 2 gear locking assemblies. These set screws go between the existing screws in the locking assembly through the unthreaded holes in the outer ring into the threaded holes in the inner ring. The purpose of these set screws is to keep pressure on the spacer that is between the gear and bearing inner race. Tighten the screws to 25 in-lb of torque. See FIGURE 7-7.

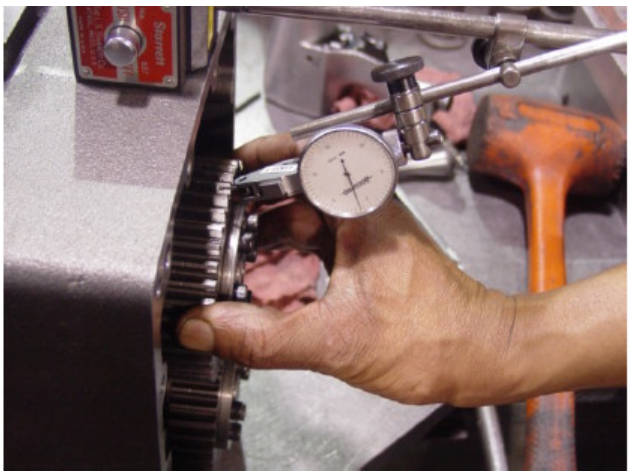


FIGURE 7-8 – MEASURE GEAR BACKLASH

56. Lock the idler rotor from turning by wedging a shop rag between the tip of a lobe and the air cylinder. Measure the backlash of the gears using a dial indicator and a magnetic base. Gear backlash is the distance (in the circumferential direction) a gear tooth can freely move when the mating gear is fixed. This should be measured in 3 places (every 1/3 turn) and recorded. Verify that the backlash is within the range specified on the clearance drawing. See FIGURE 7-8.

57. Use a feeler gauge to verify that there is at least .010“ clearance between the heads of the 4 bearing retaining bolts (10) and the inside surface of the gears.

58. Attach an oil slinger (26) with a bolt (8) and washer (6) to the gear end of the appropriate rotor shaft. On vertical models the slinger goes on the lower shaft. On horizontal models refer to the blower model designation to determine the appropriate rotor shaft. Tighten the bolt to 132 in-lbs.

59. Install a spacer (49) onto both rotor shafts on the drive end.

60. Install an oil slinger (27) onto the drive end of the appropriate rotor shaft. On vertical models the slinger goes on the lower shaft. On horizontal models refer to the blower model designation to determine the appropriate rotor shaft.

61 Apply Loctite 262 to 2 bearing locknuts (36). Install the locknuts onto both of the drive end rotor shafts using nut driver tool (EQ143816). Tighten the locknuts to 70 ft-lb.

62. Measure the runout of the teeth on both gears using a dial indicator and a magnetic base. Verify that the runout is within the range specified on the clearance drawing.

63. Check that the oil seal bore in the drive end sump cover (29) is clean, dry, and free of nicks or burrs. Lay the cover flat with the external surface facing up. Support the area under the seal bore with a block of wood. Determine the proper orientation of the seal (31). The seal has two lips. The outer lip is shorter and when installed should point toward the keyway end of the drive rotor shaft. The inner lip is longer and should point toward the oil inside of the sump.

64. Drive the oil seal into the sump cover from the external surface using the seal driver tool (EQ143956) and a press or small hammer. After installation the seal case should be flush with the external surface of the sump cover. Apply oil to both of the seal lips.

65. Apply Loctite Gasket Eliminator 515 to the flange surface of the drive end sump cover.

66. Slide the seal protection sleeve (EQ143096-13) over the drive shaft. Apply oil to the outside surface of the sleeve. Gently slide the drive end sump cover over the drive shaft.

67. Attach the cover to the bearing housing using 16 screws (5). Tighten the screws to 96 in-lbs.

68. Remove the protective sleeve from the drive shaft.

69. Apply Loctite Gasket Eliminator 515 to the flange surface of the gear end sump cover (3).

70. Attach the cover to the gear end of the air cylinder using 16 screws (5). Tighten the screws to 96 in-lbs.

71. Install plugs (47) in the 2 instrument holes in the air cylinder near the inlet and discharge port.

72. Determine the appropriate hole in each sump cover for the oil level gauge (40). The oil level will be in the lower part of the oil sump. Apply Loctite 243 to the threads of each gauge. Install one oil level gauge in each sump.

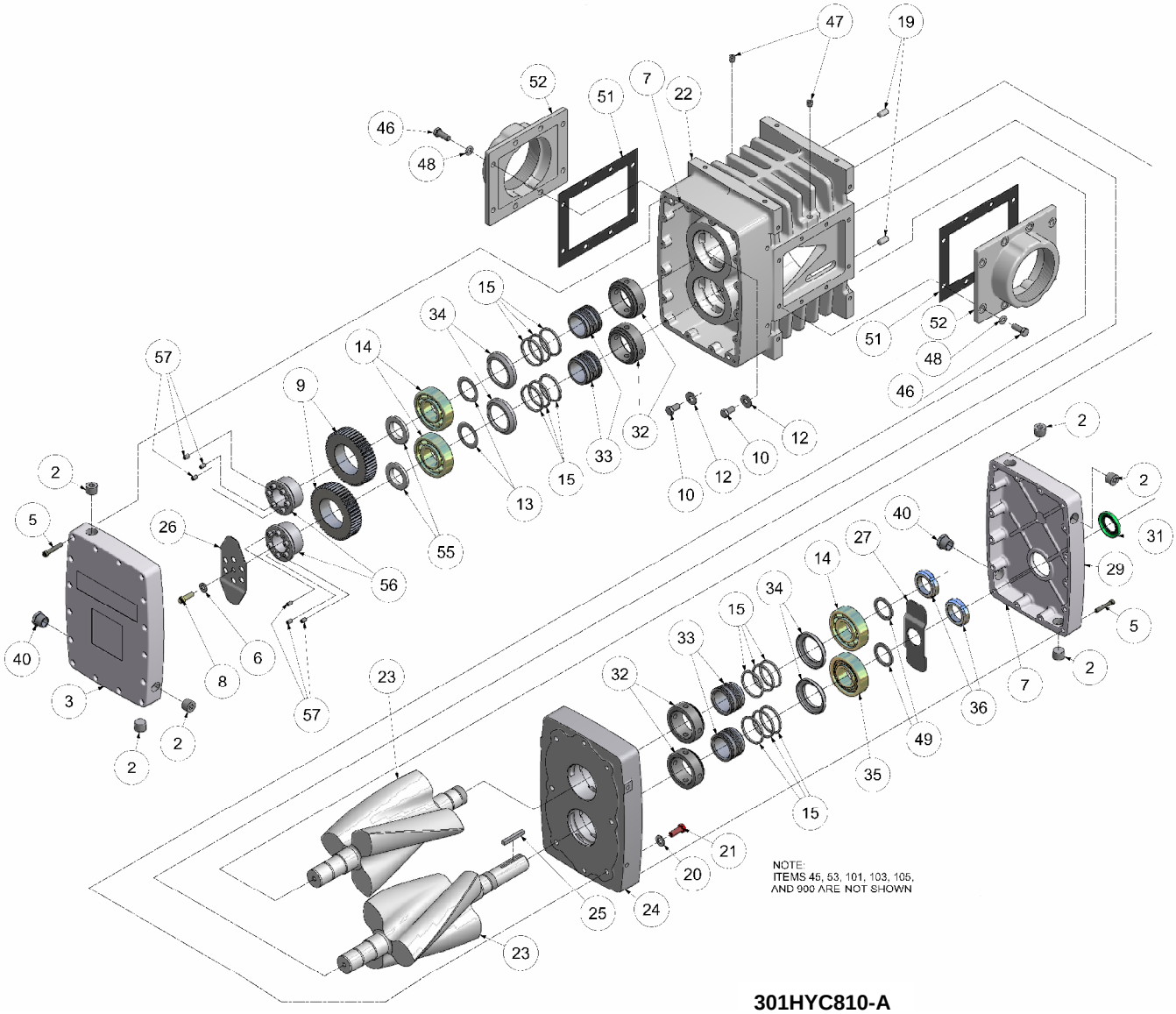
73. Install plugs (2) in the 3 remaining holes in each sump cover. Note there are no external sump breathers used on this blower.

74. Measure the runout of the end of the drive shaft using a dial indicator and a magnetic base. Verify that the runout is within the range specified on the clearance drawing.

75. Check the keyway on the end of the drive rotor for burrs. Install the drive shaft key (25) into the drive shaft. Ensure that it is a snug fit. Tape the key to the shaft so that it does not get lost.

76. Attach a port connector (52) to the inlet and discharge ports. Install a gasket (51) between the connector and the air cylinder. Use the required number of screws (46) and lockwashers (48). The screws (1/2 – 13 UNC) for the HF406 blower should be torqued to 75 ft-lbs. The screws (3/8 – 16 UNC) for the HF408 blower should be torqued to 30 ft-lbs.

SECTION 8
PARTS LIST



301HYC810-A
(Ref. Drawing)

Order by Part Number and Description. Reference Numbers are for your convenience only.

Ref. No.	Description	No. Req'd	MODEL 408 HYCL_BA	MODEL 406 HYCM_BA
2	PLUG	6	64AC4	64AC4
3	COVER-GEAR, 4"	1	300GYC602	300GYC602
5	SCREW	32	75P25	75P25
6	WASHER-PLAIN	1	95U2	95U2
7	GASKET-ELIM	1	25BC256	25BC256
8	SCREW	1	75LM115N	75LM115N
9	GEAR KIT,HELIFLOW,406,408	1	301HYC601	301HYC601
10	SCREW	4	655ED03P	655ED03P
12	WASHER-PLAIN	4	95A3	95A3
13	SHIM-SET	1	300GYC732	300GYC732
14	BEARING-BALL	3	12BA247	12BA247
15	RING-PISTON,PLAIN COMPRESSION-HOOK JOINT	12	DF139986	DF139986
19	PIN-DOWEL	2	62M48	62M48
20	WASHER-PLAIN	6	95W48	95W48
21	SCREW	6	655ED04N	655ED04N
22	CYLINDER-AIR HF408	1	304HYC002	305HYC002
23	GRP-ROTOR			
	CW DRIVE ROTATION	1	305HYC4028	304HYC4028
	CCW DRIVE ROTATION	1	306HYC4028	307HYC4028
24	HOUSING-BRG, HELIFLOW 4"	1	302HYC006	302HYC006
25	KEY-SQUARE .250 X 2.00 LG	1	900639910305	900639910305
26	SLINGER,	1	302HYC173	302HYC173
27	SLINGER,	1	301HYC173	301HYC173
29	COVER-DRIVE 4" TRIFLOW	1	300GYC477	300GYC477
31	SEAL-OIL	1	60DD811	60DD811
32	INSERT, PISTON RING STATOR, 4" TRIFLOW	4	300GYC248	300GYC248
33	CARRIER, PISTON RING 4" TRIFLOW	4	300GYC1148	300GYC1148
34	SLINGER, 4" TRIFLOW	4	302GYC173	302GYC173
35	BEARING-ROLLER	1	12BA215	12BA215
36	LOCKNUT-BRG	2	50Z7	50Z7
40	GAUGE-OIL LEVEL 1/2" NPT GLASS SIGHT	2	40P31	40P31
45	PAINT,BULK,GDP188,ALUMINM-GLOSS	0	28H284	28H284
46	SCREW	16	655ED040	----------
46	SCREW	8	----------	655ED070
47	PLUG	2	64AC1	64AC1
48	WASHER-LOCK	16	95B3	----------
48	WASHER-LOCK	8	----------	95B5
49	SPACER, DRIVE END	2	300GYC144	300GYC144
51	GASKET	2	DF135718	301HYC715
52	CONNECTOR	2	DF137356	301HYC1170
53	PLUG,CAPLUG	2	8503065	8503064
55	SPACER,GEAR END	2	300HYC144	300HYC144
56	LOCKING ASSEMBLY,RINGFEDER,1-3/8	2	22G39	22G39
57	SCREW-SET	6	VP1004579	VP1004579
*101	GRP-BASIC PARTS,	1	301HYC4000	301HYC4000
*103	LUBRICANT,AEON PD,BULK	0	28G38	28G38
*105	KIT-OVERHAUL, HELIFLOW, 406/408	1	300HYC6010	300HYC6010
*900	GRP-IDENT & INSTR - HELIFLOW CW ROT	1	300HYC4011	300HYC4011

* NOT SHOWN

WARRANTY
GARDNER DENVER® BLOWERS
HELIFLOW INDUSTRIAL SERIES

GENERAL PROVISIONS AND LIMITATIONS

Gardner Denver (the "Company") warrants to each original retail purchaser ("Purchaser") of its new products from the Company or its authorized distributor that such products are, at the time of delivery to the Purchaser, made with good material and workmanship. No warranty is made with respect to:

1. Any product which has been repaired or altered in such a way, in the Company's judgment, as to affect the product adversely.
2. Any product which has, in the Company's judgment been subject to negligence, accident, improper storage, or improper installation or application.
3. Any product which has not been operated or maintained in accordance with normal practice and with the recommendations of the Company.
4. Components or accessories manufactured, warranted and serviced by others.
5. Any reconditioned or prior owned product.

Claims for items described in (4) above should be submitted

WARRANTY PERIOD

The Company's obligation under this warranty is limited to repairing or, at its option, replacing, during normal business hours at an authorized service facility of the Company, any part which in its judgment proved not to be as warranted with the applicable Warranty Period as follows,

BARE BLOWERS

Basic bare blowers, consisting of all parts within, are warranted for 18 months from date of initial use or 24 months from date of shipment to the first purchaser, whichever occurs first.

Any disassembly or partial disassembly of the blower, or failure to return the "unopened" blower per Company instructions, will be cause for denial of warranty.

OTHER COMPONENTS

All other components are warranted for 12 months from date of initial use or 18 months from date of shipment to first purchaser, whichever comes first.

The Company reserves the right to withdraw the Uncontested Warranty where evidence indicates application outside the stated performance area, or where there is evidence of abuse.

LABOR TRANSPORTATION AND INSPECTION

The Company will provide labor, by Company representative or authorized service personnel,
for repair or replacement of any product or part thereof which in the Company's judgment is proved not to be as warranted. Labor shall be limited to the amount specified in the Company's labor rate schedule.
Labor costs in excess of the Company's rate schedule amounts or labor provided by unauthorized service personnel is not provided for by this warranty.

Transportation of Company's choice, within the continental United States, is covered by this warranty for replacement of any blower which in the Company's judgment proved not to be as warranted. For user locations outside the continental United States, the Company will provide transportation, by the carrier of its choice to and from the nearest Authorized Distributor and the Company's designated facility. The Company may require the return of any blower claimed not to be as warranted to one of its facilities as designated by the Company, transportation prepaid by Purchaser, to establish a claim under this warranty.

Replacement parts provided under the terms of the warranty are warranted for the remainder of the Warranty Period of the product upon which installed to the same extent as if such parts were original components thereof.

DISCLAIMER

THE FOREGOING WARRANTY IS EXCLUSIVE AND IT IS EXPRESSLY AGREED THAT, EXCEPT AS TO TITLE, THE COMPANY MAKES NO OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABLILITY.

THE REMEDY PROVIDED UNDER THIS WARRANTY SHALL BE THE SOLE, EXCLUSIVE AND ONLY REMEDY AVAILABLE TO PURCHASER AND IN NO CASE SHALL THE COMPANY BE SUBJJECT TO ANY OTHER OBLIGATIONS OR LIABILITIES UNDER NO CIRCUMSTANCES SHALL THE COMPANY BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, LOSSES OR DELAYS HOWSOEVER CAUSED.

No statement, representation, agreement, or understanding, oral or written, made by any agent, distributor, representative, or employee of the Company which is not contained in this Warranty will be binding upon the Company unless made in writing and executed by an officer of the Company.

This warranty shall not be effective as to any claim which is not presented with 30 days after the date upon which the product is claimed not to have been as warranted. Any action for breach of this warranty must be commenced within one year after the date upon which cause of action occurred.

Any adjustment made pursuant to this warranty shall not be construed as an admission by the Company that any product was not as warranted.

Gardner Denver®

For additional information contact your local representative or
Gardner Denver, 1800 Gardner Expressway, Quincy, IL 62305
Customer Service Department
Telephone: (800) 682-9868 Fax: (217) 221-8780
Sales and Service in all major cities.
www.gardnerdenver.com pd.blowers@gardnerdenver.com

GARDNER DENVER ISO 9001 CERTIFIED QUALITY SYSTEM

COMPRESSED AIR AND GAS INSTITUTE CAGI Member

Made in the USA by Gardner Denver

DONNÉES TECHNIQUES DE MAINTENANCE

POUR SURPRESSEUR À DÉPLACEMENT POSITIF

-

PIÈCES DE RECHANGE

MODÈLE : Heliflow 406-RHBD CW
NUMÉRO DE SÉRIE : S477467

MAINTENANCE POUR UNE UNITÉ

Item	Type/No. de pièce	Qté.	Maintenance /Remplacement	Prix unitaire
Huile	AEON PD*	3.25 pt	4500-7500 heures	30 $ pour 1 L, 330$ pour 12x1L
Élément filtre	230P	1	500 heures	41 $
Kit de maintenance***	300HYC6010	1	Lorsque requis	330 $
Courroies	VB5VX690	2	Au besoin	33 $

* AEON PD est une huile synthétique ayant des propriétés supérieures à l'huile minérale. Si de l'huile minérale est utilisée au lieu de l'huile AEON PD, le remplacement de celle-ci devrait être fait après 1500 heures d'utilisation.

** Remplir de graisse jusqu'à ce que la vieille graisse sorte par le conduit.

*** Le Kit de maintenance comprend les roulements, les joints à lèvre, les ''gaskets'', les ''shims'' les ''taper pins'' et les vis de retenue des roulements.

Conditions : Dollar CAD,30 jours net, taxes en sus, prix valides pour 2012, commande minimale de 75 $,FOB Montréal,PQ.

TECHNICAL BROCHURE
BNPE R2

NPE

316L SS

NPE SERIES END SUCTION CENTRIFUGAL PUMPS
BOMBAS CENTRÍFUGAS DE SUCCIÓN FINAL SERIE NPE

BUILT IN THE USA
ENGINEERED, ASSEMBLED & TESTED

GOULDS WATER TECHNOLOGY
a xylem brand

A FULL RANGE OF PRODUCT FEATURES
UNA GAMA TOTAL DE CARACTERÍSTICAS DEL PRODUCTO

Superior Materials of Construction: Complete AISI 316L stainless steel liquid handling components and mounting bracket for corrosion resistance, quality appearance, and improved strength and ductility.

High Efficiency Impeller: Enclosed impeller with unique floating seal ring design maintains maximum efficiencies over the life of the pump without adjustment.

Casing and Adapter Features: Stainless steel construction with NPT threaded, centerline connections, easily accessible vent, prime and drain connections with stainless steel plugs. Optional seal face vent/flush available.

Mechanical Seal: Standard John Crane Type 21 with carbon versus silicon-carbide faces, Viton elastomers, and 316 stainless metal parts. Optional high temperature and chemical duty seals available.

Motors: NEMA standard open drip-proof, totally enclosed fan cooled or explosion proof enclosures. Rugged ball bearing design for continuous duty under all operating conditions.

The various versions of the NPE are identified by a product code number on the pump label. This number is also the catalog number for the pump. The meaning of each digit in the product code number is shown at left.

Materiales Superiores de Construcción: *Componentes completos para manejo de líquidos en acero inoxidable AISI 316L y consola para el montaje para resistencia a la corrosión, apariencia de calidad, y fuerza y ductilidad mejoradas.*

Impulsor de Eficiencia Superior: El impulsor encerrado con un diseño único de anillo del sello flotante, mantiene sin ajustes, la eficiencia máxima sobre la vida de la bomba.

Características de la Carcasa y del Adaptador: *Construcción en acero inoxidable con NPT roscado, conexiones centrales, válvulas de fácil acceso, conexiones de cebado y drenaje con enchufes de acero inoxidable. Cara del sello válvula/chorro opcional disponible.*

Sello Mecánico: *Estándar John Crane Tipo 21 con carbón en contraste con caras de silicón-carbide, elastómeros de Viton, y partes metálicas de acero inoxidable 316. Sellos de alta temperatura y productos químicos están disponibles.*

Motores: *Estándar NEMA a prueba de goteo, ventilador totalmente encerrado o recintos a prueba de explosión. Diseño robusto de balineras de bolas para trabajo continuo en todas las condiciones de funcionamiento.*

Las diferentes versiones de la NPE se identifican con un número de código del producto en la etiqueta de la bomba. Este número es también el número del catálogo para la bomba. El significado de cada dígito en el número de código del producto se muestra a la izquierda.

NPE PRODUCT LINE NUMBERING SYSTEM
LÍNEA DE PRODUCTO NPE SISTEMA DE NUMERACIÓN

Example Product Code,
Ejemplo Código del Producto

1 ST 2 C 1 A 4 F R

Casing Rotation, Optional
R = 3 o'clock L = 9 o'clock
B = 6 o'clock
NOTE: Rotation when viewed from suction end of pump. Standard discharge position is 12 o'clock.

Rotación de la cubierta, opcional
R = 3 hora L = 9 hora
B = 6 hora
NOTA: *Rotación cuando está visto del extremo de la succión de la bomba. La posición estándar de la descarga es las 12.*

Seal Vent/Flush Option,
Opción de Sello Válvula/ChorroSeal Ven

Mechanical Seal and O-ring
4 = Pre-engineered standard
For optional mechanical seal modify catalog order no. with seal code listed below.

Sello Mecánico y Anillo 'O'
4 = Estándar aprobado
Para sello mecánico opcional modificar el número de orden del catálogo con el código del sello anotado abajo.

John Crane Type 21 Mechanical Seal (⅝" seal),
Sello Mecánico John Crane Tipo 21 (sello de ⅝")

Seal Code, *Código del Sello*	Rotary, *Rotativo*	Stationary, *Estacionario*	Elastomers, *Elastómeros*	Metal Parts, *Partes Metálicas*	Part No., *Pieza Número*
2	Carbon, *Carbone*	Silicon Carbide, *Carburo de silicona*	EPR	316 SS, *316 Acero inoxidable*	10K18
4			Viton		10K55
5	Silicon Carbide		EPR		10K81
6			Viton		10K62

Impeller Option . . . No Adder Required
For optional impeller diameters modify catalog order no. with impeller code listed. Select optional impeller diameter from pump performance curve.

Código del Impulsor Opcional
Para impulsores con diámetros opcionales modificar el número de orden del catálogo con el código del impulsor anotado. Escoger el impul con diámetro opcional de la curva de funcionamiento de la bomba.

Impeller Code, *Código del impulsor*	Pump Size, *Tamaño de la bomba*		
	1 x 1¼ – 6	1¼ x 1½ – 6	1½ x 2 – 6
	Diameter	Diameter	Diameter
K	–	6⅛	–
G	–	5 15/16	5⅜
H	–	5½	5
A	6⅛	5¼	4¾
B	5¾	5 1/16	4⅝
C	5 3/16	4⅞	4⅜
D	4¾	4⅝	4 1/16
E	4 7/16	4¼	3⅝
F	4 1/16	3⅞	–

Driver, *Conductor*
1 = 1 PH, ODP
2 = 3 PH, ODP
3 = 575 V, ODP
4 = 1 PH, TEFC
5 = 3 PH, TEFC
6 = 575 V, TEFC
7 = 3 PH, XP
8 = 575 V, XP
9 = 3 PH, TEFC Premium Eff.
0 = 1 PH, XP

HP Rating, *HP Potencia*
C = ½ HP E = 1 HP G = 2 HP J = 5 HP
D = ¾ HP F = 1½ HP H = 3 HP

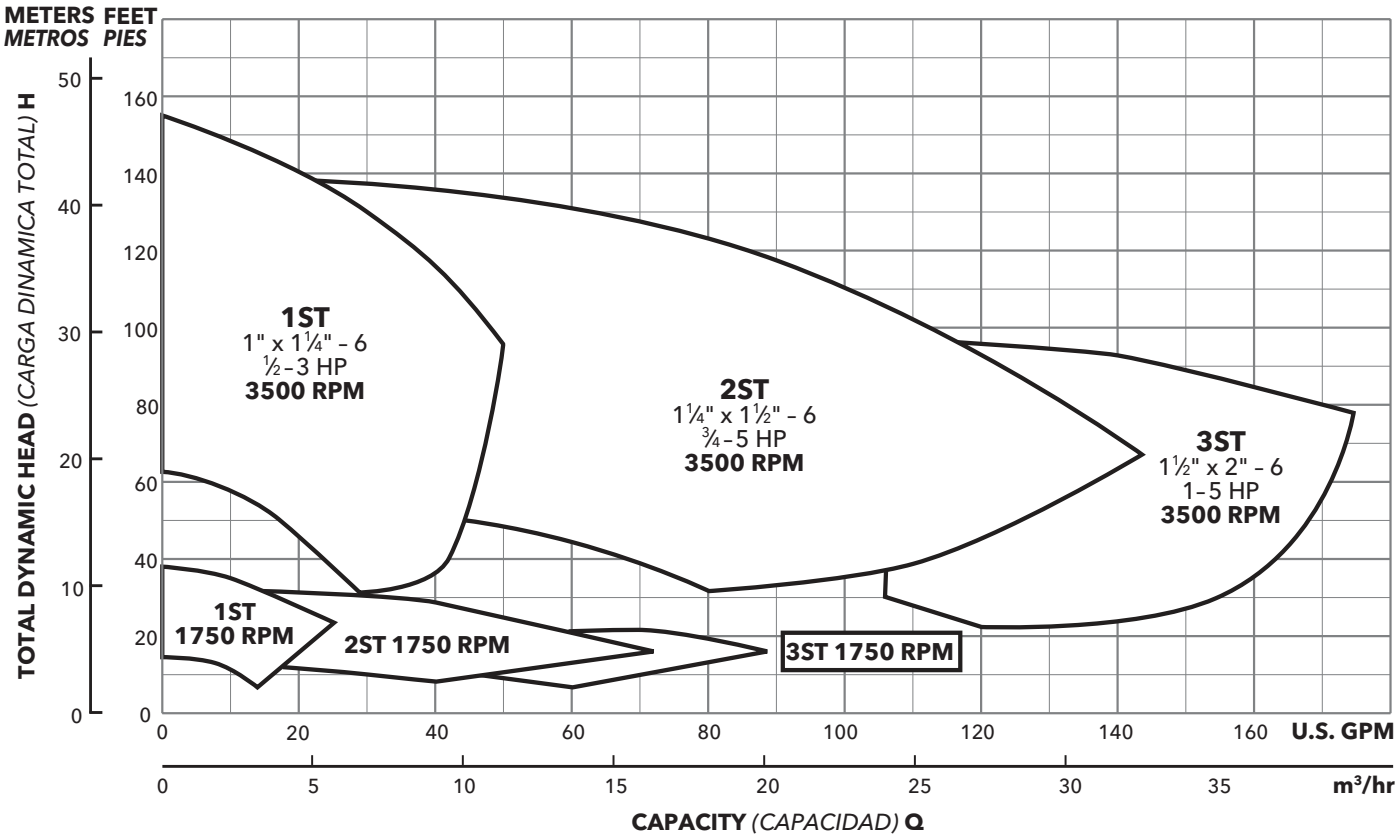
Driver: Hertz/Pole/RPM,
Conductor: Hercios/Polo/RPM
1 = 60 Hz, 2 pole, 3500 RPM
2 = 60 Hz, 4 pole, 1750 RPM
3 = 60 Hz, 6 pole, 1150 RPM
4 = 50 Hz, 2 pole, 2900 RPM
5 = 50 Hz, 4 pole, 1450 RPM

For frame mounted version, substitute the letters "FRM" in these positions.
Para la versión con el armazón montado, sustituya las letras "FRM" en estas posiciones.

Material
ST = Stainless steel, *Acero inoxidable*

Pump Size, *Tamaño de la Bomba*
1 = 1 x 1¼ – 6 2 = 1¼ x 1½ – 6 3 = 1½ x 2 – 6

PERFORMANCE COVERAGE (60 HZ)
ALCANCE DE FUNCIONAMIENTO (60 HZ)



NOTES:

Not recommended for operation beyond printed H-Q curve.

For critical application conditions consult factory.

Not all combinations of motor, impeller and seal options are available for every pump model. Please check with G&L on non-cataloged numbers.

All standard 3500 RPM ODP and TEFC motors supplied by Goulds Pumps, have minimum of 1.15 service factor. Standard catalog units may utilize available service factor. Any motors supplied other than Goulds Pumps check available service factor.

NOTAS:

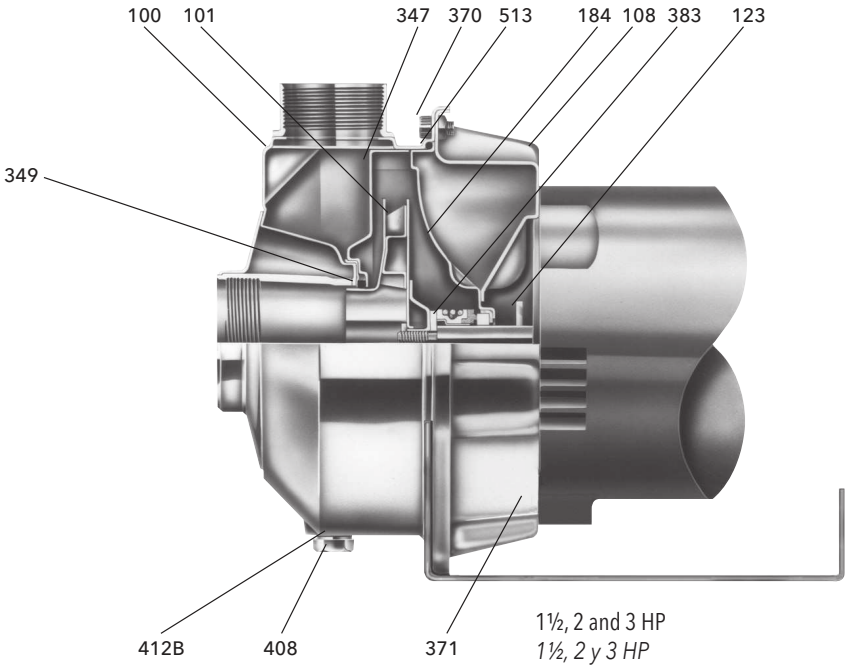
No se recomienda para funcionamiento superior al impreso en la curva H-Q.

Para condiciones de aplicaciones críticas consultar con la fábrica.

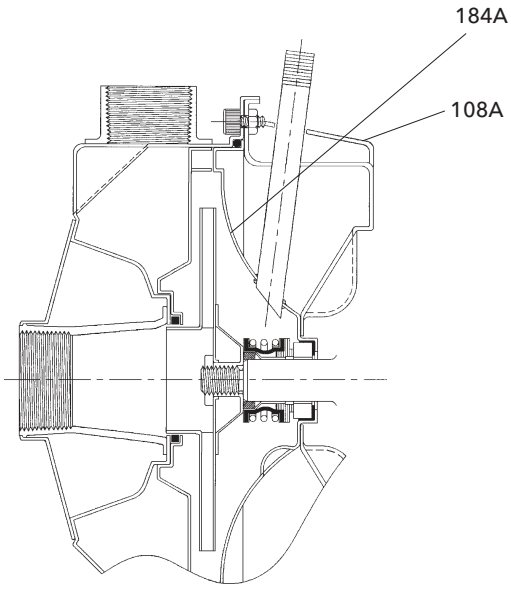
No todas las combinaciones de las opciones de motor, impulsor y sello están disponibles para cada modelo de bombas. Por favor verifique con G&L en los números no catalogados.

Todos los motores estándar de 3500 RPM, ODP (abiertos resguardados) y TEFC (totalmente encerrados con enfriamiento forzado) provistos por Goulds Pumps tienen un factor mínimo de servicio de 1,15. Las unidades estándar de catálogo pueden utilizar el factor de servicio disponible. Verificar el factor de servicio disponible de todo motor no provisto por Goulds Pumps.

NPE CLOSE COUPLED PUMP MAJOR COMPONENTS: MATERIALS OF CONSTRUCTION
BOMBA CERRADA ACOPLADA NPE COMPONENTES PRINCIPALES: MATERIALES DE CONSTRUCCIÓN

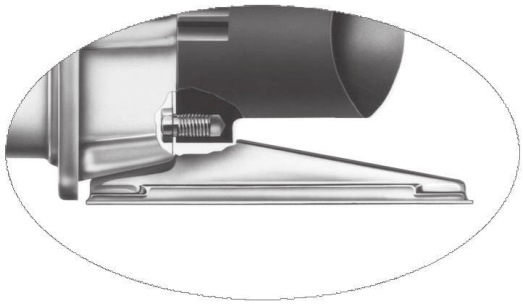


1½, 2 and 3 HP
1½, 2 y 3 HP



Seal Face Vent/Flush Option,
Opción Cara del Sello Válvula/Chorro

Item No., *Parte No.*	Description, *Descripción*	Materials, *Materiales*
100	Casing; *Carcasa*	AISI 316L SS; *AISI 316L Acero inoxidable*
101	Impeller; *Impulsor*	
108	Motor adapter; *Adaptador del motor*	
108A	Motor adapter seal vent/flush; *Sello válvula/chorro del adaptador del motor*	
123	Deflector; *Deflector*	BUNA-N
184	Seal housing; *Alojamiento del sello*	AISI 316L SS; *AISI 316L Acero inoxidable*
184 A	Seal housing seal vent/flush; *Sello válvula/chorro del alojamiento del sello*	
347	Guidevane; *Difusor*	
349	Seal ring, guidevane; *Anillo del sello, difusor*	Viton
370 *able*	Socket head screws, casing; *Encajes cabezas de tornillos, carcasa*	AISI 410 SS; *AISI 410 Acero inoxid-*
371	Bolts, motor; *Tornillos, motor*	Plated steel; Acero chapeado
383	Mechanical seal; *Sello mecánico*	**see chart, *ver tabla*
408 *able*	Drain and vent plug, casing; *Enchufes de drenaje y válvula, carcasa*	AISI 316L SS; *AISI 316L Acero inoxid-*
412B	O-ring, drain and vent plug; *Anillo 'O', enchufe de drenaje y válvula*	Viton (Standard, *estándar*) EPR (Optional, *Opcional*)
513	O-ring, casing; *Anillo 'O', carcasa*	
Motor *Motor*	NEMA standard, 56J flange; *NEMA estándar, brida 56J*	

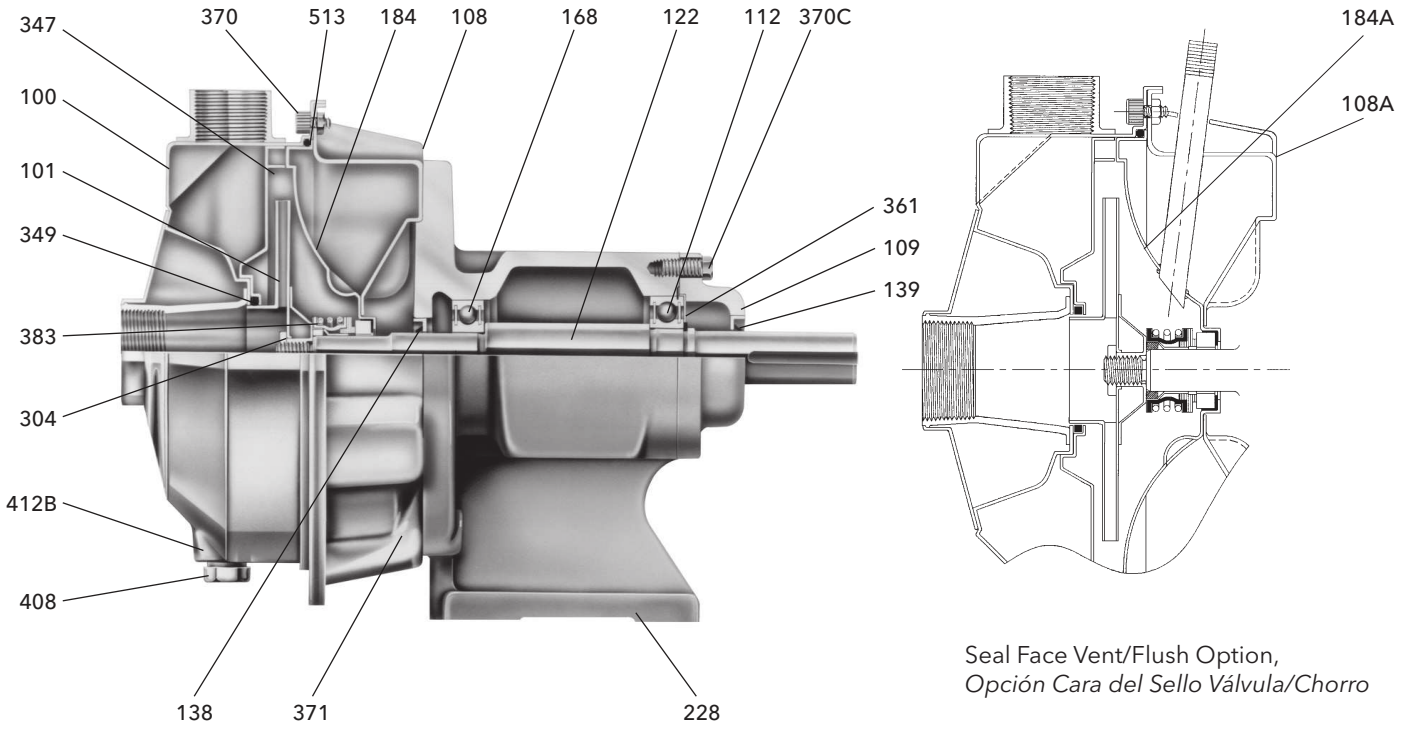


½, ¾ and 1 HP
½, ¾ y 1 HP

Footed motor for 5 HP ODP and TEFC, all explosion proof motors, see page 13.

Motor con pie para 5 HP ODP y TEFC, a prueba de explosiones motores, en la página 13.

NPE FRAME MOUNTED PUMP MAJOR COMPONENTS: MATERIALS OF CONSTRUCTION
BOMBA NPE DE ARMAZÓN MONTADO COMPONENTES PRINCIPALES: MATERIALES DE CONSTRUCCIÓN

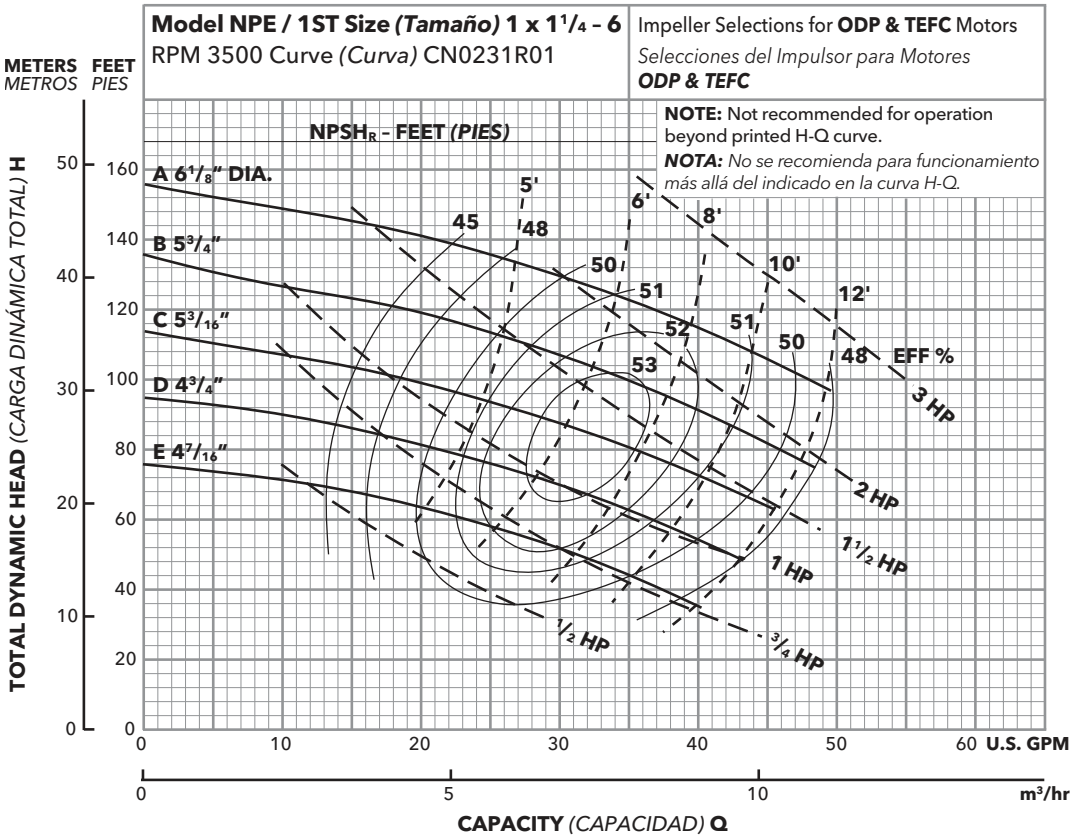


Seal Face Vent/Flush Option,
Opción Cara del Sello Válvula/Chorro

Item No., *Parte No.*	Description, *Descripción*	Materials, *Materiales*
100	Casing; *Carcasa*	AISI 316L SS; *AISI 316L Acero inoxidable*
101	Impeller; *Impulsor*	
108	Adapter; *Adaptador*	
108A	Motor adapter seal vent/flush; *Sello válvula/chorro del adaptador del motor*	
109	Bearing cover; *Cubierta de balineras*	Cast iron; *Hierro fundido*
112	Ball bearing (outboard); *Balineras de bolas (exterior)*	Steel; *Acero*
122	Shaft; *Eje*	AISI 316 SS; *AISI 316 Acero inoxidable*
138	Lip-seal (inboard); *Sello cubierto (interior)*	BUNA/steel; *BUNA/acero*
139	Lip-seal (outboard); *Sello cubierto (exterior)*	BUNA/steel; *BUNA/acero*
168	Ball bearing (inboard); *Balineras de bolas (interior)*	Steel; *Acero*
184	Seal housing; *Alojamiento del sello*	AISI 316L SS; *AISI 316L Acero inoxidable*
184 A	Seal housing seal vent/flush; *Sello válvula/chorro del alojamiento del sello*	
228	Bearing frame; *Armazón de balineras*	Cast iron, *Hierro fundido*

Item No., *Parte No.*	Description, *Descripción*	Materials, *Materiales*
304	Impeller locknut; *Contratuerca del impulsor*	AISI 316 SS; *AISI 316 Acero inoxidable*
347	Guidevane; *Difusor*	
349	Seal ring, guidevane; *Anillo del sello, difusor*	Viton
361	Retaining ring; *Anillo de retención*	Steel; Acero
370	Socket head screws, casing; *Encaje cabeza del tornillo, carcasa*	AISI 410 SS; *AISI 410 Acero inoxidable*
370C	Hex head screw, bearing cover; *Tornillo de cabeza hexagonal, cubierta de balineras*	Plated steel; *Acero chapeado*
371	Hex head screw, bearing frame; *Tornillo de cabeza hexagonal, armazón de balineras*	Plated steel; *Acero chapeado*
383	Mechanical seal; *Sello mecánico*	**see chart; ver tabla
400	Shaft key; *Llave del eje*	Steel; Acero
408	Drain and vent plug, casing; *Enchufes de drenaje y válvula, carcasa*	AISI 316 SS; *AISI 316 Acero inoxidable*
412B	O-ring, drain and vent plug; *Anillo 'O', enchufe de drenaje y válvula*	Viton (Standard, *estándar*) EPR (Optional, *Opcional*)
513	O-ring, casing; *Anillo 'O', carcasa*	

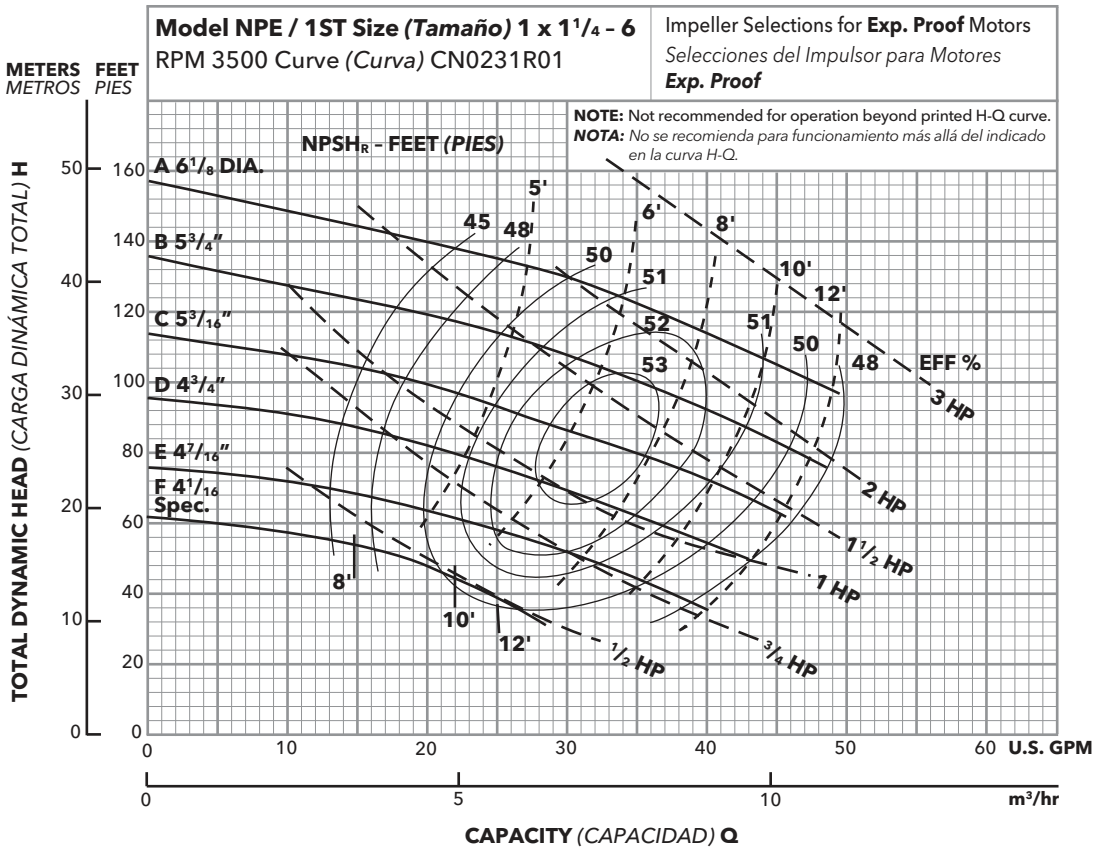
PERFORMANCE CURVES – 60 HZ, 3500 RPM
CURVAS DE FUNCIONAMIENTO – 60 HZ, 3500 RPM



Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
E	½	4 7/16"
D	¾	4¾
C	1	5 3/16
B	1½	5¾
A	2	6⅛

NOTE: Although not recommended, the pump may pass a 1/16" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 1/16".*

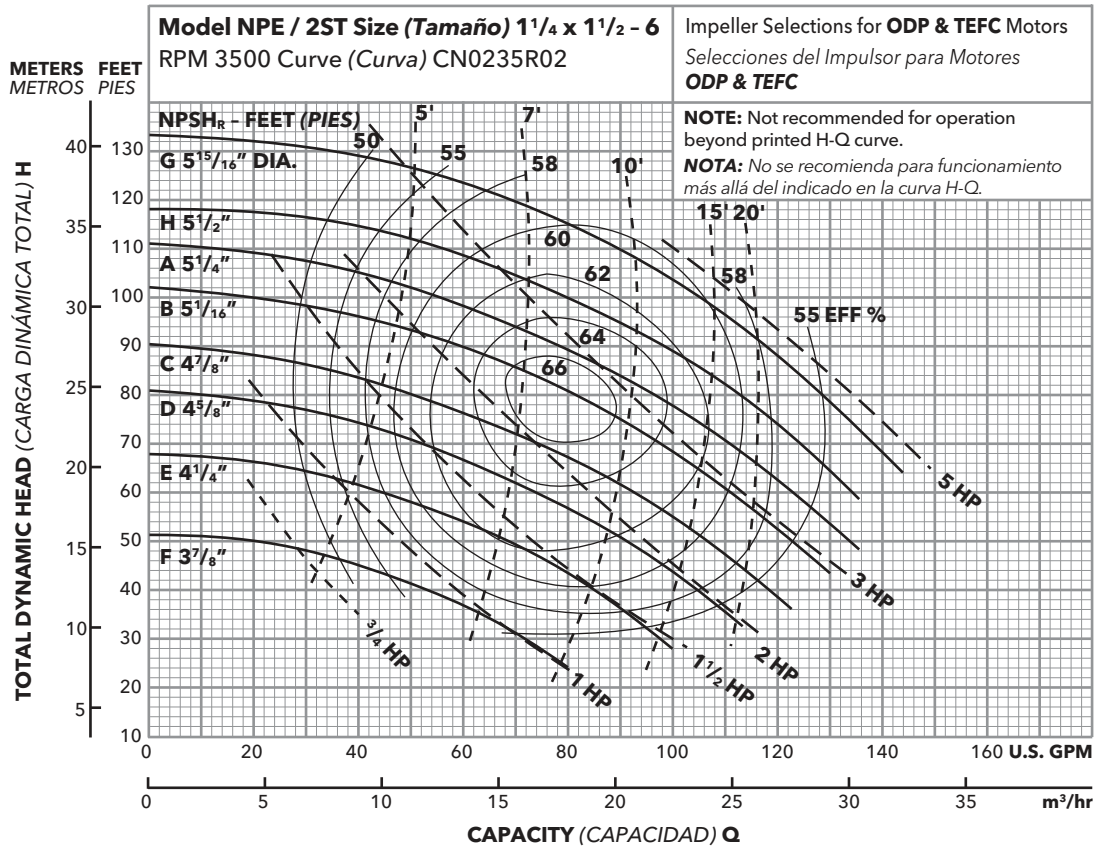


Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
F	½	4 1/16" spec.
E	¾	4 7/16
D	1	4¾
C	1½	5 3/16
B	2	5¾
A	3	6⅛

NOTE: Although not recommended, the pump may pass a 1/16" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 1/16".*

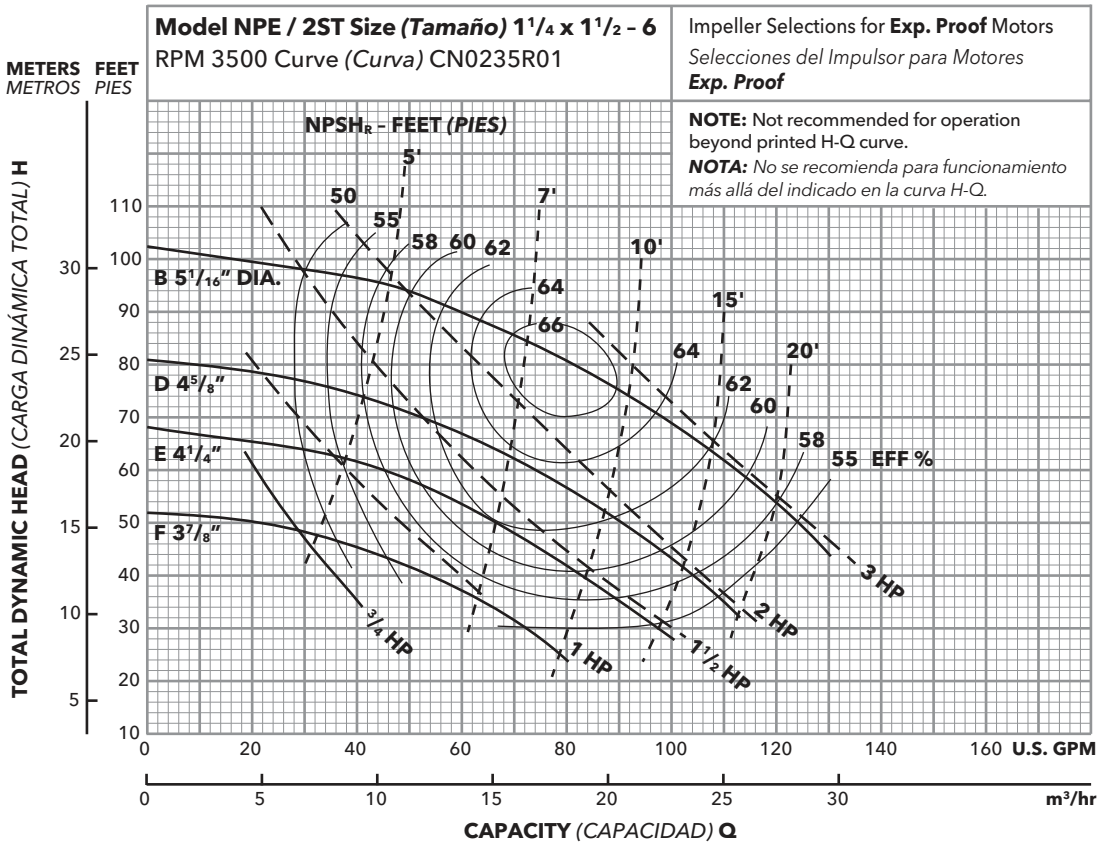
PERFORMANCE CURVES – 60 HZ, 3500 RPM
CURVAS DE FUNCIONAMIENTO – 60 HZ, 3500 RPM



Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
F	¾	3 7/8"
E	1	4 1/4
D	1½	4 5/8
C	2	4 7/8
B	3	5 1/16
A	3	5 1/4
H	5	5 1/2
G	5	5 15/16

NOTE: Although not recommended, the pump may pass a 3/16" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 3/16".*

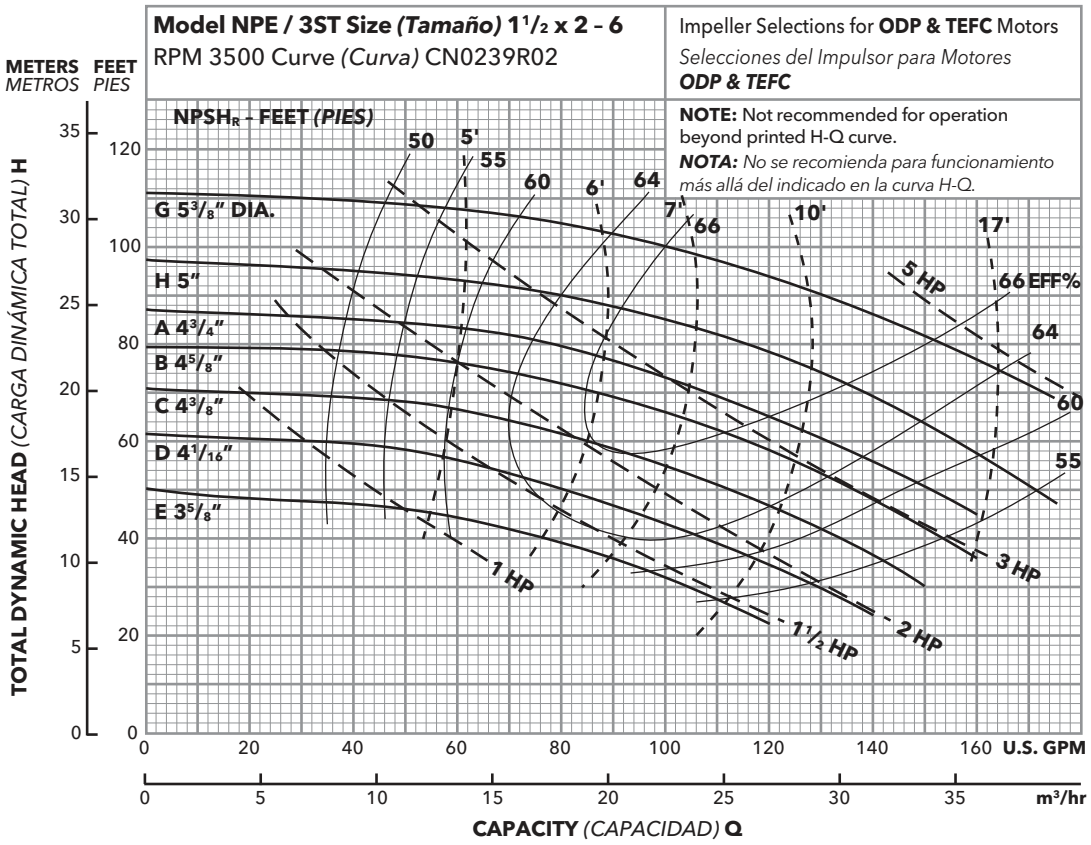


Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
F	1	3 7/8"
E	1½	4 1/4
D	2	4 5/8
B	3	5 1/16

NOTE: Although not recommended, the pump may pass a 3/16" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 3/16".*

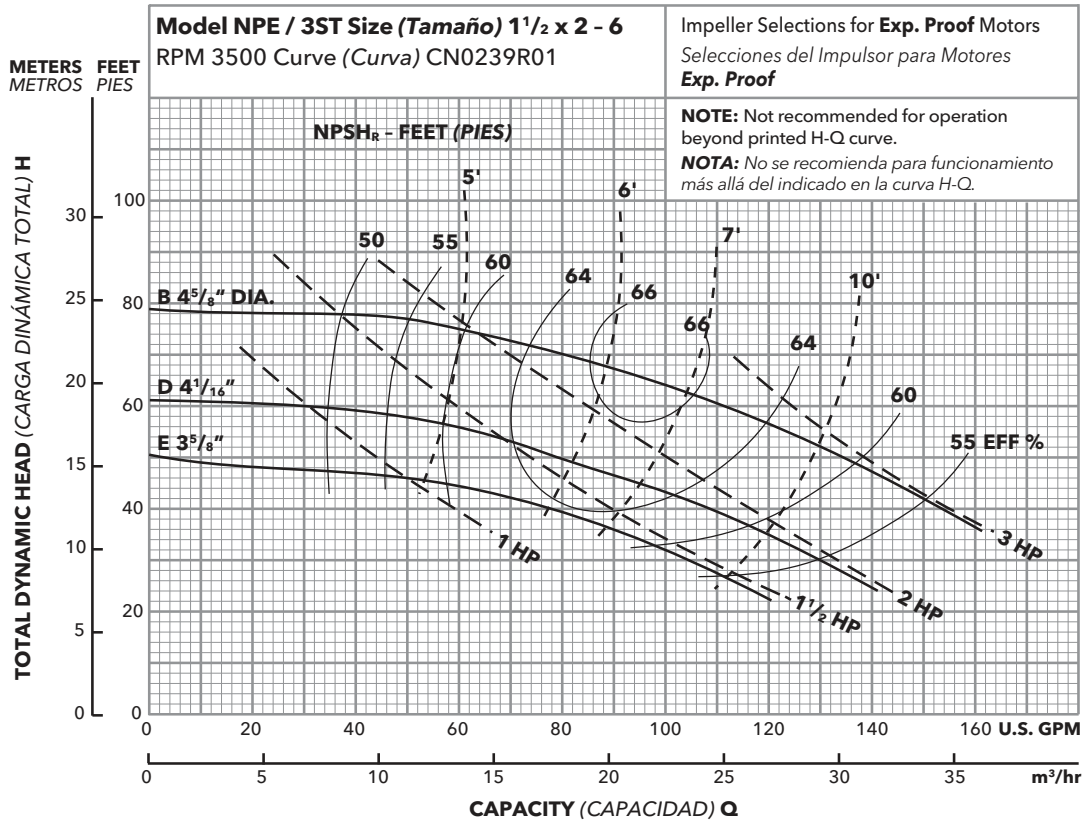
PERFORMANCE CURVES – 60 HZ, 3500 RPM
CURVAS DE FUNCIONAMIENTO – 60 HZ, 3500 RPM



Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
E	1	3 5/8"
D	1½	4 1/16
C	2	4 3/8
B	3	4 5/8
A	3	4¾
H	5	5
G	5	5 3/8

NOTE: Although not recommended, the pump may pass a 11/32" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 11/32".*

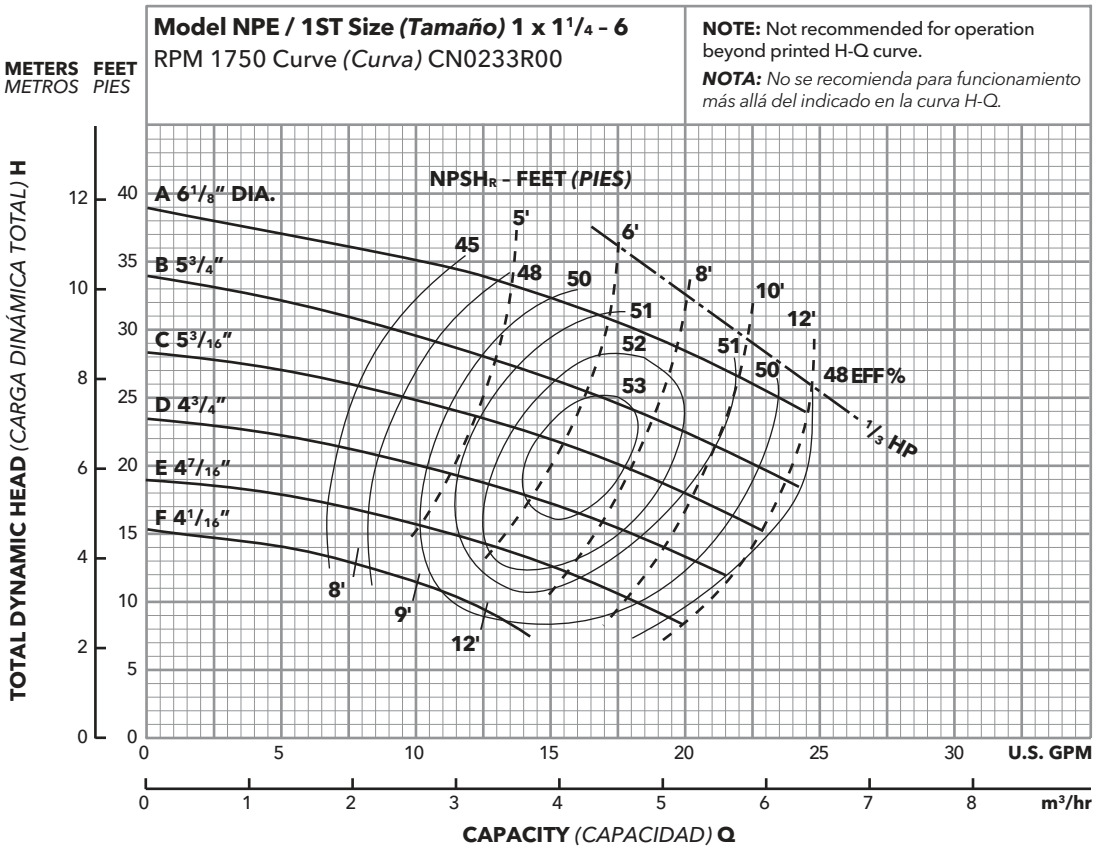


Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
E	1½	3 5/8"
D	2	4 1/16
B	3	4 5/8

NOTE: Although not recommended, the pump may pass a 11/32" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 11/32".*

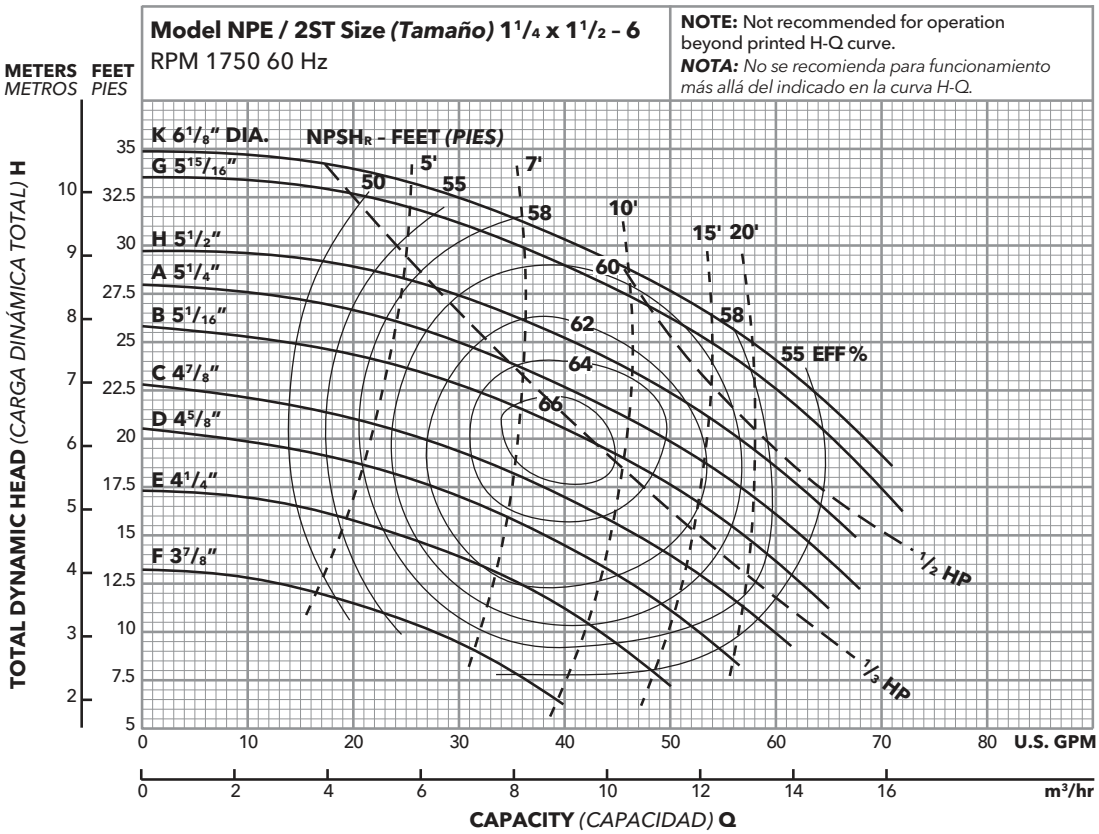
PERFORMANCE CURVES – 60 HZ, 1750 RPM
CURVAS DE FUNCIONAMIENTO – 60 HZ, 1750 RPM



Optional Impeller, *Impulsor Opcional*	
Ordering Code, *Código de Pedido*	**Dia.**
A	6⅛"
B	5¾
C	5 3/16
D	4¾
E	4 7/16
F	4 1/16

NOTE: Although not recommended, the pump may pass a 1/16" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 1/16".*

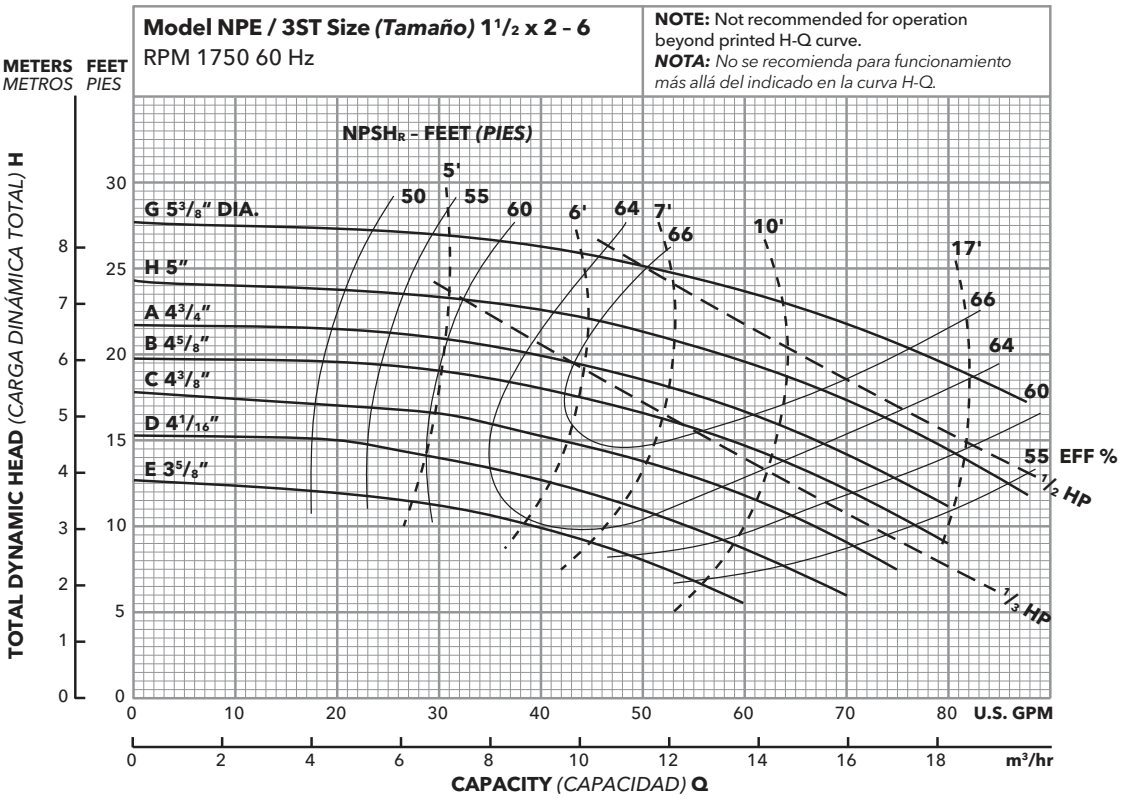


Optional Impeller, *Impulsor Opcional*	
Ordering Code, *Código de Pedido*	**Dia.**
K	6⅛"
G	5 15/16"
H	5½
A	5¼
B	5 1/16
C	4⅞
D	4⅝
E	4¼
F	3⅞

NOTE: Although not recommended, the pump may pass a 3/16" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 3/16".*

PERFORMANCE CURVES – 60 HZ, 1750 RPM
CURVAS DE FUNCIONAMIENTO – 60 HZ, 1750 RPM

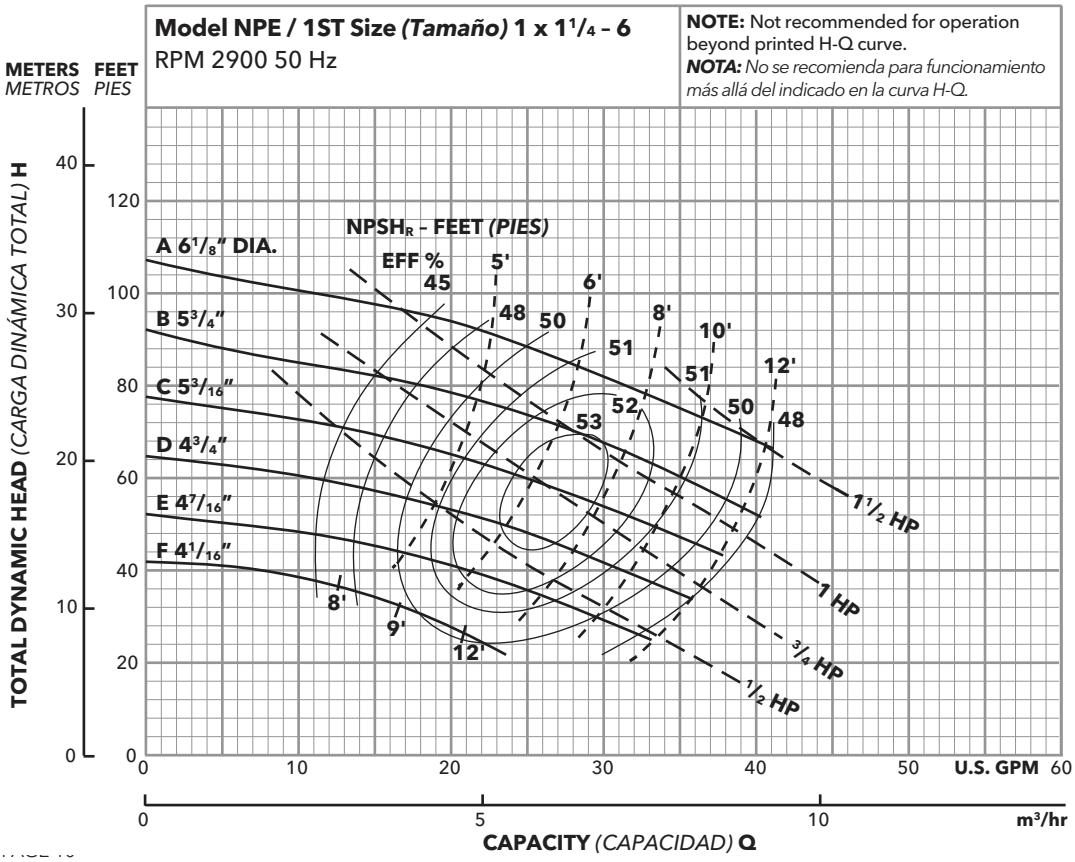


Optional Impeller, *Impulsor Opcional*	
Ordering Code, *Código de Pedido*	**Dia.**
G	5 3/8"
H	5
A	4 3/4
B	4 5/8
C	4 3/8
D	4 1/16
E	3 5/8

NOTE: Although not recommended, the pump may pass a 11/32" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 11/32".*

PERFORMANCE CURVES – 50 HZ, 2900 RPM
CURVAS DE FUNCIONAMIENTO – 50 HZ, 2900 RPM

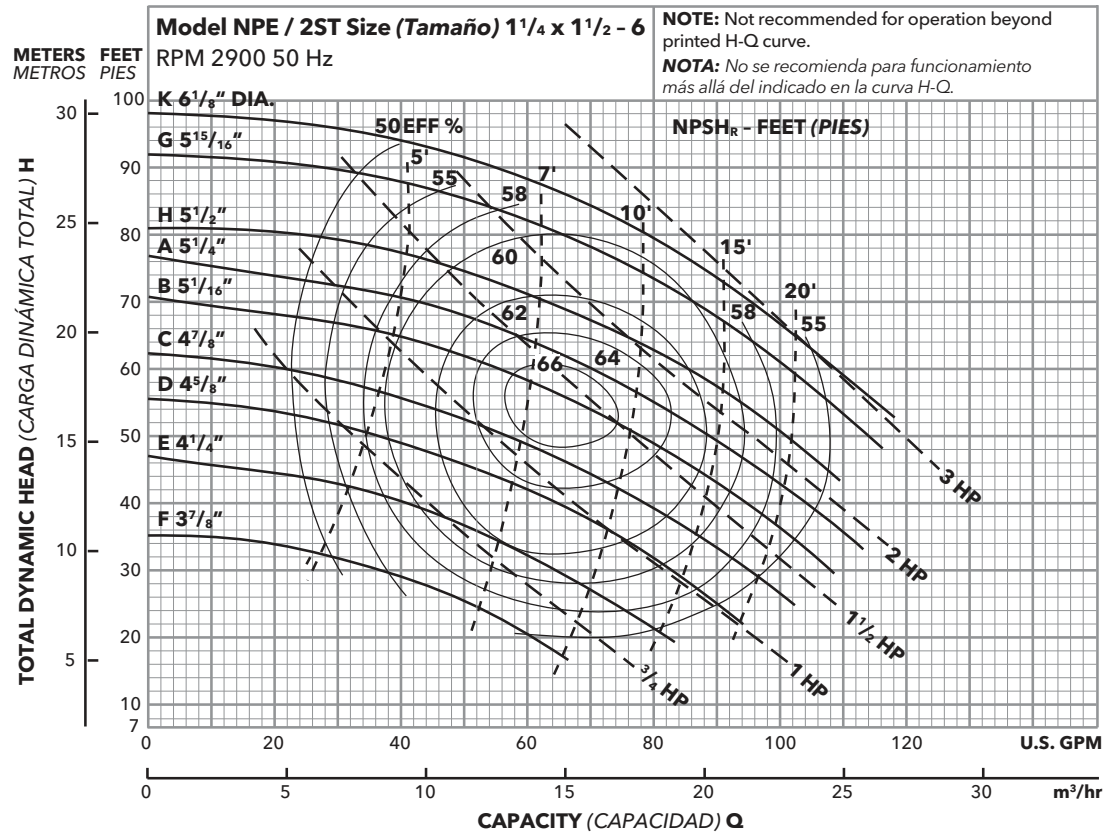


Optional Impeller, *Impulsor Opcional*	
Ordering Code, *Código de Pedido*	**Dia.**
A	6 1/8"
B	5 3/4
C	5 3/16
D	4 3/4
E	4 7/16
F	4 1/16

NOTE: Although not recommended, the pump may pass a 1/16" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 1/16".*

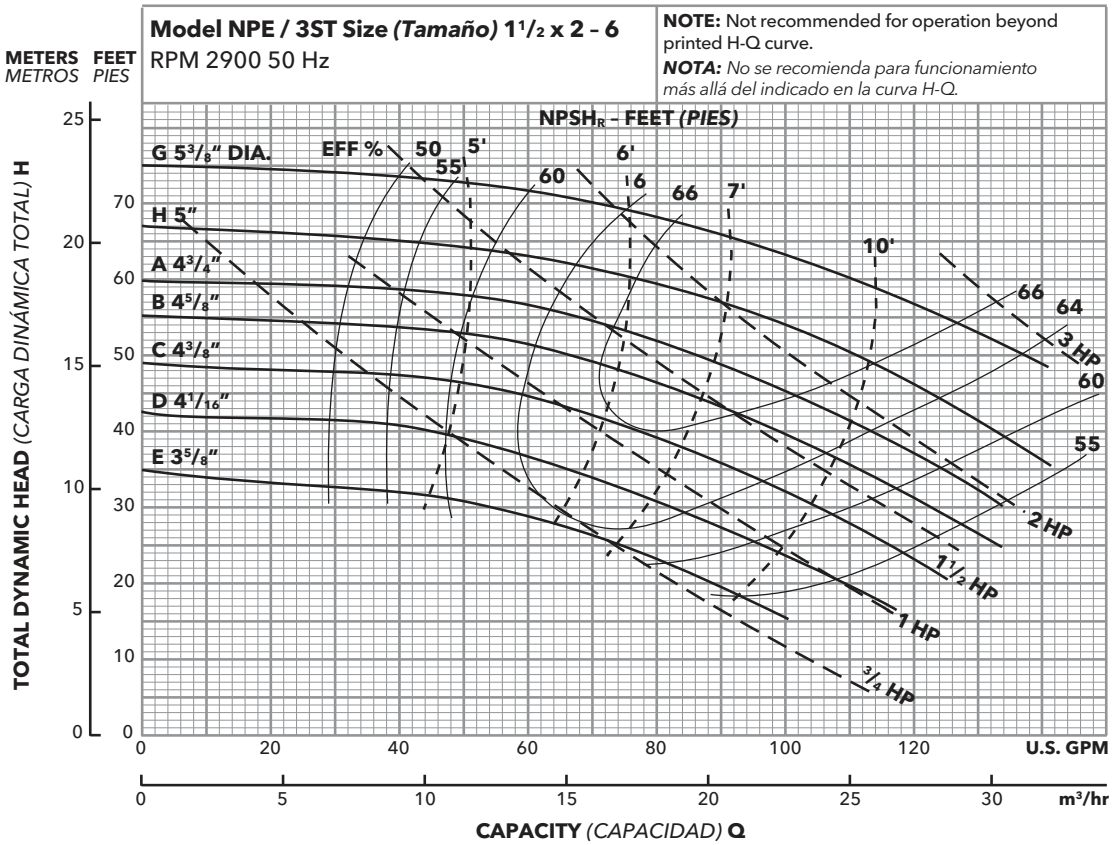
PERFORMANCE CURVES – 50 HZ, 2900 RPM
CURVAS DE FUNCIONAMIENTO – 50 HZ, 2900 RPM



Optional Impeller, *Impulsor Opcional*	
Ordering Code, *Código de Pedido*	**Dia.**
K	6⅛"
G	5 15/16"
H	5½
A	5¼
B	5 1/16
C	4⅞
D	4⅝
E	4¼
F	3⅞

NOTE: Although not recommended, the pump may pass a 3/16" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 3/16".*



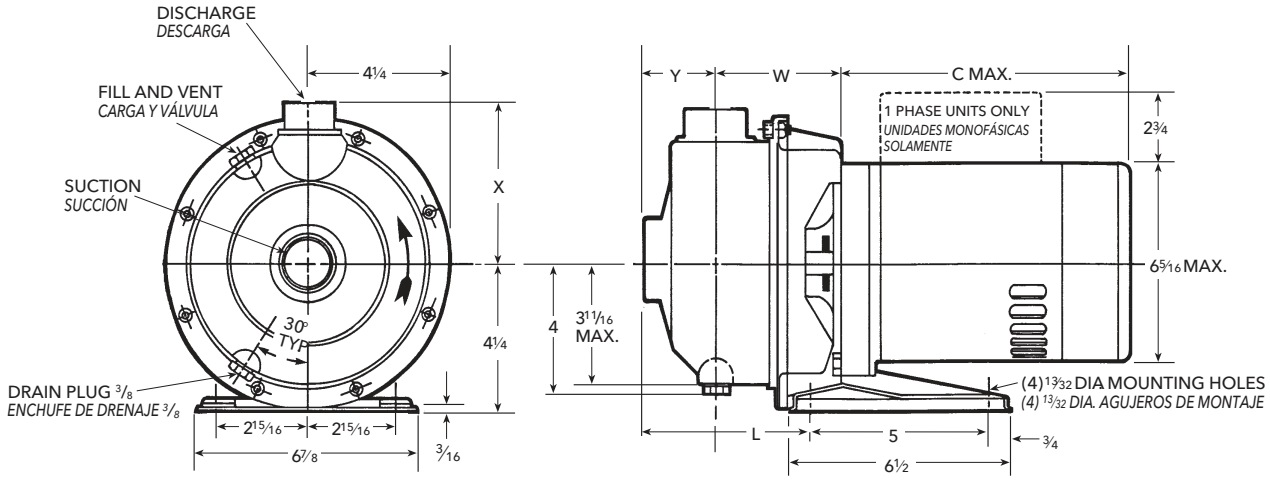
Optional Impeller, *Impulsor Opcional*	
Ordering Code, *Código de Pedido*	**Dia.**
G	5⅜"
H	5
A	4¾
B	4⅝
C	4⅜
D	4 1/16
E	3⅝

NOTE: Although not recommended, the pump may pass a 11/32" sphere.

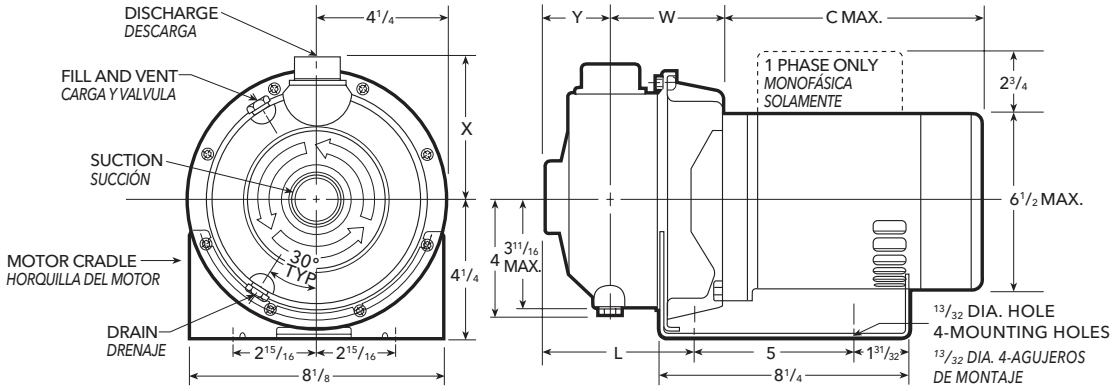
NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 11/32".*

NPE CLOSE COUPLED – DIMENSIONS, WEIGHTS AND SPECIFICATIONS
NPE ACOPLE CERRADO – DIMENSIONES, PESOS Y ESPECIFICACIONES

Clockwise Rotation Viewed from Drive End
Rotación en Dirección de las Agujas del Reloj Visto desde el Extremo del Motor



ODP and TEFC ½, ¾ and 1 HP (standard), *ODP y TEFC ½, ¾ y 1 HP (estándar)*



ODP and TEFC 1½, 2 and 3 HP (standard), *ODP y TEFC 1½, 2 y 3 HP (estándar)*

SPECIFICATIONS - *ESPECIFICACIONES*

Capacities to:
85 GPM (322L/min) at 1750 RPM
170 GPM (643L/min) at 3500 RPM

Heads to:
39 feet (12 m) at 1750 RPM
150 feet (46 m) at 3500 RPM

Working pressures to:
125 PSIG (9 bars)

Maximum temperatures to: 250° F (121° C)

Direction of rotation:
Clockwise when viewed from motor end.

Motor specifications:
NEMA 56J frame, 1750 RPM, ½ HP. 3500 RPM ½ through 5 HP. Open drip-proof, totally enclosed fan-cooled or explosion proof enclosures. Stainless steel shaft with ball bearings.

Single phase: Voltage 115/230 ODP and TEFC. (3 and 5 HP model – 230 V only) Built-in overload with auto-reset provided.

Three phase: Voltage 208-230/460 ODP, TEFC and EX PROOF.

NOTE: For three phase motors, overload protection must be provided in starter unit. Starter and heaters must be ordered separately.

Capacidades:
85 GPM (322L/min) a 1750 RPM
170 GPM (643L/min) a 3500 RPM

Cargas:
39 pies (12 m) a 1750 RPM
150 pies (46 m) a 3500 RPM

Presión de trabajo:
125 PSIG (9 baras)

Temperatura máxima:
250 ° F (121° C)

Dirección de rotación:
En dirección de las agujas del reloj visto desde el extremo final del motor.

Motores:
Armazón 56J NEMA, 1750 RPM ½ HP. 3500 RPM ½ a 5 HP. Cubiertas abiertas resguardadas, totalmente encerradas enfriadas por ventilador o a prueba de explosiones. Eje de acero inoxidable con balineras de bolas.

Monofásicos: *Voltaje 115/230 ODP y TEFC. (modelo 3 y 5 HP – 230 voltios solamente) Se proporciona protección térmica contra sobrecarga construida con reseteo automático.*

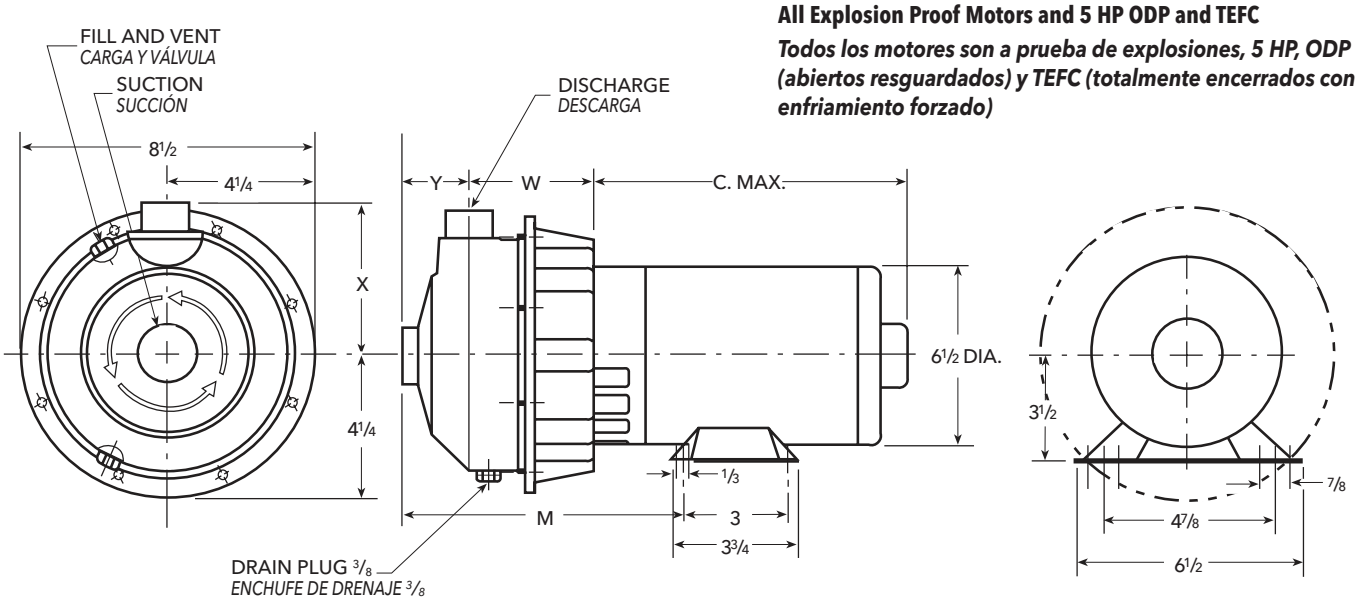
Trifásicos: *Voltaje 208-230/460 ODP, TEFC y EX PROOF.*

NOTA: *Para motores trifásicos se debe de proporcionar la protección térmica contra sobrecarga en la unidad de arranque. El arrancador y los calentadores se deben pedir por separado.*

NPE CLOSE COUPLED WITH FOOTED MOTOR, EXPLOSION-PROOF AND 5 HP MOTORS
NPE ACOPLE CERRADO CON MOTOR CON PATAS, MOTORES A PRUEBA DE EXPLOSIÓN Y 5 HP

All Explosion Proof Motors and 5 HP ODP and TEFC

Todos los motores son a prueba de explosiones, 5 HP, ODP (abiertos resguardados) y TEFC (totalmente encerrados con enfriamiento forzado)



Dimensions – Determined by Pump,
Dimensiones – Determinadas por la Bomba

Pump, *Bomba*	Suction, *Succión*	Discharge, *Descarga*	HP	W	X	Y	L	M
1ST	1¼	1	½ – 3	3 5/16	4⅜	2	4 9/16	7 5/16
2ST	1½	1¼	¾ – 5	3¾	4½	2⅛	5⅛	7⅞
3ST	2	1½	1 – 5	3¾	4⅝	2⅛	5⅛	7⅞

Available Motor Weights and Dimensions
Pesos y Dimensiones Disponibles del Motor

HP	Motor Weights, *Pesos del Motor*						C Max. Length, *(Longitud)*
	1 Phase, *Monofásicos*			3 Phase, *Trifásicos*			
	ODP	TEFC	EXP	ODP	TEFC	EXP	
½	16	21	47	19	18	27	10 3/16
¾	19	24	41	21	21	30	10 7/16
1	22	26	49	23	21	30	11 1/16
1½	28	35	56	27	27	37	11 15/16
2	33	39	60	32	33	44	12 11/16
3	40	43	–	41	37	–	13 9/16
5	42	–	–	42	45	–	13 9/16

Dimensions in inches, weights in pounds.
Dimensiones en pulgadas, pesos en libras.

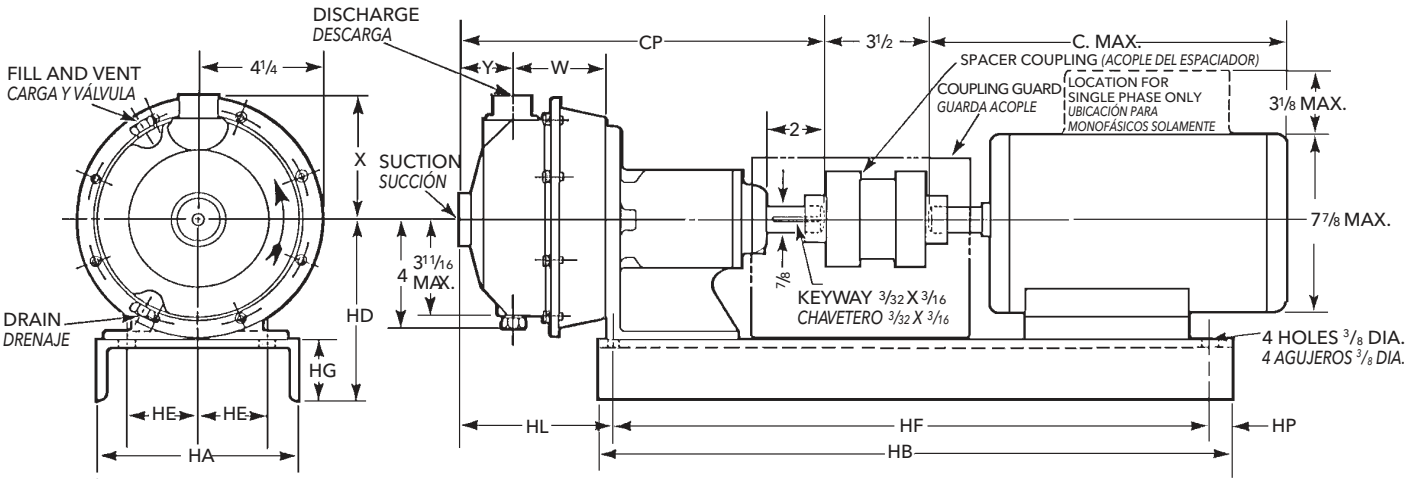
NOTES:

1. Pump will be shipped with top vertical discharge position as standard. For other orientations, remove casing bolts, rotate discharge to desired position, replace and tighten 6mm bolts to 5 – 6 lbs.-ft.
2. Motor dimensions may vary with motor manufacturers.
3. Dimensions in inches, weights in pounds.
4. For explosion proof motor dimensions consult factory for information.
5. Not to be used for construction purposes unless certified.

NOTAS:

1. *Las bombas se transportarán con la descarga vertical superior como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y reemplazar y apretar los tornillos de 6mm a 5 – 6 libras-pies.*
2. *Las dimensiones del motor puede que varíen con los fabricantes.*
3. *Dimensiones en pulgadas, pesos en libras.*
4. *Para las dimensiones de los motores a prueba de explosión consultar con la fábrica para información.*
5. *No usar para propósitos de construcción sin certificar.*

NPE FRAME MOUNTED – DIMENSIONS, WEIGHTS AND SPECIFICATIONS
NPE ARMAZÓN MONTADO – DIMENSIONES, PESOS Y ESPECIFICACIONES



SPECIFICATIONS
ESPECIFICACIONES

Capacities to:
85 GPM (322L/min) at 1750 RPM
170 GPM (643L/min) at 3500 RPM

Heads to:
39 feet (12 m) at 1750 RPM
150 feet (47 m) at 3500 RPM

Working pressures to:
125 PSIG (9 bars)

Maximum temperatures to: 250°F (121°C)

Direction of rotation:
Clockwise when viewed from motor end.

Motor specifications:
T-frame single and three phase. Open drip-proof, TEFC or explosion proof enclosures are available for 60 Hz, 3500 and 1750 RPM operation.

For three phase motors, overload protection must be provided in starter unit. Starter and heaters must be ordered separately.

Capacidades:
85 GPM (322L/min) a 1750 RPM
170 GPM (643L/min) a 3500 RPM

Cargas:
39 pies (12 m) a 1750 RPM
150 pies (47 m) a 3500 RPM

Presión de trabajo:
125 PSIG (9 baras)

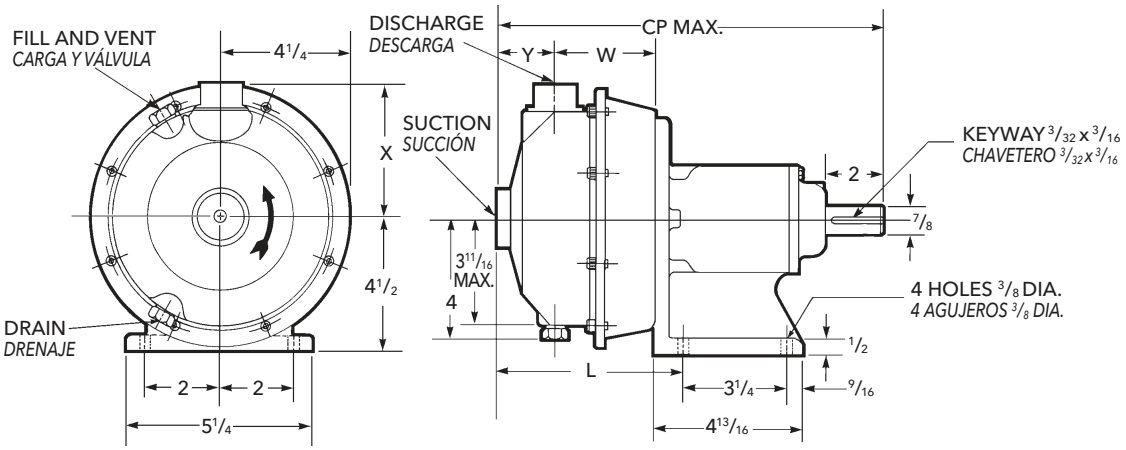
Temperatura máxima:
250°F (121°C)

Dirección de rotación: *En dirección de las agujas del reloj visto desde el extremo final del motor.*

Motores:
Armazón T- monofásico y trifásico. A prueba de goteo, TEFC o recintos a prueba de explosión están disponibles para funcionamiento de 60 Hz, 3500 y 1750 RPM.

Para motores trifásicos se debe de proporcionar la protección térmica contra sobrecarga en la unidad de arranque. El arrancador y los calentadores se deben pedir por separado.

NPE-F



Dimensions and Weights
Dimensiones y Pesos

Dimensions and Weights – Determined by Pump,
Dimensiones y Pesos – Determinados por la Bomba

Pump, *Bomba*	Suct. NPT, *Succión NPT*	Disch. NPT, *Descarga NPT*	CP	L	W	X	Y	Wt., *Peso*	Dim. "HL" Determined by Pump and Motor, *Dim. "HL" Determinadas por la Bomba y el Motor* Frame, *Armazón*		
									56	140	180
1ST	1 1/4	1	12 15/16	6 7/16	3 5/16	4 3/8	2	22 1/2	4 9/16		6 7/16
2ST	1 1/2	1 1/4	13 1/2	7	3 3/4	4 1/2	2 1/8	23	5 1/8		7
3ST	2	1 1/2				4 5/8					

Available Motor and Bedplate Dimensions and Weights,
Pesos y Dimensiones Disponibles de la Fundación y del Motor

Motor Frame, *Armazón del Motor*	HA	HB	HD	HE	HF	HG	HP	Wt. Max., *Peso Máx*	Shims, *Deflector*
56 143T 145T	8	26	6 7/8	3 1/8	22 3/8	2 3/8	1	30	1"
182T 184T	10	26	7 1/4	3 3/4	24	2 3/4	7/8	43	–

Frame Size, *Tamaño del Armazón*	Horsepower, *Fuerza* 3500 RPM				C Max.	Wt. Max., *Peso Máx.*
	Single Phase, *Monofásicos*		Three Phase, *Trifásicos*			
	ODP	TEFC	ODP	TEFC		
56	1/2 – 1 1/2	1/2 – 1 1/2	1/2 – 1	1/2 – 1	13	45
143T	–	–	1 1/2	1 1/2	13 3/8	45
145T	2	2	1 1/2 – 3	1 1/2 – 2	14 1/4	52
182T	3	3	5	3	16 5/8	63
184T	5	5	–	5	18 1/8	112

NOTES:

1. Pump will be shipped with top vertical discharge position as standard. For other orientations, remove casing bolts, rotate discharge to desired position, replace and tighten 6mm bolts to 5 – 6 lbs.-ft.
2. Motor dimensions may vary with motor manufacturers.
3. Dimensions in inches, weights in pounds.
4. For explosion proof motor dimensions consult factory for information.
5. Not to be used for construction purposes unless certified.

NOTAS:

1. *Las bombas se transportarán con la descarga vertical superior como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y reemplazar y apretar los tornillos de 6mm a 5 – 6 libras-pies.*
2. *Las dimensiones del motor puede que varíen con los fabricantes.*
3. *Dimensiones en pulgadas, pesos en libras.*
4. *Para las dimensiones de los motores a prueba de explosión consultar con la fábrica para información.*
5. *No usar para propósitos de construcción sin certificar.*

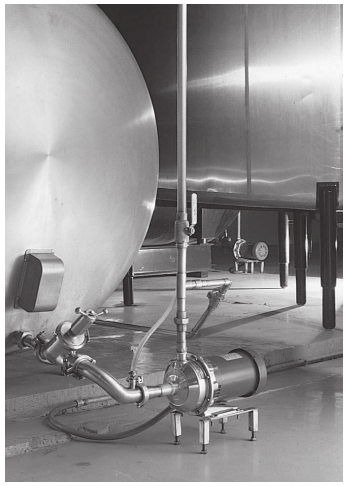
TYPICAL APPLICATIONS, *APLICACIONES TÍPICAS*

Specifically designed for a broad range of general applications traditionally requiring various materials such as all iron, bronze fitted or all bronze construction.

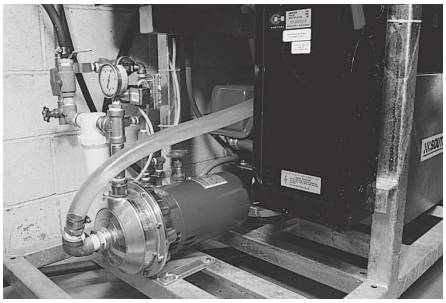
- Water circulation
- Booster service
- Liquid transfer
- Spray system
- Chillers
- Washing/cleaning systems
- Injection molding cooling
- Reverse osmosis
- Air scrubbers
- Heat exchangers
- Filtration systems
- Jockey pumps
- OEM applications
- General water services

Diseñadas específicamente para una amplia variedad de aplicaciones generales, requiriendo tradicionalmente varios materiales, tales como hierro, bronce empotrado o todas las construcciones de bronce.

- *Circulación de agua*
- *Aumento de presión*
- *Transferencia de líquidos*
- *Sistemas de aspersión*
- *Enfriadores*
- *Sistemas de lavado/limpieza*
- *Enfriamiento con molde por inyección*
- *Osmosis reversa*
- *Depuradores de aire*
- *Termopermutadores*
- *Sistemas de filtración*
- *Bombas auxiliares*
- *Aplicaciones OEM*
- *Servicios generales de agua*

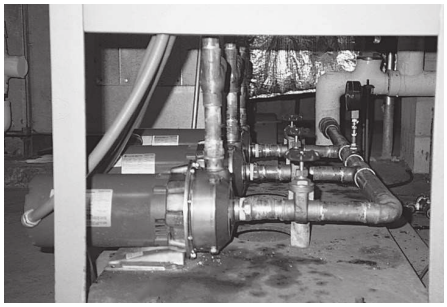


Brewery, *Fábrica de Cerveza*

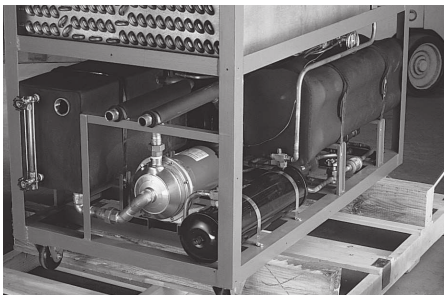


Car Wash, *Lavadero de Autos*

Pure Water/OEM, *Agua Pura/OEM*



Pressure Booster System, *Sistema de Aumento de Presión*



Chiller, *Enfriador*

xylem
Let's Solve Water

Xylem Inc.
2881 East Bayard Street Ext., Suite A
Seneca Falls, NY 13148
Phone: (866) 325-4210
Fax: (888) 322-5877
www.gouldswatertechnology.com

TERRAQUAVIE
environnement & géosynthétiques

TECHNICAL DATA SHEET

RCTQ2000

FLOATING SILT CURTAINS

PROPERTIES	UNIT	TEST METHOD	VALUE
FLOAT			
Material		Expanded polypropylene	
Size		6 pieces 10 cm x 10 cm x 244 cm	
Buoyancy	kg/m3	ASTM D-3575	945
Chemical resistance		Gasoline and diesel fuels, oils	
Float cover		Woven polyethylene with coating	
Float cover thickness	mil.	-	12
Cover's color		Yellow	
U.V. Resistance (2000 hrs)	%	ASTM G-53	80
BODY FABRIC			
Material		Reinforced polyethylene	
Grab Tensile Strength	N	ASTM D-751	453
Water Flow rate	l/min/m^2	-	-
Apparent Opening Size	microns	-	-
RENFORCEMENT			
Material		Reinforced polyethylene	
Thickness	mil.	-	16
U.V. Resistance (2000 hrs)	%	ASTM G-53	80
GROMMETS, PINS & SEAMS			
Grommets		#3 plated brass or oxide	
Seam		Lock stitch	
Thread		Nylon BST-207	
Pins		1/2 galvanized steal	

SMART3 Colorimeter

Operator's Manual

For Sales & Service Contact

geotech

2650 E. 40th Ave. • Denver, CO 80205
Phone 303-320-4764 • Fax 303-322-7242
1-800-833-7958
www.geotechenv.com

1910-MN

2.28.11

LaMotte

PO Box 329 • Chestertown, MD 21620
800-344-3100 • f 410-778-6394
www.lamotte.com

WARNING! This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision

CONTENTS

GENERAL INFORMATION

■ PACKAGING & DELIVERY

Experienced packaging personnel at LaMotte Company assure adequate protection against normal hazards encountered in transportation of shipments. After the product leaves the manufacturer, all responsibility for its safe delivery is assured by the transportation company. Damage claims must be filed immediately with the transportation company to receive compensation for damaged goods.

Should it be necessary to return the instrument for repair or servicing, pack instrument carefully in a suitable container with adequate packing material. A return authorization number must be obtained from LaMotte Company by calling 1-800-344-3100 or emailing tech@lamotte.com. Attach a letter with the authorization number to the shipping carton which describes the kind of trouble experienced. This valuable information will enable the service department to make the required repairs more efficiently.

■ GENERAL PRECAUTIONS

Before attempting to set up or operate this instrument it is important to read the instruction manual. Failure to do so could result in personal injury or damage to the equipment.

The SMART3 Colorimeter should not be stored or used in a wet or corrosive environment. Care should be taken to prevent water or reagent chemicals from wet colorimeter tubes from entering the colorimeter chamber.

NEVER PUT WET TUBES IN COLORIMETER.

■ SAFETY PRECAUTIONS

Read the labels on all LaMotte reagent containers prior to use. Some containers include precautionary notices and first aid information. Certain reagents are considered hazardous substances and are designated with a * in the instruction manual. Material Safety Data Sheets (MSDS) can be found at www.lamotte.com. Read the MSDS before using these reagents. Additional emergency information for all LaMotte reagents is available 24 hours a day from the Poison Control Center listed in the front of the phone book or by contacting the 24 hour emergency line for ChemTel 1-800-255-3924 (USA, Canada, Puerto Rico); locations outside the North American Continent 813-248-0585 (call collect). Be prepared to supply the name and four-digit LaMotte code number found on the container label or at the top of the MSDS or in the contents list of the procedure. LaMotte reagents are registered with a computerized poison control information system available to all local poison control centers.

Keep equipment and reagent chemicals out of the reach of young children.

■ LIMITS OF LIABILITY

Under no circumstances shall LaMotte Company be liable for loss of life, property, profits, or other damages incurred through the use or misuse of its products.

■ WARRANTY

LaMotte Company warrants this instrument to be free of defects in parts and workmanship for 2 years from the date of shipment. If it should become necessary to return the instrument for service during or beyond the warranty period, contact our Technical Service Department at 1-800-344-3100 or tech@lamotte.com for a return authorization number or visit www.lamotte.com for troubleshooting help. The sender is responsible for shipping charges, freight, insurance and proper packaging to prevent damage in transit. This warranty does not apply to defects resulting from action of the user such as misuse, improper wiring, operation outside of specification, improper maintenance or repair, or unauthorized modification. LaMotte Company specifically disclaims any implied warranties or merchantability or fitness for a specific purpose and will not be liable for any direct, indirect, incidental or consequential damages. LaMotte Company's total liability is limited to repair or replacement of the product. The warranty set forth above is inclusive and no other warranty, whether written or oral, is expressed or implied.

■ SPECIFICATIONS

INSTRUMENT TYPE: Colorimeter

Readout	160 x 100 backlit LCD, 20 x 6 line graphical display
Wavelengths	428 nm, 525 nm, 568 nm, 635 nm
Wavelength Accuracy	±2% FS
Readable Resolution	Determined by reagent system
Wavelength Bandwidth	10 nm typical
Photometric Range	–2 to +2 AU
Photometric Precision	± 0.001 AU at 1.0 AU
Photometric Accuracy	±0.005 AU at 1.0 AU
Sample Chamber	Accepts 25 mm diameter flat-bottomed test tubes, 10 mm square cuvettes, 16 mm COD test tubes
Light Sources	4 LEDs
Detectors	4 silicon photodiodes with integrated interference filters
Modes	Pre-programmed tests, absorbance, %T
Pre-Programmed Tests	YES, with automatic wavelength selection
User Defined Tests	Up to 25 user tests can be input
Languages	English, Spanish, French, Portuguese, Italian, Chinese, Japanese
USB Port	Mini B
Power Requirements	USB wall adapter, USB computer connection or lithium ion rechargeable battery
Battery	Charge Life: Approximately 380 tests with backlight on to 1000 tests with backlight off. (Signal averaging disabled). Battery Life: Approximately 500 charges.
Electrical Rating	Provided on nameplate label
Data Logger	500 test results stored for download to a PC
Waterproof	IP67 with USB port plug in place
Dimensions (LxWxH)	3.5 x 7.5 x 2.5 inches, 8.84 x 19.05 x 6.35 cm
Weight	13 oz, 362 g (meter only)

■ STATISTICAL & TECHNICAL DEFINITIONS RELATED TO PRODUCT SPECIFICATIONS

Method Detection Limit (MDL): "The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte."[1] Note that, "As Dr. William Horwitz once stated, 'In almost all cases when dealing with a limit of detection or limit of determination, the primary purpose of determining that limit is to stay away from it.'"[2]

Accuracy: Accuracy is the nearness of a measurement to the accepted or true value.[3] The accuracy can be expressed as a range, about the true value, in which a measurement occurs (i.e. ±0.5 ppm). It can also be expressed as the % recovery of a known amount of analyte in a determination of the analyte (i.e. 103.5 %).

Resolution: Resolution is the smallest discernible difference between any two measurements that can be made.[4] For meters this is usually how many decimal places are displayed. (i.e. 0.01). Note that the resolution many change with concentration or range. In some cases the resolution may be less than the smallest interval, if it is possible to make a reading that falls between calibration marks. A word of caution, that resolution has very little relationship to accuracy or precision. The resolution will always be less than the accuracy or precision but it is not a statistical measure of how well a method of analysis works. The resolution can be very, very good and the accuracy and precision can be very bad! This is not a useful measure of the performance of a test method.

Repeatability: Repeatability is the within-run precision.[5] A run is a single data set, from set up to clean up. Generally, one run occurs on one day. However, for meter calibrations, a single calibration is considered a single run or data set, even though it may take 2 or 3 days.

Reproducibility: Reproducibility is the between-run precision.[6]

Detection Limit (DL): The detection limit (DL) for the 2020we/wi is defined as the minimum value or concentration that can be determined by the meter, which is greater than zero, independent of matrix, glassware, and other sample handling sources of error. It is the detection limit for the optical system of the meter.

[1] CFR 40, part 136, appendix B

[2] Statistics in Analytical Chemistry: Part 7 – A Review, D. Coleman and L Vanatta, American Laboratory, Sept 2003, P. 31.

[3] Skoog, D.A., West, D. M., *Fundamental of Analytical Chemistry*, 2nd ed., Holt Rinehart and Winston, Inc, 1969, p. 26.

[4] Statistics in Analytical Chemistry: Part 7 – A Review, D. Coleman and L Vanatta, American Laboratory, Sept 2003, P. 34.

[5] Jeffery G. H., Basset J., Mendham J., Denney R. C., *Vogel's Textbook of Quantitative Chemical Analysis*, 5th ed., Longman Scientific & Technical, 1989, p. 130.

[6] Jeffery G. H., Basset J., Mendham J., Denney R. C., *Vogel's Textbook of Quantitative Chemical Analysis*, 5th ed., Longman Scientific & Technical, 1989, p. 130

■ CONTENTS AND ACCESSORIES

CONTENTS

SMART3 Colorimeter

Test Tubes, with Caps

COD/UDV Adapter

USB Wall Adapter

USB Cable

SMART3 Colorimeter Quick Start Guide

SMART3 Colorimeter Manual

ACCESSORIES

Test Tubes, with Caps	Code 0290-6
USB Cable	Code 1720
USB Wall Adapter	Code 1721
COD/UDV Adapter	Code 1724
Car Charger	Code 5-0132
SMARTLink3 Program (CD)	Code 1901-CD
Small Field Carrying Case (37.5 27.5 x 13.75 cm)	Code 1910-GCS150
Large Field Carrying Case (45 x 32.5 x 20 cm)	Code 1910-GCS440

■ EPA COMPLIANCE

The SMART3 Colorimeter is an EPA-Accepted instrument. EPA-Accepted means that the instrument meets the requirements for instrumentation as found in test procedures that are approved for the National Primary Drinking Water Regulations (NPDWR) or National Pollutant Discharge Elimination System (NPDES) compliance monitoring programs. EPA-Accepted instruments may be used with approved test procedures without additional approval.

■ CE COMPLIANCE

The SMART3 Colorimeter has earned the European CE Mark of Compliance for electromagnetic compatibility and safety. The Declaration of Conformity for the SMART3 colorimeter is available at www.lamotte.com.

■ IP67 CERTIFICATION

The SMART3 meets IP67 standards for protection against dust and immersion only when the USB port plug is in place. Documentation is available at www.lamotte.com.

■ WATER SAMPLING FOR CHEMICAL ANALYSIS

Taking Representative Samples

The underlying factor to be considered for any type of water sampling is whether or not the sample is truly representative of the source. To properly collect a representative sample:

- Sample as frequently as possible.
- Collect a large sample or at least enough to conduct whatever tests are necessary.
- Make a composite sample for the same sampling area.
- Handle the sample in such a way as to prevent deterioration or contamination before the analysis is performed.
- Perform analysis for dissolved gases such as dissolved oxygen, carbon dioxide, and hydrogen sulfide immediately at the site of sampling. Samples for testing these factors, as well as samples for pH, cannot be stored for later examination.
- Make a list of conditions or observations which may affect the sample. Other considerations for taking representative samples are dependent upon the source of the sample. Taking samples from surface waters involves different considerations than taking samples from impounded and sub-surface waters.

Sampling of Open Water Systems

Surface waters, such as those found in streams and rivers, are usually well mixed. The sample should be taken downstream from any tributary, industrial or sewage pollution source. For comparison purposes samples may be taken upstream and at the source of the pollution before mixing.

In ponds, lakes, and reservoirs with restricted flow, it is necessary to collect a number of samples in a cross section of the body of water, and where possible composite samples should be made to ensure representative samples.

To collect samples from surface waters, select a suitable plastic container with a tight fitting screw cap. Rinse the container several times with the sample to be tested, then immerse the container below the surface until it is filled to overflowing and replace the cap. If the sample is not to be tested immediately, pour a small part of the sample out and reseal. This will allow for any expansion. Any condition which might affect the sample should be listed.

Sub-surface sampling is required to obtain a vertical profile of streams, lakes, ponds, and reservoirs at specific depths. This type of sampling requires more sophisticated sampling equipment.

For dissolved oxygen studies, or for tests requiring small sample sizes, a Water

Sampler (LaMotte Code 1060) will serve as a subsurface or in-depth sampler. This weighted device is lowered to the sampling depth and allowed to rest at this depth for a few minutes. The water percolates into the sample chamber displacing the air which bubbles to the surface. When the bubbles cease to rise, the device has flushed itself approximately five times and it may be raised to the surface for examination. The inner chamber of the sampling device is lifted out and portions of the water sample are carefully dispensed for subsequent chemical analysis.

A Snap-Plunger Water Sampler (LaMotte Code 1077) is another “in-depth” sampling device which is designed to collect large samples which can be used for a multitude of tests. Basically, this collection apparatus is a hollow cylinder with a spring loaded plunger attached to each end. The device is cocked above the surface of the water and lowered to the desired depth. A weighted messenger is sent down the calibrated line to trip the closing mechanism and the plungers seal the sample from mixing with intermediate layers as it is brought to the surface. A special drain outlet is provided to draw off samples for chemical analysis.

Sampling of Closed System

To obtain representative samples from confined water systems, such as pipe lines, tanks, vats, filters, water softeners, evaporators and condensers, different considerations are required because of chemical changes which occur between the inlet and outlet water. One must have a basic understanding of the type of chemical changes which occur for the type of equipment used. Also, consideration should be given to the rate of passage and retaining time for the process water.

Temperature changes play an important part in deciding exactly what test should be performed. Process water should be allowed to come to room temperature, 20–25°C, before conducting any tests.

When drawing off samples from an outlet pipe such as a tap, allow sample to run for several minutes, rinsing the container several times before taking the final sample. Avoid splashing and introduction of any contaminating material.

■ FILTRATION

When testing natural waters that contain significant turbidity due to suspended solids and algae, filtration is an option. Reagent systems, whether EPA, Standard Methods, LaMotte or any others, will generally only determine dissolved constituents. Both EPA and Standard Methods suggest filtration through a 0.45 micron filter membrane, to remove turbidity, for the determination of dissolved constituents.** To test for total constituents, organically bound and suspended or colloidal materials, a rigorous high temperature acid digestion is necessary.

**LaMotte offers a filtering apparatus: syringe assembly (Code 1050) and membrane filters, 0.45 micron, (Code 1103).

■ AN INTRODUCTION TO COLORIMETRIC ANALYSIS

Most test substances in water are colorless and undetectable to the human eye. To test for their presence we must find a way to “see” them. The SMART3 Colorimeter can be used to measure any test substance that is itself colored or can be reacted to produce a color. In fact a simple definition of colorimetry is “the measurement of color” and a colorimetric method is “any technique used to evaluate an unknown color in reference to known colors”. In a colorimetric chemical test the intensity of the color from the reaction must be proportional to the concentration of the substance being tested. Some reactions have limitations or variances inherent to them that may give misleading results. Many such interferences are discussed with each particular test instruction. In the most basic colorimetric method the reacted test sample is visually compared to a known color standard. However, accurate and reproducible results are limited by the eyesight of the analyst, inconsistencies in the light sources, and the fading of color standards.

To avoid these sources of error, a colorimeter can be used to photoelectrically measure the amount of colored light absorbed by a colored sample in reference to a colorless sample (blank).

White light is made up of many different colors or wavelengths of light. A colored sample typically absorbs only one color or one band of wavelengths from the white light. Only a small difference would be measured between white light before it passes through a colored sample versus after it passes through a colored sample. The reason for this is that the one color absorbed by the sample is only a small portion of the total amount of light passing through the sample. However, if we could select only that one color or band of wavelengths of light to which the test sample is most sensitive, we would see a large difference between the light before it passes through the sample and after it passes through the sample.

The SMART3 Colorimeter passes one of four colored light beams through one of four optical filters which transmits only one particular color or band of wavelengths of light to the photodectector where it is measured. The difference in the amount of colored light transmitted by a colored sample is a measurement of the amount of colored light absorbed by the sample. In most colorimetric tests the amount of colored light absorbed is directly proportional to the concentration of the test factor producing the color and the path length through the sample. However, for some tests the amount of colored light absorbed is inversely proportional to the concentration.

The choice of the correct wavelength for testing is important. It is interesting to note that the wavelength that gives the most sensitivity (lower detection limit) for a test factor is the complementary color of the test sample. For example the Nitrate-Nitrogen test produces a pink color proportional to the nitrate-nitrogen concentration in the sample (the greater the nitrate-nitrogen concentration, the darker the pink color). A wavelength in the green region should be selected to analyze this sample since a pinkish-red solution absorbs mostly green light.

■ REAGENT BLANK

Some tests will provide greater accuracy if a reagent blank is determined to compensate for any color or turbidity resulting from the reagents themselves. A reagent blank is performed by running the test procedure on demineralized or deionized water. Use sample water to SCAN BLANK. Insert the reacted reagent blank in the colorimeter chamber and select SCAN SAMPLE. Note result of reagent blank. Perform the tests on the sample water as described. Subtract results of reagent blank from all subsequent test results. NOTE: Some tests require a reagent blank to be used to SCAN BLANK.

■ COLORIMETER TUBES

Colorimeter tubes which have been scratched through excessive use should be discarded and replaced with new ones. Dirty tubes should be cleaned on both the inside and outside. Fingerprints on the exterior of the tubes can cause excessive light scattering and result in errors. Handle the tubes carefully, making sure the bottom half of the tube is not handled.

LaMotte Company makes every effort to provide high quality colorimeter tubes. However, wall thicknesses and diameter of tubes may still vary slightly. This may lead to slight variations in results (e.g. if a tube is turned while in the sample chamber, the reading will likely change slightly). To eliminate this error put the tubes into the sample chamber with the same orientation every time.

The tubes that are included with the colorimeter have an index mark to facilitate this. If possible, use the same tube to SCAN BLANK and SCAN SAMPLE.

■ METER CARE

The optical system of the SMART3 must be kept clean and dry for optimal performance. Dry the colorimeter tubes before placing them in the chamber to avoid introducing moisture. For best results store the instrument in a area that is dry and free from aggressive chemical vapors.

■ SELECTING AN APPROPRIATE WAVELENGTH

The most appropriate wavelength to use when creating a calibration curve is usually the one which gives the greatest change from the lowest reacted standard concentration to the highest reacted standard concentration. However, the absorbance of the highest reacted standard concentration should never be greater than 2.0 absorbance units. Scan the lowest and highest reacted standards at different wavelengths using the absorbance mode to find the wavelength which gives the greatest change in absorbance without exceeding 2.0 absorbance units. Use this wavelength to create a calibration curve.

Below is a list of suggested wavelengths for the color of the reacted samples. Use these as a starting point.

Sample Color	Wavelength Range
Yellow	428
Pink	525
Red	568
Green and Blue	635

■ CALIBRATION

As with all pre-calibrated meters, it is highly recommended, even if not required by regulations, that the user periodically verify the performance of the meter by running standards with a predetermined concentration. Results outside of specification are an indication that the meter needs to be adjusted. This can be done following the user calibration described on page 28. If the user calibration fails to properly adjust the meter then the meter should be returned to LaMotte Company for recalibration. (See page 65).

■ CALIBRATION CURVES

The SMART3 Colorimeter contains tests for the LaMotte reagent systems. The first step in using a non-LaMotte reagent system with your SMART3 Colorimeter is to create a calibration curve for the reagent system. To create a calibration curve, prepare standard solutions of the test factor and use the reagent system to test the standard solutions with the SMART3 Colorimeter. Select a wavelength for the test as described above.

Plot the results (in ABS or %Transmittance) versus concentration to create a calibration curve. The calibration curve may then be used to identify the concentration of an unknown sample by testing the unknown, reading Absorbance or %T, and finding the corresponding concentration from the curve. The linear range of the reagent system can be determined and this information can be used to input a User Test into the SMART3 Colorimeter (see Edit User Tests, page 41).

PROCEDURE

Prepare 5 or 6 standard solutions of the factor being tested. The concentration of these standards should be evenly distributed throughout the range of the reagent system, and should include a 0 ppm standard (distilled water). For instance, the solutions could measure 0, 10%, 30%, 50%, 70%, and 90% of the system's maximum range.

1. Turn on the SMART3 Colorimeter. Select the appropriate wavelength from the absorbance mode. Be sure to select the appropriate wavelength for the color produced by the reagent system.

2. Use the unreacted 0 ppm standard to standardize the colorimeter by using it

to scan blank.

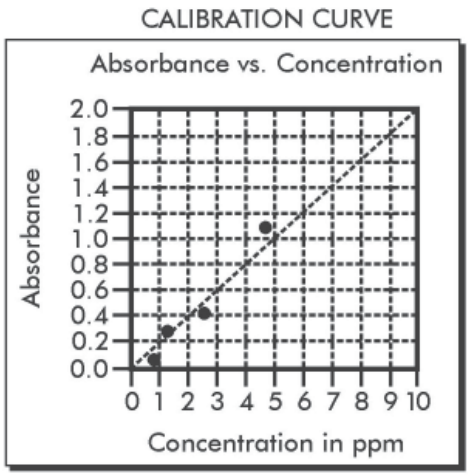
3. Following the individual reagent system instructions, react each standard solution beginning with 0 ppm. Continue with standards in increasing concentration. Record the reading and the standard solution concentration on a chart. Readings can be recorded as percent transmittance (%T) or absorbance (A).

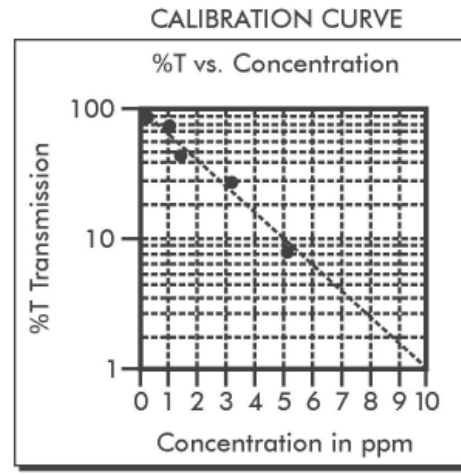
4. Plot results on graph paper or computer using any available plotting program. If results are as %T versus concentration, semilog graph paper must be used. Plot the standard solution concentrations on the horizontal, linear axis, and the %T on the vertical, logarithmic axis. If results are as absorbance versus standard solution concentration, simple linear graph paper can be used. Plot the standard solution concentration on the horizontal axis, and the absorbance on the vertical axis.

5. After plotting the results, draw a line, or curve, of best fit through the plotted points. The best fit may not connect the points. There should be approximately an equal number of points above the curve as below the curve. Some reagent systems will produce a straight line, while others produce a curve. Many computer spreadsheet programs can produce the curve of best fit by regression analysis of the standard solution data.

NOTE: Only reagent systems which produce a straight line can be used for a User Test.

A sample of each type of graph appears below:





PREPARING DILUTE STANDARD SOLUTIONS

Standard solutions should be prepared to create a calibration curve. Standard solutions can be prepared by diluting a known concentrated standard by specified amounts. A chart or computer spreadsheet can be created to determine the proper dilutions. Use volumetric flasks and volumetric pipets for all dilutions.

1. In Column A – Record the maximum concentration of test as determined by the range and path length.
2. In Column B – Record the percent of the maximum concentration the standard solution will be.
3. In Column C – Calculate the final concentration of the diluted standard solutions by multiplying the maximum concentration (In Column A) by the % of maximum concentration divided by 100. ($C = A \times {}^{B}/_{100}$).
4. In Column D – Record the final volume of the diluted sample (i.e. volume of volumetric flask).
5. In Column E – Record the concentration of the original standard.
6. In Column F – Calculate the milliliters of original standard required ($F = (C \times {}^{D}/_{E})$).

A sample chart appears below:

A	B	C = A x $^{B}/_{100}$	D	E	F = C x $^{D}/_{E}$
Maximum concentration of test	% of Maximum concentration	Final concentration of Diluted Standard	Volume of Standard	Concentration of Original Standard	mL of Original Standard Required
10.0 ppm	90	9.0 ppm	100 mL	1000 ppm	0.90 mL
10.0 ppm	70	7.0 ppm	100 mL	1000 ppm	0.70 mL
10.0 ppm	50	5.0 ppm	100 mL	1000 ppm	0.50 mL
10.0 ppm	30	3.0 ppm	100 mL	1000 ppm	0.30 mL
10.0 ppm	10	1.0 ppm	100 mL	1000 ppm	0.10 mL
10.0 ppm	0	0 ppm	100 mL	1000 ppm	0 mL

■ STANDARD ADDITIONS

A common method to check the accuracy and precision of a test is by standard additions. In this method a sample is tested to determine the concentration of the test substance. A second sample is then "spiked" by the addition of a known quantity of the test substance. The second sample is then tested. The determined concentration of the spiked sample should equal the concentration of the first plus the amount added with the spike. The procedure can be repeated with larger and larger "spikes." If the determined concentrations do not equal the concentration of the sample plus that added with the "spike", then an interference may exist.

For example, a 10.0 mL water sample was determined to contain 0.3 ppm iron. To a second 10.0 mL sample, 0.1 mL of 50 ppm iron standard was added. The concentration of iron due to the "spike" was (0.10 mL x 50 ppm)/10.0 mL = 0.50 ppm. The concentration of iron determined in the spiked sample should be 0.3 + 0.5 = 0.8 ppm iron. (Note: any error due to the increased volume from the "spike" is negligible).

LaMotte offers a line of calibration standards which can be used to generate calibration curves and perform standard additions.

■ SAMPLE DILUTION TECHNIQUES & VOLUMETRIC MEASUREMENTS

If a test result using the SMART3 Colorimeter gives an over range message then the the sample must be diluted. The test should be repeated on the diluted sample to obtain a reading which is in the concentration range for the test. (Note: This is not true for colorimetric determination of pH.)

Example:

Measure 5 mL of the water sample into a graduated cylinder. Add demineralized water until the cylinder is filled to the 10 mL line. The sample has been diluted by one-half, and the dilution factor is therefore 2. Perform the test procedure, then multiply the resulting concentration by 2 to obtain the test result.

The following table gives quick reference guidelines on dilutions of various proportions. All dilutions are based on a 10 mL volume, so several dilutions will require small volumes of the water sample. Graduated pipets should be used for all dilutions.

Size of Sample	Deionized Water to Bring Volume to 10 mL	Multiplication Factor
10 mL	0 mL	1
5 mL	5 mL	2
2.5 mL	7.5 mL	4
1 mL	9 mL	10
0.5 mL	9.5 mL	20

If the above glassware is not available, dilutions can be made with the colorimeter tube. Fill the tube to the 10 mL line with the sample then transfer it to another container. Add 10 mL volumes of demineralized water to the container and mix. Transfer back 10 mL of the diluted sample to the tube and follow the test procedure. Continue diluting and testing until a reading, which is in the concentration range for the test, is obtained. Be sure to multiply the concentration found by the dilution factor (the number of total 10 mL volumes used).

Example:

10 mL of sample is diluted with three 10 mL volumes of demineralized water; the dilution factor is four.

■ INTERFERENCES

LaMotte reagent systems are designed to minimize most common interferences. Each individual test instruction discusses interferences unique to that test. Be aware of possible interferences in the water being tested.

The reagent systems also contain buffers to adjust the water sample to the ideal pH for the reaction. It is possible that the buffer capacity of the water sample may exceed the buffer capacity of the reagent system and the ideal pH will not be obtained. If this is suspected, measure the pH of a reacted distilled water reagent blank using a pH meter. This is the ideal pH for the test. Measure the pH of a reacted water sample using the pH meter. If the pH is significantly different from the ideal value, the pH of the sample should be adjusted before testing.

Interferences due to high concentration of the substance being tested, can be overcome by sample dilution (see page 16)

■ STRAY LIGHT INTERFERENCE

When scanning samples in 16 mm tubes, such as COD, the sample chamber lid can not be closed. The COD adapter minimizes stray light. To further reduce stray light interference, do not scan sample in direct sunlight.

OPERATION OF THE SMART3 COLORIMETER

■ OVERVIEW

The SMART3 is a portable, microprocessor controlled, direct reading colorimeter. It has a graphical liquid crystal display and 6 button keypad. These allow the user to select options from the menu driven software, to directly read test results or to review stored results of previous tests in the data logger. The menus can be displayed in seven different languages.

The test library consists of over 80 LaMotte tests and 25 “User Tests”. The LaMotte tests are precalibrated for LaMotte reagent systems.The colorimeter displays the result of these tests directly in units of concentration. The 25 “User Tests” may be used to enter additional calibrations. All of these tests may be arranged in any of 3 sequences. These sequences can be modified a limitless number of times to meet changing testing needs.

The optics feature 4 different colored LEDs. Each LED has a corresponding silicon photoiode with an integrated interference filter. The interference filters select a narrow band of light from the corresponding LED for the colorimetric measurements. The microporcessor automatically selects the correct LED/ photodiode combination for the test.

A USB wall adapter, USB computer connection or lithium battery powers the SMART3.

A USB port on the back of the meter allows an interface of the meter with a Windows-based computer for real-time data acquisition and data storage using a PC. The SMART3 may be interfaced with any Windows-based computer by using the LaMotte SMARTLink3 Program.

■ COMPONENTS

Figure 1 shows a diagram of the SMART3 Colorimeter and its components.

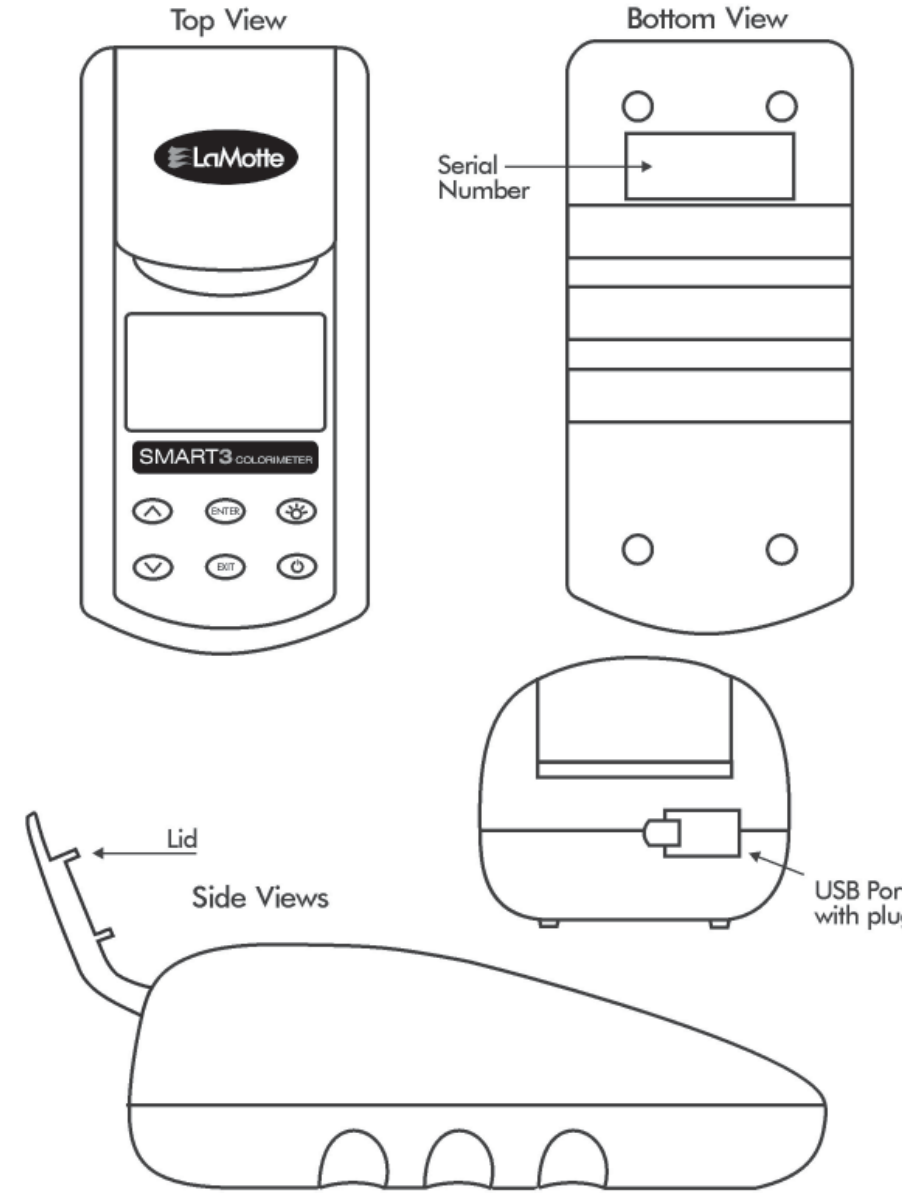


Figure 1

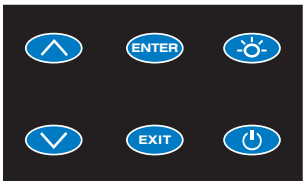
GENERAL OPERATING PROCEDURES

The operation of the SMART3 Colorimeter is controlled by a microprocessor. The microprocessor is programmed with menu driven software. A menu is a list of choices. This allows a selection of various tasks for the colorimeter to perform, such as, scan blank, scan sample, and edit test sequences. The keypad is used to make menu selections which are viewed in the display. There are three selections accessible from the Main Menu: Testing Menu, Editing Menu and Run PC Link.

■ THE KEYPAD

The keypad has 6 buttons which are used to perform specific tasks.

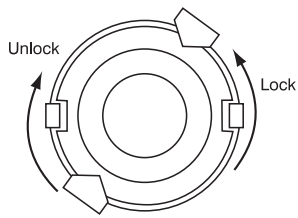
	This button will scroll up through a list of menu selections.
	The button is used to select choices in a menu viewed in the display.
	This button controls the backlight on the display.
	This button will scroll down through a list of menu selections.
	This button exits to the previous menu.
	This button turns the meter on or off.



■ SAMPLE HOLDERS

The sample chamber is designed for 25 mm round tubes. An adapter to hold 16 mm COD tubes and 1 cm square UDV cuvettes is included.

Position the COD/UDV Adapter (Code 1724) so that the notches in the adapter fit around the posts on the chamber. Turn the adapter counterclockwise until the arrows are at the top and bottom of the chamber and the adapter is locked into place. Turn the adapter clockwise to unlock the adapter and remove it from the chamber.

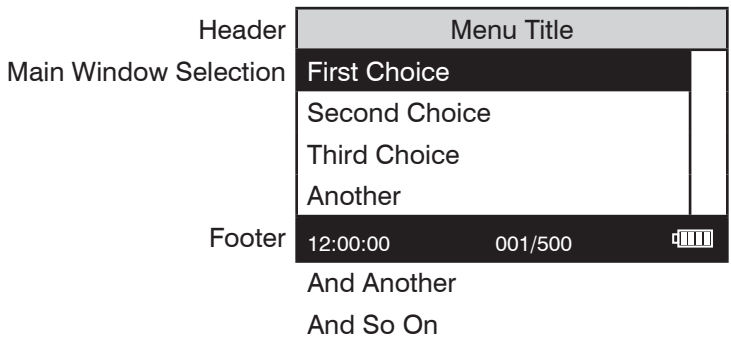


■ THE DISPLAY & THE MENUS

The display allows menu selections to be viewed and selected. These selections instruct the SMART3 to perform specific tasks. The menus are viewed in the display using two general formats that are followed from one menu to the next. Each menu is a list of choices or selections.

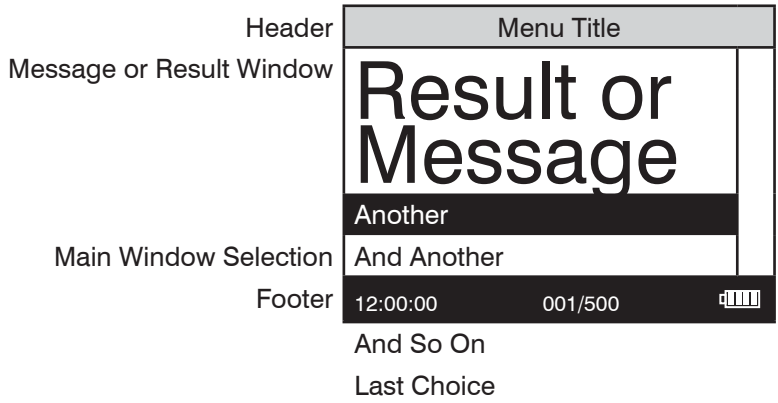
The display has a header line at the top and a footer line at the bottom. The header displays the title of the current menu. The footer line displays the time and the date, the data logger status and the battery status. The menu selection window is in the middle of the display between the header and the footer.

The menu selection window displays information in two general formats. In the first format only menu selections are displayed. Up to 4 lines of menu selections may be displayed. If more selections are available they can be viewed by pressing the arrow buttons to scroll the other menu selections into the menu selection window. Think of the menu selections as a vertical list in the display that moves up or down each time an arrow button is pressed. Some menus in the SMART3 are looping menus. The top and bottom menu choices are connected in a loop. Scrolling down past the bottom of the menu will lead to the top of the menu. Scrolling up past the top of the menu will lead to the bottom of the menu.



A black bar will indicate the menu choice. As the menu is scrolled through, the black bar will highlight different menu choices. Pressing the ENTER button will select the menu choice that is indicated by the black bar.

In the second format the menu choice window takes advantage of the graphical capabilities of the display. Large format graphic information, such as test results or error messages or the LaMotte logo is displayed. The top two lines of the display are used to display information in a large, easy to read format. The menus work in the same way as previously described but two lines of the menu are visible at the bottom of the display.



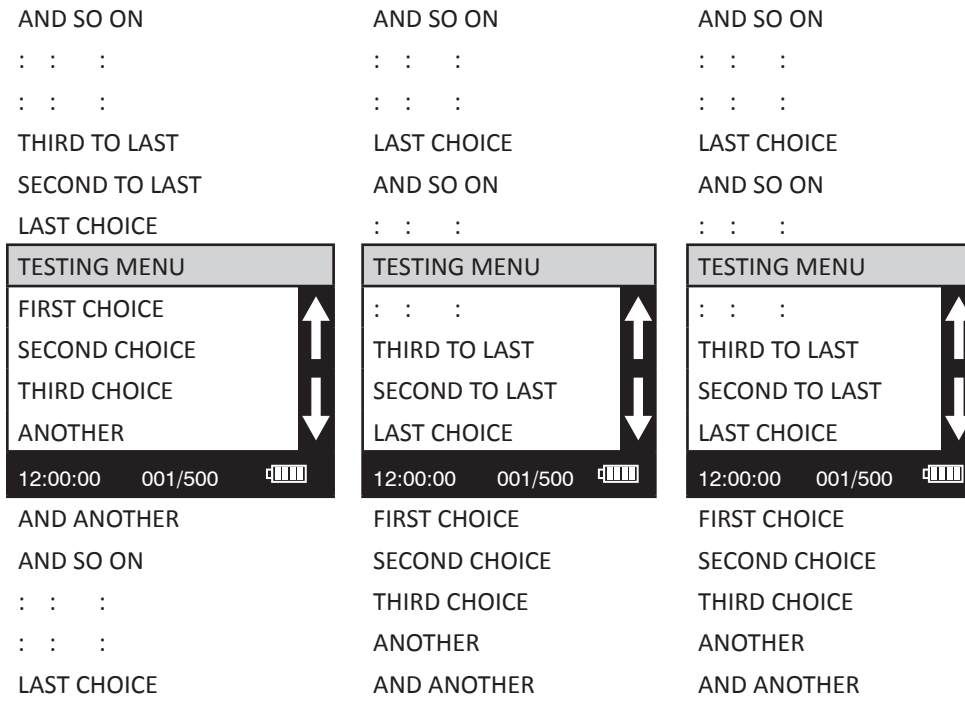
As described previously, the EXIT button allows an exit or escape from the current menu and a return to the previous menu. This allows a rapid exit from an inner menu to the main menu by repeatedly pushing the EXIT button. Pushing ⏻ at any time will turn the SMART3 off.

The display may show the following messages:

	Battery Status
	More choices are available and can be viewed by scrolling up and/or down through the display.
Header	Identifies the current menu and information on units and reagent systems if applicable.
Footer	In the data logging mode the number of the data point is displayed and the total number of data points in the memory will be shown. The footer also shows current time and battery status

■ LOOPING MENUS

Long menus, such as All Tests, incorporate a looping feature which allows the user to quickly reach the last choice in the menu from the first choice. In a looping menu the last choices in the menu are above the first choice and scrolling upward moves through the menu in reverse order. Scrolling downward moves through the menu from first choice to last but the menu starts over following the last choice. So all menu choices can be reached by scrolling in either direction. The diagrams below demonstrate a looping menu.

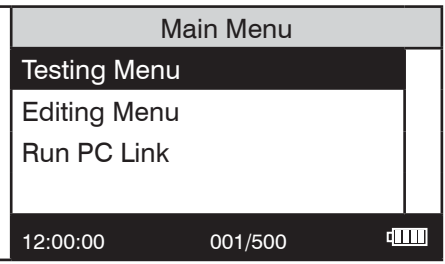


TESTING

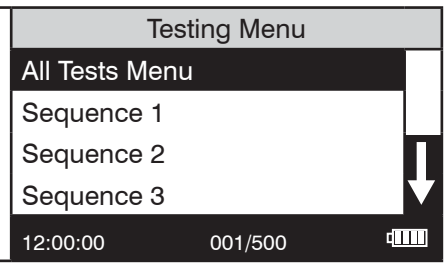
■ TESTING MENU

The Testing Menu is used to run all LaMotte pre-programmed tests, User Tests and Absorbance tests at one of four wavelengths. Testing from any of three sequences can also be done.

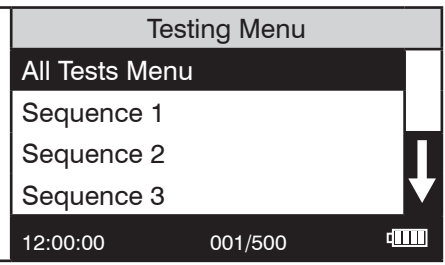
1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.



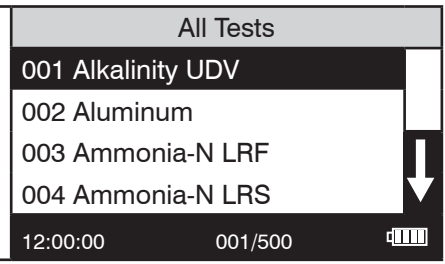
2. Press ENTER to select **Testing Menu**.



3. Press ^ or v to scroll to desired option. **All Tests** contains all of the available pre-programmed tests. The three sequences have user selected tests. Absorbance has %T/ABS tests.



4. Press ENTER to select the option.



■ TEST SEQUENCES

Sequence 1, Sequence 2, And Sequence 3 are alterable sequences. They may be edited using the Editing Menu. Any of the LaMotte pre-programmed tests or User Tests may be placed in these sequences in whatever testing order that is preferred. Some examples of typical sequences are given below.

Sequence 1	Sequence 2	Sequence 3
015 Chlorine F UDV	002 Aluminum	003 Ammonia-N LRF
079 Phosphate HR	035 Cyanuric Acid	032 Cu UDV
009 Benzotriazole	053 Iron Phenanthro	064 Nitrate-N LR
076 pH UDV	055 Manganese LR	067 Nitrite-N LR
12:00:00 001/500	12:00:00 001/500	12:00:00 001/500
061 Molybdenum HR	064 Nitrate-N LR	074 pH PR
086 Silica HR	067 Nitrite-N LR	078 Phosphate LR
045 Hydrazine	077 Phenol	085 Silica LR
032 Cu UDV	078 Phosphate LR	
051 Iron Bipyridyl	090 Sulfide LR	

These alterable sequences allow a series of tests to be setup that are run frequently. The order of the individual tests in the sequence is determined by the user. After running a test, press ENTER to select the next test in the sequence. Continue this pattern until the entire sequence has been completed.

All Tests is a fixed sequence containing the LaMotte pre-programmed tests, User Tests, and Absorbance tests.
Modification of the alterable sequences is accomplished through the Editing Menu. This menu is explained in greater detail in Editing Menu (p. 35).

Pressing EXIT while in a sequence menu will escape back to the Testing Menu.

Pressing ⏻ the at any time will turn the colorimeter off.

■ GENERAL TESTING PROCEDURES

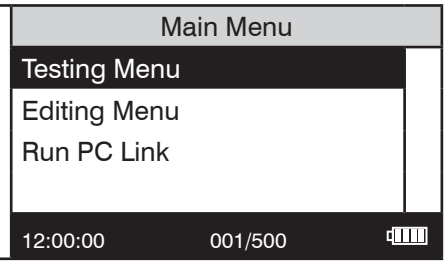
The following are some step by step examples of how to run tests from the Testing Menu. These test procedures are designed to be used with LaMotte SMART Reagent Systems.

LaMotte Company continuously updates the list of pre-programmed tests as the calibrations become available. Pre-programmed calibrations can be added to the SMART3 Colorimeter in the field. A Windows-based computer running a Windows Operating System is required.

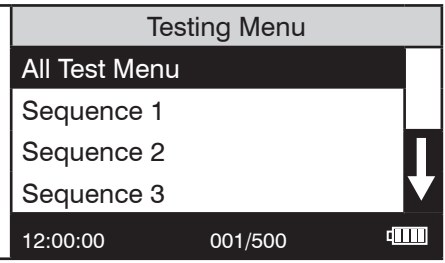
Call LaMotte Technical Services at 1-800-344-3100 (410-778-3100 outside the USA) or email at tech@lamotte.com for a current list of available calibrations and downloading instructions.

■ TESTING WITH LaMOTTE PRE-PROGRAMMED TESTS

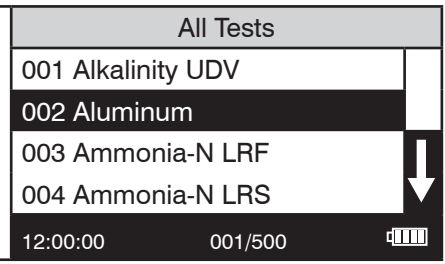
1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.



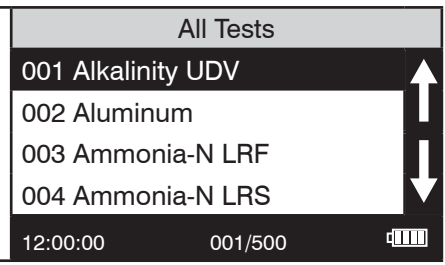
2. Press ENTER to select **Testing Menu**.



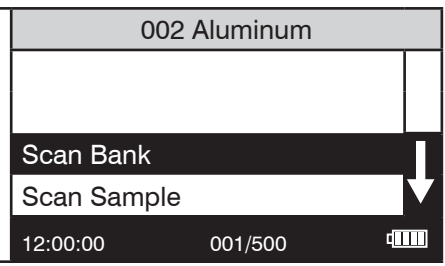
3. Press ENTER to select **All Tests Menu**.



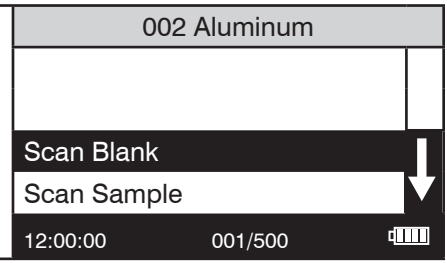
4. Press ^ or v to scroll to the desired test.



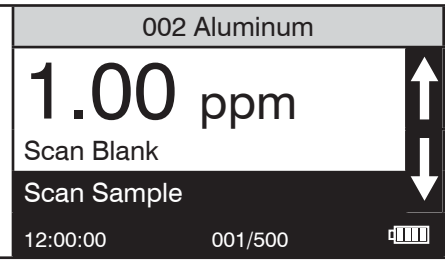
5. Press ENTER to select the test.



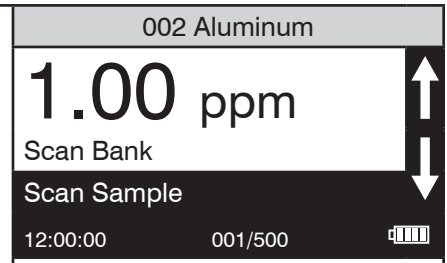
6. Insert the blank into the chamber. Close the lid.Press ENTER to scan the blank. The screen wil display **Blank Done** for about 1 second and then return to the **Test Menu**.



7. Insert the reacted sample into the chamber. Close the lid. Press ENTER to scan the sample. The screen will display **READING** for about 1 second. The result will appear on the screen.



8. To repeat the test, press ENTER to scan the sample again. The last blank scaned is used by the colorimeter for repeated scans. A different blank can be used by pressing ^ or v to scroll to Scan Blank and then scanning another blank. Scroll with ^ or v and make another selection with ENTER. The %T or Absorbance of the last test can be viewed by choosing %T/Abs. Press EXIT to escape to previous menus. NOTE: The menus loop in this screen so either ^ or v will lead to the menu selection needed.



■ CALIBRATING LaMOTTE PRE-PROGRAMMED TESTS

The LaMotte Pre-Programmed Tests have been pre-calibrated. Recalibration of the pre-programmed tests by the user is not possible. However, a procedure to standardize the calibration can be performed to obtain the most accurate readings or to meet regulatory requirements.

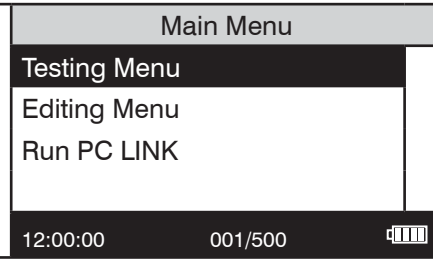
The LaMotte Pre-Programmed tests are standardized with one standard solution. To standardize over the full range of the test, the concentration of the standard should be chosen from the high end of the range. Alternatively, if samples do not cover the full range of the test, a standard should be chosen that is close to the concentration of the samples.

The standardization procedure should be followed as often as required by regulations and laws for compliance monitoring.

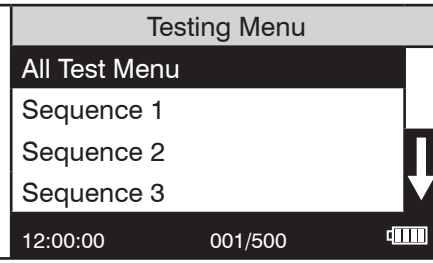
In the example below, the Aluminum calibration will be standardized.

Prepare a standard solution to be tested. In this example, 0.30 ppm aluminum.

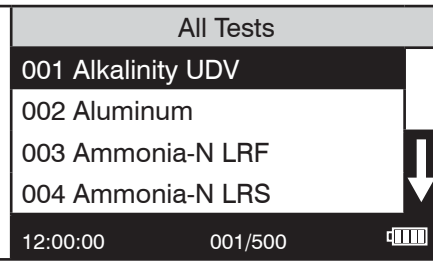
1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.



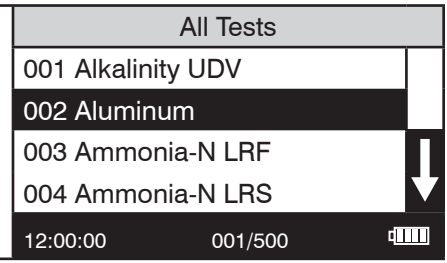
2. Press ENTER to select **Testing Menu**.



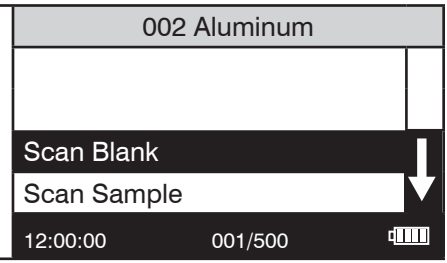
3. Press ENTER to select **All Tests Menu**.



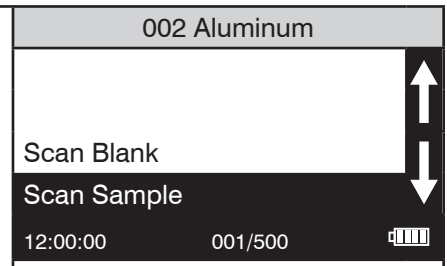
4. Press ^ or v to scroll to the desired test factor.



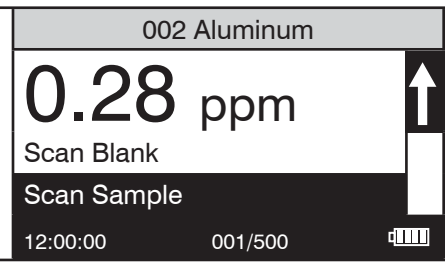
5. Press ENTER to select the test.



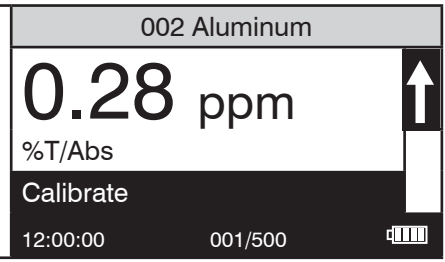
6. Follow the test procedure in the manual to test the prepared standard. Insert the blank into the chamber. Close the lid. Press ENTER to scan the blank. The screen will display **Blank Done** for about 1 second and then return to the **Test Menu**.



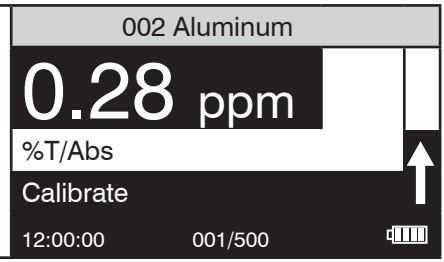
7. Insert the reacted standard solution into the chamber. Close the lid. Press ENTER to scan the sample. The screen will display **Reading** for about 1 second. The result will appear on the screen.



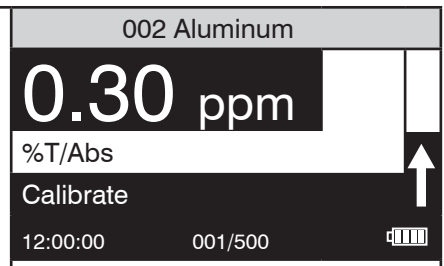
8. The displayed result can now be standardized. Press ^ or v to scroll to calibrate.



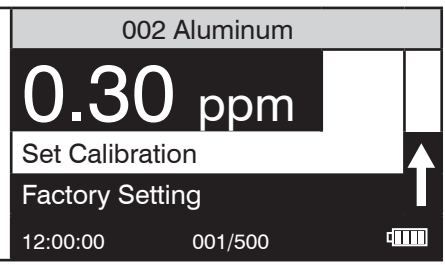
9. Press ENTER to select **Calibrate**. A reverse font (dark background with light characters) will appear to indicate that the reading can be adjusted.



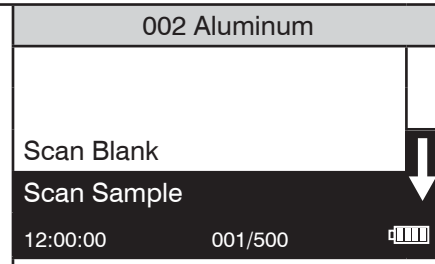
10. Press ^ or v to scroll to the concentration of the prepared standard, 0.30 in this example.
NOTE: A maximum adjustment of 10% is possible. If an adjustment of over 10% is attempted, Overrange will be displayed.



11. Press ENTER to select **Calibrate**. Two menu choices will be offered, set calibration and factory setting.

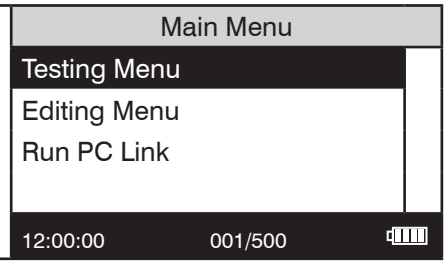


12. Press ENTER to select **Set Calibration** and save the calibration. Or press ▼ to scroll to **Factory Setting**. Press ENTER to select **Factory Setting** to revert to the factory calibration. The screen will display **Storing...** for about 1 second and the test menu will appear. The calibration has now been standardized and the meter can be used for testing. The standardization can be removed by repeating the calibration and selecting **Factory Setting**.

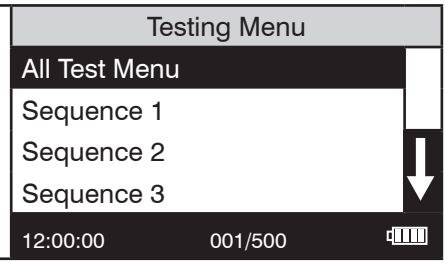


■ MEASURING IN THE ABSORBANCE MODE

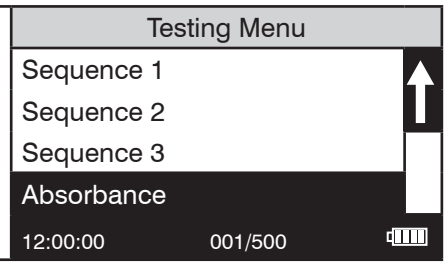
1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.



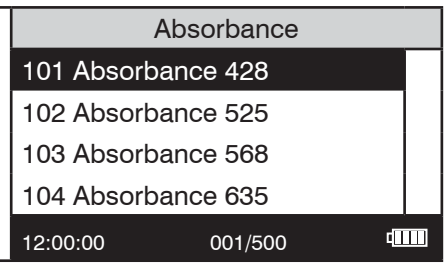
2. Press ENTER to select **Testing Menu**.



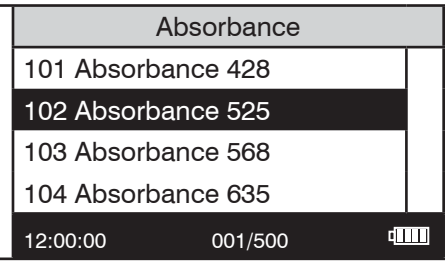
3. Press ^ or v to scroll to **Absorbance**.



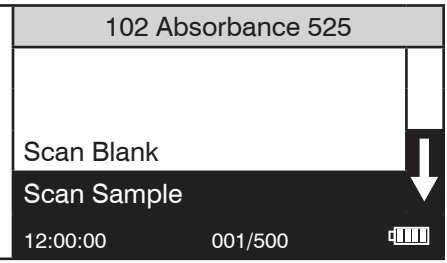
4. Press ENTER to select **Absorbance**.



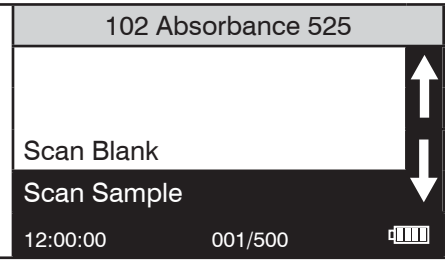
5. Press ▲ or ▼ to scroll to desired wavelength.



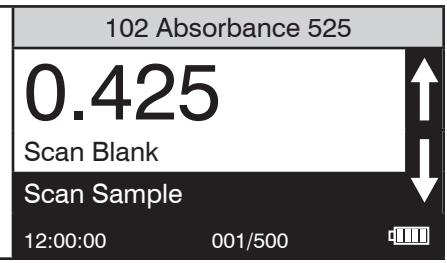
6. Press ENTER to select the wavelength.



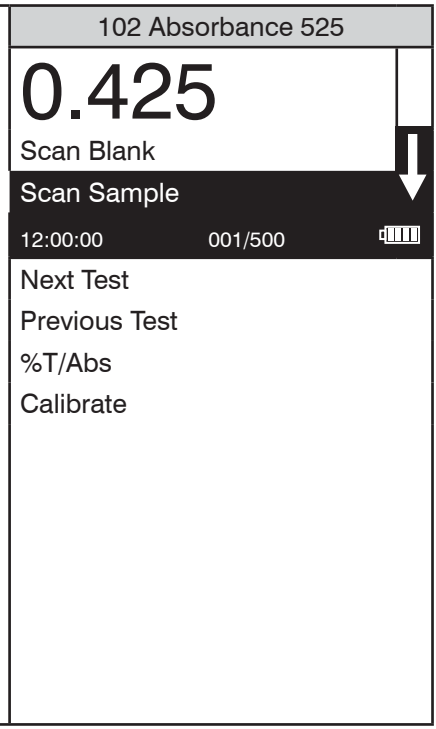
7. Insert the blank. Close the lid. Press ENTER to scan the blank. The screen wil display **Blank Done** for about 1 second and return to the Absorbance menu.



8. Insert the reacted sample. Press ENTER to scan the sample. The screen will display **Reading** for about 1 second. The result will appear on the screen.



9. To repeat the test, press ENTER to scan the sample again. The last blank scanned is used by the colorimeter for repeated scans. A different blank can be used by pressing ^ or v to scroll to **Scan Blank** and then scanning another blank. Scroll with ^ or v and make another selection with ENTER.The %T or Absorbance of the last test can be viewed by choosing %T/Abs. Press EXIT to escape to previous menus.
NOTE: The menus loop in this screen so either ^ or v will lead to the menu selection needed.
NOTE: The calibrate function does not work in the Absorbance mode.



EDITING MENU

The Editing Menu allows the user to edit sequences, edit user tests, set the clock, edit the logging function, access factory setting, set the power saving function, set the backlight time, and select a language.

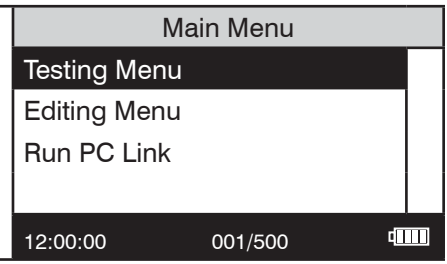
The default factory settings are:

Date Format	MM-DD-YYYY
Logging	Enabled
Power Save	5 minutes
Backlight	10 seconds
Language	English

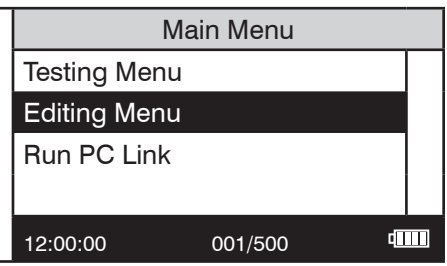
■ EDITING A SEQUENCE

The Edit Sequence menu allows three alterable test sequences (Sequence 1, Sequence 2, Sequence 3) to be edited.

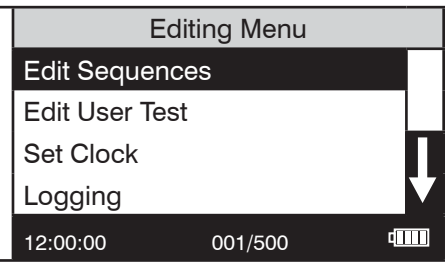
1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.



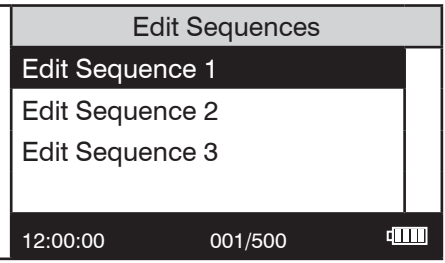
2. Press ▲ or ▼ to scroll to the **Editing Menu.**



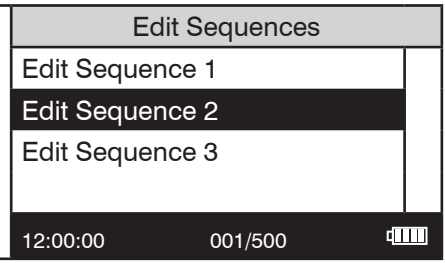
3. Press ENTER to select **Editing Menu**.



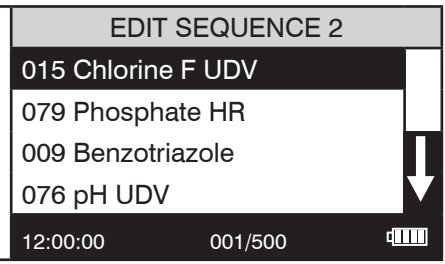
4. Press ENTER to select **Edit Sequences**.



5. Press ^ or v to scroll to the desired sequence.



6. Press ENTER to select the sequence to be edited.



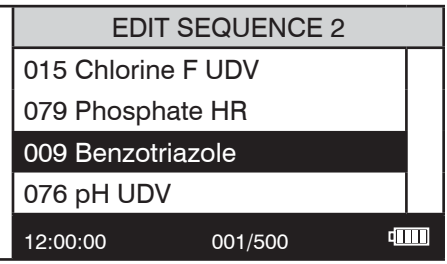
■ ADDING OR DELETING A TEST

There are three ways to alter a sequence: Insert Before, Insert After, and Delete. Insert Before adds a new test to the sequence before the selected test. Insert After adds a new test to the sequence after the selected test. Delete is used to remove an existing test from a sequence.

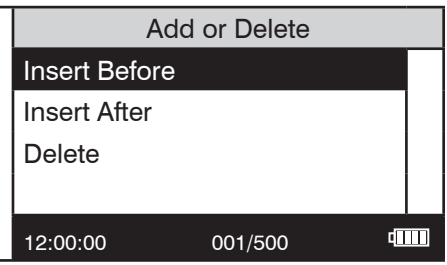
ADDING A TEST

Below is a step-by-step example of how to add a test to SEQUENCE 2 starting from the EDIT SEQUENCE 2 menu.

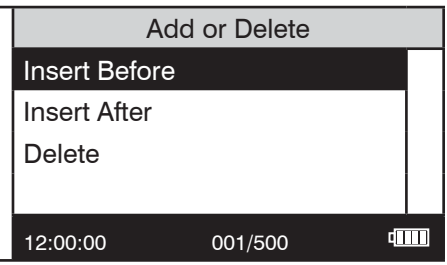
1. To add a test before or after an existing test, press ^ or v to scroll to the existing test.



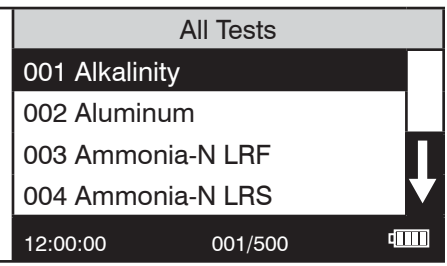
2. Press ENTER to select the existing test.



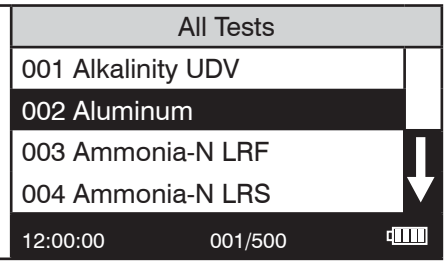
3. Press ^ or v to scroll to **Insert Before** or **Insert After**.



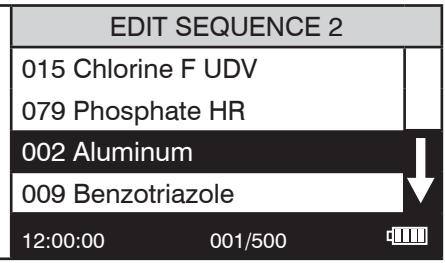
4. Press ENTER to select the option, **Insert Before**, in this example. The **All Test Menu** will appear.



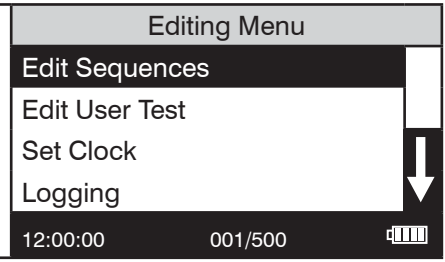
5. Press ^ or v to scroll to the test that will be added to the sequence. In this example, Aluminum.



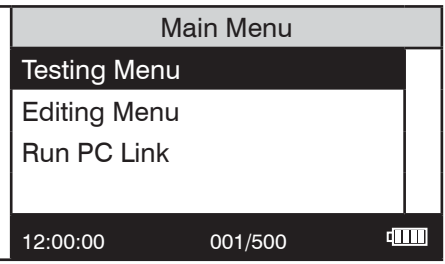
6. Press ENTER to select the test. The sequence will appear in the Edit Sequence menu and the new test will be added to the sequence. All changes in the sequence will be automatically saved.



7. Press EXIT to exit the **Edit Sequence** menu and return to the **Editing Menu**.



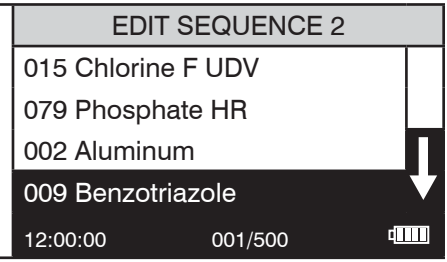
8. Press ENTER to select **Edit Sequences** to continue editing the sequences or press EXIT to return to the **Main Menu**.



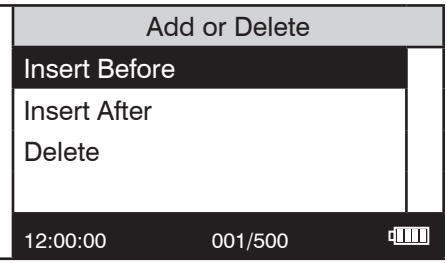
DELETING A TEST

Below is a step-by-step example of how to delete a test in SEQUENCE 2 starting from the EDIT SEQUENCE 2 menu.

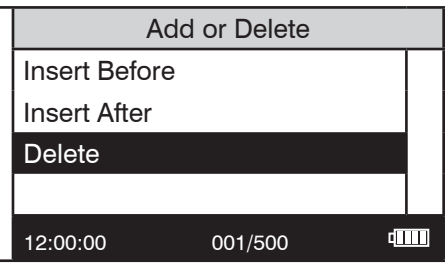
1. To delete a test, press ^ or v to scroll to the test in the sequence.



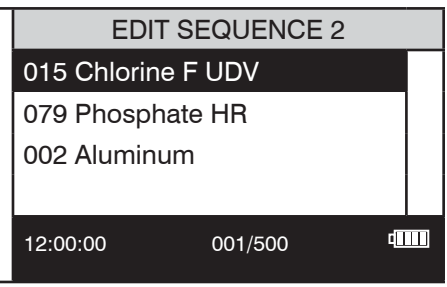
2. Press ENTER to select the test.



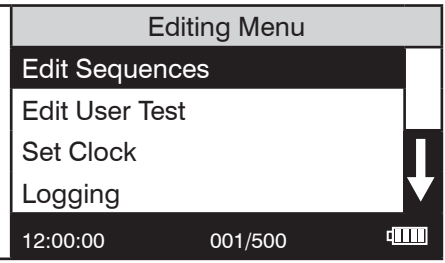
3. Press ^ or v to scroll to **Delete**.



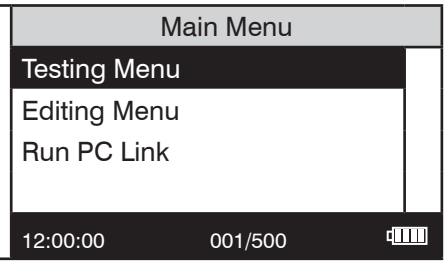
4. Press ENTER to select **Delete**. The sequence will appear in the **EDIT SEQUENCE** menu and the selected test will have been deleted. All changes to the sequence will automatically have been saved.



5. Press EXIT to exit the **Edit Sequence** menu and return to the **Editing Menu**.



6. Press ENTER to select **Edit Sequences** to continue editing the sequences or press EXIT to return to the **Main Menu**.



■ EDIT USER TESTS

If a test other than the LaMotte programmed tests is performed regularly, a calibration for it may be entered in one of the 25 User Tests. These tests are originally named “User Test 1 - 25”. It will be possible to rename the test, select a wavelength, enter a new calibration, select the number of decimal places used to display the results, and select the units. A User Test may be added for a reagent system for which no precalibrated test exists. A calibration of a LaMotte reagent system may also be entered. The calibration of a User Test can be changed at any time.

The User Tests have the ability to handle 2 data points. The colorimeter will determine the absorbance of the standards and calculate a response that will be stored to determine the concentration of future samples of unknown concentration. These standards should cover all the concentrations for the range of the test being performed and be scanned beginning with the low concentration and finishing with the high concentration (for more information about this, see CALIBRATION CURVES, page 12). Prepare these standards prior to entering a new calibration.

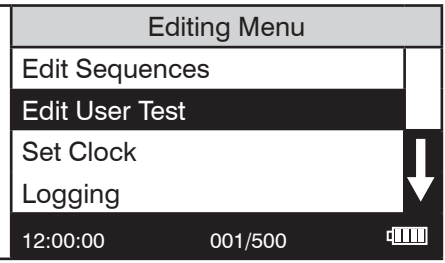
NOTE: A calibration procedure must be performed before using any of the User Tests.

The User Tests can be placed in any of the alterable sequences using Edit Sequences.

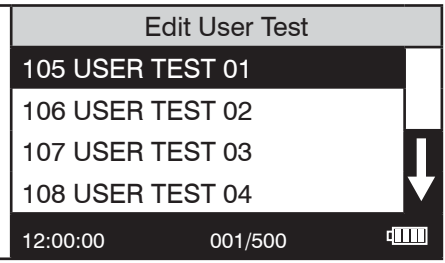
1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.	Main Menu Testing Menu Editing Menu Run PC Link 12:00:00 001/500

2. Press ∧ or ∨ to scroll to the **Editing Menu.**	Main Menu Testing Menu Editing Menu Run PC Link 12:00:00 001/500

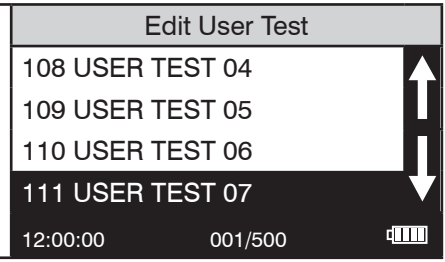
3. Press ENTER to select **Editing Menu**. Press ▼ to scroll to **Edit User Test**.



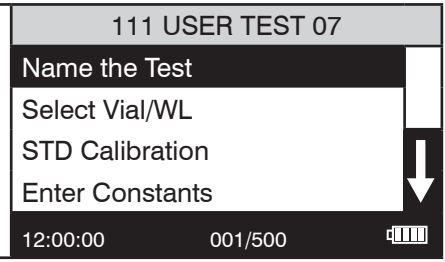
4. Press ENTER to select **Edit User Test**.



5. Press ▲ or ▼ to scroll to the desired user test.



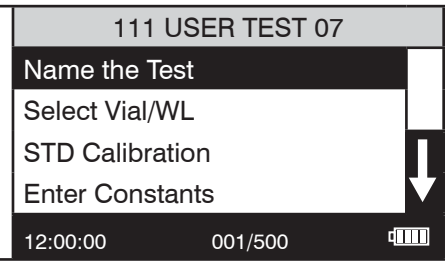
6. Press ENTER to select the **User Test**.



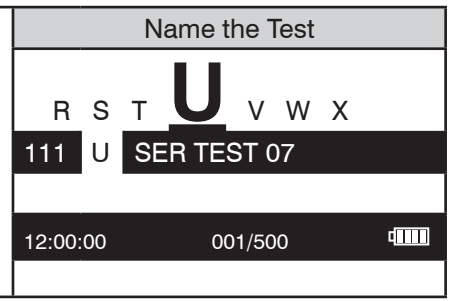
■ NAMING THE TEST

A User Test can be up to 16 characters long. The menu choices for each character are 26 upper case letters A to Z, 26 lower case letters a to z, ten numerals 0 to 9, a space, a dash (-) and a decimal point (.). The existing name is displayed on the bottom line of the display. The character which is to be edited will blink and that character is also displayed in the center of the display. The character can be changed by using ^ or v to scroll to other characters. Use ENTER to select a character. The edited name is saved at any time by pressing EXIT or by pressing ENTER after selecting the sixteenth character.

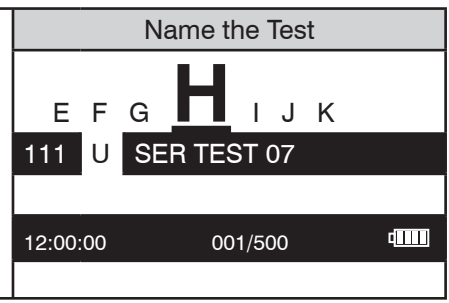
1. From the User Test menu, press v to scroll to **Name the Test**.



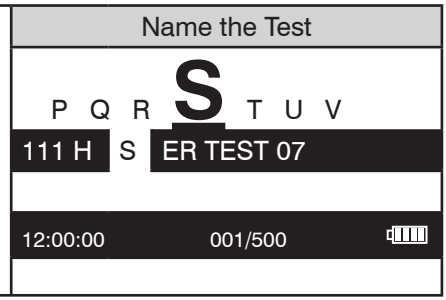
2. Press ENTER to select **Name the Test**. A reverse font (dark background with a light character) will appear to indicate the character that will be adjusted. The same character will also appear in the center of the display.



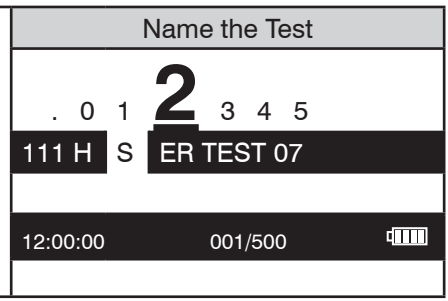
3. Press ^ or v to scroll to the desired character. In this example, the test name will be H2O.



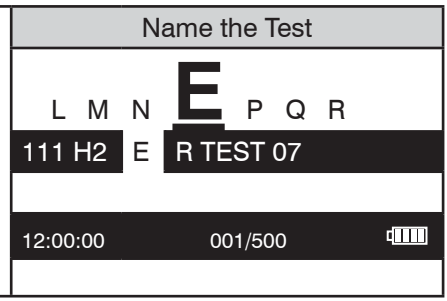
4. Press ENTER to save the character and move to the next character.



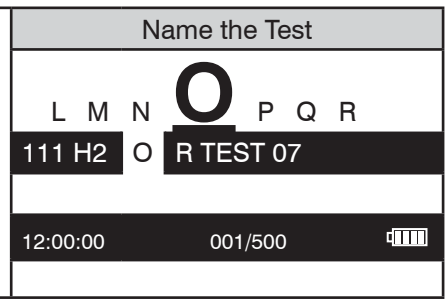
5. Press ^ or v to scroll to the desired character.

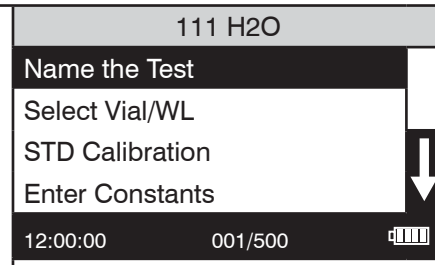


6. Press ENTER to save the character and move to the next character.



7. Press ^ or v to scroll to the desired character.

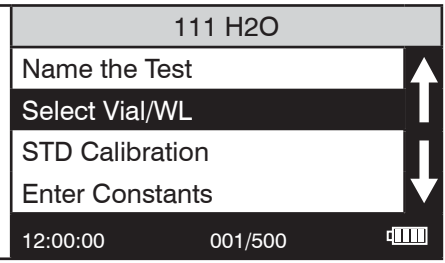


8. Press ENTER to save the character. Repeat the procedure until the test name is complete. To remove a character, change the character to a space (located after the letter z). Press EXIT to save the name. The sreen will display **Storing...** and the test name for about 1 second and the meter will return to the **Edit Test** menu.	

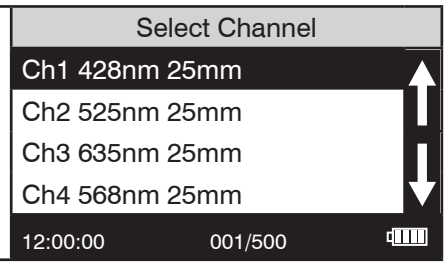
■ SELECTING THE VIAL AND WAVELENGTH

The SMART3 Colorimeter accepts three different vials (the 25 mm 0290 tube, UDVs and COD tubes) at 4 different wavelengths (428, 525, 560, and 635 nm). The colorimeter uses different settings for each of the twelve combinations of vial and wavelength. These twelve settings are called channels. Choose the channel with the correct wavelength and vial for the test.

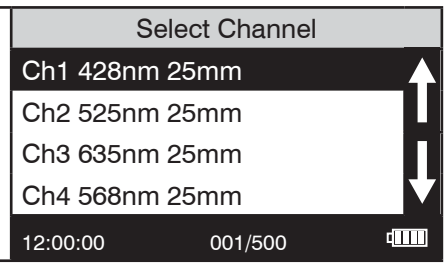
1. From the **User Test** menu, press ^ or v to scroll to Select Vial/WL.



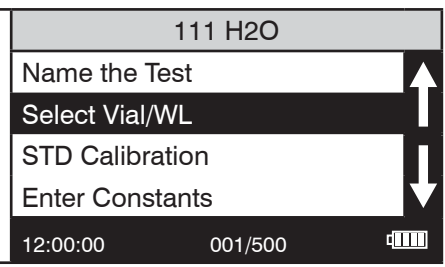
2. Press ENTER to select **Select Vial/WL**.



3. Press ^ or v to select the channel with the desired wavelength and vial size combination.



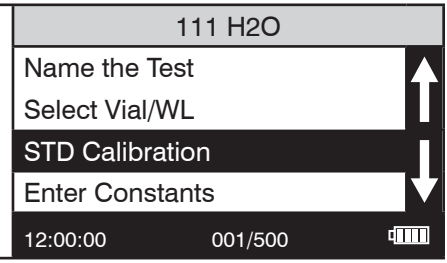
4. Press ENTER to select the channel. The screen will display **Storing...** for about 1 second and the meter will return to the **Edit Test** menu.



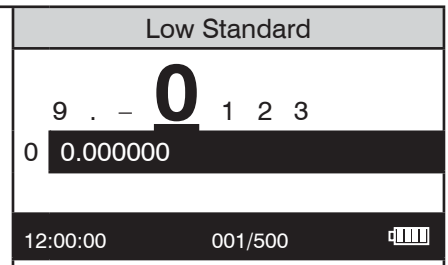
■ ENTERING A TWO POINT CALIBRATION

The SMART3 Colorimeter can scan two reacted standards and create a calibration curve. To prepare a calibration curve with multiple data points see Entering a Multiple Calibration Curve (pg. 51).

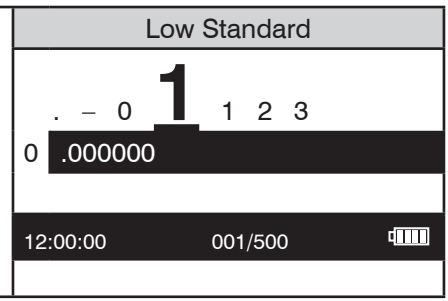
1. From the **User Test** menu, press ^ or v to scroll to **STD** (Standard) **Calibration**.



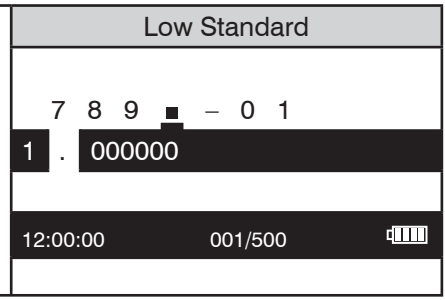
2. Press ENTER to select **STD Calibration**. The screen will display Low Standard for about 1 second and then display the Low Standard screen. A reverse font (dark background with a light character) will appear to indicate the character that will be adjusted. The same character will also appear in the center of the display.



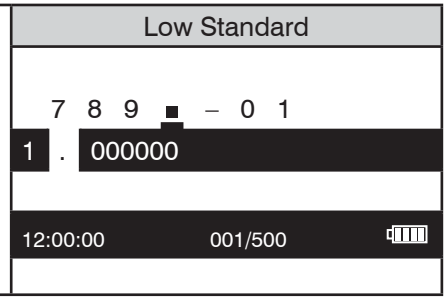
3. Press ^ or v to scroll to the first character of the low concentration. In this example, 1.00 ppm.



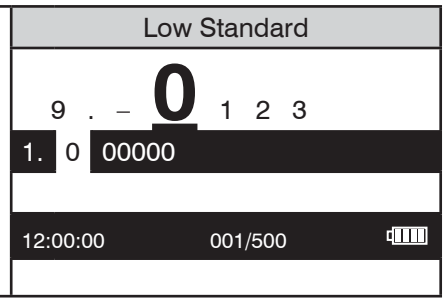
4. Press ENTER to save the character and move to the next character.



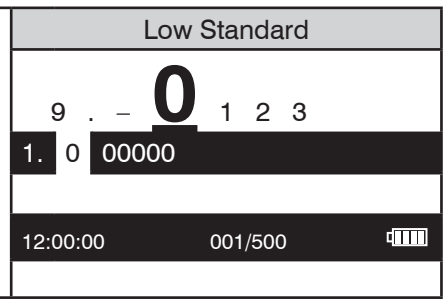
5. Press ^ or v to scroll to the desired character.



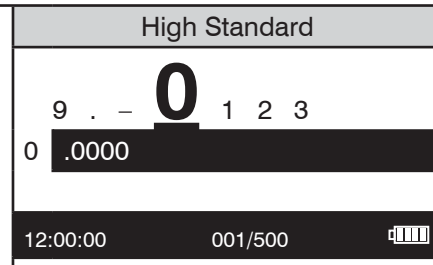
6. Press ENTER to save the character and move to the next character.



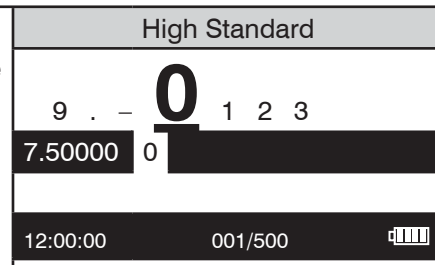
7. Press ^ or v to scroll to the desired character.



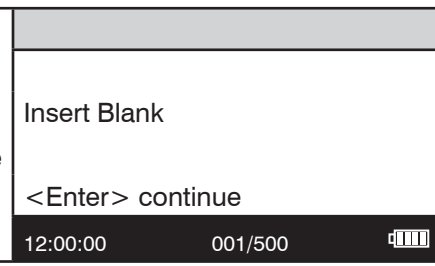
8. Press ENTER to save the character. Repeat the procedure until the low concentration value is complete. After the final character is complete the meter will save the low concentration value. The screen will display **High Standard** for about 1 minute and the meter will display the **High Standard** screen. A reverse font (dark background with a light character) will appear to indicate the character that will be adjusted. The same character will appear in the center of the display.



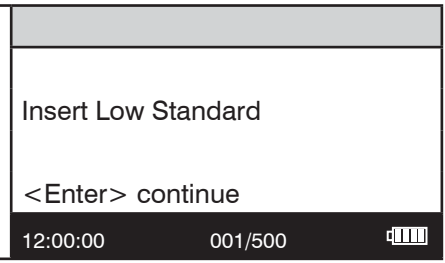
9. Use ^ or v and ENTER to select the characters for the high concentration value. In this example, 7.5 ppm.



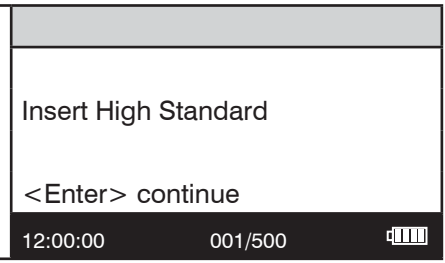
10. After the final character is entered the meter will save the high concentration value. The screen will display instructions for completing the calibration procedure.



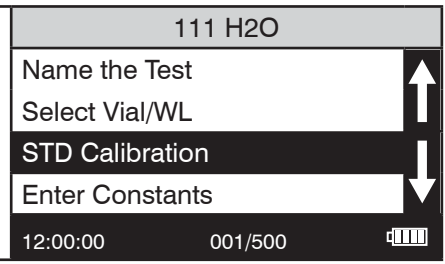
11. Insert the blank. Press ENTER. The screen will display **Blank Done...** for about 1 second and the **Insert Low Standard** screen will appear.



12. Insert the low standard. Press ENTER. The screen will display **Reading...** for about 1 second and the **Insert High Standard** screen will be displayed.



13. Insert the high standard. Press ENTER. The screen will display **Reading...** for about 1 second and the meter will return to the **Edit Test** menu.



■ ENTERING A MULTIPLE POINT CALIBRATION

The SMART3 can directly create a 2 point calibration curve. (See Entering a Two Point Calibration on page 47.) To create a multiple point calibration curve, constants obtained from a linear regression of multiple data points can be entered into the SMART 3.

1. Scan reactions of multiple concentrations at the appropriate wavelength in the absorbance mode on the SMART3.
2. Plot the concentration (y axis) versus absorbance (x axis) in a program capable of linear regression such as Excel.
3. Enter the constants obtained from the linear regression equation into the SMART3.

   For Example:

   $y = 0.001x^3 - 0.017x^2 + 0.181x - 0.049$

   K0 = – 0.049

   K1 = 0.181

   K2 = – 0.017

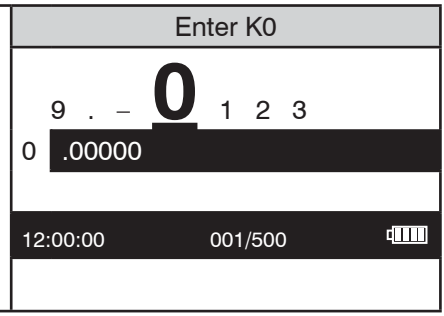
   K3 = 0.001

   OR (Over Range) = 10

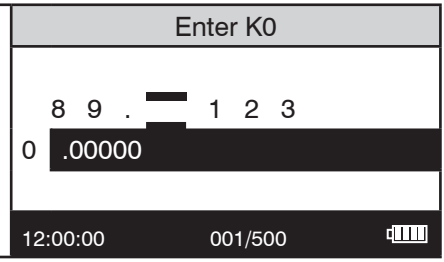
1. From the User Test menu, press ▲ or ▼ to scroll to **Enter Constants**.	111 H2O Name the Test Select Vial/WL STD Calibration Enter Constants 12:00:00 001/500

2. Press ENTER to select **Enter Constants**.	K0=0.00000 K1=0.00000 K2=0.00000 K3=0.00000 OR=100.00000 12:00:00 001/500

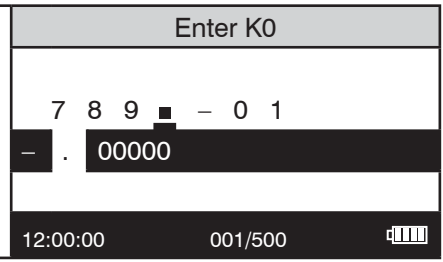
3. Press ENTER to begin entering the values for the constants. A reverse font (dark background with a light character) will appear to indicate the character that will be adjusted. The same character will also appear in the center of the display.



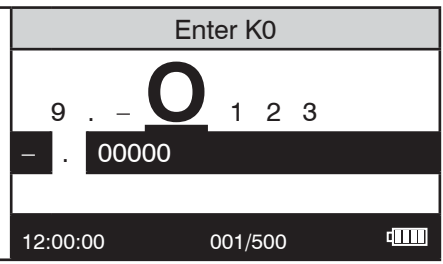
4. Press ^ or v to scroll to the first character of K0. In this example, – 0.049.



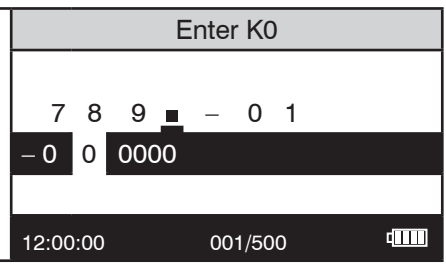
5. Press ENTER to save the character and move to the next character.



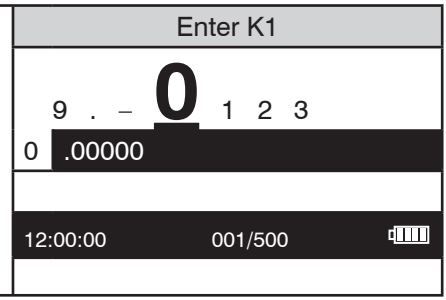
6. Press ^ or v to scroll to the next character.



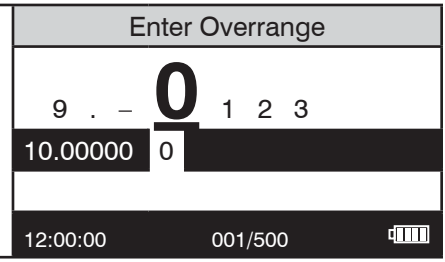
7. Press ENTER to save the character and move to the next character. Press ^ or v to scroll to the next character.



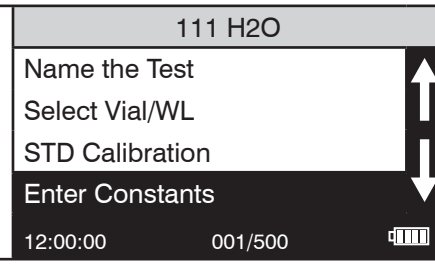
8. Press ENTER to save the character. Repeat the procedure until the K0 value is complete. After the final character is complete the meter will save the K0 value and the meter will display K1 screen.



9. Use ^ , v and ENTER to select the characters for the remaining values: K1, K2, K3, and over range. In this example, 10 ppm.



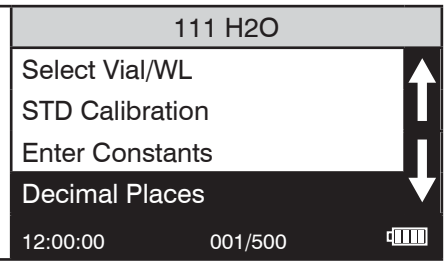
10. After the final character is entered the meter will save the constants. The screen will display **Storing...** and return to the **Edit Test** menu.



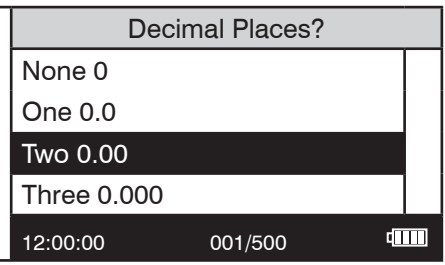
■ SELECTING THE NUMERICAL FORMAT OF THE RESULT

To input tests with very different ranges, the number of decimal places displayed for a result can be selected. A test which ranges from 20 to 1000 ppm should not be displayed with three decimal places. A test with a range from 0.010 to 0.500 needs three decimal places (the microprocessor will always calculate the concentration to many more significant figures than will be displayed). The choice of 0, 1, 2, or 3 decimal places are available.

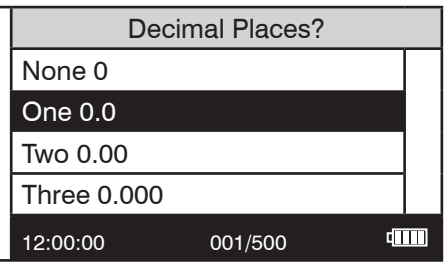
1. From the User Test menu, press ^ or v to scroll to **Decimal Places**.



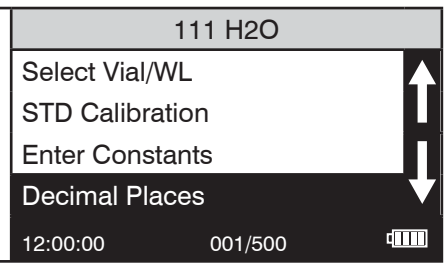
2. Press ENTER to select **Decimal Places**.



3. Press ^ or v to scroll to the desired number of decimal places.



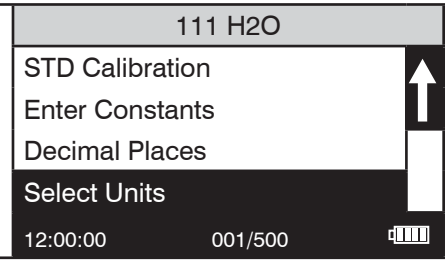
4. Press ENTER to select the decimal places. The screen wil display **Storing...** for about 1 second and the meter will return to the **Edit Test** menu.



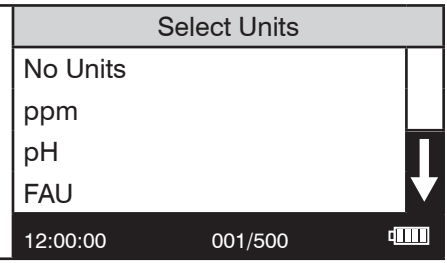
■ SELECTING THE UNITS OF CONCENTRATION

The SMART3 Colorimeter has seven options for units of concentration. They are No Units, ppm, FAU, pH, ppb, ppt and mgL.

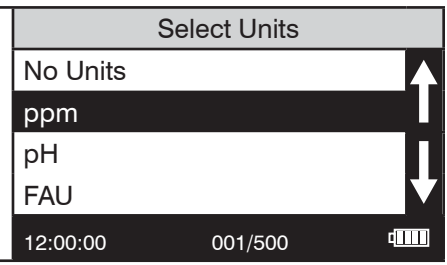
1. From the User Menu, press ^ to scroll to **Select Units**.



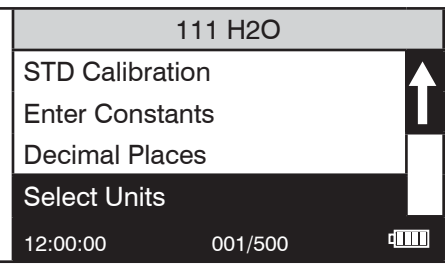
2. Press ENTER to select **Select Units**.



3. Press ^ or v to scroll to the desired units.



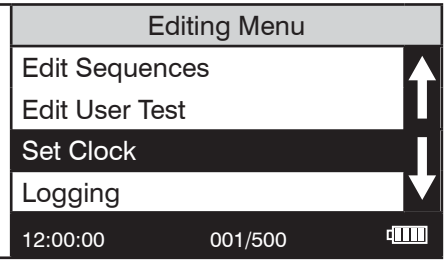
4. Press ENTER to select the units. The screen will display **Storing...** for about 1 second and the meter will return to the **Edit Test** menu.



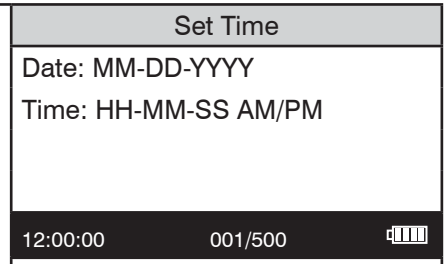
■ SETTING THE CLOCK

Setting the clock allows the correct time and date stamp to be stored with each reading in the data logger.

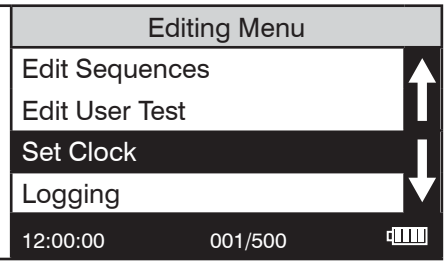
1. From the **Editing Menu**, press ▲ or ▼ to scroll to **Set Clock**.



2. Press ENTER to select **Set Clock**. The date is displayed as month-day-year. The time is displayed as hours:minutes:seconds AM/PM. Press ▲ or ▼ to scroll to the appropriate character. Press ENTER to select the character. The curser will move to the next character. Set all characters in the same manner. The character menu is a scrolling menu.



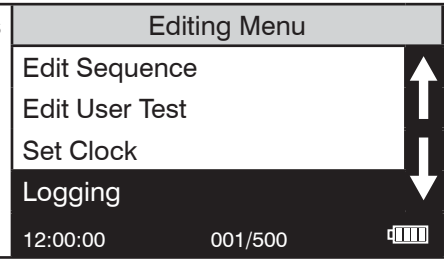
3. Press ENTER to select the final character. The time and date will be saved and the meter will return to the **Edit Test** menu.



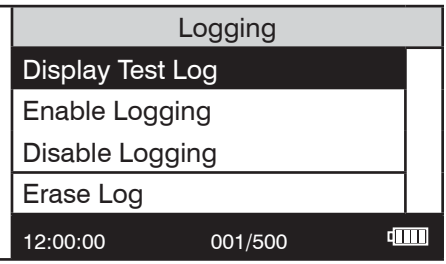
■ LOGGING DATA

The default setting for the data logger is enabled. The meter will log the last 500 data points. The counter in the center bottom of the display will show how many data points have been logged. The display will show 500+ when the data logger has exceeded 500 points and the data points are being overwritten.

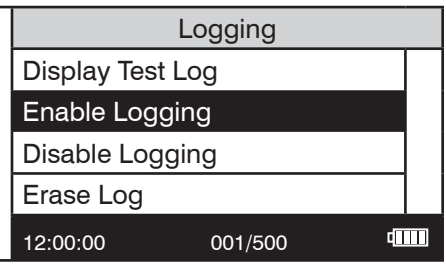
1. From the **Editing Menu**, press ▲ or ▼ to scroll to **Logging**.



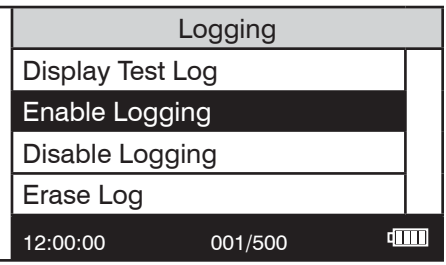
2. Press ENTER to select **Logging**.

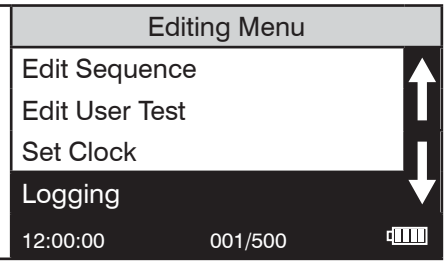


3. Press ▲ or ▼ to scroll to desired function.



4. Press ENTER. The screen will display **Storing...** for about 1 second and return to the **Logging** menu.



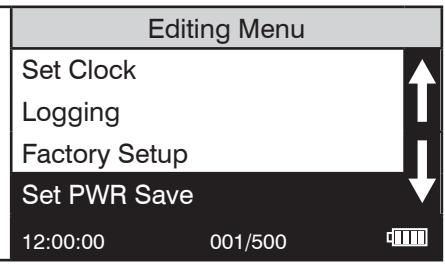
5. Press EXIT to return to the **Editing Menu**.	

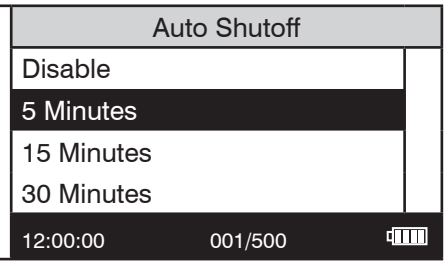
■ FACTORY SETUP

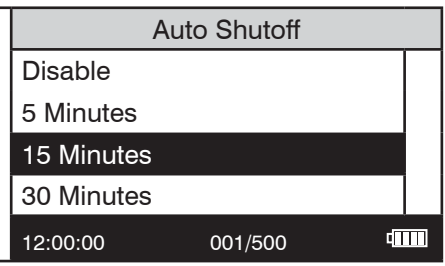
The Factory Setup menu is used in manufacturing of the SMART3 Colorimeter. This menu is not for use by the operator in the field.

■ SETTING POWER SAVE

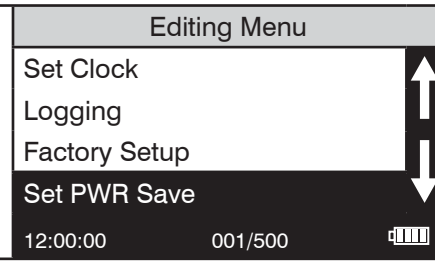
The power saving Auto Shutoff feature will turn the meter off when a button has not been pushed for a set amount of time. The default setting is disabled. To change the setting:

1. From the **Editing Menu**, press ^ or v to scroll to **Set PWR Save**.	

2. Press ENTER to select **Set PWR Save**.	

3. Press ^ or v to scroll to desired function.	

4. Press ENTER. The screen will display **Storing...** for about 1 second and the meter will return to the **Editing Menu**.

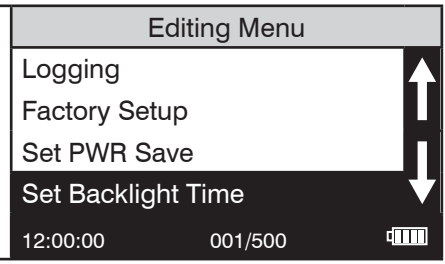


■ SETTING THE BACKLIGHT TIME

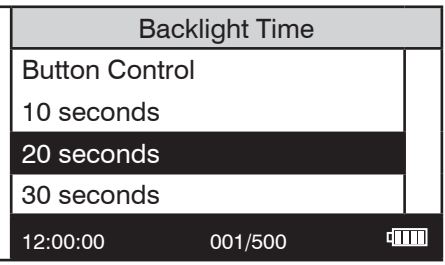
The backlight illuminates the display for enhanced viewing. The default setting is 10 seconds. If Button Control is chosen the backlight button on the key pad will act as an on/off switch and the backlight will remain on or off when the meter is being used. When one of the other settings – 10, 20 or 30 seconds – is chosen, the display will be illuminated for the specified amount of time after any button is pressed.

NOTE: The backlight feature uses a significant amount of power. The longer the backlight is on, the more frequently the battery will have to be charged if the USB/Wall Adapter is not being used.

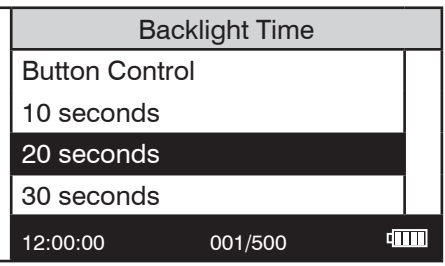
1. From the **Editing Menu**, press ▲ or ▼ to scroll to **Backlight Time**.



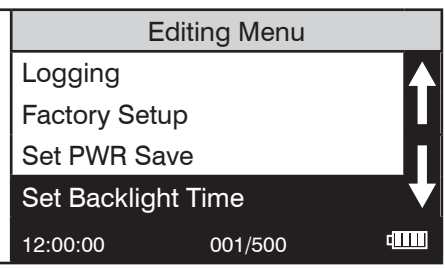
2. Press ENTER to select **Set Backlight Time**.



3. Press ▲ or ▼ to scroll to desired option.



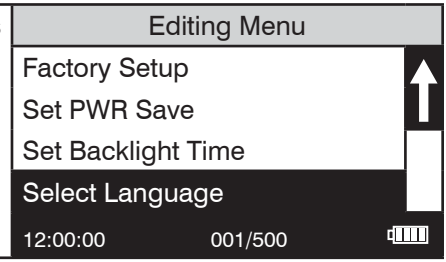
4. Press ENTER. The screen will display **Storing...** for about 1 second and the meter will return to the **Editing Menu**.



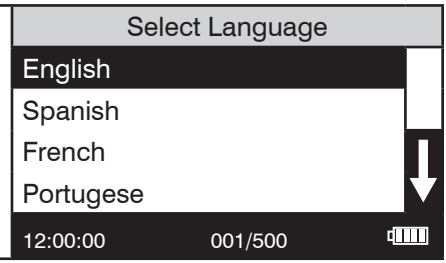
■ SELECTING A LANGUAGE

There are seven languages available in the SMART3: English, Spanish, French, Portuguese, Italian, Chinese, and Japanese.

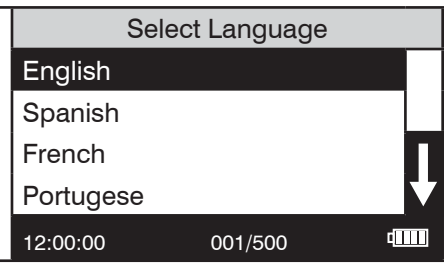
1. From the **Editing Menu**, press ▲ or ▼ to scroll to **Select Language**.



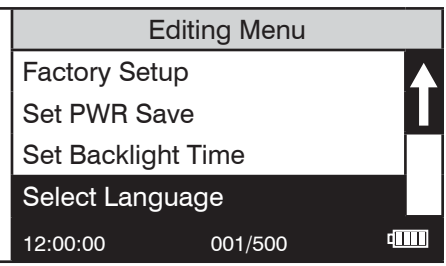
2. Press ENTER to select **Select Language**.



3. Press ▲ or ▼ to scroll to desired language.



4. Press ENTER. The screen will display **Storing...** for about 1 second and the meter will return to the **Editing Menu**.



NOTE: If meter unintentionally switches to another language, use the procedure above to reset the meter to the desired language. For example, to reset the meter to English:

1. Turn meter on.
2. Press ▼ one time. Press ENTER.
3. Press ▼ seven times. Press ENTER.
4. Press ENTER.

COMPUTER CONNECTION

■ PC LINK

The SMART3 may be interfaced with any Windows-based computer by using the LaMotte SMARTLink 3 Program and USB Cable. The program will store test information and results in a database. To transfer data from the meter to a computer, plug the smaller end of the USB cable (USB mini B connector) into the meter and the larger end of the USB cable (USB Type A connector) into a USB port on a computer. The SMART3 will send the following data: test name, wavelength, concentration, transmittance, absorbance, sample, blank, time of test, and date of test.

■ OUTPUT

USB

■ COMPUTER CONNECTION

USB Type A, USB mini B, Order Cable Code 1720.

■ SMARTLINK3

SmartLink3 records the above data and appends a test ID# which uniquely identifies the test in the database, the serial number of the meter, and a site ID# which can be used to associate the test record with a site or customer via the SmartLink3 program. It also stores a “test number” which is useful for the SMART3.

BATTERY

■ BATTERY/AC OPERATION

The SMART3 may be operated on battery power, using a USB wall adapter or USB computer connection. If using the meter as a bench top unit, use the wall adapter if possible to extend the battery life. The meter will remain on when the USB adapter is used.

To charge the battery with the wall adapter, plug the smaller end of the USB cable (USB mini B connector) into the meter and the larger end of the USB cable (USB Type A connector) into the wall adapter. Plug the wall adapter into an AC outlet. Reinsert the USB port plug after charging.

To charge the battery from a computer, plug the smaller end of the USB cable (USB mini B connector) into the meter and the larger end of the USB cable (USB Type A connector) into a USB port on a computer.

The battery icon will show no bars and flash when the unit first turns on. Then the indicator will indicate the battery status by showing 0, 1, 2, 3 or 4 bars.

It will take 5 hours to fully charge a low battery. The battery icon will flash when the battery is charging. The battery icon will show four bars and stop flashing when it is fully charged. The charging circuit will automatically switch to a float charge when the battery is fully charged. The charger may remain connected. Some computers will NOT supply power to their USB ports during standby operation. The wall adapter will charge the unit continuously.

The battery icon will show no bars and continuously flash if the battery is getting low but the unit will still operate normally. A “Low Battery” message on the status bar of the display will replace the time when the battery voltage is too low for proper operation and accuracy may be degraded. A “Shutdown Low Batt” message on the display will appear for a few seconds before the power is switched off when the battery is too low to operate the unit.

To extend the battery life:

- Shut down the unit with the power switch when not taking measurements or use the power save option to have the unit automatically turn off after 5 minutes.
- Store the unit in a cool dry place.
- Fully charge the battery before storing the unit for extended periods of time.
- Limit backlight use. The unit consumes 3X normal power with the backlight on. Set the backlight time option to 10 seconds, or select “Button Control” and keep the backlight off.

Battery replacement: The lithium ion battery used in this unit should last for many years with normal use. When it no longer powers the unit long enough to meet testing requirements it will need to be replaced. Lithium ion batteries that are properly charged and stored do not usually lose all capacity; they just have

less capacity after hundreds of charge cycles. This unit uses a custom battery assembly that is only available from LaMotte Company. Battery replacement must be performed at a LaMotte authorized repair facility. The water resistant housing of this meter should not be opened by the user. Contact LaMotte Company by phone (1-800-344-3100) or email (tech@lamotte.com) for a return authorization number.

MAINTENANCE

■ CLEANING

Clean the exterior housing with a damp, lint-free cloth. Do not allow water to enter the light chamber or any other parts of the meter. To clean the light chamber and optics area, point a can of compressed air into the light chamber and blow the pressurized air into the light chamber. Use a cotton swab dampened with Windex® window cleaner to gently swab the interior of the chamber. Do not use alcohol; it will leave a thin residue over the optics when dry.

■ REPAIRS

Should it be necessary to return the meter for repair or servicing, pack the meter carefully in a suitable container with adequate packing material. A return authorization number must be obtained from LaMotte Company by calling 800-344-3100 (US only) or 410-778-3100, faxing 410-778-6394, or emailing tech@lamotte.com. Often a problem can be resolved over the phone or by email. If a return of the meter is necessary, attach a letter with the return authorization number, meter serial number, a brief description of problem and contact information including phone and FAX numbers to the shipping carton. This information will enable the service department to make the required repairs more efficiently.

■ METER DISPOSAL

Waste Electrical and Electronic Equipment (WEEE)

Natural resources were used in the production of this equipment. This equipment may contain materials that are hazardous to health and the environment. To avoid harm to the environment and natural resources, the use of appropriate take-back systems is recommended. The crossed out wheeled bin symbol on the meter encourages the use of these systems when disposing of this equipment.

Take-back systems will allow the materials to be reused or recycled in a way that will not harm the environment. For more information on approved collection, reuse, and recycling systems contact local or regional waste administration or recycling services.

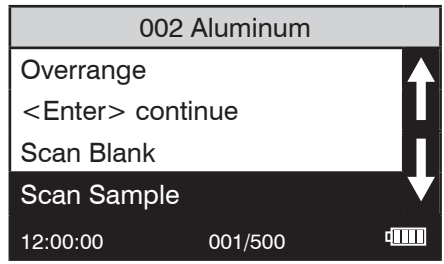
■ ERROR MESSAGES

OVER RANGE

If the message OVERRANGE is displayed when scanning a sample, the sample may be over range or under range. If the sample is over range the sample should be diluted and tested again (see Sample Dilution Techniques and Volumetric Measurements, page 16).

If overrange is displayed, press ENTER to continue testing on diluted samples.

Note: After pressing ENTER, the overrange cncentration will be displayed. This concentration is an **approximation only**.



CALIBRATION

As with all pre-calibrated meters, it is highly recommended, even if not required by regulations, that the user periodically verify the performance of the meter by running standards with a predetermined concentration. Results outside of specification are an indication that the meter needs to be adjusted. This can be done following the user calibration described on page 28. If the user calibration fails to properly adjust the meter then the meter should be returned to LaMotte Company for recalibration. (See page 65).

STRAY LIGHT

The SMART3 Colorimeter should have no problems with stray light. Make sure that the sample compartment lid is always fully closed, except when testing COD with the adapter.

■ TROUBLESHOOTING GUIDE

PROBLEM	*REASON*	*SOLUTION*
Flashing	Low battery. Readings are reliable.	Charge battery or use USB wall/computer adapter.
“Low Battery”	Battery voltage is very low. Readings are not reliable.	Charge battery or use USB wall/computer adapter.
“Shut Down Low Batt” Shut Down	Battery is too low to operate the unit.	Charge battery or use USB wall/computer adapter.
“Overrange”	Sample is outside of acceptable range.	Dilute sample and test again.
Unusually large negative or positive readings when performing calibration	Incorrect standards used to calibrate meter.	Use fresh 0.0 standard in clean tube. Reset meter to factory default settings. Recalibrate meter.

SMART3 Colorimeter

Test Procedures

1910-TEST

2.28.11

WARNING! This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision

LaMotte
PO Box 329 • Chestertown, MD 21620
800-344-3100 • f 410-778-6394
www.lamotte.com

SMART3 COLORIMETER REAGENT SYSTEMS

SMART3 REAGENT SYSTEMS LIST

LaMotte Company continuously updates the list of pre-programmed tests as the calibrations become available. Pre-programmed calibrations can be added to the SMART3 Colorimeter in the field. A Windows-based computer running a Windows Operating System and an 8 pin mini-DIN/9 pin F D-submin serial cable (order Code 1771) are required.

Call LaMotte Technical Services at 1-800-344-3100 (410-778-3100 outside the USA) or email at tech@lamotte.com for a current list of available calibrations and downloading instructions.

Test Factor (Test #)	Range (ppm)	MDL	Test Method (# of Reagents)	# of Tests
Alkalinity-UDV (001)	0–200	10	Unit Dose Vials (1)	50
Aluminum (002)	0.00–0.30	0.01	Eriochrome Cyanine R (4)	50
Ammonia Nitrogen-Low Range, Fresh Water (003)	0.00–1.00	0.05	Salicylate (3)	25
Ammonia Nitrogen-Low Range, Salt Water (004)	0.00–1.00	0.10	Salicylate (3)	25
Ammonia Nitrogen-High Range (005)	0.00–4.00	0.05	Nesslerization (2)	50
Benzotriazole (009)	0.0–30.0	0.5	UV Photolysis (3)	50
Biguanide (006)	0–70	2	Colorimetric	50
Borate-UDV (007)	0.0–80.0	5.0	Unit Dose Vial (1)	50
Boron (008)	0.00-0.80	0.05	Azomethine-H (2)	50
Bromine-Low Range (010)	0.00–9.00	0.1	DPD (3)	100
Bromine-UDV (011)	0.0–20.0	0.25	DPD (1)	50
Cadmium (012)	0.00–1.00	0.04	PAN (4)	50
Carbohydrazide (013) *See Oxygen Scavengers*	0.000–0.900	0.01	Iron Reduction (3)	100
Chloride-TesTab (020)	0.0–30.0	0.4	Argentometric (1)	50
Chlorine-Liquid DPD (017)	0.00–4.00	0.03	DPD (3)	144
Chlorine-Tablet DPD (014)	0.00–4.00	0.03	DPD (3)	100
Chlorine-Free-UDV (015)	0.00–10.00	0.10	DPD (1)	50
Chlorine-Total-UDV (18)	0.00–10.00	0.10	DPD (1)	50
Chlorine Dioxide (019)	0.00–8.00	0.10	DPD (2)	100
Chromium, Hexavalent (021)	0.00–1.00	0.01	Diphenylcarbohydrazide	50
Chromium, Hex, Tri, Total (021)	0.00–1.00	0.01	Diphenylcarbohydrazide	50
Cobalt (023)	0.00–2.00	0.04	PAN (3)	50

COD-Low Range (024)	0–150	7.5	Digestion (1)	25
COD-Standard Range (025)	0-1500	40	Digestion (1)	25
COD-High Range (026)	0–15000	400	Digestion (1)	25
Color (027)	0–1000	20	Platinum Cobalt (0)	–
Copper-BCA-Low Range (028)	0.00–3.50	0.04	Bicinchoninic Acid (1)	50
Copper-Cuprizone (030)	0.00–2.50	0.03	Cuprizone (2)	50
Copper-DDC (031)	0.00–7.00	0.10	Diethyldithiocarbamate (1)	50
Copper-UDV (032)	0.0–4.0	0.1	Bicinchoninic Acid (1)	50
Cyanide (034)	0.00-0.50	0.01	Pyridine-Barbituric Acid (5)	50
Cyanuric Acid (035)	5–200	10	Melamine (1)	50
Cyanuric Acid-UDV (036)	5–150	10	Melamine (1)	50
DEHA (037) *See Oxygen Scavengers*	0.000–0.700	0.01	Iron Reduction (3)	100
Dissolved Oxygen (038)	0.0–10.0	0.6	Winkler Colorimetric (3)	100
Erythorbic Acid (049) *See Oxygen Scavengers*	0.00–3.00	0.02	Iron Reduction (3)	100
Fluoride (040)	0.00–2.00	0.10	SPADNS (2)	50
Hardness (Total) UDV (043)	0–450	10	Unit dose Vial (1)	50
Hydrazine (045)	0.00–1.00	0.01	P-dimethyl-aminobenzaldehyde (2)	50
Hydrogen Peroxide-Low Range (046)	0.00–1.50	0.02	DPD (2)	100
Hydrogen Peroxide-High Range (047)	0.0–80.0	0.5	DPD (2)	50
Hydrogen Peroxide-Shock (048)	0–300	5	DPD (2)	100
Hydroquinone (049) *See Oxygen Scavengers*	0.00–2.00	0.01	Iron Reduction (3)	100
Iodine (050)	0.00–14.00	0.15	DPD (2)	100
Iron-Bipyridyl (051)	0.00–6.00	0.10	Bipyridyl (2)	50
Iron-Phenanthroline (053)	0.00–5.00	0.06	1,10 Phenanthroline (2)	50
Iron-UDV (052)	0.00–10.00	0.05	Bipyridyl (1)	50
Lead (054)	0.00–5.00	0.10	PAR (5)	50
Manganese-Low Range (055)	0.00–0.70	0.01	PAN (3)	50
Manganese-High Range (056)	0.0–15.0	–	Periodate (2)	50
Mercury (057)	0.00–1.50	0.01	TMK (3)	50
Methylethylketoxime (058) *See Oxygen Scavengers*	0.00–3.00	0.01	Iron Reduction (3)	100
Molybdenum-High Range (061)	0.0–50.0	0.6	Thioglycolate (3)	50
Nickel (063)	0.00–8.00	0.15	Dimethylglyoxime (6)	50
Nitrate Nitrogen-Low Range (064)	0.00–3.00	0.10	Cadmium Reduction (2)	20

Nitrate TesTab (065)	0-60	5	Zinc Reduction (1)	50
Nitrate-UDV (066)	0.00-80.0	2	Zinc Reduction (1)	100
Nitrite Nitrogen-Low Range (067)	0.00–0.80	0.02	Diazotization (2)	20
Nitrogen, Total (069)	3-25 mg/L	3 mg/L	Chromotropic Acid/Digestion (6)	25
Oxygen Scanvengers	various	various	DEHA (3)	50
Ozone-DPD (070)	0.00–3.00	0.03	DPD (3)	144
Ozone-Low Range (071)	0.00–0.40	0.02	Indigo Trisulfonate (3)	100
Ozone-High Range (072)	0.00–3.00	0.05	Indigo Trisulfonate (3)	20
pH-Chlorophenol Red (073)	5.0–6.8	–	Chlorophenol Red (1)	100
pH-Phenol Red (074)	6.6–8.4	–	Phenol Red (1)	100
pH-Thymol Blue (075)	8.0–9.6	–	Thymol Blue (1)	100
Phenol (077)	0.00-6.00	0.05	Aminoabtipyrine (2)	50
Phosphate-Low Range (078)	0.00–3.00	0.05	Ascorbic Acid Reduction (2)	25
Phosphate-High Range (079)	0.0–70.0	0.5	Vanodomolybd-phosphoric Acid (1)	25
Phosphorus, ppb (080)	0–3000 ppb	50	Ascorbic Acid/Reduction (5)	50
Phosphorus, Total, Low Range (081)	0.00–3.50 mg/L	0.50	Ascorbic Acid/Digestion	25
Phosphorus, Total, High-Range (082)	0.0–70.0 mg/L	5	Molybdovanadate/Digestion (5)	25
Potassium (083)	0.0-10.0	0.8	Tetraphenylboron (2)	100
Silica-Low Range (085)	0.0–4.0	0.05	Heteropoly Blue (4)	50
Silica-High Range (086)	0–75	0.5	Silicomolybdate (3)	50
Sulfate-High Range (089)	0–100	3	Barium Chloride (1)	50
Sulfide-Low Range (090)	0.00–1.50	0.06	Methylene Blue (3)	50
Surfactants (094)	0.00-8.00	0.75	Bromphenol Blue (3)	100
Tannin (096)	0.0–10.0	0.1	Tungsto-molybdophosphoric Acid (2)	50
Tolytriazole (009) *See Benzotriazole*	0.0–30.0	0.5	UV Photolysis (3)	50
Turbidity (098)	0.0–30.0 FTU	3	Absorption (0)	–
Zinc-Low Range (099)	0.00–3.00	0.05	Zincon (6)	50

ALKALINITY–UDV

UNIT DOSE VIALS • CODE 4318-J

QUANTITY	CONTENTS	CODE
1	Alkalinity Unit Dose Vials, 20 pouches	4318-J

Equipment needed but not supplied:

STANDARD ACCESSORY PACKAGE · CODE 1961		
1	Package of 3 Vials (empty)	0156
1	Syringe, 3 mL, plastic	1184
1	Foil Storage Bag	9467

Or:

ADVANCED ACCESSORY PACKAGE · CODE 1962		
1	Pipettor, 3mL	30528
1	Pipet Tip (0-5 mL)	30695
1	Cuvette Rack	31695
1	Package of 3 Vials (empty)	0156
1	Foil Storage Bag	9467

APPLICATION:	Drinking and surface waters; swimming pool water.
RANGE:	0–200 ppm as $CaCO_3$
MDL:	10 ppm
METHOD	The sample is added to a buffered indicator reagent. The color that develops, ranging from yellow to blue, will indicate the amount of alkalinity in the sample.
SAMPLE HANDLING & PRESERVATION:	Samples should be analyzed as soon as possible after collection. Sample may be refrigerated for 24 hours.
INTERFERENCES:	Quats and poly quats at high concentrations will interfere.

PROCEDURE

Use COD/UDV adapter

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **001 Alkalinity UDV**) from **TESTING MENU**.
4. Scroll to and select **001 Alkalinity UDV** from menu.
5. Rinse a clean vial (0156) with sample water.
6. Use the syringe (1184) to add 3 mL of sample to the vial.
7. Insert the vial into chamber, close lid and select SCAN BLANK.
8. Remove vial from the colorimeter.
9. Use the syringe (1184) to add 3 mL of sample to an Alkalinity-UDV vial (4318).
10. Wait 90 seconds.
11. Invert vial 3 times to mix.

    NOTE: If powder residue remains in the bottom of the vial after inverting, invert once more and tap bottom of vial sharply once or twice to dislodge powder. Mix.
12. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
13. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTES: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

UDVs from opened pouches should be used promptly. Store unused vials from opened pouches in the Foil Storage Bag (9467) to extend the shelf life of the reagent. Generally, UDVs stored in the bag should be used within 10 days if the humidity is less than 50% and within 5 days if humidity is greater than 50%. The Foil Storage Bag contains a desiccant pack with indicator. When the indicator in the window turns from blue to pink, the bag should be replaced.

ALUMINUM

ERIOCHROME CYANINE R METHOD
CODE 364I-01-SC

QUANTITY	CONTENTS	CODE
5 g	*Aluminum Inhibitor Reagent	*7865-C
2 x 120 mL	*Aluminum Buffer Reagent	*7866-J
120 mL	Aluminum Indicator Reagent	7867-J
15 mL	Aluminum Complexing Reagent	7868-E
1	Spoon, 0.05 g, plastic	0696
2	Pipets, 1.0 mL, plastic	0354
1	Test Tube, glass, 5 mL w/cap	0230

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Aluminum is the third most common element in the earth's crust, which accounts for its wide appearance in many water supplies. Aluminum exists in water as soluble salts, colloidal compounds, and insoluble compounds. In wastewater that has been treated by alum coagulation it will appear in one or more of the above forms. Properly treated drinking water should have an aluminum concentration below 0.05 mg/L.

APPLICATION:	Drinking, surface, and saline waters; domestic and industrial wastewater.
RANGE:	0.00–0.30 ppm Aluminum
MDL:	0.01 ppm
METHOD:	Aluminum ions buffered to a pH of 6.0 react with Eriochrome Cyanine R dye to produce a pink to red complex in proportion to the concentration.
SAMPLE HANDLING & PRESERVATION:	Collect sample in acid washed glass or plastic bottle. Analyze as soon as possible.
INTERFERENCES:	Fluoride and polyphosphate will interfere. Interference from iron and manganese is eliminated by the addition of an inhibitor.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **002 Aluminum**).
4. Scroll to and select **002 Aluminum** from menu.
5. Rinse a clean colorimeter tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into colorimeter chamber and select **SCAN BLANK**.
7. Rinse a clean test tube (0230) with sample water. Fill to the 5 mL line with sample.
8. Remove tube from colorimeter. Empty sample from tube (0290).
9. Add 5 mL sample from test tube (0230) to empty tube (0290).
10. Use the 0.05 g spoon (0696) to add one measure of *Aluminum Inhibitor Reagent (7865). Cap and mix to dissolve powder.
11. Use a 1.0 mL pipet (0354) to add 2 mL of *Aluminum Buffer Reagent (7866). Cap and mix.
12. Use a second 1.0 mL pipet (0354) to add 1 mL of Aluminum Indicator Reagent (7867). Cap and mix contents. Wait 5 minutes for maximum color development.
13. At end of 5 minute waiting period, mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
14. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For the best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Add 5 drops of Aluminum Complexing Reagent (7868). Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

AMMONIA NITROGEN - LOW RANGE

SALICYLATE METHOD • CODE 3659-01-SC

QUANTITY	CONTENTS	CODE
60 mL	*Salicylate Ammonia #1	*3978-H
10 g	*Salicylate #2	*7457-D
2 x 5 g	*Salicylate #3 Reagent Powder	*7458-C
1	Spoon, 0.1 g, plastic	0699
1	Spoon, 0.15 g, plastic	0727
1	Pipet, 1.0 mL, plastic	0354

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Ammonia nitrogen is present in various concentrations in many surface and ground water supplies. Any sudden change in the concentration of ammonia nitrogen in a water supply is cause for suspicion. A product of microbiological activity, ammonia nitrogen is sometimes accepted as chemical evidence of pollution when encountered in natural waters.

Ammonia is rapidly oxidized in natural water systems by special bacterial groups that produce nitrite and nitrate. This oxidation requires that dissolved oxygen be available in the water. Ammonia is an additional source of nitrogen as a nutrient which may contribute to the expanded growth of undesirable algae and other forms of plant growth that overload the natural system and cause pollution.

APPLICATION:	Low concentrations of ammonia in fresh, brackish and salt water; fresh and salt water aquariums.
RANGE:	0.00 - 1.00 ppm Ammonia-Nitrogen
MDL:	0.05 ppm Fresh Water 0.10 ppm Salt Water
METHOD:	Salicylate and ammonia react at high pH in the presence of a chlorine donor and an iron catalyst to form a blue indophenol dye, the concentration of which is proportional to the ammonia concentration in the sample.
SAMPLE HANDLE & PRESERVATION:	Ammonia solutions tend to be unstable and should be analyzed immediately. Samples may be stored for 24 hours at 4°C or 28 days at –20°C.
INTERFERENCES:	There are few interferences in most natural waters. High concentrations of reducing agents, such as hydrazine, react with the chlorine donor and can result in negative interferences. Color and turbidity can also interfere.

PROCEDURE - FRESH WATER

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **003 Ammonia-N LRF**) from **TESTING MENU**.
4. Scroll to and select **003 Ammonia-N LRF** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**. (See Note.)
7. Remove tube from colorimeter. Use the 1.0 mL plastic pipet (0354) to add 2.0 mL of *Salicylate Ammonia #1 (3978). Cap and mix.
8. Use the 0.15 g spoon (0727) to add two measures of *Salicylate #2 Reagent (7457). Cap and mix until dissolved. Wait 1 minute.
9. At end of 1 minute waiting period use 0.1 g spoon (0699) to add two measures of *Salicylate #3 Reagent Powder (7458). Cap and shake vigorously for at least 30 seconds and all solid has dissolved. Wait 12 minutes for maximum color development.
10. At the end of the 12 minute waiting period, immediately mix and insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
11. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

CALCULATIONS:

To express results as Unionized Ammonia (NH_3):

ppm Unionized Ammonia (NH_3) =
ppm Ammonia-Nitrogen (NH_3–N) x 1.2

To express results as Ionized Ammonia (NH_4):

ppm Ionized Ammonia (NH_4^+) =
ppm Ammonia-Nitrogen (NH_3–N) x 1.3

To determine the percentages of Unionized and Ionized Ammonia-Nitrogen, consult the Appendix.

NOTE: It is strongly suggested that a reagent blank be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

PROCEDURE - SALT WATER

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select TESTING MENU.
3. Select **ALL TESTS** (or another sequence containing **004 Ammonia-N LRS**) from TESTING MENU.
4. Scroll to and select **004 Ammonia-N LRS** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**. (See Note.)
7. Remove tube from colorimeter. Use the 1.0 mL plastic pipet (0354) to add 2.0 mL of *Salicylate Ammonia #1 (3978). Cap and mix.
8. Use the 0.15 g spoon (0727) to add two measures of *Salicylate #2 Reagent (7457). Cap and mix until dissolved. Wait 1 minute.
9. At end of 1 minute waiting period use 0.1 g spoon (0699) to add two measures of *Salicylate #3 Reagent Powder (7458). Cap and shake vigorously for at least 30 seconds and all solid has dissolved. Wait 20 minutes for maximum color development.
10. At the end of the 20 minute waiting period, immediately mix and insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
11. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

CALCULATIONS:

To express results as Unionized Ammonia (NH_3):

ppm Unionized Ammonia (NH_3) =
ppm Ammonia-Nitrogen (NH_3–N) x 1.2

To express results as Ionized Ammonia (NH_4):

ppm Ionized Ammonia (NH_4^+) =
ppm Ammonia-Nitrogen (NH_3–N) x 1.3

To determine the percentages of Unionized and Ionized Ammonia-Nitrogen, consult the Appendix.

NOTE: It is strongly suggested that a reagent blank be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

AMMONIA NITROGEN - HIGH RANGE

NESSLERIZATION METHOD •CODE 3642-SC

QUANTITY	CONTENTS	CODE
30 mL	Ammonia Nitrogen Reagent #1	V-4797-G
2 x 30 mL	*Ammonia Nitrogen Reagent #2	*V-4798-G
1	Pipet, 1 mL, plastic	0354

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Ammonia nitrogen is present in various concentrations in many surface and ground water supplies. Any sudden change in the concentration of ammonia nitrogen in a water supply is cause for suspicion. A product of microbiological activity, ammonia nitrogen is sometimes accepted as chemical evidence of pollution when encountered in natural waters.

Ammonia is rapidly oxidized in natural water systems by special bacterial groups that produce nitrite and nitrate. This oxidation requires that dissolved oxygen be available in the water. Ammonia is an additional source of nitrogen as a nutrient which may contribute to the expanded growth of undesirable algae and other forms of plant growth that overload the natural system and cause pollution.

APPLICATION:	Drinking, surface, and saline waters; domestic and industrial wastes.
RANGE:	0.00–4.00 ppm Ammonia Nitrogen
MDL:	0.05 ppm
METHOD:	Ammonia forms a colored complex with Nessler's Reagent in proportion to the amount of ammonia present in the sample. Rochelle salt is added to prevent precipitation of calcium or magnesium in undistilled samples.
SAMPLE HANDLING & PRESERVATION:	Ammonia solutions tend to be unstable and should be analyzed immediately. Sample may be stored for 24 hours at 4°C or 28 days at –20°C.
INTERFERENCES:	Sample turbidity and color may interfere. Turbidity may be removed by a filtration procedure. Color interference may be eliminated by blanking the instrument with a sample blank.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Scroll to and select **ALL TESTS** (or another sequence containing **005 Ammonia-N HR**) from **TESTING MENU**.
4. Scroll to and select **005 Ammonia-N HR** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**. (See Note)
7. Remove tube from colorimeter. Add 8 drops of Ammonia Nitrogen Reagent #1 (V-4797). Cap and mix. Wait 1 minute.
8. Use the 1.0 mL pipet (0354) to add 1.0 mL of *Ammonia Nitrogen Reagent #2 (V-4798). Cap and mix. Allow 5 minutes for maximum color development.
9. At end of the 5 minute waiting period, immediately mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
10. Press ⏻ to turn the colorimeter off or press the EXIT exit to a previous menu or make another menu selection.

CALCULATIONS:

To express results as Unionized Ammonia (NH_3):

ppm Unionized Ammonia (NH_3) =
ppm Ammonia-Nitrogen (NH_3–N) x 1.2

To express results as Ionized Ammonia (NH_4):

ppm Ionized Ammonia (NH_4^+) =
ppm Ammonia-Nitrogen (NH_3–N) x 1.3

To determine the percentages of Unionized and Ionized Ammonia-Nitrogen, consult the Appendix.

NOTE: It is strongly suggested that a reagent blank be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

BENZOTRIAZOLE/TOLYLTRIAZOLE

UV Photolysis Method • CODE 4047

QUANTITY	CONTENTS	CODE
15 g	*Benzotriazole Reagent	*3818-E
25 mL	Potassium Sodium Tartrate Solution	7841WT-G
25 mL	*Sulfuric Acid	*6139WT-G
1	pH Test Papers, 1–11	2956
1	Spoon, 0.25 g, plastic	0695
1	Erlenmeyer Flask, 25 mL, glass	2-2109
1	Graduated Cylinder, 25 mL, glass	0417

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Equipment needed but not supplied:

1	UV Shielding Goggles	31041
1	Pen-Ray UV Lamp	31041-1
1	Pen-Ray Lamp Power Source	31041-2

Proper safety precautions must be followed when using the Pen-Ray UV lamp and power source (31041-1 and 31041-2) to prevent eye and skin damage. Always wear the UV Shielding Goggles (31041) while the lamp is turned on. Never handle the lamp itself; always hold it by the socket. Wipe the lamp dry with a clean, soft tissue after each test. Do not operate the lamp outside the Erlenmeyer Flask filled with water.

Benzotriazole and tolyltriazole form strong complexes with metals. They are used in antifreeze for cars, lubricating oil, and photographic anti-fogging agents. In cooling water systems benzotriazole and tolyltriazole are used as corrosion and rust inhibitors together with many kinds of scale inhibitors, bactericides and algaecides.

APPLICATION:	Corrosion and rust inhibitors in cooling water systems
RANGE:	0.0 – 30.0 ppm Benzotriazole 0.0 – 30.0 ppm Tolyltriazole
MDL:	0.5 ppm Benzotriazole 0.5 ppm Tolyltriazole
METHOD:	Benzotriazole and tolyltriazole are UV-photolyzed in a buffered solution with a pH between 4 and 6. A yellow color develops in proportion to the concentration of triazole present.
SAMPLE HANDLING & PRESERVATION:	Samples should be analyzed as soon as possible after collection.
INTERFERENCES:	Tolyltriazole with interfere in the benzotriazole test. Benzotriazole will interfere in the tolyltriazole test. Strong reducing or oxidizing agents will interfere.

BENZOTRIAZOLE PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select Testing Menu.
3. Select **ALL TESTS** (or another sequence containing **009 Benzotriazole**) from **TESTING MENU**.
4. Scroll to and select **009 Benzotriazole** from menu.
5. Rinse a tube (0290) with sample water. Fill to 10 mL with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove the tube from colorimeter. Discard the sample.
8. Adjust the sample water temperature to between 20 and 25°C if necessary.
9. Fill the graduated cylinder (0417) to the 25 mL line with sample water. Transfer to the Erlenmeyer Flask (2-2109).
10. Use the pH Test Paper (2956) to check the pH of the sample. If the pH is not between 4 and 6, add one drop of *Sulfuric Acid, 1.0N (6139). Swirl to mix. Continue adding *Sulfuric Acid, 1.0N (6139) one drop at a time, swirling to mix and checking the pH after each drop, until the pH is between 4 and 6.
11. Add 10 drops of Potassium Sodium Tartrate (7841WT).
12. Use the 0.25 g spoon (0695) to add one measure of *Benzotriazole Reagent (3818). Swirl to mix until the powder has dissolved.
13. Replace the flask in the slot in the case. Insert the Pen-Ray Lamp (31041-1) into the flask. Plug in the Pen-Ray Power Source (31041-2) and turn the lamp on for exactly 5 minutes. Remove the lamp from the flask. Rinse and wipe the lamp dry.
14. Fill a test tube (0290) to the 10 mL line with the digested sample. Cap tube.
15. Insert tube into chamber, close lid and select SCAN SAMPLE. Record result in ppm Benzotriazole.
16. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

TOLYLTRIAZOLE PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select Testing Menu.
3. Select **ALL TESTS** (or another sequence containing **097 Tolyltriazole**) from **TESTING MENU**.
4. Scroll to and select **097 Tolyltriazole** from menu.
5. Rinse a tube (0290) with sample water. Fill to 10 mL with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove the tube from colorimeter. Discard the sample.
8. Adjust the sample water temperature to between 20 and 25°C if necessary.
9. Fill the graduated cylinder (0417) to the 25 mL line with sample water. Transfer to the Erlenmeyer Flask (2-2109).
10. Use the pH Test Paper (2956) to check the pH of the sample. If the pH is not between 4 and 6, add one drop of *Sulfuric Acid, 1.0N (6139). Swirl to mix. Continue adding *Sulfuric Acid, 1.0N (6139) one drop at a time, swirling to mix and checking the pH after each drop, until the pH is between 4 and 6.
11. Add 10 drops of Potassium Sodium Tartrate (7841WT).
12. Use the 0.25 g spoon (0695) to add one measure of *Benzotriazole Reagent (3818). Swirl to mix until the powder has dissolved.
13. Replace the flask in the slot in the case. Insert the Pen-Ray Lamp (31041-1) into the flask. Plug in the Pen-Ray Power Source (31041-2) and turn the lamp on for exactly 5 minutes. Remove the lamp from the flask. Rinse and wipe the lamp dry.
14. Fill a test tube (0290) to the 10 mL line with the digested sample. Cap tube.
15. Insert tube into chamber, close lid and select SCAN SAMPLE. Record result in ppm Tolyltriazole.
16. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

BIGUANIDE

COLORIMETRIC METHOD • CODE 4044

QUANTITY	CONTENTS	CODE
2 X 60 mL	Biguanide Indicator	3994-H
1	Pipet, plastic, 1.0 mL	0354

Biguanide is a non-chlorine, non-bromine chemical sanitizer. It is more stable than chlorine or bromine and has little chemical odor. Biguanide is an effective bacteriacide but, unlike chlorine and bromine, it does not destroy organic contaminants. Therefore, hydrogen peroxide is added to biguanide pools on a regular basis to eliminate organic contaminants. The optimum recommended level of biguanide is 30 to 50 ppm.

APPLICATION:	Swimming pools
RANGE:	0–70 ppm Biguanide
MDL:	2 ppm
METHOD:	Biguanide complexes with the proprietary indicator to produce a colored solution. The color ranges from yellow through green to blue depending on the biguanide concentration.
SAMPLE HANDLING & PRESERVATION:	Samples should be analyzed as soon as possible.
INTERFERENCES:	The only interfering substances that are likely to be encountered in pool water are oxidized manganese and oxidizing agents, such as chlorine, bromine and ozone.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select Testing Menu.
3. Select **ALL TESTS** (or another sequence containing **006 Biguanide**) from **TESTING MENU**.
4. Scroll to and select **006 Biguanide** from menu.
5. Rinse a tube (0290) with sample water. Fill to 10 mL with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove the tube from colorimeter.
8. Use the 1.0 mL pipet (0354) to add 2.0 mL of Biguanide Indicator (3994). Cap and invert three times to mix.
9. Wait 1 minute.
10. Insert the tube into chamber. Close lid.
11. Select **SCAN SAMPLE**. Record result in ppm Biguanide
12. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

BORATE - UDV

UNIT DOSE VIALS • CODE 4322-J

QUANTITY	CONTENTS	CODE
50	Borate UDV, 20 pouches	4322-J

Equipment needed but not supplied:

STANDARD ACCESSORY PACKAGE · CODE 1961		
1	Package of 3 Vials (empty)	0156
1	Syringe, 3 mL, plastic	1184
1	Foil Storage Bag	9467

Or:

ADVANCED ACCESSORY PACKAGE · CODE 1962		
1	Pipettor, 3mL	30528
1	Pipet Tip (0-5 mL)	30695
1	Cuvette Rack	31695
1	Package of 3 Vials (empty)	0156
1	Foil Storage Bag	9467

Some swimming pools use a borate buffering system. Borates lower the level of carbon dioxide in the pool, which slows algae growth. This results in a lower chlorine requirement. Free chlorine levels in pools with borate systems can be maintained at 1.0 ppm.

Small amounts of boron are necessary for plant growth but large amounts can be toxic. In humans, boron aids in the uptake of calcium and the production of strong bones. An excess of boron can affect the central nervous system resulting in a syndrome known as borism. Some natural waters may contain small amounts of boron. Large concentrations may be due to industrial effluent entering waterways. Boron compounds are used in cleaning compounds, paper and paints, fertilizers, glass and ceramics, fire retardants and the production of alloys. In the atomic energy field, boron is a component of neutron shields and nuclear reactors.

APPLICATION:	swimming pools, surface and saline waters, hydroponic solutions, industrial waste.
RANGE:	0.00 – 80.0 ppm boron
MDL:	5 ppm
METHOD:	Borate reacts with a selective boron indicator powder to form a colored complex at pH 7.2 to 7.4 in proportion to the concentration of boron present.
SAMPLE HANDLING & PRESERVATION:	Store samples in polyethylene bottles. Do not use borate detergents or glassware.
INTERFERENCES:	Interferences in swimming pool water are unlikely.

PROCEDURE

Use COD/UDV adapter

1. Press ⏻ until colorimeter turns on.
2. Press ENTER to select Testing Menu.
3. Select **ALL TESTS** (or another sequence containing **007 Borate UDV**) from **TESTING MENU**.
4. Scroll to and select **007 Borate UDV** from menu.
5. Rinse a clean vial (0156) with sample water.
6. Use the syringe (1184) to add 3mL of sample to the vial.
7. Insert the vial into chamber, close the lid and select **SCAN BLANK**.
8. Remove the vial from the colorimeter.
9. Use the syringe (1184) to add 3mL of sample to a Borate UDV vial (4322).
10. Wait 3 minute.
11. Invert the vial three times to mix.

    NOTE: If powder residue remains in the bottom of the vial after inverting or air bubbles form, invert once more and tap bottom of vial sharply once or twice to dislodge powder and bubbles. Mix.

12. Immediately insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result in ppm borate.
13. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents are obtained.

NOTE: UDVs from opened pouches should be used promptly. Store unused vials from opened pouches in the Foil Storage Bag (9467) to extend the shelf life of the reagent. Generally, UDVs stored in the bag should be used within 10 days if the humidity is less than 50% and within 5 days if humidity is greater than 50%. The Foil Storage Bag contains a desiccant pack with indicator. When the indicator in the window turns from blue to pink, the bag should be replaced.

BORON

AZOMETHINE-H METHOD · CODE 4868-01

QUANTITY	CONTENTS	CODE
120 mL	*Boron Buffer	*4869-J
10 g	*Boron Indicator Powder	*4870-D
1	Pipet, plastic, 1.0 mL	0354
1	Spoon, 0.15 g	0727
1	Dark storage chamber, brown	0108

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Small amounts of boron are necessary for plant growth but large amounts can be toxic. In humans, boron aids in the uptake of calcium and the production of strong bones. An excess of boron can affect the central nervous system resulting in a syndrome known as borism. Some natural waters may contain small amounts of boron. Large concentrations may be due to industrial effluent entering waterways. Boron compounds are used in cleaning compounds, paper and paints, fertilizers, glass and ceramics, fire retardants and the production of alloys. In the atomic energy field, boron is a component of neutron shields and nuclear reactors. Some swimming pools use boron buffering systems.

APPLICATION:	Surface and saline waters, hydroponic solutions, industrial waste, swimming pools.
RANGE:	0.00–0.80 ppm Boron
MDL:	0.05
METHOD:	Azomethine-H and borate form a yellow complex at pH 6 in proportion to the concentration of boron present.
SAMPLE HANDLING & PRESERVATION:	Store samples in polyethylene bottles. Do not use borate detergents or glassware.
INTERFERENCES:	Interferences in drinking water are unlikely. Manganese, zirconium, chromium, titanium, copper, vanadium, aluminum, beryllium and iron may cause high results.

PROCEDURE

1. This test requires a Reagent Blank. Rinse a tube (0290) with clear, colorless, boron free water. Fill to 10 mL line with clear, colorless, boron free water.
2. Use the 1.0 mL pipet (0354) to add 2 mL of *Boron Buffer (4869). Cap and mix.
3. Use the 0.15 g spoon (0727) to add one level measure of *Boron Indicator Powder (4870). Press full spoon against side of jar to compress powder. Scrape off excess powder on inside neck of bottle. Tap excess off spoon handle.
4. Cap and shake vigorously for 30 seconds.
5. Insert the tube into meter chamber. Close lid.
6. Start a timer set for 30 minutes. Do not open the lid during the waiting time. The reaction is photosensitive.
7. Rinse a clean tube (0290) with Sample Water. Fill to the 10 mL line with sample water. Repeat steps 2–4.
8. Insert the tube into the Dark Storage Chamber (0108). Close top.
9. Start a second timer set for 30 minutes. Do not open the chamber during the waiting time. The reaction is photosensitive.
10. When 2 minutes remain on the first timer (Reagent Blank), press and hold ON button until colorimeter turns on.
11. Press and hold ⏻ until colorimeter turns on.
12. Press ENTER to select **TESTING MENU**.
13. Select **ALL TESTS** (or another sequence containing **008 Boron**) from **TESTING MENU**.
14. Scroll to and select **008 Boron** from menu.At the end of the Reagent Blank 30 minute waiting period, remove Reagent Blank tube from meter chamber. Invert several times to mix.
15. Insert the tube into meter chamber, close lid and select SCAN BLANK.
16. Remove the tube from colorimeter.
17. At the end of the Sample Water 30 minute waiting period, remove Sample Water tube from Dark Storage Chamber. Invert several times to mix.
18. Insert tube into meter chamber, close lid and select SCAN SAMPLE. Record result in ppm boron.
19. Press ⏻ to turn colorimeter off or press the EXIT to exit to a previous menu or make another menu selection.

BROMINE

DPD TABLET METHOD • CODE 3643-SC

QUANTITY	CONTENTS	CODE
100	*DPD #1 Instrument Grade Tablets	*6903A-J
100	*DPD #3 Instrument Grade Tablets	*6197A-J
15 mL	Glycine Solution	6811-E
1	Tablet Crusher	0175

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Like chlorine, bromine is an effective germicidal agent employed in drinking water treatment, pool and spa water sanitization, food service sanitation, and other public health applications.

APPLICATION:	Drinking, surface, and saline waters; swimming pool water; domestic and industrial waters and wastes.
RANGE:	0.00–9.00 Bromine
MDL:	0.1 ppm
METHOD:	In buffered sample bromine reacts with diethyl-p-phenylene diamine (DPD) to produce a pink-red color in proportion to the concentration of bromine present.
SAMPLE HANDLING & PRESERVATION:	Bromine in aqueous solutions is not stable, and the bromine content of samples or solutions, particularly weak solutions, will rapidly decrease. Exposure to sunlight or agitation will accelerate the reduction of bromine present in such solutions. For best results start analysis immediately after sampling. Samples to be analyzed for bromine cannot be preserved or stored.
INTERFERENCE:	The only interfering substance likely to be encountered in water is oxidized manganese. The extent of this interference can be determined by treating a sample with sodium arsenite to destroy the bromine present so that the degree of interference can be estimated. Iodine and chlorine can also interfere, but these are not normally present unless they have been added as sanitizers.

PROCEDURE A:
BROMINE (NO CHLORINE)

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **010 Bromine LR**) from **TESTING MENU**.
4. Scroll to and select 010 **Bromine LR** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Add one *DPD #1 Instrument Grade Tablet (6903A). Cap tube and and shake for 10 seconds. Invert slowly 5 times. Solution will turn pink if bromine is present.
8. Insert tube into chamber, close lid and select **SCAN SAMPLE**.
9. Press ⏻ to turn colorimeter off or press the EXIT to exit to a previous menu or make another menu selection.

PROCEDURE B:
BROMINE IN THE PRESENCE OF CHLORINE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **010 Bromine-LR**) from **TESTING MENU**.
4. Scroll to and select **010 Bromine-LR** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber close lid and select **SCAN BLANK**.
7. Rinse a second clean tube (0290) with sample water. Fill to the 10 mL line with sample. Add 5 drops of Glycine Solution (6811). Cap and mix.
8. Remove blank from colorimeter. Add one *DPD#1 Instrument Grade Tablet (6903). Cap tube and shake for 10 seconds. Invert slowly 5 times. Solution will turn pink if bromine is present. Insert tube into chamber, close lid and select **SCAN SAMPLE**.
9. Press ⏻ to turn colorimeter off or press the EXIT to exit to a previous menu or make another menu selection.

PROCEDURE C:
FREE AVAILABLE, TOTAL AVAILABLE & COMBINED CHLORINE IN THE PRESENCE OF BROMINE

1. Perform the test for free and combined chlorine as previously described.
2. Perform the test for bromine in the presence of chlorine.

Calculations:

Residual Bromine (ppm) = Reading BR

Free Chlorine in the Presence of Bromine = Free Chlorine - 0.45 (Reading BR)

Total Chlorine in the Presence of Bromine = Total Chlorine - 0.45 (Reading BR)

Combined Chlorine in the Presence of Bromine = Total Chlorine - Free Chlorine

NOTE: Combined chlorine is not affected by the presence of bromine, so the calculation is the same as when only chlorine is present.

BROMINE - UDV

DPD METHOD–UNIT DOSE VIALS · CODE 4311-J

QUANTITY	CONTENTS	CODE
1	*Free Chlorine Unit Dose Vials, 20 pouches	*4311-J

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Equipment needed but not supplied:

STANDARD ACCESSORY PACKAGE · CODE 1961		
1	Package of 3 Vials (empty)	0156
1	Syringe, 3 mL, plastic	1184
1	Foil Storage Bag	9467

Or:

ADVANCED ACCESSORY PACKAGE · CODE 1962		
1	Pipettor, 3mL	30528
1	Pipet Tip (0-5 mL)	30695
1	Cuvette Rack	31695
1	Package of 3 Vials (empty)	0156
1	Foil Storage Bag	9467

Like chlorine, bromine is an effective germicidal agent employed in drinking water treatment, pool and spa water sanitization, food service sanitation, and other public health applications.

APPLICATION:	Drinking, surface, and saline waters; swimming pool water; domestic and industrial waters and wastes.
RANGE:	0.0–20.0 ppm Bromine
MDL:	0.25 ppm
METHOD:	In buffered sample bromine reacts with diethyl-p-phenylene diamine (DPD) to produce a pink-red color in proportion to the concentration of bromine present.
SAMPLE HANDLING & PRESERVATION:	Bromine in aqueous solutions is not stable, and the bromine content of samples or solutions, particularly weak solutions, will rapidly decrease. Exposure to sunlight or agitation will accelerate the reduction of bromine present in such solutions. For best results start analysis immediately after sampling. Samples to be analyzed for bromine cannot be preserved or stored.
INTERFERENCE:	The only interfering substance likely to be encountered in water is oxidized manganese. The extent of this interference can be determined by treating a sample with sodium arsenite to destroy the bromine present so that the degree of interference can be estimated. Iodine and chlorine can also interfere, but these are not normally present unless they have been added as sanitizers.

PROCEDURE

Use COD/UDV adapter.

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select Testing Menu.
3. Select **ALL TESTS** (or another sequence containing **011 Bromine-UDV**) from **TESTING MENU**.
4. Scroll to and select **011 Bromine-UDV** from menu.
5. Rinse a clean vial (0156) with sample water.
6. Use the syringe (1184) to add 3mL of sample to the vial.
7. Insert the vial into chamber, close the lid and select **SCAN BLANK**.
8. Remove the vial from the colorimeter.
9. Use the syringe (1184) to add 3mL of sample to a *Free Chlorine UDV vial (4311).
10. Shake vigorously until powder dissolves completely.

    NOTE: If powder residue remains in the bottom of the vial after inverting or air bubbles form, invert once more and tap bottom of vial sharply once or twice to dislodge powder and bubbles. Mix.
11. Immediately insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result in ppm bromine.
12. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTES: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents are obtained.

UDVs from opened pouches should be used promptly. Store unused vials from opened pouches in the Foil Storage Bag (9467) to extend the shelf life of the reagent. Generally, UDVs stored in the bag should be used within 10 days if the humidity is less than 50% and within 5 days if humidity is greater than 50%. The Foil Storage Bag contains a desiccant pack with indicator. When the indicator in the window turns from blue to pink, the bag should be replaced.

CADMIUM

PAN METHOD • CODE 4017-01

QUANTITY	CONTENTS	CODE
60 mL	*Buffered Ammonia Reagent	*4020-H
15 mL	Sodium Citrate, 10%	6253-E
30 mL	*PAN Indicator	*4021-G
30 mL	Stabilizing Reagent	4022-G
1	Pipet, 1.0 mL, plastic	0354
2	Pipet, 0.5 mL, plastic	0369

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Cadmium is used in batteries, paint pigments, electroplating processes, and with other metals in the preparation of alloys. The solubility of cadmium in natural water is proportional to the hardness or alkalinity of the water. Cadmium is not an essential nutrient for plants and animals. It is extremely toxic and can accumulate in the kidneys and liver.

APPLICATION:	Drinking and surface waters; domestic and industrial wastewater.
RANGE:	0.00–1.00 ppm Cadmium
MDL:	0.04 ppm
METHOD:	PAN (1-[2-Pyridylazo]-2-Naphthol) forms a red complex with Cadmium (Cd^{+2}) at a pH of 10.
SAMPLE HANDLING & PRESERVATION:	Analyze sample as soon as possible. If sample must be stored, acidify with nitric acid to a pH below 2.
INTERFERENCES:	Ag^{+2}, Co^{+2}, Cu^{+2}, Mn^{+2}, Ni^{+2}, Zn^{+2}, Y^{+3}, In^{+3}

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **012 Cadmium**) from **TESTING MENU**.
4. Scroll to and select **012 Cadmium** from menu.
5. Rinse a tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Use the 1.0 mL pipet (0354) to add 1.0 mL of *Buffered Ammonia Reagent (4020). Swirl to mix.
8. Add two drops of Sodium Citrate, 10% (6253). Swirl to mix.
9. Use a 0.5 mL pipet (0369) to add 0.5 mL of PAN Indicator (4021). Swirl to mix.
10. Use a 0.5 mL pipet (0369) to add 0.5 mL Stabilizing Reagent (4022). Cap and mix.
11. Immediately insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
12. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

CHLORIDE

ARGENTOMETRIC METHOD · CODE 3693-SC

QUANTITY	CONTENTS	CODE
50	*Chloride Spectrophotometric Grade Tablets	*3885A-H
1	Tablet Crusher	0175

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Chloride is one of the major anions found in water and sewage. The presence of chlorides in large amounts may be due to the natural process of water passing through salt formations in the earth, or it may be evidence of the intrusion of seawater or pollution from industrial processes or domestic wastes. The salt content of water affects the distribution of plant and animal life in an aquatic system, based on the amount of salt they can tolerate.

APPLICATION:	Drinking, surface, and saline waters; domestic and industrial wastewaters.
RANGE:	0.0–30.0 ppm Chloride
MDL:	0.4 ppm
METHOD:	Silver nitrate reacts with chloride to form turbid silver chloride in proportion to the amount of chloride in the sample.
SAMPLE HANDLING & PRESERVATION:	Collect samples in clean, chemically resistant glass or plastic containers. No preservative is needed if sample is to be stored.
INTERFERENCES:	Substances in amounts normally found in drinking water will not interfere. Bromide, iodide, cyanide, sulfide, thiosulfate, sulfide and orthophosphate will interfere.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **020 Chloride Tablet**) from **TESTING MENU**.
4. Scroll to and select **020 Chloride Tablet** from menu.
5. Rinse a tube (0290) with sample water. Fill to 10 mL line with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove the tube from colorimeter.
8. Add one *Chloride Spectrophotometric Grade Tablet (3885A).
9. Use Tablet Crusher (0175) to crush tablet.
10. Cap tube.
11. Invert 2 times.
12. Wait 3 minutes. Do NOT mix.
13. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result in ppm chloride.
14. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples.

The reagent system is temperature sensitive. The calibration is for 25ºC If sample is at 30ºC, multiply resulting ppm by 1.1. If the sample is at 20º, multiply ppm by 0.9.

CHLORINE

LIQUID DPD METHOD · CODE 4859

QUANTITY	CONTENTS	CODE
30 mL	DPD 1A Free Chlorine Reagent	P-6740-G
30 mL	*DPD 1B Free Chlorine Reagent	*P-6741-G
30 mL	*DPD 3 Total Chlorine Reagent	*P-6743-G

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

All water for cities and communities must be sanitized; even waters that come from clean sources, protected watersheds, reservoirs, and deep wells, are commonly sanitized to assure safety. Chlorine is the most commonly used sanitizer for several reasons: it is effective against a wide range of microorganisms, the cost is low, and the methods of applying it have been well developed. If an adequate concentration of chlorine is present in the water for a few minutes, disease producing bacteria will be destroyed. A number of conditions affect the sanitizing action of chlorine. In municipal systems these can be controlled so that if chlorine is detectable, it can be assumed that bacteria have been killed. The factors that influence the rate of sanitization are temperature, pH, presence of other materials that react with chlorine, time, and the concentrations of the various chlorine combinations that are formed in the water with ammonia and other substances that react with chlorine.

The fact that chlorine can be easily detected and measured makes chlorine a favorite water sanitizer of those concerned with the public safety of water supplies. Chlorine concentrations in the range of 0.1 to 0.4 parts per million are usually maintained in municipal supplies.

Chlorine can be added in the form of chlorine gas, liquid sodium hypochlorite (bleach), granular calcium hypochlorite or as organic chlorine compounds. Chlorine is not present in natural water supplies; if it is present it is the result of chlorination of a water supply or of chlorinated compounds being discharged as waste from industrial operations. The presence of chlorine in concentrations above 0.5 parts per million should be considered evidence of pollution from chlorine treated effluents or from a process in which high concentrations of chlorine are used.

APPLICATION:	Drinking, surface, and saline waters; swimming pool water; domestic and industrial wastes.
RANGE:	0.00–4.00 ppm Chlorine
MDL:	0.03 ppm
METHOD:	In the absence of iodide, free available chlorine reacts instantly with DPD to produce a red color. Subsequent addition of potassium iodide evokes a rapid color response from the combined forms of chlorine (chloramines).
SAMPLE HANDLING & PRESERVATION:	Chlorine in aqueous solutions is not stable, and the chlorine content of samples or solutions, particularly weak solutions, will rapidly decrease. Exposure to sunlight or agitation will accelerate the reduction of chlorine present in such solutions. For best results, start analysis immediately after sampling. Samples to be analyzed for chlorine cannot be preserved or stored.
INTERFERENCE:	The only interfering substance likely to be encountered in water is oxidized manganese. The extent of this interference can be determined by treating a sample with sodium arsenite to destroy the chlorine present so that the degree of interference can be measured. Iodine and bromine can give a positive interference, but these are not normally present unless they have been added as sanitizers.

PROCEDURE–FREE CHLORINE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select Testing Menu.
3. Select **ALL TESTS** (or another sequence containing **016 Chlorine Liq DPD**) from **TESTING MENU**.
4. Scroll to and select **016 Chlorine Liq DPD** from menu.
5. Rinse a tube (0290) with sample water. Fill to 10 mL with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove the tube from colorimeter.
8. Add 5 drops of DPD 1A Free Chlorine Reagent (P-6740).
9. Add 5 drops of *DPD 1B Free Chlorine Reagent (P-6741). Cap and mix.
10. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result as ppm free chlorine.

PROCEDURE–TOTAL CHLORINE

11. Add 5 drops of *DPD 3 Total Chlorine Reagent (P-6743). Cap and mix.

    NOTE: For wastewater samples, Standard Methods for the Examination of Water and Wastewater recommends waiting 2 minutes for full color development.
12. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result as ppm total chlorine.
13. Subtract the Free Chlorine reading from the Total Chlorine reading to determine ppm combined chlorine.
14. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

CHLORINE

DPD TABLET METHOD • CODE 3643-SC

QUANTITY	CONTENTS	CODE
100	*DPD #1 Instrument Grade Tablets	*6903A-J
100	*DPD #3 Instrument Grade Tablets	*6197A-J
15 mL	Glycine Solution	6811-E
1	Tablet Crusher	0175

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All water for cities and communities must be sanitized; even waters that come from clean sources, protected watersheds, reservoirs, and deep wells, are commonly sanitized to assure safety. Chlorine is the most commonly used sanitizer for several reasons: it is effective against a wide range of microorganisms, the cost is low, and the methods of applying it have been well developed. If an adequate concentration of chlorine is present in the water for a few minutes, disease producing bacteria will be destroyed. A number of conditions affect the sanitizing action of chlorine. In municipal systems these can be controlled so that if chlorine is detectable, it can be assumed that bacteria have been killed. The factors that influence the rate of sanitization are temperature, pH, presence of other materials that react with chlorine, time, and the concentrations of the various chlorine combinations that are formed in the water with ammonia and other substances that react with chlorine.

The fact that chlorine can be easily detected and measured makes chlorine a favorite water sanitizer of those concerned with the public safety of water supplies. Chlorine concentrations in the range of 0.1 to 0.4 parts per million are usually maintained in municipal supplies.

Chlorine can be added in the form of chlorine gas, liquid sodium hypochlorite (bleach), granular calcium hypochlorite or as organic chlorine compounds. Chlorine is not present in natural water supplies; if it is present it is the result of chlorination of a water supply or of chlorinated compounds being discharged as waste from industrial operations. The presence of chlorine in concentrations above 0.5 parts per million should be considered evidence of pollution from chlorine treated effluents or from a process in which high concentrations of chlorine are used.

APPLICATION:	Drinking, surface, and saline waters; swimming pool water; domestic and industrial wastes.
RANGE:	0.00–4.00 ppm Chlorine
MDL:	0.03 ppm
METHOD:	In the absence of iodide, free available chlorine reacts instantly with DPD to produce a red color. Subsequent addition of potassium iodide evokes a rapid color response from the combined forms of chlorine (chloramines).
SAMPLE HANDLING & PRESERVATION:	Chlorine in aqueous solutions is not stable, and the chlorine content of samples or solutions, particularly weak solutions, will rapidly decrease. Exposure to sunlight or agitation will accelerate the reduction of chlorine present in such solutions. For best results, start analysis immediately after sampling. Samples to be analyzed for chlorine cannot be preserved or stored.
INTERFERENCE:	The only interfering substance likely to be encountered in water is oxidized manganese. The extent of this interference can be determined by treating a sample with sodium arsenite to destroy the chlorine present so that the degree of interference can be measured. Iodine and bromine can give a positive interference, but these are not normally present unless they have been added as sanitizers.

PROCEDURE–FREE CHLORINE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **014 Chlorine**) from **TESTING MENU**.
4. Scroll to and select **014 Chlorine** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Add one *Chlorine DPD #1 Instrument Grade Tablet (6903A). Cap tube and shake for 10 seconds.Invert slowly 5 times. Solution will turn pink if free chlorine is present.
8. Immediately insert tube into chamber, close lid and select **SCAN SAMPLE**.

PROCEDURE–COMBINED CHLORINE

9. Add one *Chlorine DPD #3 Instrument Grade Tablet (6197A) to sample from Step 8 above. Cap tube and shakefor 10 seconds. Invert slowly 5 times. An increase in color represents combined chlorine.

   NOTE: For wastewater samples, Standard Methods for the Examination of Water and Wastewater recommends waiting 2 minutes for full color development.
10. Insert sample into chamber, close lid and select **SCAN SAMPLE**. Record result as Total Chlorine.
11. Subtract free chlorine reading from total chlorine reading to obtain concentration of combined chlorine.
12. Press the ⏻ to turn off the colorimeter or press the EXIT to exit to a previous menu or make another menu selection.

CHLORINE, FREE - UDV

DPD METHOD–UNIT DOSE VIALS · CODE 4311-J

QUANTITY	CONTENTS	CODE
1	*Free Chlorine Unit Dose Vials, 20 pouches	*4311-J

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Equipment needed but not supplied:

STANDARD ACCESSORY PACKAGE · CODE 1961

1	Package of 3 Vials (empty)	0156
1	Syringe, 3 mL, plastic	1184
1	Foil Storage Bag	9467

Or:

ADVANCED ACCESSORY PACKAGE · CODE 1962

1	Pipettor, 3mL	30528
1	Pipet Tip (0-5 mL)	30695
1	Cuvette Rack	31695
1	Package of 3 Vials (empty)	0156
1	Foil Storage Bag	9467

All water for cities and communities must be sanitized; even waters that come from clean sources, protected watersheds, reservoirs, and deep wells, are commonly sanitized to assure safety. Chlorine is the most commonly used sanitizer for several reasons: it is effective against a wide range of microorganisms, the cost is low, and the methods of applying it have been well developed. If an adequate concentration of chlorine is present in the water for a few minutes, disease producing bacteria will be destroyed. A number of conditions affect the sanitizing action of chlorine. In municipal systems these can be controlled so that if chlorine is detectable, it can be assumed that bacteria have been killed. The factors that influence the rate of sanitization are temperature, pH, presence of other materials that react with chlorine, time, and the concentrations of the various chlorine combinations that are formed in the water with ammonia and other substances that react with chlorine.

The fact that chlorine can be easily detected and measured makes chlorine a favorite water sanitizer of those concerned with the public safety of water supplies. Chlorine concentrations in the range of 0.1 to 0.4 parts per million are usually maintained in municipal supplies.

Chlorine can be added in the form of chlorine gas, liquid sodium hypochlorite (bleach), granular calcium hypochlorite or as organic chlorine compounds. Chlorine is not present in natural water supplies; if it is present it is the result of chlorination of a water supply or of chlorinated compounds being discharged as waste from industrial operations. The presence of chlorine in concentrations above 0.5 parts per million should be considered evidence of pollution from chlorine treated effluents or from a process in which high concentrations of chlorine are used.

APPLICATION:	Drinking, surface, and saline waters; swimming pool water; domestic and industrial wastes.
RANGE:	0.00–10.00 ppm Chlorine
MDL:	0.10 ppm
METHOD:	In the absence of iodide, free available chlorine reacts instantly with DPD to produce a red color. Subsequent addition of potassium iodide evokes a rapid color response from the combined forms of chlorine (chloramines).
SAMPLE HANDLING & PRESERVATION:	Chlorine in aqueous solutions is not stable, and the chlorine content of samples or solutions, particularly weak solutions, will rapidly decrease. Exposure to sunlight or agitation will accelerate the reduction of chlorine present in such solutions. For best results, start analysis immediately after sampling. Samples to be analyzed for chlorine cannot be preserved or stored.
INTERFERENCE:	The only interfering substance likely to be encountered in water is oxidized manganese. The extent of this interference can be determined by treating a sample with sodium arsenite to destroy the chlorine present so that the degree of interference can be measured. Iodine and bromine can give a positive interference, but these are not normally present unless they have been added as sanitizers.

PROCEDURE

Use COD/UDV adapter.

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select Testing Menu.
3. Select **ALL TESTS** (or another sequence containing **015 Chlorine F UDV**) from **TESTING MENU**.
4. Scroll to and select **015 Chlorine F UDV** from menu.
5. Rinse a clean vial (0156) with sample water.
6. Use the syringe (1184) to add 3mL of sample to the vial.
7. Insert the vial into chamber, close the lid and select **SCAN BLANK**.
8. Remove the vial from the colorimeter.
9. Use the syringe (1184) to add 3mL of sample to a *Free Chlorine UDV vial (4311).
10. Invert 3 times to mix.

    NOTE: If powder residue remains in the bottom of the vial after inverting or air bubbles form, invert once more and tap bottom of vial sharply once or twice to dislodge powder and bubbles. Mix.
11. Immediately insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result in ppm free chlorine.
12. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTES: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

UDVs from opened pouches should be used promptly. Store unused vials from opened pouches in the Foil Storage Bag (9467) to extend the shelf life of the reagent. Generally, UDVs stored in the bag should be used within 10 days if the humidity is less than 50% and within 5 days if humidity is greater than 50%. The Foil Storage Bag contains a desiccant pack with indicator. When the indicator in the window turns from blue to pink, the bag should be replaced.

CHLORINE, TOTAL - UDV

DPD METHOD–UNIT DOSE VIALS · CODE 4312-J

QUANTITY	CONTENTS	CODE
1	*Total Chlorine Unit Dose Vials, 20 pouches	*4312-J

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Equipment needed but not supplied:

STANDARD ACCESSORY PACKAGE · CODE 1961

1	Package of 3 Vials (empty)	0156
1	Syringe, 3 mL, plastic	1184
1	Foil Storage Bag	9467

Or:

ADVANCED ACCESSORY PACKAGE · CODE 1962

1	Pipettor, 3mL	30528
1	Pipet Tip (0-5 mL)	30695
1	Cuvette Rack	31695
1	Package of 3 Vials (empty)	0156
1	Foil Storage Bag	9467

All water for cities and communities must be sanitized; even waters that come from clean sources, protected watersheds, reservoirs, and deep wells, are commonly sanitized to assure safety. Chlorine is the most commonly used sanitizer for several reasons: it is effective against a wide range of microorganisms, the cost is low, and the methods of applying it have been well developed. If an adequate concentration of chlorine is present in the water for a few minutes, disease producing bacteria will be destroyed. A number of conditions affect the sanitizing action of chlorine. In municipal systems these can be controlled so that if chlorine is detectable, it can be assumed that bacteria have been killed. The factors that influence the rate of sanitization are temperature, pH, presence of other materials that react with chlorine, time, and the concentrations of the various chlorine combinations that are formed in the water with ammonia and other substances that react with chlorine.

The fact that chlorine can be easily detected and measured makes chlorine a favorite water sanitizer of those concerned with the public safety of water supplies. Chlorine concentrations in the range of 0.1 to 0.4 parts per million are usually maintained in municipal supplies.

Chlorine can be added in the form of chlorine gas, liquid sodium hypochlorite (bleach), granular calcium hypochlorite or as organic chlorine compounds. Chlorine is not present in natural water supplies; if it is present it is the result of chlorination of a water supply or of chlorinated compounds being discharged as waste from industrial operations. The presence of chlorine in concentrations above 0.5 parts per million should be considered evidence of pollution from chlorine treated effluents or from a process in which high concentrations of chlorine are used.

APPLICATION:	Drinking, surface, and saline waters; swimming pool water; domestic and industrial wastes.
RANGE:	0.00–10.00 ppm Chlorine
MDL:	0.10 ppm
METHOD:	In the absence of iodide, free available chlorine reacts instantly with DPD to produce a red color. Subsequent addition of potassium iodide evokes a rapid color response from the combined forms of chlorine (chloramines).
SAMPLE HANDLING & PRESERVATION:	Chlorine in aqueous solutions is not stable, and the chlorine content of samples or solutions, particularly weak solutions, will rapidly decrease. Exposure to sunlight or agitation will accelerate the reduction of chlorine present in such solutions. For best results, start analysis immediately after sampling. Samples to be analyzed for chlorine cannot be preserved or stored.
INTERFERENCE:	The only interfering substance likely to be encountered in water is oxidized manganese. The extent of this interference can be determined by treating a sample with sodium arsenite to destroy the chlorine present so that the degree of interference can be measured. Iodine and bromine can give a positive interference, but these are not normally present unless they have been added as sanitizers.

PROCEDURE

Use COD/UDV adapter.

1. Press and hold  until colorimeter turns on.
2. Press  to select Testing Menu.
3. Select **ALL TESTS** (or another sequence containing **017 Chlorine T UDV**) from **TESTING MENU**.
4. Scroll to and select **017 Chlorine T UDV** from menu.
5. Rinse a clean vial (0156) with sample water.
6. Use the syringe (1184) to add 3mL of sample to the vial.
7. Insert the vial into chamber, close the lid and select **SCAN BLANK**.
8. Remove the vial from the colorimeter.
9. Use the syringe (1184) to add 3mL of sample to a *Total Chlorine UDV vial (4312).
10. Invert 3 times to mix.

    NOTE: If powder residue remains in the bottom of the vial after inverting or air bubbles form, invert once more and tap bottom of vial sharply once or twice to dislodge powder and bubbles. Mix.
11. Wait 2 minutes.
12. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result in ppm total chlorine.
13. Press  to turn the colorimeter off or press  to exit to a previous menu or make another menu selection.

NOTES: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

UDVs from opened pouches should be used promptly. Store unused vials from opened pouches in the Foil Storage Bag (9467) to extend the shelf life of the reagent. Generally, UDVs stored in the bag should be used within 10 days if the humidity is less than 50% and within 5 days if humidity is greater than 50%. The Foil Storage Bag contains a desiccant pack with indicator. When the indicator in the window turns from blue to pink, the bag should be replaced.

CHLORINE DIOXIDE

DPD METHOD • CODE 3644-SC

QUANTITY	CONTENTS	CODE
100	*DPD #1 Instrument Grade Tablets	*6903A-J
15 mL	Glycine Solution	6811-E
1	Tablet Crusher	0175

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Chlorine dioxide is used as a substitute for and an adjunct to chlorine in water treatment. It is better than chlorine in eliminating taste and odor in certain cases. Chlorine dioxide, unlike chlorine, does not produce carcinogenic chlorinated organic compounds when reacted with organic materials. A disadvantage is the higher cost of producing chlorine dioxide compared to chlorine.

APPLICATION:	Drinking and pool waters; domestic and industrial wastewater; food sanitization.
RANGE:	0.00–8.00 ppm Chlorine Dioxide
MDL:	0.10 ppm
METHOD:	Chlorine dioxide reacts with DPD to form a red color in proportion to the concentration.
SAMPLE HANDLING & PRESERVATION:	Test as soon as possible to avoid loss of chlorine dioxide.
INTERFERENCE:	Chlorine interference can be removed with the use of glycine. Very high levels of chloramines may interfere if the test result is not read immediately. Oxidized manganese interferes but can be removed with arsenite. Bromine and iodine interfere. Chromate interference can be removed with a thioacetamide blank correction.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **019 Chlorine Diox**) from TESTING MENU.
4. Scroll to and select **019 Chlorine Diox** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Add 5 drops of Glycine Solution (6811).
8. Add one *Chlorine DPD #1 Instrument Grade Tablet (6903A). Cap and shake for 10 seconds. Invert 5 times slowly. Fill to 10 mL line with sample water. Solution will turn pink if chlorine dioxide is present.
9. Immediately insert tube into chamber, close lid and select **SCAN SAMPLE**.
10. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

CHROMIUM, HEXAVALENT

DIPHENYLCARBOHYDRAZIDE METHOD
CODE 3645-SC

QUANTITY	CONTENTS	CODE
10 g	*Chromium Reagent Powder	*V-6276-D
1	Spoon, 0.1 g, plastic	0699
50	Filter Paper	0465-H
1	Funnel, Plastic	0459

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Chromium may be present in water containing waste from industries such as metal plating. It is considered to be a toxic chemical and, if present in an amount of over 0.5 ppm, is evidence of contamination from untreated or incompletely treated industrial waste.

Chromium is one of a class of heavy metals found in the bottom mud of polluted bodies of water. Certain shellfish are capable of concentrating this element, endangering the health of its ultimate consumer, human or animal.

APPLICATION:	Drinking, surface, & saline waters; domestic and industrial wastewaters.
RANGE:	0.00–1.00 ppm Chromium
MDL:	0.01 ppm
METHOD:	Hexavalent chromium reacts with 1,5 diphenylcarbohydrazide under acidic conditions to form a red-purple color in proportion to the amount of chromium present.
SAMPLE HANDLING & PRESERVATION:	Analysis for chromium should be made as quickly as possible after sample collection since storage in glass or plastic containers may result in low chromate values.
INTERFERENCES:	High concentrations of mercurous and mercuric ions may impart a blue color to the chromium determination. Iron and vanadium in concentrations above 1 mg/L may result in a yellow color. However, the vanadium color becomes negligible 10 minutes after the addition of diphenylcarbohydrazide.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **021 Chromium**) from **TESTING MENU**.
4. Scroll to and select **021 Chromium** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Use the 0.1g spoon (0699) to add one measure of *Chromium Reagent Powder (V-6276). Cap and shake until powder dissolves. Wait 3 minutes for full color development.
8. During waiting period, fold a piece of filter paper (0465) in half then half again to form a cone. Push corners together to open end, and insert into funnel (0459).
9. At the end of 3 minute waiting period, filter sample into a clean tube. Mix. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
10. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTES: To convert result to ppm chromate (CrO_4^{-2}) multiply by 2.23. To convert result to ppm sodium chromate (Na_2CrO_4) multiply by 3.12.

Highly buffered waters may give poor results and require a more careful pH adjustment. Before adding *Chromium Reagent Powder, adjust pH of sample to pH 3–4.

CHROMIUM - HEXAVALENT, TRIVALENT & TOTAL

DIPHENYLCARBOHYDRAZIDE METHOD
CODE 3698-SC

QUANTITY	CONTENTS	CODE
60 mL	*Sulfuric Acid, 5N	*7681-H
10 g	*Chromium Reagent Powder	*V-6276-D
15 mL	*Sodium Azide, 5%	*7683-E
30 mL	Potassium Permanganate, 0.5%	7682-G
60 mL	Deionized Water	5115PT-H
1	Pipet, plain, glass, w/cap	0341
1	Pipet, 1.0 mL, plastic	0354
1	Spoon, 0.1 g, plastic	0699
1	Graduated Cylinder, 50 mL, glass	0418
1	Erlenmeyer Flask, 125 mL, glass	0431
1	Test tube holder	1113
1	Filter Paper	0465
1	Funnel, Plastic	0459

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

A toxic chemical, chromium is found in two forms in the water; trivalent chromium (Cr^{3+}) and hexavalent chromium (Cr^{6+}). Chromium enters the water from industrial waste. Hexavalent chromium is more toxic than trivalent chromium. Levels greater than 0.5 ppm indicate improperly treated industrial waste. It is important to maintain chromium levels at or below 0.5 ppm, because clams and other shellfish will store chromium in their systems, accumulating levels which may be dangerous to the consumer, whether human or animal.

APPLICATION:	Drinking, surface, & saline water; domestic and industrial waste.
RANGE:	0.00–1.00 ppm Chromium
MDL:	0.01 ppm
METHOD:	The trivalent chromium is converted to hexavalent chromium by permanganate under acidic conditions. Hexavalent chromium reacts with 1,5 diphenylcarbohydrazide under acidic conditions to form a red-purple color in proportion to the amount of chromium present.
SAMPLE HANDLING & PRESERVATION:	Analysis for chromium should be made as quickly as possible after sample collection since storage in glass or plastic containers may result in low chromate values.
INTERFERENCES:	High concentrations of mercurous and mercuric ions may interfere.

HEXAVALENT CHROMIUM PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **021 Chromium**) from **TESTING MENU**.
4. Scroll to and select **021 Chromium** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to 10 mL line with sample water.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Use 0.1 g spoon (0699) to add one level measure of *Chromium Reagent Powder (V-6276). Cap and shake for one minute. Wait 3 minutes.
8. During the waiting period, fold a piece of filter paper in half, then in half again to form a cone. Push corners together to open end, and insert into funnel (0459).
9. At the end of 3 minute waiting period, filter sample into a clean tube (0290). Cap and mix. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
10. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

TOTAL CHROMIUM WITH ACID DIGESTION PROCEDURE

1. Fill graduated cylinder (0418) to 50 mL line with sample water. Transfer to Erlenmeyer flask (0431).
2. Use the 1 mL pipet (0354) to add 5 mL (five measures) of *Sulfuric Acid, 5N (7681). Swirl to mix.

   NOTE: Highly buffered waters may require pH adjustment. Adjust the pH of highly buffered samples to 7.0 ±0.5. Continue procedure.
3. Place flask on burner or hot plate. Bring solution to a gentle boil.
4. Fill pipet (0341) with Potassium Permanganate, 0.5% (7682). While gently swirling flask, add Potassium Permanganate, 0.5% (7682), 2 drops at a time to boiling solution, until solution turns a dark pink color which persists for 10 minutes. Continue boiling.
5. Add one drop of *Sodium Azide, 5% (7683) to boiling solution. Boil for approximately 30 seconds. If pink color does not fade, add another drop of *Sodium Azide, 5%. Continue adding *Sodium Azide, 5% one drop at a time

until pink color disappears.

6. Remove flask from heat. Cool sample under running water. This is the digested sample.
7. Pour digested sample into clean graduated cylinder (0418). Dilute to the 50 mL line with Deionized Water (5115).
8. Press and hold ⏻ until colorimeter turns on.
9. Press ENTER to select **TESTING MENU**.
10. Select **ALL TESTS** or another sequence containing **021 Chromium**) from **TESTING MENU**.
11. Scroll to and select **021 Chromium** from menu.
12. Rinse a clean tube (0290) with sample water. Fill to 10 mL line with sample water.
13. Insert tube into chamber, close lid and select **SCAN BLANK**.
14. Remove tube from colorimeter. Use 0.1 g spoon (0699) to add one level measure of *Chromium Reagent Powder (V-6276). Cap and shake for one minute. Wait 3 minutes.
15. During the waiting period, fold a piece of filter paper in half, then in half again to form a cone. Push corners together to open end, and insert into funnel (0459).
16. Filter sample into a clean tube (0290). Cap and mix. Insert tube of filtered sample into chamber, close lid and select **SCAN SAMPLE**. Record result.
17. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

TRIVALENT CHROMIUM PROCEDURE

Subtract hexavalent chromium from total chromium. Record as ppm trivalent chromium.

Trivalent Chromium = Total Chromium – Hexavalent Chromium

COBALT

PAN METHOD · CODE 4851

QUANTITY	CONTENTS	CODE
60 mL	*Cobalt Buffer	*4852-H
60 mL	*Cobalt Indicator Reagent	*4853-H
30 mL	*Stabilizer Solution	*4854-G
2	Pipet, 1.0 mL, plastic	0354
1	Pipet, 0.5 mL, plastic	0353

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Cobalt rarely occurs in natural water. It is used in the manufacture of alloys to increase corrosion resistance and strength. It is found in wastewaters as a corrosion by-product.

APPLICATION:	Industrial wastewater.
RANGE:	0.00–2.00 ppm Cobalt
MDL:	0.04 ppm
METHOD:	PAN (1-[2-Pyridylazo]-2-Naphthol) forms a greenish complex with Cobalt (Co^{+2}) at a pH of 5.
SAMPLE HANDLING & PRESERVATION:	Store samples in acid-washed plastic bottles. Adjust pH to less than 2 with nitric acid. Adjust sample pH to 5 before testing.
INTERFERENCES:	Iron (+2) and high concentrations of heavy metals.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **023 Cobalt**) from TESTNG MENU.
4. Scroll to and select **023 Cobalt** from menu.
5. Rinse a tube (0290) with sample water. Fill to 10 mL with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove the tube from colorimeter.
8. Use the 1.0 mL pipet (0354) to add 1 mL of *Cobalt Buffer (4852). Cap and mix.
9. Use the other 1.0 mL pipet (0354) to add 1 mL of *Cobalt Indicator Reagent (4853). Cap and mix.
10. Wait 3 minutes.
11. Use the 0.5 mL pipet (0353) to add 0.5 mL *Stabilizer Solution (4854). Cap and invert 15 times to thoroughly mix.
12. Wait 5 minutes. DO NOT MIX.
13. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result in ppm cobalt.
14. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

COD – LOW RANGE

MERCURY FREE DIGESTION METHOD • CODE 0072-SC
MERCURY DIGESTION METHOD • CODE 0075-SC

QUANTITY	CONTENTS	CODE
25	*COD Low Range Mercury Free Tubes	*0072-SC
or 25	*COD Low Range Mercury Tubes	*0075-SC

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

COD Low Range Mercury Free Tubes are not USEPA approved.

COD Low Range Mercury Tubes are USEPA approved.

Equipment needed but not supplied:

1	COD Adapter	5-0087
1	COD Reactor, 12 tube, 110V	5-0102
or 1	COD Reactor, 12 tube, 230V	5-0102-EX2
1	Measuring Pipet, 1.0 mL	2-2110
1	Pipet Bulb	2-2164

Chemical Oxygen Demand (COD) is a measure of the amount of organic matter in water which is susceptible to oxidation by chemical oxidants. COD can be empirically related to the Biological Oxygen Demand (BOD) and organic carbon content of a specific source of water. This correlation must be determined experimentally for each source of water.

APPLICATION:	Domestic and industrial wastes.
RANGE:	0–150 mg/L COD
MDL:	7.5 mg/L
METHOD:	Dichromate in the presence of silver salts, at high temperature in a closed system, oxidizes most organic compounds to 95-100% of the theoretical amount. This process is called digestion. As dichromate oxidizes the organic compounds, the amount of yellow color is reduced. The remaining yellow color is measured colorimetrically at the 420 nm and is directly proportional to the COD of the sample.
SAMPLE HANDLING & PRESERVATION:	Collect samples in glass and test as soon as possible. If samples must be stored, preservation is accomplished by the addition of concentrated H2SO4 to adjust the pH below 2. Samples with suspended solids should be homogenized in a blender (100 mL for 30 seconds) and then stirred gently with a magnetic stirrer.
INTERFERENCES:	Volatile organic compounds are not oxidized to the extent that they are in the vapor above the digestion solution. Therefore, they do not contribute to the COD reading. Chloride concentrations above 10% of COD interfere with the mercury free tubes. Chloride above 2000 ppm will interfere with the mercury tubes. Nitrite gives a positive interference of 1.1 ppm O_2 per ppm NO_2–N which is insignificant unless nitrite concentrations are very high. Other reduced inorganic compounds are stoichiometrically oxidized, causing a positive interference. Corrections can be made for these compounds based upon their stoichiometry and concentrations. When scanning samples in 16 mm tubes, such as COD, the sample chamber lid can not be closed. Use the COD adapter to minimize stray light interference. To further reduce stray light interference, do not scan sample in direct sunlight.

PROCEDURE

Use COD/UDV adapter.

1. Homogenize sample if necessary.
2. Preheat COD heater block to 150±2°C.
3. Remove cap from COD tube. Hold tube at a 45° angle. Use a volumetric pipet, to carefully add 2.0 mL sample water allowing the sample to run down the side of the tube.
4. Cap and mix thoroughly.
5. Rinse the outside of the tube with distilled water. Wipe dry with a paper towel.
6. Repeat steps 3 through 5 using 2.0 mL distilled water. This is the reagent blank.
7. Place tubes in preheated COD block heater and maintain temperature at 150±2°C for two hours.
8. At the end of the heating period turn the heater off. Wait 20 minutes for the tubes to cool to 120°C or less.
9. Remove tubes from block heater. Invert several times to mix.
10. Allow to cool to room temperature.
11. Press and hold ⏻ until colorimeter turns on.
12. Press ENTER to select **TESTING MENU**.
13. Select **ALL TESTS** (or another sequence containing **024 COD LR**) from PROGRAMMED TESTS menu.
14. Scroll to and select **024 COD LR** from menu.
15. Wipe the blank tube with a damp towel to remove fingerprints and smudges. Wipe with a dry towel.
16. Insert reagent blank tube into chamber. Select **SCAN BLANK**.
17. Remove tube from colorimeter.
18. Insert digested water sample tube into chamber. Select **SCAN SAMPLE**. Record result. For the most accurate results, take three readings on each sample and average the results.
19. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTES: Reagents are light sensitive. Unused reagents should be stored in the shipping container, and in the refrigerator if possible, until needed.

A reagent blank should be run with each set of samples and with each lot of reagents.

The reacted blank will be stable if stored in the dark.

To eliminate error caused by contamination, wash all glassware with 20% sulfuric acid.

For greater accuracy, a minimum of three repetitions should be performed and the results averaged.

Some samples may be digested completely in less than two hours. The concentration may be measured at 15 minute intervals while the vials are still hot until the reading remains unchanged. The vials should be cooled to room temperature before the final measurement is taken.

COD – STANDARD RANGE

MERCURY FREE DIGESTION METHOD • CODE 0073-SC
MERCURY DIGESTION METHOD • CODE 0076-SC

QUANTITY	CONTENTS	CODE
25	*COD Standard Range Mercury Free Tubes	*0073-SC
or 25	*COD Standard Range Mercury Tubes	*0076-SC

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

COD Standard Range Mercury Free Tubes are not USEPA approved.

COD Standard Range Mercury Tubes are USEPA approved.

Equipment needed but not supplied:

1	COD Adapter	5-0087
1	COD Reactor, 12 tube, 110V	5-0102
or 1	COD Reactor, 12 tube, 230V	5-0102-EX2
1	Measuring Pipet, 1.0 mL	2-2110
1	Pipet Bulb	2-2164

Chemical Oxygen Demand (COD) is a measure of the amount of organic matter in water which is susceptible to oxidation by chemical oxidants. COD can be empirically related to the Biological Oxygen Demand (BOD) and organic carbon content of a specific source of water. This correlation must be determined experimentally for each source of water.

APPLICATION:	Domestic and industrial wastes.
RANGE:	0–1500 mg/L COD
MDL:	40 mg/L
METHOD:	Dichromate in the presence of silver salts, at high temperature in a closed system, oxidizes most organic compounds to 95-100% of the theoretical amount. This process is called digestion. As dichromate oxidizes the organic compounds, a green complex is formed. The concentration of the green complex is measured at 605 nm and is directly proportional to the COD of the sample.
SAMPLE HANDLING & PRESERVATION:	Collect samples in glass and test as soon as possible. If samples must be stored, preservation is accomplished by the addition of concentrated H_2SO_4 to adjust the pH below 2. Samples with suspended solids should be homogenized in a blender (100 mL for 30 seconds) and then stirred gently with a magnetic stirrer.
INTERFERENCES:	Volatile organic compounds are not oxidized to the extent that they are in the vapor above the digestion solution. Therefore, they do not contribute to the COD reading. Chloride concentrations above 10% of COD interfere with the mercury free tubes. Chloride above 2000 ppm will interfere with the mercury tubes. Nitrite gives a positive interference of 1.1 ppm O_2 per ppm NO_2–N which is insignificant unless nitrite concentrations are very high. Other reduced inorganic compounds are stoichiometrically oxidized, causing a positive interference. Corrections can be made for these compounds based upon their stoichiometry and concentrations. When scanning samples in 16 mm tubes, such as COD, the sample chamber lid can not be closed. Use the COD adapter to minimize stray light interference. To further reduce stray light interference, do not scan sample in direct sunlight.

PROCEDURE

Use COD/UDV adapter.

1. Homogenize sample if necessary.
2. Preheat COD heater block to 150±2°C.
3. Remove cap from COD tube. Hold tube at a 45° angle. Use a volumetric pipet, to carefully add 2.0 mL sample water allowing the sample to run down the side of the tube.
4. Cap and mix thoroughly.
5. Rinse the outside of the vial with distilled water. Wipe dry with a paper towel.
6. Repeat steps 2 through 5 using 2.0 mL distilled water. This is the reagent blank.
7. Place tubes in preheated COD block heater and maintain temperature at 150±2°C for two hours.
8. At the end of the heating period turn the heater off. Wait 20 minutes for the tubes to cool to 120°C or less.
9. Remove tubes from block heater. Invert several times to mix.
10. Allow to cool to room temperature.
11. Press and hold ⏻ until colorimeter turns on.
12. Press ENTER to select **TESTING MENU**.
13. Select **ALL TESTS** (or another sequence containing **025 COD SR**) from **TESTING MENU** menu.
14. Wipe the blank tube with a damp towel to remove fingerprints and smudges. Wipe with a dry towel.
15. Scroll to and select **025 COD SR** from menu.
16. Insert reagent blank tube into chamber. Select **SCAN BLANK**.
17. Remove tube from colorimeter.
18. Insert digested water sample tube into chamber. Select **SCAN SAMPLE**. Record result. For the most accurate results, take three readings on each sample and average the results.
19. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTES: Reagents are light sensitive. Unused reagents should be stored in the shipping container, and in the refrigerator if possible, until needed.

A reagent blank should be run with each set of samples and with each lot of reagents.

The reacted blank will be stable if stored in the dark.

To eliminate error caused by contamination, wash all glassware with 20% sulfuric acid.

For greater accuracy, a minimum of three repetitions should be performed and the results averaged.

Some samples may be digested completely in less than two hours. The concentration may be measured at 15 minute intervals while the vials are still hot until the reading remains unchanged. The vials should be cooled to room temperature before the final measurement is taken.

COD – HIGH RANGE

MERCURY FREE DIGESTION METHOD • CODE 0074-SC
MERCURY DIGESTION METHOD • CODE 0077-SC

QUANTITY	CONTENTS	CODE
25	*COD High Range Mercury Free Tubes	*0074-SC
or 25	*COD High Range Mercury Tubes	*0077-SC

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

COD High Range Mercury Free Tubes and COD High Range Mercury Tubes are not USEPA approved.

Equipment needed but not supplied:

1	COD Adapter	5-0087
1	COD Reactor, 12 tube, 110V	5-0102
or 1	COD Reactor, 12 tube, 230V	5-0102-EX2
1	Measuring Pipet, 1.0 mL	2-2110
1	Pipet Bulb	2-2164

Chemical Oxygen Demand (COD) is a measure of the amount of organic matter in water which is susceptible to oxidation by chemical oxidants. COD can be empirically related to the Biological Oxygen Demand (BOD) and organic carbon content of a specific source of water. This correlation must be determined experimentally for each source of water.

APPLICATION:	Domestic and industrial wastes.
RANGE:	0–15000 mg/L COD
MDL:	400 mg/L
METHOD:	Dichromate in the presence of silver salts, at high temperature in a closed system, oxidizes most organic compounds to 95-100% of the theoretical amount. This process is called digestion. As dichromate oxidizes the organic compounds, a green complex is formed. The concentration of the green complex is measured at 605 nm and is directly proportional to the COD of the sample.
SAMPLE HANDLING & RESERVATION:	Collect samples in glass and test as soon as possible. If samples must be stored, preservation is accomplished by the addition of concentrated H2SO4 to adjust the pH below 2. Samples with suspended solids should be homogenized in a blender (100 mL for 30 seconds) and then stirred gently with a magnetic stirrer.
INTERFERENCES:	Volatile organic compounds are not oxidized to the extent that they are in the vapor above the digestion solution. Therefore, they do not contribute to the COD reading. Contains mercury sulfate to prevent interference from chloride. Nitrite gives a positive interference of 1.1 ppm O_2 per ppm NO_2–N, which is insignificant unless nitrite concentrations are very high. Other reduced inorganic compounds are stoichiometrically oxidized, causing a positive interference. Corrections can be made for these compounds based upon their stoichiometry and concentrations. When scanning samples in 16 mm tubes, such as COD, the sample chamber lid can not be closed. Use the COD adapter to minimize stray light interference. To further reduce stray light interference, do not scan sample in direct sunlight.

PROCEDURE

Use COD/UDV adapter.

1. Homogenize sample if necessary.
2. Preheat COD heater block to 150±2°C.
3. Remove cap from COD tube. Hold tube at a 45° angle. Use a graduated pipet, to carefully add 0.2 mL sample water allowing the sample to run down the side of the tube.
4. Cap and mix thoroughly.
5. Rinse the outside of the tube with distilled water. Wipe dry with a paper towel.
6. Repeat steps 3 through 5 using 0.2 mL distilled water. This is the reagent blank.
7. Place tubes in preheated COD block heater and maintain temperature at 150±2°C for two hours.
8. At the end of the heating period turn the heater off. Wait 20 minutes for the tubes to cool to 120°C or less.
9. Remove tubes from block heater. Invert several times to mix.
10. Allow to cool to room temperature.
11. Press and hold ⏻ until colorimeter turns on.
12. Press ENTER to select **TESTING MENU**.
13. Select **ALL TESTS** (or another sequence containing **026 COD HR**) from TESTING MENU menu.
14. Wipe the blank tube with a damp towel to remove fingerprints and smudges. Wipe with a dry towel.
15. Scroll to and select **026 COD HR** from menu.
16. Insert reagent blank tube into chamber. Select **SCAN BLANK**.
17. Remove tube from colorimeter.
18. Insert digested water sample tube into chamber. Select **SCAN SAMPLE**. Record result. For the most accurate results, take three readings on each sample and average the results.
19. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTES: Reagents are light sensitive. Unused reagents should be stored in the shipping container, and in the refrigerator if possible, until needed.

A reagent blank should be run with each set of samples and with each lot of reagents.

The reacted blank will be stable if stored in the dark.

To eliminate error caused by contamination, wash all glassware with 20% sulfuric acid.

For greater accuracy, a minimum of three repetitions should be performed and the results averaged.

COLOR

PLATINUM COBALT METHOD
NO REAGENTS REQUIRED

Color in water may be attributed to humus, peat, plankton, vegetation, and natural metallic ions, such as iron and manganese, or industrial waste. Color is removed to make water suitable for domestic and industrial use. Color may have to be removed from industrial waste before it is discharged to a waterway.

APPLICATION:	Potable water and water with color due to natural materials.
RANGE:	0–1000 color units
MDL:	20 Cu
METHOD:	Color is determined by a meter that has been calibrated with colored standards of known platinum cobalt concentration. True color, the color of water in which the turbidity has been removed, is measured.
SAMPLE HANDLING & PRESERVATION:	Collect all samples in clean glassware. Determine color as soon as possible to avoid biological or chemical changes that could occur in the sample during storage.
INTERFERENCES:	Turbidity will interfere. Filter before testing.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **027 Color**) from **TESTING MENU**.
4. Scroll to and select **027 Color** from menu.
5. Rinse a tube (0290) with color-free water (distilled or deionized water). Fill to 10 mL line with color-free water.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Empty tube.
8. Rinse tube with sample water. Fill to 10 mL line with water sample.
9. Insert tube with sample water, close lid and select **SCAN SAMPLE**. Record result in color units.
10. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

COPPER – LOW RANGE

BICINCHONINIC ACID METHOD • CODE 3640-SC

QUANTITY	CONTENTS	CODE
50	*Copper Tablets	*T-3808-H

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

The copper content of drinking water generally falls below 0.03 parts per million, but copper levels as high as 1.0 part per million will give water a bitter taste. Waters testing as high as 1.0 part per million copper have probably been treated with a copper compound, like those used in the control of algae, or have become contaminated from untreated industrial wastes. The addition of copper sulfate to lakes causes an increase in the copper content of the sediments. Acid waters and those high in free carbon dioxide may cause the corrosion or “eating away” of copper, brass and bronze pipes and fittings. This corrosion results in the addition of copper into the water supply.

APPLICATION:	Drinking, surface, and saline waters; domestic and industrial wastes.
RANGE:	0.00–3.50 ppm Copper
MDL:	0.04 ppm
METHOD:	Copper ions form a purple complex with bicinchoninic acid around pH 6-7, in proportion to the concentration of copper in the sample.
SAMPLE HANDLING & PRESERVATION:	Copper has a tendency to be adsorbed to the surface of the sample container. Samples should be analyzed as soon as possible after collection. If storage is necessary, 0.5 mL of 20% HCl per 100 mL of sample will prevent “plating out.” However, a correction must be made to bring the reaction into the optimum pH range.
INTERFERENCES:	High concentrations of oxidizing agents, calcium, and magnesium interfere. Silver can also interfere.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **028 Cu BCA Tablet**) from **TESTING MENU**.
4. Scroll to and select **028 Cu BCA Tablet** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter and add one *Copper Tablet (T-3808). Cap and shake vigorously until tablet dissolves. Solution will turn purple if copper is present. Wait 2 minutes.
8. At end of 2 minute waiting period, mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
9. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

COPPER

CUPRIZONE METHOD • CODE 4023

QUANTITY	CONTENTS	CODE
15 mL	Copper A	P-6367-E
15 mL	*Copper B	*P-6368-E

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

The copper content of drinking water generally falls below 0.03 parts per million, but copper levels as high as 1.0 part per million will give water a bitter taste. Waters testing as high as 1.0 part per million copper have probably been treated with a copper compound, like those used in the control of algae, or have become contaminated from untreated industrial wastes. The addition of copper sulfate to lakes causes an increase in the copper content of the sediments. Acid waters and those high in free carbon dioxide may cause the corrosion or “eating away” of copper, brass and bronze pipes and fittings. This corrosion results in the addition of copper to the water supply.

APPLICATION:	Drinking, surface, and domestic waters. Pools and spas.
RANGE:	0.00–2.50 ppm Copper
MDL:	0.03 ppm
METHOD:	Copper ions form a blue complex with cuprizone, in a 1 to 2 ratio, at a pH of about 8, in proportion to the concentration of copper in the sample.
SAMPLE HANDLING & PRESERVATION:	Copper has a tendency to be adsorbed to the surface of the sample container. Samples should be analyzed as soon as possible after collection. If storage is necessary, 0.5 mL of 20% hydrochloric acid per 100 mL of sample will prevent “plating out”. However, a correction must be made to bring the reaction into the optimum pH range.
INTERFERENCES:	Hg^{+1} at 1 ppm. Cr^{+3}, Co^{+2}, and silicate at 10 ppm. As^{+3}, Bi^{+3}, Ca^{+2}, Ce^{+3}, Ce^{+4}, Hg^{+2}, Fe^{+2}, Mn^{+2}, Ni^{+2} and ascorbate at 100 ppm. Many other metal cations and inorganic anions at 1000 ppm. EDTA at all concentrations.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **030 Cu Cuprizone**) from **TESTING MENU**.
4. Scroll to and select **030 Cu Cuprizone** from menu.
5. Rinse a tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter and add 5 drops of Copper A (6367). Cap and mix.
8. Add 5 drops of *Copper B (6368). Cap and mix.
9. Wait 5 minutes. Mix.
10. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
11. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents are obtained.

The reaction may stain the tubes. Scrub tubes thoroughly after each use.

COPPER

DIETHYLDITHIOCARBAMATE METHOD • CODE 3646-SC

QUANTITY	CONTENTS	CODE
15 mL	*Copper 1	*6446-E

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

The copper content of drinking water generally falls below 0.03 parts per million, but copper levels as high as 1.0 part per million will give water a bitter taste. Waters testing as high as 1.0 part per million copper have probably been treated with a copper compound, like those used in the control of algae, or have become contaminated from untreated industrial wastes. The addition of copper sulfate to lakes causes an increase in the copper content of the sediments. Acid waters and those high in free carbon dioxide may cause the corrosion or “eating away” of copper, brass and bronze pies and fittings. This corrosion results in the addition of copper into the water supply.

APPLICATION:	Drinking, surface, and saline waters; domestic and industrial wastes.
RANGE:	0.00–7.00 ppm Copper
MDL:	0.10 ppm
METHOD:	Copper ions form a yellow colored chelate with diethyldithiocarbamate around pH 9-10 in proportion to the concentration of copper in the sample.
SAMPLE HANDLING & PRESERVATION:	Copper has a tendency to be adsorbed to the surface of the sample container. Samples should be analyzed as soon as possible after collection. If storage is necessary, 0.5 mL of 20% hydrochloric acid per 100 mL of sample will prevent “plating out.” However, a correction must be made to bring the reaction into the optimum pH range.
INTERFERENCES:	Bismuth, cobalt, mercurous, nickel and silver ions and chlorine (6 ppm or greater) interfere and must be absent.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **031 Cu Thiocarbamate**) from **TESTING MENU**.
4. Scroll to and select **031 Cu Thiocarbamate** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter and add 5 drops of *Copper 1 (6446). Cap and mix. Solution will turn yellow if copper is present.
8. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
9. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: The reaction may stain the tubes. Scrub the tubes thoroughly after each use.

COPPER – UDV

BICINCHONINIC ACID METHOD–UNIT DOSE VIALS CODE 4314-J

QUANTITY	CONTENTS	CODE
1	Copper Unit Dose Vials, 20 pouches	4314-J

Equipment needed but not supplied:

STANDARD ACCESSORY PACKAGE · CODE 1961		
1	Package of 3 Vials (empty)	0156
1	Syringe, 3 mL, plastic	1184
1	Foil Storage Bag	9467

Or:

ADVANCED ACCESSORY PACKAGE · CODE 1962		
1	Pipettor, 3mL	30528
1	Pipet Tip (0-5 mL)	30695
1	Cuvette Rack	31695
1	Package of 3 Vials (empty)	0156
1	Foil Storage Bag	9467

The copper content of drinking water generally falls below 0.03 parts per million, but copper levels as high as 1.0 part per million will give water a bitter taste. Waters testing as high as 1.0 part per million copper have probably been treated with a copper compound, like those used in the control of algae, or have become contaminated from untreated industrial wastes. The addition of copper sulfate to lakes causes an increase in the copper content of the sediments. Acid waters and those high in free carbon dioxide may cause the corrosion or “eating away” of copper, brass and bronze pipes and fittings. This corrosion results in the addition of copper to the water supply.

APPLICATION:	Drinking, surface, and saline waters; domestic and industrial wastes.
RANGE:	0.0–4.0 ppm Copper
MDL:	0.1 ppm
METHOD:	Cupric ions form a purple complex with bicinchoninic acid around pH 6–7, in proportion to the concentration of copper in the sample.
SAMPLE HANDLING & PRESERVATION:	Copper has a tendency to be adsorbed to the surface of the sample container. Samples should be analyzed as soon as possible after collection. If storage is necessary, 0.5 mL of 20% hydrochloric acid per 100 mL of sample will prevent “plating out”. However, a correction must be made to bring the reaction into the optimum pH range.
INTERFERENCES:	High concentrations of oxidizing agents, calcium, and magnesium interfere. Silver can also interfere.

PROCEDURE

Use COD/UDV adapter.

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **032 Copper UDV**) from **TESTING MENU**.
4. Scroll to and select **032 Copper UDV** from menu.
5. Rinse a clean vial (0156) with sample water.
6. Use the syringe (1184) to add 3 mL of sample to the vial.
7. Insert the vial into chamber, close lid and select **SCAN BLANK**.
8. Remove vial from the colorimeter.
9. Use the syringe (1184) to add 3 mL of sample to a Copper UDV vial (4314).
10. Wait 2 minutes.
11. Invert vial 3 times to mix.

    NOTE: If powder residue remains in the bottom of the vial after inverting, or if air bubbles form, invert once more and tap bottom of vial sharply once or twice to dislodge powder or bubbles. Mix.
12. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
13. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

UDVs from opened pouches should be used promptly. Store unused vials from opened pouches in the Foil Storage Bag (9467) to extend the shelf life of the reagent. Generally, UDVs stored in the bag should be used within 10 days if the humidity is less than 50% and within 5 days if humidity is greater than 50%. The Foil Storage Bag contains a desiccant pack with indicator. When the indicator in the window turns from blue to pink, the bag should be replaced.

CYANIDE

PYRIDINE-BARBITURIC ACID METHOD
CODE 3660-01-SC

QUANTITY	CONTENTS	CODE
60 mL	Cyanide Buffer	2850PS-H
5 g	*Cyanide Cl Reagent	*2794DS-C
5 g	*Cyanide Indicator Reagent	*2793DS-C
15 mL	*Hydrochloric Acid 1N	*6130-E
15 mL	*Sodium Hydroxide 1N	*4004-E
2	Spoons, 0.1 g, plastic	0699
1	Pipet, plastic, 1.0 mL	0354
1	pH Short Range Test Paper, pH 9–14	2955
1	Stirring Rod, Plastic	0519

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

The presence of cyanide in water has a significant effect on the biological activity of the system. Cyanides may exist in water in a variety of forms which vary in toxicity. Cyanide is a by-product of industrial waste from petroleum refining and plating.

APPLICATION:	Low level concentrations in drinking and surface waters; domestic and industrial waters. This method determines only those cyanides amenable to chlorination.
RANGE:	0.00–0.50 ppm Cyanide
MDL:	0.01 ppm
METHOD:	Cyanides react with a chlorine donor to form cyanogen chloride, which subsequently reacts with Pyridine and Barbituric Acid to form a red-blue compound in proportion to the amount of cyanide originally present. The concentration of the red-blue compound is determined spectrophotometrically.
SAMPLE HANDLING & PRESERVATION:	Cyanide solutions tend to be unstable and should be analyzed as soon as possible. Samples can be stabilized by adjusting the pH to greater than 12 with NaOH. However, the pH will have to be readjusted to pH 10.5 before performing the test.
INTERFERENCES:	Oxidizing agents and aldehydes can react with cyanide, while reducing agents, such as sulfite, react with the chlorine donor; both can cause negative interferences. Thiocyanate and chloride both react as cyanide in this test and will give a positive interference. Color and turbidity can also interfere.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to selct **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **034 Cyanide**) from **TESTING MENU**.
4. Scroll to and select **034 Cyanide** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Dip the end of plastic rod (0519) into water sample and touch it to a small piece (1/4 inch) of pH test paper (2955) to wet paper. Read pH immediately from color chart.
   a) If pH is below 10, raise the pH by adding *Sodium Hydroxide, 1N (4004) one drop at a time with stirring. Check pH after each drop with a new piece of pH test paper. Continue adjustment until pH is between 10.5 and 11.0.
   b) If pH is above 11.5, lower pH by adding *Hydrochloric Acid (6130) one drop at a time with stirring. Check pH after each drop with a new piece of pH test paper. Continue adjustment until pH is between 10.5 and 11.0.
7. Insert tube into chamber, close lid and select SCAN BLANK.
8. Remove tube from colorimeter. Use the 1.0 mL pipet (0354) to add 1.0 mL of Cyanide Buffer (2850PS) to tube. Cap and mix.
9. Use one 0.1 g spoon (0699) to add one level measure of *Cyanide Cl Reagent (2794DS). Cap and invert 10 times to mix. Wait 30 seconds.
10. During the 30 second waiting period, carefully fill a second 0.1 g spoon (0699) with one level measure of *Cyanide Indicator Reagent (2793DS).
11. At the end of the 30 second waiting period, immediately add the level measure of *Cyanide Indicator Reagent (2793DS). Cap and shake vigorously for 20 seconds. Wait 20 minutes for maximum color development.
12. At the end of the twenty minute waiting period, mix, insert tube into chamber, close lid and select SCAN SAMPLE. Record result.
13. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

CYANURIC ACID

MELAMINE METHOD–TURBIDITY • CODE 366I-01-SC

QUANTITY	CONTENTS	CODE
2 x 100 mL	*Cyanuric Acid Test Solution	*4856-J
1	Syringe, 5 mL	0807

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Cyanuric acid is added to swimming pool water as a stabilizing agent for free chlorine residuals. It minimizes the loss of chlorine from the action of ultraviolet rays in sunlight. Cyanuric acid levels in pools should be maintained between 25 and 75 ppm and various public health associations recommend that the concentration should never exceed 100-150 ppm.

APPLICATION:	Swimming pool waters.
RANGE:	5–200 ppm Cyanuric Acid
MDL:	10 ppm
METHOD:	A buffered solution of melamine forms a precipitate with cyanuric acid in proportion to the amount of cyanuric acid present. The amount of particles in suspension is measured turbidimetrically.
SAMPLE HANDLING & PRESERVATION:	Cyanuric acid samples should be analyzed as soon as possible after collection. Deterioration of the sample can be minimized by keeping samples in the dark or refrigerated until analysis can be performed.
INTERFERENCES:	No known interference from compounds normally found in pool water. Temperature of the sample should be maintained between 70°F and 80°F for best results. Check for stray light interference (see p. 69).

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **035 Cyanuric Acid**) from **TESTING MENU**.
4. Scroll to and select **035 Cyanuric Acid** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter and pour out water. Use a graduated cylinder or similar to measure 5 mL of sample water and pour into colorimeter tube.
8. Use the 5 mL syringe (0807) to add 5 mL of *Cyanuric Acid Test Solution (4856). Cap and mix thoroughly. A precipitate will form if cyanuric acid is present. Wait 1 minute.

   NOTE: This reagent bottle has a special fitting which enables the syringe to be inserted into the top of the bottle. With syringe in place, invert bottle and withdraw syringe plunger until 5 mL of reagent is contained in the syringe barrel. Remove syringe from reagent bottle and depress plunger to dispense into the tube.
9. At end of 1 minute waiting period, mix thoroughly, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
10. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For the most accurate results, the sample and reagents should be at 25 ±4°C.

CYANURIC ACID – UDV

MELAMINE METHOD-TURBIDITY–UNIT DOSE VIALS CODE 4313-J

QUANTITY	CONTENTS	CODE
1	Cyanuric Acid Unit Dose Vials, 20 pouches	4313-J

Equipment needed but not supplied:

STANDARD ACCESSORY PACKAGE · CODE 1961		
1	Package of 3 Vials (empty)	0156
1	Syringe, 3 mL, plastic	1184
1	Foil Storage Bag	9467

Or:

ADVANCED ACCESSORY PACKAGE · CODE 1962		
1	Pipettor, 3mL	30528
1	Pipet Tip (0-5 mL)	30695
1	Cuvette Rack	31695
1	Package of 3 Vials (empty)	0156
1	Foil Storage Bag	9467

Cyanuric acid is added to swimming pool water as a stabilizing agent for free chlorine residuals. It minimizes the loss of chlorine from the action of ultraviolet rays in sunlight. Cyanuric acid levels should be maintained between 25 and 75 ppm and various public health associations recommend that the concentration should never exceed 100–150 ppm.

APPLICATION:	Swimming pool water.
RANGE:	5–150 ppm Cyanuric Acid
MDL:	10 ppm
METHOD:	A buffered solution of melamine forms a precipitate with cyanuric acid in proportion to the amount of cyanuric acid present. The amount of particles in suspension is measured turbidimetrically.
SAMPLE HANDLING & PRESERVATION:	Cyanuric acid samples should be analyzed as soon as possible after collection. Deterioration of the sample can be minimized by keeping samples in the dark or refrigerated until analysis can be performed.
INTERFERENCES:	No known interference from compounds normally found in pool water. Temperature of the sample should be maintained between 70°F and 80°F for best results. Check for stray light interference (see p. 17).

PROCEDURE

Use COD/UDV adapter.

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to selct **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **036 Cyanuric UDV**) from **TESTING MENU**.
4. Scroll to and select **036 Cyanuric UDV** from menu.
5. Rinse a clean vial (0156) with sample water.
6. Use the syringe (1184) to add 3 mL of sample to the vial.
7. Insert the vial into chamber, close lid and select **SCAN BLANK**.
8. Remove vial from colorimeter.
9. Use the syringe (1184) to add 3 mL of sample to a Cyanuric Acid UDV vial (4313).
10. Invert the vial 3 times to mix.
11. Wait 2 minutes.
12. Invert vial 3 more times to mix.

    NOTE: If powder residue remains in the bottom of the vial after inverting or air bubbles form, invert once more and tap bottom of vial sharply once or twice to dislodge powder and bubbles. Mix.
13. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
14. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

UDVs from opened pouches should be used promptly. Store unused vials from opened pouches in the Foil Storage Bag (9467) to extend the shelf life of the reagent. Generally, UDVs stored in the bag should be used within 10 days if the humidity is less than 50% and within 5 days if humidity is greater than 50%. The Foil Storage Bag contains a desiccant pack.

DISSOLVED OXYGEN

WINKLER COLORIMETRIC METHOD • CODE 3688-SC

QUANTITY	CONTENTS	CODE
30 mL	*Manganese Sulfate Solution	*4167-G
30 mL	*Alkaline Potassium Iodide Azide	*7166-G
30 mL	*Sulfuric Acid 1:1	*6141WT-G
1	Sample Tube, screw cap	29180
1	Cap	28570

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Dissolved oxygen is vital to the survival of aquatic organisms. Naturally present, dissolved oxygen enters the water when plants photosynthesize. Wind and wave action also cause oxygen from the air to dissolve into water. Dissolved oxygen is consumed by aquatic animals and by the oxidation, or chemical breakdown, of dead and decaying plants and animals. The concentration of dissolved oxygen in natural waters can range from 0 to 14 ppm and is effected by temperature and salinity.

APPLICATION:	This method is applicable for the determination of dissolved oxygen in drinking water, all surface waters and wastewater.
MDL:	0.6 ppm
RANGE:	0.0–10.0 Dissolved Oxygen
METHOD:	This method uses the azide modification of the Winkler Method with a colorimetric determination of the yellow iodine produced from the reaction with the dissolved oxygen.
INTERFERENCES:	The presence of other oxidizing agents may cause positive interferences. Reducing may cause negative interferences. Nitrite interferences are eliminated with the azide modification.

COLLECTION & TREATMENT OF THE WATER SAMPLE

Steps 1 through 4 below describe proper sampling technique in shallow water. For sample collection at depths beyond arm's reach, special water sampling apparatus is required (e.g. the LaMotte Water Sampling Chamber, Code 1060; Model JT-1 Water Samplers, Code 1077; Water Sampling Outfit, Code 3103; or Water Sampling Bottle, Code 3-0026).

1. To avoid contamination, thoroughly rinse the screw cap Sample Tube (29180) with sample water.
2. Tightly cap Sample Tube and submerge to the desired depth. Remove cap and allow the Sample Tube to fill.
3. Tap the sides of the submerged tube to dislodge any air bubbles clinging to the inside. Replace the cap while the Sample Tube is still submerged.
4. Retrieve Sample Tube and examine it carefully to make sure that no air bubbles are trapped inside. Once a satisfactory sample has been collected, proceed immediately with Steps 5 and 6 to "fix" the sample.

   NOTE: Be careful not to introduce air into the sample while adding the reagents in steps 5 and 6. Simply drop the reagents into the sample. Cap carefully, and mix gently.
5. Add 2 drops of *Manganese Sulfate Solution (4167) and 2 drops of *Alkaline Potassium Iodide Azide (7166). Cap and mix by inverting several times. A precipitate will form. Allow the precipitate to settle below the shoulder of the tube before proceeding.
6. Add 8 drops of *Sulfuric Acid, 1:1 (6141WT). Cap and gently mix until the precipitate has dissolved. A clear-yellow to brown-orange color will develop, depending on the oxygen content of the sample.

NOTE: It is very important that all "brown flakes" are dissolved completely. If the water has a high DO level this could take several minutes. If flakes are not completely dissolved after 5 minutes, add 2 drops of *Sulfuric Acid 1:1 (6141WT) and continue mixing.

NOTE: Following the completion of step 6, contact between the water sample and the atmosphere will not affect the test result. Once the sample has been "fixed" in this manner, it is not necessary to perform the actual test procedure immediately. Thus, several samples can be collected and "fixed" in the field, and then carried back to a testing station or laboratory where the test procedure is to be performed.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **038 Disolved Oxygen**) from TESTING MENU.
4. Scroll to and select **038 Disolved Oxygen** from menu.
5. Rinse a clean tube (0290) with untreated sample water. Fill to the 10 mL line with sample. This tube is the BLANK.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Fill a second tube (0290) to the 10 line with the treated “Fixed” sample. This tube is the SAMPLE.
8. Remove BLANK from colorimeter, insert SAMPLE tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
9. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

FLUORIDE

SPADNS METHOD • CODE 3647-02-SC

QUANTITY	CONTENTS	CODE
4 x 30 mL	*Acid Zirconyl SPADNS Reagent	*3875-G
2 x 30 mL	*Sodium Arsenite Solution	*4128-G
1	Pipet, 0.5 mL, plastic	0353
1	Pipet, 1.0 mL, plastic	0354

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Fluoride may occur naturally in some ground waters or it may be added to public drinking water supplies to maintain a 1.0 mg/L concentration to prevent dental cavities. At higher concentrations, fluoride may produce an objectionable discoloration of tooth enamel called fluorosis, though levels up to 8 mg/L have not been found to be physiologically harmful.

NOTE: This procedure uses the EPA approved Reagent System for fluoride found in method 4500-F-D, 18th Edition of Standard Methods, pp. 1-27.

APPLICATION	Drinking and surface waters; domestic and industrial waters.
RANGE:	0.00–2.00 ppm Fluoride
MDL:	0.10 ppm
METHOD:	Colorimetric test based upon the reaction between fluoride and zirconium dye lake. The fluoride reacts with the dye lake, dissociating a portion of it into a colorless complex ion and dye. As the fluoride concentration increases, the color produced becomes progressively lighter. Samples may be stored and refrigerated in plastic containers.
SAMPLE HANDLING & PRESERVATION:	
INTERFERENCES:	The following substances produce a positive interference at the concentration given:

Chloride (Cl^-)	7000 mg/L
Phosphate (PO_4^{-3})	16 mg/L
$(NaPO_3)_6$	1 mg/L

The following substances produce a negative interference at the concentration given:

Alkalinity ($CaCO_3$)	5000 mg/L
Aluminum (Al^{3+})	0.1 mg/L
Iron (Fe^{3+})	10 mg/L
Sulfate (SO_4^{-2})	200 mg/L

Color and turbidity must be removed or compensated for in the procedure. Temperature should be maintained within 5°C of room temperature.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **040 Fluoride**) from **TESTING MENU**.
4. Scroll to and select **040 Fluoride** from menu.
5. This test requires a reagent blank. Rinse a clean tube (0290) with clear, colorless, fluoride free water. Fill to the 10 mL line with clear, colorless, fluoride free water.
6. Use the 0.5 mL pipet (0353) to add 0.5 mL of *Sodium Arsenite Solution (4128). Cap and mix.
7. Use the 1.0 mL pipet (0354) to add 2 measures of *Acid-Zirconyl SPADNS Reagent (3875). Cap and mix thoroughly. (This is the reagent blank.)
8. Insert tube into chamber, close lid and select **SCAN BLANK**.
9. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample water. Repeat steps 7 and 8.
10. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
11. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

HARDNESS, TOTAL – UDV

UNIT DOSE VIALS • CODE 4309-J

QUANTITY	CONTENTS	CODE
1	Calcium Hardness Unit Dose Vials, 20 pouches	4309-J

Equipment needed but not supplied:

STANDARD ACCESSORY PACKAGE · CODE 1961		
1	Package of 3 Vials (empty)	0156
1	Syringe, 3 mL, plastic	1184
1	Foil Storage Bag	9467

Or:

ADVANCED ACCESSORY PACKAGE · CODE 1962		
1	Pipettor, 3mL	30528
1	Pipet Tip (0-5 mL)	30695
1	Cuvette Rack	31695
1	Package of 3 Vials (empty)	0156
1	Foil Storage Bag	9467

APPLICATION:	Drinking and surface waters; swimming pool water.
RANGE:	0–450 ppm as $CaCO_3$ Total Hardness
MDL:	10 ppm
METHOD:	Calcium and magnesium react in a strongly buffered medium with an indicator to develop a pale purple color in proportion to the concentration.
SAMPLE HANDLING & PRESERVATION:	Samples should be analyzed as soon as possible after collection. If storage is necessary, add 0.5 mL of 20 % hydrochloric acid per 100 mL of sample. However, the added acid will have to be neutralized with NaOH before testing.
INTERFERENCES:	Heavy metals will interfere.

PROCEDURE

Use COD/UDV adapter.

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **043 Hardness UDV**) from **TESTING MENU**.
4. Scroll to and select **043 Hardness UDV** from menu.
5. Rinse a clean vial (0156) with sample water.
6. Use the syringe (1184) to add 3 mL of sample to the vial.
7. Insert the vial into chamber, close lid and select **SCAN BLANK**.
8. Remove vial from the colorimeter.
9. Use the syringe (1184) to add 3 mL of sample to a Calcium Hardness UDV vial (4309).
10. Shake vigorously for 10 seconds.
11. Wait one minute.
12. Invert vial 3 times to mix.

    NOTE: Firmly tap side of vial 5-10 times to remove all air bubbles.
13. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
14. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTES: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

UDVs from opened pouches should be used promptly. Store unused vials from opened pouches in the Foil Storage Bag (9467) to extend the shelf life of the reagent. Generally, UDVs stored in the bag should be used within 10 days if the humidity is less than 50% and within 5 days if humidity is greater than 50%. The Foil Storage Bag contains a desiccant pack with indicator. When the indicator in the window turns from blue to pink, the bag should be replaced.

HYDRAZINE

p-DIMETHYLAMINOBENZALDEHYDE METHOD
CODE 3656-01-SC

QUANTITY	CONTENTS	CODE
2 x 60 mL	*Hydrazine Reagent A	*4841-H
10 g	*Hydrazine Reagent B Powder	*4842-D
1	Pipet, 1.0 mL, plastic	0354
1	Spoon, 0.15 g, plastic	0727

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Hydrazine, N_2H_4, is added to the water in high pressure boilers to reduce corrosion by acting as an oxygen scavenger.

APPLICATION:	Water and boiler water, industrial waste water.
RANGE:	0.00–1.00 ppm Hydrazine
MDL:	0.01 ppm
METHOD:	p-Dimethylaminobenzaldehyde reacts with hydrazine under acidic conditions to form a yellow color in proportion to the amount of hydrazine present.
SAMPLE HANDLING & PRESERVATION:	Samples should be analyzed as soon as possible after collection due to the ease with which hydrazine becomes oxidized. Acidification of the sample may increase the time between collection and analysis.
INTERFERENCES:	The substances normally present in water do not interfere with the test, with the exception of strong oxidizing agents.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **045 Hydrazine**) from **TESTING MENU**.
4. Scroll to and select **045 Hydrazine** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Use the 1 mL pipet (0354) to add 4 mL of *Hydrazine Reagent A (4841). Cap and mix.
8. Use the 0.15 g spoon (0727) to add one measure of *Hydrazine Reagent B Powder (4842). Cap and shake vigorously for 10 seconds. Wait 2 minutes for maximum color development. An undissolved portion of Hydrazine Reagent B may remain in bottom of tube without adversely affecting results.
9. At the end of the 2 minute waiting period, mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
10. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

HYDROGEN PEROXIDE – LOW RANGE

DPD METHOD • CODE 3662-SC

QUANTITY	CONTENTS	CODE
30 mL	*Hydrogen Peroxide Reagent #1	*6452-G
100	*Hydrogen Peroxide LR Tablets	*6454A-J
1	Tablet Crusher	0175

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Hydrogen peroxide, H_2O_2, is a colorless compound that is widely used as a bleaching or decolorizing agent in the manufacture of many commercial products. As an oxidizing compound it is also used in the treatment of sewage to reduce odors and corrosion due to hydrogen sulfide. It may also be used as a sanitizing agent for water treatment. Hydrogen peroxide is relatively unstable, and for this reason it dissipates quickly and leaves no residuals.

APPLICATION:	Drinking and surface waters; domestic and industrial waste water.
RANGE:	0.00–1.50 ppm Hydrogen Peroxide
MDL:	0.02 ppm
METHOD:	Hydrogen peroxide reacts with an excess of potassium iodide through the action of a catalyst and buffer to release an equivalent amount of iodine. The iodine in turn reacts with diethyl-p-phenylenediamine (DPD) to produce a pink-red color in proportion to the iodine released.
SAMPLE HANDLING & PRESERVATION:	Hydrogen peroxide is not stable in aqueous solutions. Exposure to sunlight and agitation will accelerate the reduction of hydrogen peroxide in dilute solutions. For best results start analysis immediately after sampling.
INTERFERENCES:	The likelihood of other oxidizing compounds interfering with this method is eliminated by the presence of hydrogen peroxide. Manganese may interfere and should be removed before analysis

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select Testing Menu.
3. Select **ALL TESTS** (or another sequence containing **046 H Peroxide LR**) from **TESTING MENU**.
4. Scroll to and select **046 H Peroxide LR** from menu.
5. Rinse a clean tube (0290) with sample water. Fill o the 10 mL line with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove the tube from colorimeter and add 4 drops of *Hydrogen Peroxide Reagent #1 (6452). Cap and mix.
8. Add one *Hydrogen Peroxide LR Tablet (6454A). Crush tablet with Tablet Crusher (0175). Cap and mix for 30 seconds. Solution will turn pink if hydrogen peroxide is present. Wait 5 minutes for full color development.
9. At the end of 5 minute waiting period, mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
10. Press ⏻ to turn the meter off or press EXIT to exit to a previous menu or make another menu selection.

NOTES: For best possible results, a blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

For the most accurate results, the sample and reagents should be at 25 ±4°C.

HYDROGEN PEROXIDE – HIGH RANGE

DPD METHOD • CODE 4045-01

QUANTITY	CONTENTS	CODE
30 mL	*Hydrogen Peroxide Reagent #1	*6452-G
100	*Hydrogen Peroxide LR Tablets	*6454A-J
1	Tablet Crusher	0175
1	Pipet, glass	0342

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Large quantities of hydrogen peroxide are added to a swimming pool to "shock" it. Shocking breaks down waste products and re-establishes a positive level of sanitizer. While many types of shock can be used with chlorine or bromine pools, only hydrogen peroxide can be used to shock biguanide pools.

Hydrogen peroxide, H_2O_2, is a colorless compound that is widely used as a bleaching or decolorizing agent in the manufacture of many commercial products. As an oxidizing compound it is also used in the treatment of sewage to reduce odors and corrosion due to hydrogen sulfide. It may also be used as a sanitizing agent for water treatment. Hydrogen peroxide is relatively unstable, and for this reason it dissipates quickly and leaves no residuals.

APPLICATION:	Drinking, industrial, domestic and swimming pool waters
RANGE:	0–80 ppm Hydrogen Peroxide
MDL:	0.5 ppm
METHOD:	Hydrogen peroxide reacts with an excess of potassium iodide through the action of a catalyst and buffer to release an equivalent amount of iodine. The iodine in turn reacts with diethyl-p-phenylenediamine (DPD) to produce a pink-red color in proportion to the iodine released.
SAMPLE HANDLING & PRESERVATION:	Hydrogen peroxide is not stable in aqueous solutions. Exposure to sunlight and agitation will accelerate the reduction of hydrogen peroxide in dilute solutions. For best results start analysis immediately after sampling.
INTERFERENCES:	The likelihood of other oxidizing compounds interfering with this method is eliminated by the presence of hydrogen peroxide. Manganese may interfere and should be removed before analysis

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select Testing Menu.
3. Select **ALL TESTS** (or another sequence containing **047 H Peroxide HR**) from **TESTING MENU**.
4. Scroll to and select **047 H Peroxide HR** from menu.
5. Use the pipet (0342) to add 5 drops of the sample water to a tube (0290).
6. Dilute to the 10 mL line with distilled or hydrogen peroxide-free water.
7. Insert the tube into chamber, close lid and select **SCAN BLANK**.
8. Remove the tube from colorimeter and add 4 drops of *Hydrogen Peroxide Reagent #1 (6452). Cap and mix.
9. Add one *Hydrogen Peroxide LR Tablet (6454A). Crush tablet with Tablet Crusher (0175). Cap and mix for 30 seconds. Solution will turn pink if hydrogen peroxide is present. Wait 5 minutes for full color development.
10. At the end of 5 minute waiting period, mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
11. Press ⏻ to turn the meter off or press EXIT to exit to a previous menu or make another menu selection.

NOTES: For best possible results, a blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

For the most accurate results, the sample and reagents should be at 25 ±4°C.

HYDROGEN PEROXIDE – SHOCK

DPD METHOD • CODE 4045

QUANTITY	CONTENTS	CODE
30 mL	*Hydrogen Peroxide Reagent #1	*6452-G
100	*Hydrogen Peroxide LR Tablets	*6454A-J
1	Tablet Crusher	0175
1	Pipet, glass	0342

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Large quantities of hydrogen peroxide shock are added to a swimming pool to "shock" it. Shocking breaks down waste products and re-establishes a positive level of sanitizer. While many types of shock can be used with chlorine or bromine pools, only hydrogen peroxide shock can be used to shock biguanide pools.

APPLICATION:	Swimming pools
RANGE:	0–300 ppm Hydrogen Peroxide Shock
MDL:	5 ppm
METHOD:	Hydrogen peroxide reacts with an excess of potassium iodide through the action of a catalyst and buffer to release an equivalent amount of iodine. The iodine in turn reacts with diethyl-p-phenylenediamine (DPD) to produce a pink-red color in proportion to the iodine released.
SAMPLE HANDLING & PRESERVATION:	Hydrogen peroxide is not stable in aqueous solutions. Exposure to sunlight and agitation will accelerate the reduction of hydrogen peroxide in dilute solutions. For best results start analysis immediately after sampling.
INTERFERENCES:	The likelihood of other oxidizing compounds interfering with this method is eliminated by the presence of hydrogen peroxide. Manganese may interfere and should be removed before analysis

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select Testing Menu.
3. Select **ALL TESTS** (or another sequence containing **048 H Peroxide Shock**) from **TESTING MENU**.
4. Scroll to and select **048 H Peroxide Shock** from menu.
5. Use the pipet (0342) to add 5 drops of the sample water to a tube (0290).
6. Dilute to the 10 mL line with distilled or hydrogen peroxide-free water.
7. Insert the tube into chamber, close lid and select **SCAN BLANK**.
8. Remove the tube from colorimeter and add 4 drops of *Hydrogen Peroxide Reagent #1 (6452). Cap and mix.
9. Add one *Hydrogen Peroxide LR Tablet (6454A). Crush tablet with Tablet Crusher (0175). Cap and mix for 30 seconds. Solution will turn pink if hydrogen peroxide is present. Wait 5 minutes for full color development.
10. At the end of 5 minute waiting period, mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
11. Press ⏻ to turn the meter off or press EXIT to exit to a previous menu or make another menu selection.

NOTES: For best possible results, a blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

For the most accurate results, the sample and reagents should be at 25±4°C.

IODINE

DPD METHOD TABLET • CODE 3643-SC

QUANTITY	CONTENTS	CODE
100	*DPD #1 Instrument Grade Tablets	*6903A-J
100	*DPD #3 Instrument Grade Tablets	*6197A-J
15 mL	Glycine Solution	6811-E
1	Tablet Crusher	0175

Like chlorine and bromine, iodine is an effective germicidal agent employed in drinking water treatment, pool and spa water sanitization, food service sanitation, and other public health applications.

APPLICATION:	Drinking, surface, and saline waters; swimming pool water; domestic and industrial wastes.
RANGE:	0.00–14.00 ppm Iodine
MLD:	0.15 ppm
METHOD:	In a buffered sample iodine reacts with diethyl-p-phenylene-diamine (DPD) to produce a pink-red color in proportion to the concentration of iodine present.
SAMPLE HANDLING & PRESERVATION:	Iodine in aqueous solutions is not stable, and the iodine content of samples or solutions, particularly weak solutions, will rapidly decrease. Exposure to sunlight or agitation will accelerate the reduction of iodine present in such solutions. For best results start analysis immediately after sampling. Samples to be analyzed for iodine cannot be preserved or stored.
INTERFERENCE:	The only interfering substance likely to be encountered in water is oxidized manganese. The extent of this interference can be determined by treating a sample with sodium arsenite to destroy the iodine present so that the degree of interference can be measured. Chlorine and bromine can give a positive interference, but these are not normally present unless they have been added as sanitizers.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **050 Iodine**) from **TESTING MENU**.
4. Scroll to and select **050 Iodine** from menu.
5. Rinse a clean tube (0290) with sample water. Fill tube to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Add one *DPD #1 Tablet Instrument Grade (6903A). Cap and shake 10 seconds. Invert slowly 5 times. Solution will turn pink if iodine is present. Wait 15 seconds. Mix.
8. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
9. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

IRON

BIPYRIDYL METHOD • CODE 3648-SC

QUANTITY	CONTENTS	CODE
30 mL	*Iron Reagent #1	*V-4450-G
5 g	*Iron Reagent #2 Powder	*V-4451-C
1	Pipet, 0.5 mL, plastic	0353
1	Spoon, 0.1 g, plastic	0699

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Most natural waters contain some iron. Its presence may vary from small traces to very large amounts in water which is contaminated by acid mine wastes. For domestic use, the concentration should not exceed 0.2 ppm and for some industrial applications not even a trace of iron can be tolerated. There are many means available for removing or reducing the iron content. Water softening resins are effective for removing small amounts of iron and special ion exchange materials are selective for iron removal. High concentrations of iron can be removed by such chemical processes as oxidation and lime or lime-soda softening. Because of the many means of removing or reducing the amount of iron in water, the particular method employed will depend largely on the form of iron which is present and the end use of the treated water.

APPLICATION:	Drinking, surface and saline waters; domestic and industrial wastes.
RANGE:	0.00–6.00 ppm Iron
MDL:	0.10 ppm
METHOD:	Ferric iron is reduced to ferrous iron and subsequently forms a colored complex with bipyridyl for a quantitative measure of total iron.
SAMPLE HANDLING & PRESERVATION:	The sample container should be cleaned with acid and rinsed with deionized water. Addition of acid to adjust the sample to pH 2–3 will prevent deposition of iron on the container walls. Samples should be analyzed as soon as possible.
INTERFERENCES:	Strong oxidizing agents interfere, as well as copper and cobalt in excess of 5.0 mg/L.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **051 Iron Bipyridyl**) from **TESTING MENU**.
4. Scroll to and select **051 Iron Bipyridyl** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Use the 0.5 mL pipet (0353) to add one measure of *Iron Reagent #1 (V-4450). Cap and mix.
8. Use the 0.1 g spoon (0699) to add 0.1 g of *Iron Reagent #2 Powder (V-4451). Cap and shake vigorously for 30 seconds. Wait three minutes for maximum color development.
9. At the end of 3 minute waiting period, DO NOT MIX. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
10. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

IRON – UDV

BIPYRIDYL METHOD–UNIT DOSE VIALS · CODE 4315-J

QUANTITY	CONTENTS	CODE
1	*Total Iron Unit Dose Vials, 20 pouches	*4315-J

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Equipment needed but not supplied:

STANDARD ACCESSORY PACKAGE · CODE 1961

1	Package of 3 Vials (empty)	0156
1	Syringe, 3 mL, plastic	1184
1	Foil Storage Bag	9467

Or:

ADVANCED ACCESSORY PACKAGE · CODE 1962

1	Pipettor, 3mL	30528
1	Pipet Tip (0-5 mL)	30695
1	Cuvette Rack	31695
1	Package of 3 Vials (empty)	0156
1	Foil Storage Bag	9467

Most natural waters contain some iron. Its presence may vary from small traces to very large amounts in water which is contaminated by acid mine wastes. For domestic use, the concentration should not exceed 0.2 ppm and for some industrial applications not even a trace of iron can be tolerated. There are many means available for removing or reducing iron content. Water softening resins are effective for removing small amounts of iron and special ion exchange materials are selective for iron removal. High concentrations of iron can be removed by such chemical processes as oxidation and lime or lime-soda softening. Because of the many means of removing or reducing the amount of iron in water, the particular method employed will depend largely on the form of iron which is present and the end use of the treated water.

APPLICATION:	Drinking, surface, and saline waters; domestic and industrial wastes.
RANGE:	0.00–10.00 ppm
MDL:	0.05 ppm
METHOD:	Ferric iron is reduced to ferrous iron and subsequently forms a colored complex with bipyridyl for a quantitative measure of total iron.
SAMPLE HANDLING & PRESERVATION:	The sample container should be cleaned with acid and rinsed with deionized water. Addition of acid to adjust the sample th pH 2-3 will prevent deposition of iron on the container walls. Samples should be analyzed as soon as possible.
INTERFERENCES:	Strong oxidizing agents interfere, as well as copper and cobalt in excess of 5.0 ppm.

PROCEDURE

Use COD/UDV adapter.

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **052 Iron-UDV**) from **TESTING MENU**.
4. Scroll to and select **052 Iron-UDV** from menu.
5. Rinse a clean vial (0156) with sample water.
6. Use the syringe (1184) to add 3 mL of sample to the vial.
7. Insert the vial into the chamber, close the lid and select **SCAN BLANK**.
8. Remove the vial from the colorimeter.
9. Use the syringe (1184) to add 3 mL of sample to an *Iron UDV vial (4315).
10. Wait 2-3 minutes.
11. Invert vial 3 times to mix.
12. NOTE: If powder residue remains in the bottom of the vial after inverting, or air bubbles form, invert vial once more and tap bottom of vial sharply once or twice to dislodge powder or bubbles. Mix.
13. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
14. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents are obtained.

UDVs from opened pouches should be used promptly. Store unused vials from opened pouches in the Foil Storage Bag (9467) to extend the shelf life of the reagent. Generally, UDVs stored in the bag should be used within 10 days if the humidity is less than 50% and within 5 days if humidity is greater than 50%. The Foil Storage Bag contains a desiccant pack with indicator. When the indicator in the window turns from blue to pink, the bag should be replaced.

IRON

1,10-PHENANTHROLINE METHOD • CODE 3668-SC

QUANTITY	CONTENTS	CODE
15 mL	*Acid Phenanthroline Indicator	*2776-E
5 g	*Iron Reducing Reagent	*2777-C
1	Spoon, 0.1 g, plastic	0699

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Most natural waters contain some iron. Its presence may vary from small traces to very large amounts in water which is contaminated by acid mine wastes. For domestic use, the concentration should not exceed 0.2 ppm and for some industrial applications not even a trace of iron can be tolerated. There are many means available for removing or reducing the iron content. Water softening resins are effective for removing small amounts of iron and special ion exchange materials are selective for iron removal. High concentrations of iron can be removed by such chemical processes as oxidation and lime or lime-soda softening. Because of the many means of removing or reducing the amount of iron in water, the particular method employed will depend largely on the form of iron which is present and the end use of the treated water.

APPLICATION:	Drinking, surface and saline waters; domestic and industrial wastes.
RANGE:	0.00–5.00 ppm Iron
MDL:	0.06 ppm
METHOD:	Ferric iron is reduced to ferrous iron and subsequently forms a colored complex with phenanthroline for a quantitative measure of total iron.
SAMPLE HANDLING & PRESERVATION	The sample container should be cleaned with acid and rinsed with deionized water. Addition of acid to adjust the sample to pH 2–3 will prevent deposition of iron on the container walls. Samples should be analyzed as soon as possible after collection since ferrous iron undergoes oxidation to ferric iron.
INTERFERENCES:	Strong oxidizing agents, cyanide, nitrite, and phosphates, chromium, zinc in concentrations exceeding 10 times that of iron; cobalt and copper in excess of 5 mg/L, and nickel in excess of 2 mg/L. Bismuth, cadmium, mercury, , and silver precipitate phenanthroline.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **053 Iron Phenthro**) from **TESTING MENU**.
4. Scroll to and select **053 Iron Phenthro** from menu.
5. Rinse a clean tube (0290)with sample water. Fill to the 10 mL mark with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove the tube from colorimeter. Remove the cap and add 6 drops of *Acid Phenanthroline Indicator (2776). Cap and invert the tube 4 times to mix reagents. Wait five minutes for maximum color development.
8. After five minutes, mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result as ppm Ferrous Iron.
9. Remove the tube from colorimeter. Use the 0.1g spoon (0699) to add one measure of *Iron Reducing Reagent (2777). Cap and invert 15 times times to mix. Wait 5 minutes for maximum color delelopment.
10. After 5 minutes, mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result as ppm Total Iron.
11. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.
12. Total Iron (ppm) - Ferrous Iron (ppm) = Ferric Iron (ppm)

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

LEAD

PAR METHOD · CODE 4031

QUANTITY	CONTENTS	CODE
250 mL	*Ammonium Chloride Buffer	*4032-K
15 mL	*Sodium Cyanide, 10%	*6565-E
30 mL	*PAR Indicator	*4033-G
30 mL	Stabilizing Reagent	4022-G
15 mL	*DDC Reagent	*4034-E
1	Syringe, 5 mL, plastic	0807
2	Pipet, 0.5 mL, plastic	0353

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The average concentration of lead is 0.003 ppm in streams and less than 0.1 ppm in groundwater. Lead in a water supply may come from mine and smelter discharges or from industrial waste. Lead is used in the production of batteries, solder, pigments, insecticides, ammunition and alloys. Tetraethyl Lead has been used for years as an anti-knock reagent in gasoline. Lead may also enter water supplies when corrosive water dissolves pipes, plumbing fixtures and materials containing lead. Lead accumulates in the body and is toxic by ingestion.

APPLICATION:	Drinking and surface waters; domestic and industrial wastewater.
RANGE:	0.00–5.00 ppm Lead
MDL:	0.10 ppm
METHOD:	Lead and calcium ions form a red complex with PAR (4- [2'-pyridylazo] resorcinol), at a pH of about 10. When sodium diethyldithiocarbamate is added, the lead/PAR complex is destroyed leaving the calcium/PAR complex. The difference between the two measurements is due to the lead concentration.
SAMPLE HANDLING & PRESERVATION:	Analyze sample as soon as possible. If sample must be stored, acidify with nitric acid to a pH of below 2.
INTERFERENCES:	Calcium greater than 100 ppm (250 ppm $CaCO_3$) will interfere. Low concentrations of cerium, iron, manganese, magnesium, sulfur, tin, and EDTA will also interfere.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **054 Lead**) from **TESTING MENU**.
4. Scroll to and select **054 Lead** from menu.
5. Rinse a tube (0290) with sample water. Fill to 10 mL with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove the tube from colorimeter. Empty the tube. Use the Syringe (0807) to add 5mL of sample to the tube.
8. Add 5 mL *Ammonium Chloride Buffer (4032) to fill the tube to the 10 mL line. Swirl to mix.
9. Add 3 drops *Sodium Cyanide, 10% (6565). Swirl to mix.
10. Use the 0.5 mL pipet (0353) to add 0.5 mL *PAR Indicator (4033). Swirl to mix.
11. Use the 0.5 mL pipet (0353) to add 0.5 mL Stabilizing Reagent (4022). Cap and mix.
12. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result in ppm as Reading A.
13. Remove tube from colorimeter. Add 3 drops *DDC Reagent (4034). Cap and mix.
14. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result in ppm as Reading B.
15. Calculate result:
    Lead (ppm) = Reading A - Reading B
16. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

MANGANESE – LOW RANGE

PAN METHOD • CODE 3658-01-SC

QUANTITY	CONTENTS	CODE
2x60 mL	*Hardness Buffer Reagent	*4255-H
30 mL	*Manganese Indicator Reagent	*3956-G
15 mL	*Sodium Cyanide, 10%	*6565-E
1	Pipet, 0.5 mL, plastic	0369
1	Pipet, 1.0 mL, plastic	0354

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Manganese is present in ground water in the divalent state due to the lack of oxygen. In surface waters manganese may be in various oxidation states as soluble complexes or as suspended compounds. Manganese is rarely present in excess of 1 mg/L. It may cause an objectionable taste or cause staining problems in laundry, but manganese levels normally encountered in water seldom produce any health hazard.

Manganese is removed from water by various means including chemical precipitation, pH adjustment, aeration, superchlorination and the use of ion exchange resins.

APPLICATION:	Drinking and surface waters; domestic and industrial wastewaters.
RANGE:	0.00–0.70 ppm Manganese
MDL:	0.01 ppm
METHOD:	PAN (1-[2-Pyridylazo]-2-Naphthol) forms a red complex with Manganese (Mn^{+2}) at a pH of 10 to 11.
SAMPLE HANDLING & PRESERVATION:	Manganese may oxidize readily in neutral water and precipitate from solution. It may adhere to or be absorbed by container walls, especially glass. Acidified samples can be stored in plastic.
INTERFERENCES:	None. Test is quite specific.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **055 Manganese LR**) from **TESTING MENU**.
4. Scroll to and select **055 Manganese LR** from menu.
5. Rinse a tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Use the 1.0 mL pipet (0354) to add 2.0 mL (two measures) of *Hardness Buffer Reagent (4255). Swirl to mix.
8. Add 2 drops of *Sodium Cyanide, 10% (6565). Cap and mix.
9. Use the 0.5 mL pipet (0369) to add 0.5 mL of *Manganese Indicator Reagent (3956). Cap and mix.
10. Immediately insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
11. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

MANGANESE – HIGH RANGE

PERIODATE METHOD • CODE 3669-SC

QUANTITY	CONTENTS	CODE
10 g	Manganese Buffer Reagent	6310-D
15 g	*Manganese Periodate Reagent	*6311-E
1	Spoon, 0.1 g, plastic	0699
1	Spoon, 0.15 g, plastic	0727

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Manganese is present in ground water in the divalent state due to the lack of oxygen. In surface waters, manganese may be in various oxidation states as soluble complexes or as suspended compounds. Manganese is rarely present in excess of 1 mg/L. It may impart an objectionable taste or cause staining problems in laundry, but manganese levels normally encountered in water seldom produce any health hazards. Manganese is removed from water by various means, including chemical precipitation, pH adjustment, aeration, superchlorination and the use of ion exchange resins.

APPLICATION:	Drinking and surface waters, domestic and industrial wastewaters.
RANGE:	0.0–15.0 Manganese
MDL:	0.3 ppm
METHOD:	Periodate oxidizes soluble manganous compounds into permanganate.
SAMPLE HANDLING & PRESERVATION:	Manganese may oxidize readily in a neutral water and precipitate from solution. It may adhere to or be absorbed by container walls, especially glass. Acidified samples can be stored in plastic.
INTERFERENCES:	Reducing substances capable of reacting with periodate or permanganate must be removed or destroyed before the periodate oxidation is attempted.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **056 Manganese HR**) from **TESTING MENU**.
4. Scroll to and select **056 Manganese HR** from menu.
5. Rinse a tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Use the 0.1 g spoon (0699) to add two measures of Manganese Buffer Reagent (6310). Cap and mix until powder dissolves.
8. Use the 0.15 g spoon (0727) to add one measure of *Manganese Periodate Reagent (6311). Cap and shake for one minute. An undissolved portion of the reagent may remain in the bottom of the tube without adversely affecting the test results. Wait two minutes for maximum color development. Solution will turn pink if manganese is present.
9. At the end of the two minute waiting period, mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
10. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

MERCURY

TMK METHOD · CODE 4861

QUANTITY	CONTENTS	CODE
50	*TMK Tablets	*4862-H
2 x 250 mL	*Propyl Alcohol	*4863-K
250 mL	*Acetate Buffer	*4864-K
1	Tablet Crusher	0175
1	Test Tube, 10 , glass, w/cap	0778
1	Pipet, 1.0 mL, plastic	0354
1	0.5 mL, plastic	0353

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Mercury occurs in small amounts in soil, streams and groundwater. It is used in the production of amalgams, mirror coatings and measuring devices such as thermometers, barometers and manometers. Pharmaceuticals and paints contain mercury. It is also used in fungicides and pesticides and as a mold retardant on paper. Some forms of mercury are very toxic and can accumulate in the aquatic food chain.

APPLICATION:	Drinking and surface waters; domestic and industrial wastewater.
RANGE:	0.00–1.50 ppm Mercury
MDL:	0.01 ppm
METHOD:	Mercuric ions (Hg^{+2}) form a colored complex with 4, 4'-bis (dimethylamino) thiobenzophenone (Thio-Michler's ketone, TMK) at pH 3.
SAMPLE HANDLING & PRESERVATION:	Analyze sample as soon as possible. If sample must be stored, treat with HNO_3 to reduce th pH to less than 2 and store in a glass container.
INTERFERENCES:	Palladium and other noble metals (gold, platinum, rhodium, iridium, ruthenium), iodide and reducing agents such as hydroxylamine hydrochloride, ascorbic acid, sulfite and thiosulfate. Interference due to silver is eliminated if chloride is present.

PREPARATION OF *TMK INDICATOR

NOTE: Prepare *TMK Indicator daily. Keep out of direct sunlight.

1. Fill test tube (0778) to the 10 mL line with *Propyl Alcohol (4863).
2. Add one *TMK Tablet (4862).
3. Use tablet crusher (0175) to completely crush tablet.
4. Cap and mix. Shake vigorously for 30 seconds.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **057 Mercury**) from **TESTING MENU**.
4. Scroll to and select **057 Mercury** from menu.
5. Rinse a tube (0290) with sample water. Fill to 10 mL with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove the tube from colorimeter.
8. Use the 1.0 mL pipet (0354) to add 3 mL of *Acetate Buffer (4864). Cap and mix.
9. Use the 0.5 mL pipet (0353) to add 0.5 mL of prepared *TMK Indicator. Cap and mix.
10. Wait one minute.
11. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result as ppm Mercury.
12. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure using distilled or deionized water. This test result is the reagent blank. Subtract the reagent blank results from all subsequent test results of unknown samples. It is recommended that a reagent blank be determined each time *TMK Indicator is prepared.

MOLYBDENUM – HIGH RANGE

THIOGLYCOLATE METHOD • CODE 3699-03-SC

QUANTITY	CONTENTS	CODE
2 x 30 mL	*Mo Buffer	*3997-G
2 x 30 mL	*Molybdenum Oxidizing Reagent	*6485-G
2.5g	*Molybdenum Indicator Powder	*6486-S
1	Spoon, 0.05g, plastic	0696
2	Pipets, 1.0 mL, plastic w/cap	0372

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Molybdenum occurs naturally in the earth's crust as molybdenite and wolfenite, and is an important element in many biochemical reactions, including nitrogen fixation. In industrial processes, such as the operation of boilers and cooling towers, molybdenum, in the form of sodium molybdate, is used as a corrosion inhibitor.

APPLICATIONS:	Boiler and cooling water.
RANGE:	0.0–50.0 ppm Molybdenum
MDL:	0.6 ppm
METHOD:	Calcium thioglycolate reacts with molybdenum to give a yellow color with an intensity proportional to the amount of molybdenum present.
SAMPLE HANDLING & PRESERVATION:	Molybdenum samples may be stored in either plastic or glass containers.
INTERFERENCES:	Nickel levels less than 50 ppm do not interfere; aluminum levels less than 10 ppm do not interfere; chromate at higher concentrations interferes due to the intense yellow color. Ferrous iron levels below 50 ppm do not interfere, but low levels of ferric iron will cause a large blank. Highly buffered samples may exceed the capacity of the system possibly producing inaccurate results. Samples with high levels of nitrite will eventually develop a pale orange color. Scan the sample immediately to avoid this inteference.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU.**
3. Select **ALL TESTS** (or another sequence containing **061 Molybdenum HR**) from TESTING MENU.
4. Scroll to and select **061 Molybdenum HR** from menu.
5. Fill clean tube (0290) to 10 mL line with sample water.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Use a 1.0 mL pipet (0372) to add 1.0 mL of *Mo Buffer (3997). Cap and mix.
8. Use a second 1.0 mL pipet (0372) to add 1.0 mL of *Molybdenum Oxidizing Reagent (6485). Cap and mix.
9. Use 0.05 g spoon (0696) to add one measure of Molybdenum Indicator Powder (6486). Cap and mix until powder dissolves. Solution will turn yellow if molybdenum is present. Mix the tbe to remove bubbles.
10. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
11. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NICKEL

DIMETHYLGLYOXIME METHOD • CODE 3663-SC

QUANTITY	CONTENTS	CODE
60 mL	*Hydrochloric Acid, 2.5N	*6251PS-H
30 g	*Ammonium Persulfate Reagent	*6566-G
30 mL	*Silver Nitrate Solution, 0.0141N	*6346WT-G
250 mL	Sodium Citrate, 10%	6253-K
60 mL	*Dimethylglyoxime, 1%	*6254-H
60 mL	*Ammonium Hydroxide, Conc.	*6537-H
3	Pipets, 1.0 mL, plastic	0354
1	Spoon, 0.1 g, plastic	0699
1	Test tube, 5-10-12.9-15-20-25, glass, w/cap	0608
1	Graduated Cylinder, 10 mL, glass	0416

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Nickel is not usually found in natural waters except as a result of contamination from industrial wastewaters as a corrosion product of stainless steel and nickel alloys. Nickel may also enter surface waters from plating bath process water.

APPLICATION:	Drinking and surface waters; domestic and industrial wastewater.
RANGE:	0.00–8.00 ppm Nickel
MDL:	0.15 ppm
METHOD:	Nickel under basic conditions forms a colored complex with dimethylglyoxime in proportion to the concentration of nickel.
SAMPLE HANDLING & PRESERVATION:	Samples may be collected in either plastic or glass containers and preserved by adding 5 mL of concentrated nitric acid per liter.
INTERFERENCES:	Organic matter interferes. Cobalt, iron, copper, manganese and chromium do not interfere if each of the concentrations is below 15 ppm.

PROCEDURE

1. Use the 10 mL graduated cylinder (0416) to measure 10 mL of sample water. Pour into glass test tube (0608).
2. Use the 1 mL pipet (0354) to add 1 mL of *Hydrochloric Acid, 2.5N (6251).
3. Use the 0.1 g spoon (0699) to add 2 measures of *Ammonium Persulfate Reagent (6566). Add two drops of *Silver Nitrate Solution, 0.0141N (6346WT). Mix until the powder has dissolved. The solution will be slightly cloudy at this point.
4. Use 10 mL graduated cylinder (0416) to add 5 mL of Sodium Citrate, 10% (6253).
5. Use a second 1 mL pipet (0354) to add 1 mL of *Ammonium Hydroxide, Conc. (6537). Mix, then dilute to 25 mL with deionized water.
6. Use a third 1 mL pipet (0354) to add 1 mL of *Dimethylglyoxime, 1% (6254). Mix. Wait 20 minutes for color development.
7. At end of 20 minute waiting period fill a clean tube (0290) to the 10 mL line with the developed test sample.
8. Fill a second clean tube (0290) to 10 mL line with deionized water or untreated sample water. This is the blank.
9. Press and hold ⏻ until colorimeter turns on.
10. Press ENTER to select **TESTING MENU**.
11. Select **ALL TESTS** (or another sequence containing **063 Nickel**) from **TESTING MENU**.
12. Scroll to and select **063 Nickel** from menu.
13. Insert the blank into chamber, close lid and select **SCAN BLANK**.
14. Insert test sample into chamber, close lid and select **SCAN SAMPLE**. Record result.
15. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: It is strongly suggested that a reagent blank be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples.

NITRATE

ZINC REDUCTION · CODE 3689-SC

QUANTITY	CONTENTS	CODE
50	*Nitrate Spectrophotometric Grade Tablets	*3881A-H
1	Tablet Crusher	0175

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Nitrogen is essential for plant growth, but excessive amounts in water supplies can result in nutrient pollution. Nitrates, in conjunction with phosphate, stimulate the growth of algae creating water quality problems. Nitrogen compounds may enter water as nitrates or be converted to nitrates from agricultural fertilizers, sewage, industrial and packing house wastes, drainage from livestock feeding areas and manure. Nitrates in large amounts in drinking water can cause “blue baby syndrome” (methemoglobenemia) in infants in less than 6 months of age and other health problems. US Public Health Service Drinking Water Standards state that 44 ppm nitrate should not be exceeded. To the sanitary and industrial engineer, concentrations of less than 4 ppm are acceptable.

APPLICATION:	Drinking, surface, and saline waters; domestic and industrial waters.
RANGE:	0–60 ppm Nitrate
MDL:	Zinc is used to reduce nitrate to nitrite. The nitrite that was originally present, plus the reduced nitrate, reacts with chromotropic acid to form a red color in proportion to the amount of nitrite in the sample.
METHOD:	5 ppm
SAMPLE HANDLING & PRESERVATION:	Analysis should be made as soon as possible. If analysis cannot be made within 24 hours, the sample should be refrigerated at 4°C. When samples must be stored for more than 24 hours, add 2 mL of concentrated sulfuric acid per liter of sample. For best results, the analysis for nitrate should be determined at temperatures between 20°C and 25°C.
INTERFERENCES:	Nitrite interferes at all concentrations. Strong oxidizing and reducing substances interfere. Low results might be obtained for samples that contain high concentrations of copper and iron.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **065 Nitrate-TT**) from **TESTING MENU**.
4. Scroll to and select **065 Nitrate-TT** from menu.
5. Rinse a tube (0290) with sample water. Fill to 10 mL line with sample.
6. Insert the tube into chamber, close lid and select SCAN BLANK.
7. Remove the tube from colorimeter.
8. Add one *Nitrate Spectrophotometric Grade Tablet (3881A-H).
9. Use Tablet Crusher (0175) to crush tablet.
10. Cap tube.
11. Invert tube 60 times per minute for 2 minutes (one inversion equals 180°).
12. Wait 5 minutes. Do not mix.
13. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result in ppm nitrate.

15. Press ⏻ to turn the colorimeter off or press EXIT button to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples.

To convert nitrate (NO_3) results to nitrate-nitrogen (NO_3-N), divide by 4.4.

NITRATE - UDV

ZINC REDUCTION METHOD-UNIT DOSE VIALS •CODE 4321-J

QUANTITY	CONTENTS	CODE
50	Nitrate UDV	4321-J

Equipment needed but not supplied:

STANDARD ACCESSORY PACKAGE · CODE 1961		
1	Package of 3 Vials (empty)	0156
1	Syringe, 3 mL, plastic	1184
1	Foil Storage Bag	9467

Or:

ADVANCED ACCESSORY PACKAGE · CODE 1962		
1	Pipettor, 3mL	30528
1	Pipet Tip (0-5 mL)	30695
1	Cuvette Rack	31695
1	Package of 3 Vials (empty)	0156
1	Foil Storage Bag	9467

Nitrogen is essential for plant growth, but excessive amounts in water supplies can result in nutrient pollution. Nitrates may enter the water from leaves or debris but other sources of nitrates include well water supplies, localized spraying of lawn or crop fertilizers, acid rain, bird droppings and bather wastes, urine and sweat. Nitrates, in conjunction with phosphate, stimulate the growth of algae creating water quality problems. Pools that are properly maintained usually do not have unexpected difficulty controlling algae, even in the presence of low levels of nitrates. Higher levels of nitrates can make algae control more difficult and increase the amount of chlorine required to maintain satisfactory control of algae. The only practical way to remove nitrates is to drain the water. Nitrates also cause problems in drinking water. Large amounts can cause “blue baby syndrome” (methemoglobenemia) in infants in less than 6 months of age and other health problems.

APPLICATION:	swimming pools, drinking water, surface and saline waters
RANGE:	0.00 – 80.0 ppm nitrate
MDL:	2 ppm
METHOD:	Zinc is used to reduce nitrate to nitrite. The nitrite that was originally present, plus the reduced nitrate, reacts with chromotropic acid to form a red color in proportion to the amount of nitrite in the sample.
SAMPLE HANDLING & PRESERVATION:	Analysis should be made as soon as possible. If analysis cannot be made within 24 hours, the sample should be refrigerated at 4°C. When samples must be stored for more than 24 hours, add 2 mL of concentrated sulfuric acid per liter of sample. For best results, the analysis for nitrate should be determined at temperatures between 20°C and 25°C.
INTERFERENCES:	Nitrite interferes at all concentrations. Strong oxidizing and reducing substances interfere. Low results might be obtained for samples that contain high concentrations of copper and iron.

PROCEDURE

Use COD/UDV adapter.

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing (**066 Nitrate UDV**) from **TESTING MENU**.
4. Scroll to and select **066 Nitrate UDV** from menu.
5. Rinse a clean vial (0156) with sample water.
6. Use the syringe (1184) to add 3 mL of sample to the vial.
7. Insert the vial into chamber, close lid and select **SCAN BLANK**.
8. Remove vial from the colorimeter.
9. Use the syringe (1184) to add 3 mL of sample to a Nitrate UDV vial (4321).
10. Shake vigorously for 30 seconds, then wait 3 minutes.
11. Invert vial once.

    NOTE: If powder residue remains in the bottom of the vial after inverting, or if air bubbles form, invert once more and tap bottom of vial sharply once or twice to dislodge powder or bubbles. Mix.
12. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
13. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

UDVs from opened pouches should be used promptly. Store unused vials from opened pouches in the Foil Storage Bag (9467) to extend the shelf life of the reagent. Generally, UDVs stored in the bag should be used within 10 days if the humidity is less than 50% and within 5 days if humidity is greater than 50%. The Foil Storage Bag contains a desiccant pack with indicator. When the indicator in the window turns from blue to pink, the bag should be replaced.

NITRATE-NITROGEN – LOW RANGE

CADMIUM REDUCTION METHOD • CODE 3649-SC

QUANTITY	CONTENTS	CODE
2 x 60 mL	*Mixed Acid Reagent	*V-6278-H
5 g	*Nitrate Reducing Reagent	*V-6279-C
1	Spoon, 0.1 g, plastic	0699
1	Dispenser Cap	0692

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Nitrogen is essential for plant growth, but the presence of excessive amounts in water supplies presents a major pollution problem. Nitrogen compounds may enter water as nitrates or be converted to nitrates from agricultural fertilizers, sewage, industrial and packing house wastes, drainage from livestock feeding areas, farm manures and legumes. Nitrates in large amounts can cause “blue babies” (methemoglobinemia) in infants less than six months of age. Nitrate concentration is an important factor to be considered in livestock products, where, in addition to causing methemoglobinemia, it is responsible for many other problems. Nitrates in conjunction with phosphate stimulate the growth of algae with all of the related difficulties associated with excessive algae growth.

U.S. Public Health Service Drinking Water Standards state that 10 ppm nitrate nitrogen should not be exceeded. To the sanitary and industrial engineer, concentrations of less than 1 ppm are acceptable.

APPLICATION:	This method determines nitrate levels in drinking, surface, saline waters, domestic and industrial waters.
RANGE:	0.00–3.00 ppm Nitrate Nitrogen
MDL:	0.10 ppm
METHOD:	Powdered cadmium is used to reduce nitrate to nitrite. The nitrite that is originally present plus reduced nitrate is determined by diazotization of sulfanilamide and nitrite followed by coupling with N-(1 naphthyl)-ethylenediamine dihydrochloride to form a highly colored azo dye which is measured colorimetrically.
SAMPLE HANDLING & PRESERVATION:	Analysis should be made as soon as possible. If analysis cannot be made within 24 hours, the sample should be preserved by refrigeration at 4°C. When samples must be stored for more than 24 hours, they can be preserved by adding 2 mL of concentrated sulfuric acid per liter of sample. For best results, the analysis for nitrate should be determined at temperatures between 20°C and 25°C.
INTERFERENCES:	Nitrite interferes at all levels. Strong oxidizing and reducing substances interfere. Low results might be obtained for samples that contain high concentrations of iron and copper.

PROCEDURE

NOTE: Place Dispenser Cap (0692) on *Mixed Acid Reagent (V-6278). Save this cap for refill reagents.

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **064 Nitrate-N LR**) from **TESTING MENU**.
4. Scroll to and select **064 Nitrate-N LR** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter and pour off 5 mL into graduated cylinder or similar. Discard the remaining sample.
8. Pour the 5mL sample from a graduated cylinder or similar into the tube. Use the graduated cylinder or similar to measure 5 mL of *Mixed Acid Reagent (V-6278) and add to tube. Cap and mix. Wait 2 minutes before proceeding to Step 10.
9. Use the 0.1 g spoon (0699) to add two measures of *Nitrate Reducing Reagent (V-6279). Cap.
10. Hold tube by index finger and thumb and mix by inverting approximately 60 times a minute for four minutes. Wait 10 minutes for maximum color development.

    NOTE: At end of waiting period an undissolved portion of Nitrate Reducing Reagent may remain in bottom of the tube without affecting results.
11. At the end of the 10 minute waiting period, mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
12. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents are obtained.

To convert Nitrate Nitrogen (NO_3–N) results to ppm Nitrate (NO_3^-), multiply by 4.4.

NITRITE-NITROGEN – LOW RANGE

DIAZOTIZATION METHOD • CODE 3650-SC

QUANTITY	CONTENTS	CODE
2 x 60 mL	*Mixed Acid Reagent	*V-6278-H
5 g	*Color Developing Reagent	*V-6281-C
1	Spoon, 0.1 g, plastic	0699
1	Dispenser Cap	0692

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Nitrite represents an intermediate state in the nitrogen cycle, usually resulting from the bacterial decomposition of compounds containing organic nitrogen. Under aerobic conditions bacteria oxidize ammonia to nitrites; and under anaerobic conditions, bacteria reduce nitrates to nitrites. Nitrites are often used as preservatives when added to certain foods.

The nitrite concentration of drinking water rarely exceeds 0.1 ppm (mg/L).

APPLICATION:	This method is applicable for the determination of nitrite in drinking, surface and saline waters; domestic and industrial wastes.
RANGE:	0.00–0.80 ppm Nitrite-Nitrogen
MDL:	0.02 ppm
METHOD:	The compound formed by diazotization of sulfanilamide and nitrite is coupled with N–(1–naphthyl)–ethylenediamine to produce a reddish-purple color, which is read colorimetrically.
SAMPLE HANDLING & PRESERVATION:	Samples should be analyzed as soon as possible. They may be stored for 24 to 48 hours at 4°C.
INTERFERENCES:	There are few known interfering substances at concentration less than 1000 times the nitrite-nitrogen concentration; however, the presence of strong oxidants or reductants may readily affect nitrite concentrations. High alkalinity (above 600 mg/L) will give low results due to a shift in pH.

PROCEDURE

NOTE: Place Dispenser Cap (0692) on *Mixed Acid Reagent (V-6278). Save this cap for refill reagents.

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **067 Nitrite-N LR**) from **TESTING MENU**.
4. Scroll to and select **067 Nitrite-N LR** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter and pour off 5 mL into a graduated cylinder or similar. Discard the remaining sample.
8. Pour the 5 mL sample from the graduated cylinder into the colorimeter tube. Use graduated cylinder or similar to measure 5 mL of *Mixed Acid Reagent (V-6278) and add to tube. Cap and mix.
9. Use the 0.1 g spoon (0699) to add two measures of *Color Developing Reagent (V-6281). Cap and mix by gently inverting for 1 minute. Wait 5 minutes for maximum color development.
10. At the end of the 5 minute waiting period, mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
11. Press ⏻ to turn colorimeter off or press EXIT button to exit to a previous menu or make another menu selection.

NOTE: To convert nitrite-nitrogen (NO_2–N) results to ppm nitrite (NO_2^-), multiply results by 3.3.

NITROGEN, TOTAL

CHROMOTROPIC ACID WITH PERSULFATE DIGESTION METHOD • CODE 4026-01

QUANTITY	CONTENTS	CODE
25	Total Nitrogen Hydroxide Reagent Tubes	4040-G
5 g	*Digestion Reagent Powder	*4036-C
60 mL	Deionized Water	*5115PS-H
5 g	*Total Nitrogen Reagent A Powder	*4041-C
30	*Total Nitrogen Reagent B Tablets	*4042A-G
25	*Total Nitrogen Acid Reagent Tubes	*4043-G
2	Spoon, 0.15 g, plastic	0727
4	Pipets, 1.0 mL, plastic	0354
2	Funnels, plastic	0459

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Note: for greater accuracy, use laboratory grade pipets.

Equipment needed but not supplied:

1	COD Adapter	5-0087
1	COD Reactor, 12 tube, 110V	5-0102
or 1	COD Reactor, 12 tube, 230V	5-0102-EX2
1	Measuring Pipet, 1.0 mL	2-2110
1	Pipet Bulb	2-2164
1	Wipes	2-2069
1	Test Tube Holder	2-2190

Nitrogen is essential for plant growth, but the presence of excessive amounts in water supplies presents a major pollution problem. Nitrogen compounds may enter water as nitrates or be converted to nitrates from agricultural fertilizers, sewage, industrial and packing house wastes, drainage from livestock feeding areas, farm manures and legumes. Nitrates in large amounts can cause “blue babies” (methemoglobinemia) in infants less than six months of age. Nitrate concentration is an important factor to be considered in livestock products, where, in addition to causing methemoglobinemia, it is responsible for many

other problems. Nitrates in conjunction with phosphate stimulate the growth of algae with all of the related difficulties associated with excessive algae growth.

U.S. Public Health Service Drinking Water Standards state that 10 ppm nitrate nitrogen should not be exceeded. To the sanitary and industrial engineer, concentrations of less than 1 ppm are acceptable.

APPLICATION:	Drinking, surface, saline, domestic and industrial waters.
RANGE:	3–25 mg/L Total Nitrogen
MDL:	3 mg/L
METHOD:	All forms of nitrogen are converted to nitrate by an alkaline persulfate digestion. Interference from halogen oxides is eliminated by the addition of sodium metabisulfite. Nitrate reacts in acid with chromotropic acid to form a yellow color in proportion to the amount of nitrate in the treated sample.
SAMPLE HANDLING & PRESERVATION:	If the sample can not be analyzed immediately, the sample should be preserved by adjusting the pH to 2 or less with concentrated sulfuric acid and refrigerated at 4°C. Warm the sample to room temperature and neutralize with 5.0 N sodium hydroxide before analyzing.
INTERFERENCES:	Bromide (>60 ppm) and chloride (>1000 ppm) will have a positive interference.

PROCEDURE

Use COD/UDV adapter.

1. Preheat COD reactor to 100 ±2°C. Follow safety precautions.
2. Remove caps from two *Total Nitrogen Hydroxide Reagent Tubes (4040).
3. Use a 0.15 g spoon (0727) and a funnel (0459) to add one level measure of *Digestion Reagent Powder (4036) to each tube. Tap funnel to dispense powder completely.
4. Use a 1.0 mL pipet (0354) to add 2.0 mL of Deionized Water (5115PS), or organic-free water, to one tube. This is the blank.
5. Use another 1.0 mL pipet (0354) to add 2.0 mL of sample to the other tube. This is the sample.
6. Cap both tubes and shake vigorously for 30 seconds.
7. Place the tubes in the COD reactor for 30 minutes.
8. After exactly 30 minutes, turn the reactor off. Carefully remove the tubes from the reactor and allow them to cool to room temperature.
9. At the end of the cooling period, press and hold ON button until colorimeter turns on.
10. Press and hold ⏻ until colorimeter turns on.
11. Press ENTER to select **TESTING MENU**.
12. Select **ALL TESTS** (or another sequence containing **069 Nitrogen Total**) from **TESTING MENU**.
13. Scroll to and select **069 Nitrogen Total** from menu.
14. Carefully remove caps from the digested tubes.
15. Use a 0.15 g spoon (0727) and a funnel (0459) to add one level measure of *Total Nitrogen Reagent A Powder (4041). Tap funnel to dispense powder completely. Cap the tubes and shake for 15 seconds.
16. Wait 3 minutes.
17. Remove the caps from the tubes. Add one *Total Nitrogen Reagent B Tablet (4042) to each tube. Cap the tubes and shake for 45 seconds or until the tablet disintegrates.
18. Wait 2 minutes.
19. Remove the caps from the reacted tubes. Carefully remove the caps from two *Total Nitrogen Acid Reagent Tubes (4043).

    CAUTION: Tubes contain a strong acid.
20. Use another 1.0 mL pipet (0354) to add 2 mL of digested, treated blank to one Total Nitrogen Acid Reagent Tube. This is the blank.
21. Use another 1.0 mL pipet (0354) to add 2 mL of digested, treated sample to

the other Total Nitrogen Acid Reagent Tube. This is the sample.

22. Cap the tubes and invert 10 times to mix.

    CAUTION: The tubes will be hot.

    Note: Invert slowly and completely for accurate results. Hold tubes with caps up. Invert the tube and wait for the air bubble to flow to the bottom of the tube. Turn the tube upright and wait for the air bubble to return to the top of the tube. This is one inversion.

23. Wait 5 minutes.
24. Wipe the tubes with a damp towel to remove fingerprints and smudges. Wipe with a dry towel.
25. Insert the blank tube into the chamber. Select SCAN BLANK. Remove the blank tube from the colorimeter.
26. Insert the sample tube into the chamber. Select SCAN SAMPLE. Record the result as Total Nitrogen in mg/L N.
27. Press  to turn the colorimeter off or press  to exit to a previous menu or make another menu selection.

NOTES: For greater accuracy, use laboratory grade pipets.

To order reagent refills, Order Code R-4026.

OXYGEN SCAVENGERS

DEHA (DIETHYLHYDROXYLAMINE), CARBOHYDRAZIDE, ERYTHORBIC ACID, HYDROQUINONE, MEHTYLETHYLKETOXIME

IRON REDUCTION METHOD · CODE 4857

QUANTITY	CONTENTS	CODE
15 mL	*DEHA Reagent #1	*4791-E
15 mL	*DEHA Reagent #2	*4792-E
15 mL	*DEHA Reagent #3	*4793-E

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Oxygen can lead to corrosion in many parts of a boiler. Oxygen scavengers are added to the water to eliminate oxygen and thus decrease the chance of corrosion. Diethylhydroxylamine (DEHA) is a volatile oxygen scavenger used in boilers. It can also passivate steel and has a low toxicity.

APPLICATION:	Boilers
RANGE:	0.000–0.700 ppm DEHA (Diethylhydroxylamine) 0.000–0.900 ppm Carbohydrazide 0.00–3.00 ppm Erythorbic Acid 0.00–2.00 ppm Hydroquinone 0.00–3.00 ppm Methylethylketoxime
MDL:	0.004 ppm DEHA 0.01 ppm Carbohydrazide 0.02 ppm Erythorbic Acid 0.01 ppm Hydroquinone 0.01 ppm Methylethylketoxime
METHOD:	Ferric iron is reduced to ferrous iron by oxygen scavengers in proportion to the concentration in the sample. The resulting ferrous iron reacts with an indicator to produce a purple color.
SAMPLE HANDLING & PRESERVATION:	Analyze samples immediately. Rinse sample containers and glassware with 1:1 hydrochloric acid to avoid iron contamination.
INTERFERENCES:	Other oxygen scavengers, such as DEHA, carbohydrazide, erythorbic acid, hydroquinone and methylethylketoxime will interfere. Stray light and substances which complex iron or reduce ferric iron will also interfere.

DEHA PROCEDURE

1. Press and hold  until colorimeter turns on.
2. Press  to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **037 DEHA**) from **TESTING MENU**.
4. Scroll to and select **037 DEHA** from menu.
5. Rinse a tube (0290) with sample water. Fill to 10 mL with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove the tube from colorimeter.
8. Add 3 drops of *DEHA Reagent #1 (4791). Swirl to mix.
9. Add 3 drops of *DEHA Reagent #2 (4792). Swirl to mix.
10. Add 3 drops of *DEHA Reagent #3 (4793). Invert 3 times to mix.
11. Insert the tube into chamber. Close lid.
12. Wait 15 minutes. Do not open the lid during the waiting time. The reaction is photosensitive.
13. Remove tube from chamber. Invert 2 times to mix.
14. Immediately insert tube into chamber, close lid and select **SCAN SAMPLE**. Read within 30 seconds. Record result in ppm DEHA.
15. Press  to turn the colorimeter off or press  to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

CARBOHYDRAZIDE PROCEDURE

1. Press and hold  until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **013 Carbohydrazide**) from **TESTING MENU**.
4. Scroll to and select **013 Carbohydrazide** from menu.
5. Rinse a tube (0290) with sample water. Fill to 10 mL with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove the tube from colorimeter.
8. Add 3 drops of *DEHA Reagent #1 (4791). Swirl to mix.
9. Add 3 drops of *DEHA Reagent #2 (4792). Swirl to mix.
10. Add 3 drops of *DEHA Reagent #3 (4793). Invert 3 times to mix.
11. Insert the tube into chamber. Close lid.
12. Wait 15 minutes. Do not open the lid during the waiting time. The reaction is photosensitive.
13. Remove tube from chamber. Invert 2 times to mix.
14. Immediately insert tube into chamber, close lid and select **SCAN SAMPLE**. Read within 30 seconds. Record result in ppm carbohydrazide.
15. Press  to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

ERYTHORBIC ACID PROCEDURE

1. Press and hold  until colorimeter turns on.
2. Press  to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **039 Erythorbic Acid**) from **TESTING MENU**.
4. Scroll to and select **039 Erythorbic Acid** from menu.
5. Rinse a tube (0290) with sample water. Fill to 10 mL with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove the tube from colorimeter.
8. Add 3 drops of *DEHA Reagent #1 (4791). Swirl to mix.
9. Add 3 drops of *DEHA Reagent #2 (4792). Swirl to mix.
10. Add 3 drops of *DEHA Reagent #3 (4793). Invert 3 times to mix.
11. Insert the tube into chamber. Close lid.
12. Wait 15 minutes. Do not open the lid during the waiting time. The reaction is photosensitive.
13. Remove tube from chamber. Invert 2 times to mix.
14. Immediately insert tube into chamber, close lid and select **SCAN SAMPLE**. Read within 30 seconds. Record result in ppm erythorbic acid.
15. Press  to turn the colorimeter off or press  to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

HYDROQUINONE PROCEDURE

1. Press and hold  until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **049 Hydroquinone**) from **TESTING MENU**.
4. Scroll to and select **049 Hydroquinone** from menu.
5. Rinse a tube (0290) with sample water. Fill to 10 mL with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove the tube from colorimeter.
8. Add 3 drops of *DEHA Reagent #1 (4791). Swirl to mix.
9. Add 3 drops of *DEHA Reagent #2 (4792). Swirl to mix.
10. Add 3 drops of *DEHA Reagent #3 (4793). Invert 3 times to mix.
11. Insert the tube into chamber. Close lid.
12. Wait 15 minutes. Do not open the lid during the waiting time. The reaction is photosensitive.
13. Remove tube from chamber. Invert 2 times to mix.
14. Immediately insert tube into chamber, close lid and select **SCAN SAMPLE**. Read within 30 seconds. Record result in ppm hydroquinone.
15. Press  to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

METHYLETHYLKETOXIME PROCEDURE

1. Press and hold  until colorimeter turns on.
2. Press  to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **058 Ketoxime**) from **TESTING MENU**.
4. Scroll to and select **058 Ketoxime** from menu.
5. Rinse a tube (0290) with sample water. Fill to 10 mL with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove the tube from colorimeter.
8. Add 3 drops of *DEHA Reagent #1 (4791). Swirl to mix.
9. Add 3 drops of *DEHA Reagent #2 (4792). Swirl to mix.
10. Add 3 drops of *DEHA Reagent #3 (4793). Invert 3 times to mix.
11. Insert the tube into chamber. Close lid.
12. Wait 15 minutes. Do not open the lid during the waiting time. The reaction is photosensitive.
13. Remove tube from chamber. Invert 2 times to mix.
14. Immediately insert tube into chamber, close lid and select **SCAN SAMPLE**. Read within 30 seconds. Record result in ppm methylethylketoxime.
15. Press  to turn the colorimeter off or press  to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

OZONE

DPD METHOD • CODE 4881

QUANTITY	CONTENTS	CODE
30 mL	DPD #1A Free Chlorine Reagent	P-6740-G
30 mL	*DPD #1B Free Chlorine Reagent	*P-6741-G
30 mL	*DPD #3 Total Chlorine Reagent	*P-6743-G
2 x 15 mL	Glycine Solution	6811-E

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Note: The primary use for this kit is in applications that use only ozone and no other oxidizing disinfectants.

Ozone is sometimes used in place of, or in conjunction with, chlorine or other halogens for disinfection of pool, spa or drinking waters. Recently, large aquatic facilities have begun using ozone as a disinfectant in many artificial habitats.

APPLICATION:	Bottled water, aquatic waters, and non-chlorinated waters.
RANGE:	0.00 – 3.00 mg/L Ozone
MDL:	0.03 mg/L
METHOD:	In the presence of iodide, ozone reacts instantly with the buffered diethyl-p-phenylenediamine indicator (DPD) to produce a red color in proportion to the amount of ozone present.
SAMPLE HANDLING & PRESERVATION:	Ozone in aqueous solutions, particularly weak solutions, is not stable. Exposure to sunlight or agitation will accelerate the reduction of ozone. Fill sample containers to the top and cap tightly. Analyze samples as soon as possible after collection.
INTERFERENCES:	Interferences are other oxidizers, such as, chlorine, bromine, iodine, and oxidized manganese. The DPD reagent system used in this kit has a significant interference from chlorine. The interference from chlorine only is eliminated with the addition of glycine.

PROCEDURE - OZONE ONLY

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **070 Ozone DPD**) from **TESTING MENU**.
4. Scroll to and select **070 Ozone DPD** from menu.
5. Rinse a tube (0290) with sample water. Fill to 10 mL with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter.
8. Add 5 drops *DPD #3 Total Chlorine Reagent (6743). Swirl to mix.
9. Add 5 drops DPD #1 A Free Chlorine Reagent (6740) and 5 drops *DPD #1B Free Chlorine Reagent (6741).
10. Cap and invert to mix. Make reading within 30 seconds.
11. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result as mg/L ozone.
12. Press ⏻ to turn the meter off or press EXIT to exit to a previous menu or make another menu selection.

NOTES: For best possible results, a blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents are obtained.

PROCEDURE - OZONE WITH CHLORINE PRESENT

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **070 Ozone DPD**) from **TESTING MENU**.
4. Scroll to and select **070 Ozone DPD** from menu.
5. Rinse a tube (0290) with sample water. Fill to 10 mL with sample.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter.
8. Add 5 drops *DPD #3 Total Chlorine Reagent (6743). Swirl to mix.
9. Add 5 drops DPD #1 A Free Chlorine Reagent (6740) and 5 drops *DPD #1B Free Chlorine Reagent (6741).
10. Cap and invert to mix. Make reading within 30 seconds.
11. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result as Reading A (ozone + total chlorine).
12. Rinse a tube (0290) with sample water. Fill to 10 mL with sample.
13. Add 5 drops of Glycine Solution (6811). Swirl to mix.
14. Add 5 drops *DPD #3 Total Chlorine Reagent (6743). Swirl to mix.
15. Add 5 drops DPD #1 A Free Chlorine Reagent (6740) and 5 drops *DPD #1B Free Chlorine Reagent (6741).
16. Cap and invert to mix. Make reading within 30 seconds.
17. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result as Reading B (ozone).
18. Calculate the ozone concentration in mg/L ozone.

    Reading A – Reading B = mg/L ozone

19. Press ⏻ to turn the meter off or press EXIT to exit to a previous menu or make another menu selection.

NOTES: For best possible results, a blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents are obtained.

OZONE

INDIGO METHOD • CODE 365I-SC

QUANTITY	CONTENTS	CODE
15 mL	Chlorine Inhibitor	3990-E
250 mL	*Ozone Buffer	*3991-K
30 mL	Indigo Blue Stock Solution	3989-G
1	Sampling Apparatus	0681
1	Pipet, transfer, 1.0 mL	2-2170
1	Pipet, transfer, 5 mL	0329
1	Pump, 10 mL	30527
1	Bottle, HR Reagent, amber glass	0680-J
1	Graduated Cylinder, 50 mL, glass	0418

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Ozone is sometimes used in place of, or in conjunction with, chlorine or other halogens for disinfection of pool, spa, or drinking waters. Recently, large aquatic facilities have begun using ozone as a disinfectant in many artificial habitats.

APPLICATION:	Drinking, pool and aquatic waters.
RANGE:	0.00–0.40 ppm Ozone, Low Range 0.00–3.00 ppm Ozone, High Range
MDL:	0.02 ppm Ozone, Low Range 0.05 ppm Ozone, High Range
METHOD:	Ozone rapidly and stoichiometrically decolorizes Indigo Trisulfonate under acidic conditions.
SAMPLE HANDLING & PRESERVATION:	Ozone is extremely unstable in aqueous solutions. Test must be performed immediately and the sample must not be agitated.
INTERFERENCES:	Manganese at any level interferes.

PROCEDURE–LOW RANGE

A. PREPARATION OF HR REAGENT

NOTE: The quantity of Indigo Blue Stock solution (3989) supplied will prepare one batch of HR Reagent for the High Range Ozone procedure or five batches of HR Reagent for the Low Range Ozone procedure.

1. Use the 50 mL graduated cylinder to carefully add 45 mL of *Ozone Buffer (3991) to amber glass bottle marked HR Reagent (0680).
2. Use the 5 mL transfer pipet (0329) and pump (30527) to add 5 mL of Indigo Blue Stock Solution (3989) to the amber glass bottle. Cap and mix.

B. DETERMINATION OF OZONE

3. Use the 1.0 mL transfer pipet (2-2170) and pump (30527) to add 1.0 mL of HR Reagent to each of 2 clean tubes (0290).
4. If chlorine is present add 3 drops Chlorine Inhibitor (3990) to each tube. Cap tubes.
5. Take one of the prepared tubes (0290) and sampling apparatus (0681) to sampling site.
6. Lower end of tubing of sampling apparatus to desired depth. Slowly withdraw and depress plunger several times to purge syringe and tubing. Slowly withdraw plunger to fill purged syringe.
7. Remove plastic tubing from syringe. Remove cap from the prepared tube. Place tip of syringe against inside of the prepared tube. Slowly depress plunger and fill to the 10 mL line and cap. This is the Sample Tube.
   NOTE: DO NOT SHAKE OR INVERT THE SAMPLE.
8. Fill the second prepared tube (0290) to the 10 mL line with ozone free water. This is the Reagent Blank.
9. Press and hold ⏻ until colorimeter turns on.
10. Press ENTER to select **TESTING MENU**.
11. Select **ALL TESTS** (or another sequence containing **071 Ozone LR**) from **TESTING MENU**.
12. Scroll to and select **071 Ozone LR** from menu.
13. Insert the Reagent Blank tube into chamber, close lid and select **SCAN BLANK**.
14. Insert reacted Sample Tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
15. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: HR Reagent must be made fresh each week. If reagent is refrigerated, it may be kept up to 3 weeks.

PROCEDURE–HIGH RANGE

A. PREPARATION OF HR REAGENT

NOTE: The quantity of Indigo Blue Stock solution (3989) supplied will prepare one batch of HR Reagent for the High Range Ozone procedure or five batches of HR Reagent for the Low Range Ozone procedure.

1. Use the 50 mL graduated cylinder to carefully add 25 mL of *Ozone Buffer (3991) to amber glass bottle marked HR Reagent (0680).
2. Use the 50 mL graduated cylinder to carefully add 25 mL of Indigo Blue Stock Solution (3989) to the amber glass bottle. Cap and mix.

B. DETERMINATION OF OZONE

3. Use the 1.0 mL transfer pipet (2-2170) and pump (30527) to add 1.0 mL of HR Reagent to each of 2 clean tubes (0290).
4. If chlorine is present add 3 drops Chlorine Inhibitor (3990) to each tube. Cap tubes.
5. Take one of the prepared tubes (0290) and sampling apparatus (0681) to sampling site.
6. Lower end of tubing of sampling apparatus to desired depth. Slowly withdraw and depress plunger several times to purge syringe and tubing. Slowly withdraw plunger to fill purged syringe.
7. Remove plastic tubing from syringe. Remove cap from the prepared tube. Place tip of syringe against inside of the prepared tube. Slowly depress plunger and fill to the 10 mL line and cap. This is the Sample Tube.
   NOTE: DO NOT SHAKE OR INVERT THE SAMPLE.
8. Fill the second prepared tube (0290) to the 10 mL line with ozone free water. This is the Reagent Blank.
9. Press and hold ⏻ until colorimeter turns on.
10. Press ENTER to select **TESTING MENU**.
11. Select **ALL TESTS** (or another sequence containing **072 Ozone HR**) from **TESTING MENU**.
12. Scroll to and select **072 Ozone HR** from menu.
13. Insert the Reagent Blank tube into chamber, close lid and select **SCAN BLANK**.
14. Insert reacted Sample Tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
15. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: HR Reagent must be made fresh each week. If reagent is refrigerated, it may be kept up to 3 weeks.

pH

COLORIMETRIC METHOD • CODE 3700-01-SC

QUANTITY	CONTENTS	CODE
60 mL	Chlorphenol Red Indicator	V-2209-H
60 mL	Phenol Red Indicator	V-2304-H
60 mL	Thymol Blue Indicator	V-2213-H
3	Pipets, 0.5 mL, plastic w/caps	0369

The term pH (always written with a lower case p and an upper case H) is correctly defined as the negative logarithm of the hydrogen ion concentration. More simply, the term pH can be considered to be an index of the amount of hydrogen ion present in a substance, or is a measure of the acidity of the substance. This index is important as it can be used to quickly identify the acid, neutral or alkaline (basic) nature of materials. Acidic substances have a pH less than 7.0, neutral substances have a pH equal to 7.0 and alkaline substances have a pH greater than 7.0.

Most natural waters have pH values from pH 5.0 to pH 8.5. Acidic, freshly fallen rain water may have a pH value of pH 5.5 to pH 6.0. When it reacts with soils and minerals containing weakly alkaline materials, the hydroxyl ion concentration will increase and the hydrogen ion concentration will decrease. Then the water may become slightly alkaline with a pH of 8.0 to 8.5. Natural sea water has a pH value of 8.1, and changes from this value indicate that water from an inland source is entering the body of sea water.

Waters more acidic than pH 5.0 and more alkaline than pH 8.5 to 9.0 should be viewed with suspicion. Mine drainage and acidic industrial wastes are the principal factors in increasing the acidity of water, and alkaline industrial wastes are the cause of high pH values.

Because pH measurements can be made so simply, and because they can tell so much about the past and future reactions of water, they are routinely made in water quality studies. Sudden changes in pH values serve as warning signals that water quality may be adversely affected through the introduction of contaminants.

APPLICATION: Drinking, surface, and saline waters, swimming pool water; domestic and industrial wastes.

METHOD: The various pH indicators exhibit a specific color change over a narrow pH range. The color changes are measured colorime trically.

SAMPLE HANDLING & PRESERVATION: Sample should be analyzed immediately after collection.

INTERFERENCES: Sample color and turbidity interfere with the colorimetric pH measurement. Color interference may be removed bystandardizing the instrument with the original water sample. Two drops of 0.1N sodium thiosulfate per 100 mL of sample will eliminate chlorine interference.

INDICATOR, RANGE, & TEST NAME:

pH Indicator	pH	SMART3 Test Name
Chlorphenol Red	5.0-6.8	073 pH CPR
Phenol Red	6.6-8.4	074 pH PR
Thymol Blue	8.0-9.6	075 pH TB

PROCEDURE

1. Use Indicator, Range, & Test Name chart to select the indicator, corresponding to anticipated pH range and to determine corresponding test name to select from colorimeter menu.
2. Press and hold ⏻ until colorimeter turns on.
3. Press ENTER to select **TESTING MENU**.
4. Select **ALL TESTS** (or another sequence containing the appropriate pH test name) from **TESTING MENU**.
5. Scroll to and select the appropriate pH test name from menu.
6. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
7. Insert tube into chamber, close lid and select **SCAN BLANK**.
8. Remove tube from colorimeter. Use the 0.5 mL pipet (0369) to add exactly 0.5 mL of the pH indicator for the chosen range. Cap and mix.
9. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
10. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

PHENOL

AMINOANTIPYRINE METHOD • CODE 3652-01-SC

QUANTITY	CONTENTS	CODE
5 g	Aminoantipyrine Reagent	7825-C
30 mL	*Ammonium Hydroxide Solution	*7826-G
2 x 60 mL	*Potassium Ferricyanide Solution	*7827-H
1	Spoon, 0.1 g, plastic	0699
1	Pipet, plain, plastic	0352
1	Pipet, 1.0 mL, plastic	0354

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Phenols may occur in domestic and industrial waste waters and in drinking water supplies. Chlorination of waters containing phenols may produce odiferous and objectionable tasting chlorophenols. Natural waters sedom contain more than 1 mg/L phenol.

APPLICATION:	Drinking and surface waters; domestic and industrial waste water.
RANGE:	0.00–6.00 ppm Phenol
MDL:	0.05 ppm
METHOD:	4-Aminoantipyrine is oxidized in the presence of all ortho- and meta- substituted phenols to form a colored complex in proportion to the amount of phenol present.
SAMPLE HANDLING & PRESERVATION:	Phenols are subject to biological and chemical oxidation. Samples should be analyzed within 4 hours after collection. If sample cannot be analyzed within 4 hours, it can be preserved by acidification with phosphoric acid to pH 4.0.
INTERFERENCES:	Oxidizing and reducing chemicals, alkaline pH values, and phenol decomposing bacteria may interfere with the test.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **077 Phenol**) from **TESTING MENU**.
4. Scroll to and select **077 Phenol** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select SCAN BLANK.
7. Remove tube from colorimeter. Use the 0.1 g spoon (0699) to add one measure of Aminoantipyrine Reagent (7825-C). Cap and mix.
8. Use the plain pipet (0352) to add 4 drops of *Ammonium Hydroxide Solution (7826). Cap and mix.
9. Use the 1 mL pipet (0354) to add 2 mL of *Potassium Ferricyanide Solution (7827). Cap and mix. Solution will almost immediately develop a reddish hue if phenols are present.
10. Insert tube into chamber, close lid and select SCAN SAMPLE. Record result.
11. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

PHOSPHATE – LOW RANGE

ASCORBIC ACID REDUCTION METHOD
CODE 3653-SC

QUANTITY	CONTENTS	CODE
60 mL	*Phosphate Acid Reagent	*V-6282-H
5 g	*Phosphate Reducing Reagent	*V-6283-C
1	Pipet, 1 mL, plastic	0354
1	Spoon, 0.1 g, plastic	0699

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Phosphorus is an important nutrient for aquatic plants. The amount found in water is generally not more than 0.1 ppm unless the water has become polluted from waste water sources or excessive drainage from agricultural areas. When phosphorus is present in excess of the concentrations required for normal aquatic plant growth, a process called eutrophication takes place. This creates a favorable environment for the increase in algae and weeds. When algae cells die, oxygen is used in the decomposition and fish kills often result. Rapid decomposition of dense algae scums with associated organisms give rise to foul odors and hydrogen sulfide gas.

APPLICATION:	Drinking, surface and saline waters; domestic and industrial wastes (Method based on reactions that are specific for orthophosphate).
RANGE:	0.00–3.00 ppm Orthophosphate
MDL:	0.05 ppm
METHOD:	Ammonium molybdate and antimony potassium tartrate react in a filtered acid medium with dilute solution of PO_4^{-3} to form an antimony-phosphomolybdate complex. This complex is reduced to an intense blue colored complex by ascorbic acid. The color is proportional to the amount of phosphate present. (Only orthophosphate forms a blue color in this test.) Polyphosphates (and some organic phosphorus compounds) may be converted to the orthophosphate form by sulfuric acid digestion. Organic phosphorus compounds may be converted to the orthophosphate form by persulfate digestion.
SAMPLE HANDLING & PRESERVATION:	If benthic deposits are present in the area being sampled, great care should be taken not to include these deposits. If the analysis cannot be performed the same day of collection, the sample should be preserved by the addition of 2 mL of concentrated sulfuric acid or 40 mg mercuric chloride per liter and refrigerated at 4°C.
INTERFERENCES:	a. No interference from copper, iron, or silicate at concentrations many times the concentration of sea water. However, high iron concentrations can cause precipitation and subsequent loss of phosphorus. b. Salt error for samples ranging from 5% to 20% salt content was found to be less than 1%. c. Mercuric chloride, $HgCl_2$, when used as the preservative, interferes when the chloride levels are low (less than 50 mg/L). This interference is overcome by spiking samples with a minimum of 50 mg/L of sodium chloride.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **078 Phosphate LR**) from **TESTING MENU**.
4. Scroll to and select **078 Phosphate LR** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Use 1.0 mL pipet (0354) to add 1.0 mL of *Phosphate Acid Reagent (V-6282). Cap and mix.
8. Use the 0.1 g spoon (0699) to add one measure of *Phosphate Reducing Reagent (V-6283). Cap and mx until powder dissolves. Wait 5 minutes for full color development. Solution will turn blue if phosphates are present.
9. At end of 5 minute waiting period, mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
10. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

PHOSPHATE – HIGH RANGE

VANADOMOLYBDOPHOSPHORIC ACID METHOD
CODE 3655-SC

QUANTITY	CONTENTS	CODE
4 x 30 mL	*VM Phosphate Reagent	*4410-G
1	Pipet, 1.0 mL, plastic	0354

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Phosphate treatments in boiler and cooling water and other industrial water systems are run at levels up to 100 ppm orthophosphate. These high levels permit the use of a simpler, high range test.

APPLICATION:	Boiler, cooling, and industrial water.
RANGE:	0.0–70.0 ppm Phosphate
MDL:	0.5 ppm
METHOD:	Orthophosphate reacts in acid conditions with ammonium vanadomolybdate to form vanadomolybdophosphoric acid. This yellow color is proportional to the concentration of orthophosphate and is read colorimetrically.
SAMPLE HANDLING & PRESERVATION:	If the analysis cannot be performed the same day of collection, the sample should be preserved by the addition of 2 mL of concentrated sulfuric acid or 40 mg mercuric chloride per liter and refrigerated at 4°C.
INTERFERENCES:	Silica interferes only if the sample is heated. Arsenate, fluoride, thorium, bismuth, sulfide, thiosulfate, and thiocyanate cause negative interference.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **079 Phosphate HR**) from **TESTING MENU**.
4. Scroll to and select **079 Phosphate HR** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Use the 1.0 mL pipet (0354) to add 2.0 mL of *VM Phosphate Reagent (4410). Cap and mix. Wait 5 minutes for full color development.
8. After 5 minute waiting period, mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
9. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

PHOSPHATE ppb

ASCORBIC ACID REDUCTION METHOD
CODE 3653-SC

QUANTITY	CONTENTS	CODE
60 mL	*Phosphate Acid Reagent	*V-6282-H
5 g	*Phosphate Reducing Reagent	*V-6283-C
1	Pipet, 1 mL, plastic	0354
1	Spoon, 0.1 g, plastic	0699

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Phosphorus is an important nutrient for aquatic plants. The amount found in water is generally not more than 0.1 ppm unless the water has become polluted from waste water sources or excessive drainage from agricultural areas. When phosphorus is present in excess of the concentrations required for normal aquatic plant growth, a process called eutrophication takes place. This creates a favorable environment for the increase in algae and weeds. When algae cells die, oxygen is used in the decomposition and fish kills often result. Rapid decomposition of dense algae scums with associated organisms give rise to foul odors and hydrogen sulfide gas.

APPLICATION:	Drinking, surface and saline waters; domestic and industrial wastes (Method based on reactions that are specific for orthophosphate).
RANGE:	0–3000 ppm Orthophosphate
MDL:	50 ppb
METHOD:	Ammonium molybdate and antimony potassium tartrate react in a filtered acid medium with dilute solution of PO_4^{-3} to form an antimony-phosphomolybdate complex. This complex is reduced to an intense blue colored complex by ascorbic acid. The color is proportional to the amount of phosphate present. (Only orthophosphate forms a blue color in this test.) Polyphosphates (and some organic phosphorus compounds) may be converted to the orthophosphate form by sulfuric acid digestion. Organic phosphorus compounds may be converted to the orthophosphate form by persulfate digestion.
SAMPLE HANDLING & PRESERVATION:	If benthic deposits are present in the area being sampled, great care should be taken not to include these deposits. If the analysis cannot be performed the same day of collection, the sample should be preserved by the addition of 2 mL of concentrated sulfuric acid or 40 mg mercuric chloride per liter and refrigerated at 4°C.
INTERFERENCES:	a. No interference from copper, iron, or silicate at concentrations many times the concentration of sea water. However, high iron concentrations can cause precipitation and subsequent loss of phosphorus. b. Salt error for samples ranging from 5% to 20% salt content was found to be less than 1%. c. Mercuric chloride, $HgCl_2$, when used as the preservative, interferes when the chloride levels are low (less than 50 mg/L). This interference is overcome by spiking samples with a minimum of 50 mg/L of sodium chloride.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **080 Phosphate ppb**) from **TESTING MENU**.
4. Scroll to and select **080 Phosphate ppb** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Use 1.0 mL pipet (0354) to add 1.0 mL of *Phosphate Acid Reagent (V-6282). Cap and mix.
8. Use the 0.1 g spoon (0699) to add one measure of *Phosphate Reducing Reagent (V-6283). Cap and shake until powder dissolves. Wait 5 minutes for full color development. Solution will turn blue if phosphates are present.
9. At end of 5 minute waiting period, mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
10. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

PHOSPHORUS, TOTAL - LOW RANGE

ASCORBIC ACID REDUCTION WITH PERSULFATE DIGESTION METHOD • CODE 4024-01

QUANTITY	CONTENTS	CODE
25	*Total Phosphorus Acid Reagent Tubes	*4035-G
5 g	*Digestion Reagent Powder	*4036-C
2 X 30 mL	*Total Phosphorus LR Hydroxide Reagent	*4038-G
2 X 30 mL	*Phosphate Acid Reagent	*V-6282-G
5 g	Phosphate Reducing Reagent	V-6283-C
1	Spoon, 0.15 g, plastic	0727
3	Pipets, 1.0 mL, plastic	0354
1	Spoon, 0.1 g, plastic	0699
2	Funnels, plastic	0459

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NOTE: For greater accuracy, use laboratory grade pipets.

Equipment needed but not supplied:

1	COD Adapter	5-0087
1	COD Reactor, 12 tubes, 120V	5-0102
or 1	COD Reactor, 12 tubes, 230V	5-0102-EX2

Optional Equipment:

1	Volumetric pipet, 5.0 mL	2-2174
2	Volumetric pipets, 1.0 mL	2-2170
1	Pipet Bulb	2-2164
1	Wipes	2-2069
1	Test Tube Holder	2-2190

Phosphorus in natural waters and wastewaters occurs almost exclusively in the form of orthophosphates, condensed phosphates (pyro-, meta- and other polyphosphates) and organically bound phosphates. Phosphates may be added in small amounts to water supplies during treatment. Larger amounts are introduced to water used for cleaning or laundering as components of commercial cleaning preparations. Phosphates are used to treat boiler water and are components of agricultural and residential fertilizers. Phosphorus is an important nutrient for aquatic plants. The amount found in natural water is generally not more than 0.1 mg/L unless the water has become polluted from wastewater sources or excessive drainage from agricultural areas.

APPLICATION:	Drinking, surface and saline waters; domestic and industrial waste water.
RANGE:	0.00 –3.50 mg/L Total Phosphorus as Phosphate
MDL:	0.50 mg/L
METHOD:	Pretreatment of the sample with heat and acid provides conditions for the hydrolysis of condensed inorganic phosphates. Heat, acid and persulfate convert the organic phosphates to orthophosphate during the digestion. Ammonium molybdate and antimony potassium tartrate react in a filtered acid medium with dilute solutions of phosphate to form an antimony-phosphomolybdate complex. This complex is reduced to an intense blue colored complex by ascorbic acid. The color is proportional to the amount of phosphate present.
SAMPLE HANDLING & PRESERVATION:	Rinse sample bottle with 1:1 hydrochloric acid followed by deionized water. Do not use phosphate detergents. If the sample can not be analyzed immediately, the sample should be preserved by adjusting the pH to 2 or less with concentrated sulfuric acid and refrigerated at 4°C. Warm the sample to room temperature and neutralize with 5.0 N sodium hydroxide before analyzing.
INTERFERENCES:	Large amounts of turbidity may interfere. Aluminum (200 ppm), Arsenate (any level), Chromium (100 ppm), Copper (10 ppm), Iron (100 ppm), Nickel (300 ppm), Silica (50 ppm), Silicate (10 ppm), Sulfide (90 ppm) and Zinc (80 ppm) will interfere.

PROCEDURE

Use COD/UDV adapter.

1. Preheat COD reactor to 150 ±2°C. Follow safety precautions.
2. Remove cap from a *Total Phosphorus Acid Reagent Tube (4035). Use a 1.0 mL pipet (0354) to add 5.0 mL of sample.
3. Use the 0.15 g spoon (0727) and a funnel (0459) to add one level measure of *Digestion Reagent Powder (4036). Tap funnel to dispense powder completely. Cap tube tightly and shake until powder completely dissolves.
4. Place the tube in the COD reactor for 30 minutes.
5. At the end of the heating period, turn the reactor off. Carefully remove the tube from the reactor and allow it to cool to room temperature.
6. At the end of the cooling period, press and hold ⏻ until colorimeter turns on.
7. Press ENTER to select **TESTING MENU**.
8. Select **ALL TESTS** (or another sequence containing **081 Phosphate T LR**) from **TESTING MENU**.
9. Scroll to and select **081 Phosphate T LR** from the menu.
10. Carefully remove the cap from the digested tube. Use another 1 mL pipet (0354) to add 1.0 mL of *Total Phosphorus LR Hydroxide Reagent (4038) to the tube. Cap and invert to mix.
11. Wipe the tube with a damp towel to remove fingerprints and smudges. Wipe with a dry towel.
12. Insert the tube into the chamber. Select **SCAN BLANK**. Remove the tube from the colorimeter.
13. Use another 1 mL pipet (0354) to add *1.0 mL of Phosphate Acid Reagent (V-6282). Cap and invert tube to mix.
14. Use the 0.1g spoon (0699) and a funnel (0459) to add one level spoon of Phosphate Reducing Reagent (V-6283). Tap funnel to dispense powder completely. Cap tube and shake until powder dissolves.
15. Wait 5 minutes.
16. Wipe the vials with a damp towel to remove fingerprints and smudges. Wipe with a dry towel.
17. Insert the tube into the chamber. Select **SCAN SAMPLE**. Record the result as Total Phosphorus in mg/L PO_4.
18. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTES: For greater accuracy, use laboratory grade pipets.

PHOSPHORUS, TOTAL – HIGH RANGE

MOLYBDOVANADATE METHOD WITH ACID PERSULFATE DIGESTION • CODE 4025-01

QUANTITY	CONTENTS	CODE
25	*Total Phosphorus Acid Reagent Tubes	*4035-G
60 mL	Deionized Water	5115PS-H
5 g	*Digestion Reagent Powder	*4036- C
2 X 30 mL	*Total Phosphorus HR Hydroxide Reagent	*4037-G
30 mL	*Total Phosphorus HR Indicator Reagent	*4039-G
1	Spoon, 0.15 g	0727
3	Pipets 1.0 mL, plastic	0354
1	Pipet, 0.5 mL	0353
1	Funnel, plastic	0459

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NOTE: For greater accuracy, use laboratory grade pipets.

Equipment needed but not supplied:

1	COD Adapter	5-0087
1	COD Reactor, 12 vial, 120V	5-0102
Or 1	COD Reactor, 12 vial, 23V	5-0102-EX2
Or 1	COD Reactor, 25 vial, 115V/230V	5-0094

Optional Equipment:

1	Volumetric pipet, 2.0 mL	2-2168
2	Volumetric pipet, 5.0 mL	2-2174
1	Volumetric pipet, 0.5 mL	30503
1	Pipet Bulb	2-2164
1	Wipes	2-2069
1	Test Tube Holder	2-2190

Phosphorus in natural waters and wastewaters occurs almost exclusively in the form of orthophosphates, condensed phosphates (pyro-, meta- and other polyphosphates) and organically bound phosphates. Phosphates may be added in small amounts to water supplies during treatment. Larger amounts are introduced to water used for cleaning or laundering, as components of commercial cleaning preparations. Phosphates are used to treat boiler water and are components of agricultural and residential fertilizers. Phosphorus is an important nutrient for aquatic plants. The amount found in natural water is generally not more than 0.1 mg/L unless the water has become polluted from wastewater sources or excessive drainage from agricultural areas.

APPLICATION:	Boiler, cooling, and industrial water.
RANGE:	0.0–70 mg/L Total Phosphorus as phosphate
MDL:	5 mg/L
METHOD:	Pretreatment of the sample with heat and acid provides conditions for the hydrolysis of condensed inorganic phosphates. Heat, acid and persulfate convert the organic phosphates to orthophosphate during digestion. Orthophosphate reacts in acidic conditions with ammonium vanadomolybdate to form vanadomolybdophosphoric acid. The resulting yellow color is proportional to the concentration of orthophosphate.
SAMPLE HANDLING & PRESERVATION:	Rinse sample bottle with 1:1 hydrochloric acid followed by deionized water. Do not use phosphate detergents. If the sample can not be analyzed immediately, the sample should be preserved by adjusting the pH to 2 or less with concentrated sulfuric acid and refrigerated at 4°C. Warm the sample to room temperature and neutralize with 5.0 N sodium hydroxide before analyzing.
INTERFERENCES:	Large amounts of turbidity may interfere. Silica and arsenate interfere only if the sample is heated. Arsenite, fluoride, thorium, bismuth, molybdate, thiosulfate, and thiocyanate cause negative interference. Ferrous iron concentrations above 100 ppm will interfere.

PROCEDURE

Use COD/UDV adapter.

1. Preheat COD reactor to 150 ±2°C. Follow safety precautions.
2. Remove cap from a *Total Phosphorus Acid Reagent Tube (4035). Use a 1.0 mL pipet (0354) to add 5.0 mL of Deionized Water (5115PS). This is the blank.
3. Remove cap from a *Total Phosphorus Acid Reagent Tube (4035). Use the 1.0 mL pipet (0354) to add 5.0 mL of sample water. This is the sample.
4. Use the 0.15 g spoon (0727) and a funnel (0459) to add one level measure of *Digestion Reagent Powder (4036) to each tube. Tap funnel to dispense powder completely. Cap tube tightly and shake until powder dissolves completely.
5. Place the tubes in the COD reactor for 30 minutes.
6. At the end of the heating period, turn the reactor off. Carefully remove the tubes from the reactor block and allow them to cool to room temperature.
7. Carefully remove the caps from the digested tubes. Use another 1 mL pipet (0354) to add 2.0 mL of *Total Phosphorus HR Hydroxide Reagent (4037) to each tube. Cap and invert to mix.
8. Use the 0.5 mL pipet (0353) to add 0.5 mL *Total Phosphorus HR Indicator Reagent (4039) to each tube. Cap and invert to mix. Wait 7 minutes.
9. During the waiting period, press and hold ⏻ until colorimeter turns on.
10. Press ENTER to select **TESTING MENU**.
11. Select **ALL TESTS** (or another sequence containing **082 Phosphate T HR**) from **TESTING MENU**.
12. Scroll to and select **082 Phosphate T HR** from the menu.
13. Wipe the tubes with a damp towel to remove fingerprints and smudges. Wipe with a dry towel.
14. Insert the blank tube into the chamber. Select **SCAN BLANK**. Remove the blank tube from the colorimeter.
15. Insert the sample tube into the chamber. Select **SCAN SAMPLE**. Record the result as Total Phosphorus in mg/L PO_4.
16. Press ⏻ to turn the colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For greater accuracy, use laboratory grade pipets.

POTASSIUM

TETRAPHENYLBORON METHOD • CODE 3639-SC

QUANTITY	CONTENTS	CODE
30 mL	*Sodium Hydroxide, 1.0N	*4004WT-G
5 g	*Tetraphenylboron Powder	*6364-C
1	Spoon, 0.05 g, plastic	0696

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Potassium, as the seventh most common element on the Earth, may be found in minor quantities in most water supplies. It seldom exceeds 10 ppm in drinking water and usually is less than 2 ppm. In some brine or runoff in agricultural areas the potassium concentration may reach 100 ppm.

APPLICATION:	Drinking, surface, and saline water.
RANGE:	0.0–10.0 ppm Potassium
MDL:	0.8 ppm
METHOD:	Potassium reacts with sodium tetraphenylborate to form a colloidal white precipitate in quantities proportional to the potassium concentration.
SAMPLE HANDLING & PRESERVATION:	Store samples in polyethylene bottles, not in soft glass where leaching of potassium from the glass may occur. Samples may be acidified to pH 2 with nitric acid, but should be neutralized before analyzing.
INTERFERENCE:	Calcium and magnesium interfere at very high concentrations. Check for stray light interference (see p. 69).

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **083 Potassium**) from **TESTING MENU**.
4. Scroll to and select **083 Potassium** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select SCAN BLANK.
7. Remove tube from colorimeter. Add 4 drops of *Sodium Hydroxide, 1.0N (4004WT). Cap and mix.
8. Use the 0.05 g spoon (0696) to add one measure of *Tetraphenylboron Powder (6364). Cap and shake vigorously until all of the powder has dissolved. Wait 5 minutes.
9. At end of 5 minute waiting period, mix tube again to suspend any settled precipitate. Insert tube into chamber, close lid and select SCAN SAMPLE. Record result.
10. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTES: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents are obtained.

For the most accurate results, the sample and reagents should be at 25±4°C.

SILICA – LOW RANGE

HETEROPOLY BLUE METHOD • CODE 3664-SC

QUANTITY	CONTENTS	CODE
30 mL	*Silica Reagent #1	*V-4466-G
30 mL	*Silica Reagent #2	*V-4467-G
30 mL	*Silica Reagent #3	*V-4468-G
10 g	*Silica Reagent #4	*V-6284-D
1	Spoon, 0.1 g, plastic	0699

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Silicon dioxide, SiO_2, commonly known as silica, occurs in all natural water. Silica may be present as suspended, insoluble particles in a colloidal or polymeric state. It may also be present in a reactive form as silicic acid or silicate ions. Silica is a major nutrient for diatoms. A silica cycle occurs in many bodies of water containing organisms, such as diatoms, that use silica in their skeletal structure. The silica removed from the water may be slowly returned to solution by the decomposition of the dead organisms. The major source of silica in natural water is from the decomposition of silicate minerals in the drainage basin from which the waters flow.

The presence of silica is particularly objectionable in water used for boiler feed water purposes, as it may cause the formation of a hard, dense scale which has unusually high resistance to heat transfer. Serious loss of turbine efficiency results from insoluble silica turbine blade deposits caused by vaporization of silica from boiler water.

APPLICATION:	Drinking, surface and saline waters; domestic and industrial wastes.
RANGE:	0.0–4.0 ppm Silica
MDL:	0.05 ppm
METHOD:	Reactive silica forms a complex with ammonium molybdate in an acidic solution to produce a yellow-green color in proportion to the amount of silica present. Phosphate also reacts with molybdate but the addition of oxalic acid eliminates the molybdophosphoric acid complex. This silica molybdate complex is then reduced by ascorbic acid to produce an intense blue color.
SAMPLE HANDLING & PRESERVATION:	Silica samples may be preserved by refrigeration at 4°C in plastic containers up to one week without any change in silica concentration.
INTERFERENCES:	Sulfides and large amounts of iron interfere. Color and turbidity may be removed by standardizing the instrument with the original water sample. Since silica is a component of glass waste and a common contaminant, it is suggested to run a reagent blank using silica-free water. The blank value is subtracted from the sample concentrations.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **085 Silica LR**) from **TESTING MENU**.
4. Scroll to and select **085 Silica LR** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**. (See Note)
7. Remove tube from colorimeter. Add 6 drops *Silica Reagent #1 (V-4466). Cap and invert to mix.
8. Add 12 drops of *Silica Reagent #2 (V-4467). Cap and mix. Wait 5 minutes.
9. Add 8 drops of *Silica Reagent #3 (V-4468). Cap and mix. Wait 2 minutes.
10. Use the 0.1 g spoon (0699) to add one measure of *Silica Reagent #4 (V-6284). Cap and mix gently until powder has dissolved. Wait 5 minutes for full color development.
11. At end of 5 minute waiting period, mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
12. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents are obtained.

SILICA – HIGH RANGE

SILICOMOLYBDATE METHOD • CODE 3687-SC

QUANTITY	CONTENTS	CODE
30 mL	*Silica Reagent #1	*V-4466-G
30 mL	*Silica Reagent #2	*V-4467-G
15 mL	*Silica Reagent #3	*V-4468-G

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Silicon dioxide, SiO_2, commonly known as silica, occurs in all natural water. Silica may be present as suspended, insoluble particles in a colloidal or polymeric state. It may also be present in a reactive form as silicic acid or silicate ions. Silica is a major nutrient for diatoms. A silica cycle occurs in many bodies of water containing organisms, such as diatoms, that use silica in their skeletal structure. The silica removed from the water may be slowly returned to solution by the decomposition of the dead organisms. The major source of silica in natural water is from the decomposition of silicate minerals in the drainage basin from which the waters flow.

The presence of silica is particularly objectionable in water used for boiler feed water purposes, as it may cause the formation of a hard, dense scale which has unusually high resistance to heat transfer. Serious loss of turbine efficiency results from insoluble silica turbine blade deposits caused by vaporization of silica from boiler water.

APPLICATION:	Boilers and cooling towers; domestic and industrial wastes.
RANGE:	0–75 ppm Silica
MDL:	0.5 ppm
METHOD:	Silica forms a complex with ammonium molybdate in an acidic solution to produce a yellow color in proportion to the amount of silica present. Phosphate also reacts with molybdate but the addition of oxalic acid eliminates the molybdophosphoric acid complex.
SAMPLE HANDLING & PRESERVATION:	Silica samples may be preserved by refrigeration at 4°C in plastic containers up to one week without any change in silica concentration.
INTERFERENCES:	Sulfides and large amounts of iron interfere. Color and turbidity may be removed by standardizing the instrument with the original water sample.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **086 Silica HR**) from **TESTING MENU**.
4. Scroll to and select **086 Silica HR** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Add 6 drops *Silica Reagent #1 (V-4466). Cap and invert to mix.
8. Add 12 drops of *Silica Reagent #2 (V-4467). Cap and mix. Wait 5 minutes.
9. At end of 5 minute waiting period, add 8 drops of *Silica Reagent #3 (V-4468). Cap and mix.
10. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
11. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: To extend the range to 100 ppm, perform a 2:1 dilution of water sample, with silica-free water. Perform test and multiply result by 2.

SULFATE – HIGH RANGE

BARIUM CHLORIDE METHOD • CODE 3665-SC

QUANTITY	CONTENTS	CODE
10 g	*Sulfate Reagent	*V-6277-D
1	Spoon, 0.1 g, plastic	0699

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

The most common mineral forms of sulfur are iron sulfide, lead sulfide, zinc sulfide and as calcium sulfate and magnesium sulfate. In most fresh waters the sulfate ion is the second or third most abundant anion, being exceeded only by bicarbonate and, in some cases, silicate. Sulfur, in the form of sulfate, is considered an important nutrient element. Mineral springs are rich in sulfate and feed appreciable quantities of this compound to the watershed. Acid mine water drainage is a form of pollution which may contribute extremely large amounts of sulfate content to natural waters. Other sources of sulfate include waste material from pulp mills, steel mills, food processing operations and municipal wastes. Many bacteria obtain sulfur from sulfate for the synthesis of amino acids. In lakes and streams low in oxygen, this process of sulfate reduction causes the production of hydrogen sulfide, with its characteristic offensive odor. Calcium sulfate and magnesium sulfate contribute significantly to the hardness of water. Under natural conditions, the quantities ordinarily to be expected in lakes are between 3 and 30 parts per million.

APPLICATION:	Drinking and surface waters, domestic and industrial wastes.
RANGE:	0–100 ppm Sulfate
MDL:	3 ppm
METHOD:	Sulfate ion is precipitated in an acid medium with barium chloride to form a barium sulfate suspension in proportion to the amount of sulfate present.
SAMPLE HANDLING & PRESERVATION:	Sulfate samples may be preserved by refrigeration at 4°C up to 7 days in glass or plastic containers without any change in concentration.
INTERFERENCE:	Suspended matter and color interference may be removed by a filtration step. Silica in excess of 500 mg/L will interfere. Check for stray light interference (see page 69).

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **089 Sulfate HR**) from **TESTING MENU**.
4. Scroll to and select **089 Sulfate HR** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Use the 0.1 g spoon (0699) to add one measure of *Sulfate Reagent (V-6277). Cap and shake until powder dissolves. A white precipitate will develop if sulfates are present. Wait 5 minutes.
8. Mix tube again. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
9. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: If the sulfate concentration of the test sample is greater than 100 ppm, it is recommended that a dilution be made with deionized water and the results multiplied by the dilution factor.

A white film is deposited on the inside of test tubes as a result of the sulfate test. Thoroughly clean and rinse test tubes after each test.

For the most accurate results, samples and reactions should be at 25±4°C.

SULFIDE – LOW RANGE

METHYLENE BLUE METHOD • CODE 3654-02-SC

QUANTITY	CONTENTS	CODE
2 x 30	*Sulfide Reagent A	*V-4458-G
15 mL	*Sulfide Reagent B	*V-4459-E
2 x 60 mL	Sulfide Reagent C	4460-H
2	Pipets, 1.0 mL, plastic	0354

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Sulfide occurs in many well water supplies and sometimes is formed in lakes or surface waters. In distribution systems, it may be formed as a result of bacterial action on organic matter under anaerobic conditions. It may also be found in waters receiving sewage or industrial wastes. Lake muds rich in sulfates produce hydrogen sulfide during periods of very low oxygen levels that result from stagnation. Concentrations of a few hundredths of a part per million (or milligram per liter) cause a noticeable odor. At low concentrations, this odor is described as “musty”; at high concentration, as “rotten eggs.” Removal of sulfide odor is accomplished by aeration or chlorination. Hydrogen sulfide, a toxic substance, acts as a respiratory depressant in both humans and fish.

APPLICATION:	Drinking, surface and saline waters; domestic and industrial wastes.
RANGE:	0.00–1.50 ppm Sulfide
MDL:	0.06 ppm
METHOD:	Under suitable conditions the sulfide ion reacts with p-aminodimethylaniline and ferric chloride to produce methylene blue in proportion to the sulfide concentration. Ammonium phosphate is added to remove the color due to the ferric iron.
SAMPLE HANDLING & PRESERVATION:	Samples must be taken with a minimum of aeration since sulfide is volatilized by aeration and any oxygen which is taken up will destroy sulfides by chemical action. Samples that are used for total sulfide concentrations may be preserved by adding 2M zinc acetate solution at a dosage of 2 mL per liter of sample. This precipitates sulfide as inert zinc sulfide. Determination of dissolved sulfides in samples not preserved with zinc acetate must be started within 3 minutes of sampling.
INTERFERENCES:	Strong reducing agents such as sulfite, thiosulfate, and hydrosulfite prevent the formation of the color or diminish its intensity. High concentrations of sulfide will inhibit the reaction, but dilution of the sample prior to analysis eliminates this problem.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **090 Sulfide LR**) from **TESTING MENU**.
4. Scroll to and select **090 Sulfide LR** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Use the 1.0 mL pipet (0354) to add 1.0 mL of *Sulfide Reagent A (V-4458). Cap and mix.
8. Add 6 drops of Sulfide Reagent B (V-4459). Cap and mix. Wait 1 minute. Solution will turn blue if sulfides are present.
9. Use the 1.0 mL pipet (0354) to add 2.0 mL of Sulfide Reagent C (4460). Cap and mix. Color development is immediate and stable.
10. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
11. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

SURFACTANTS

ION PAIR EXTRACTION–BROMPHENOL BLUE INDICATOR METHOD • CODE 4876-01

QUANTITY	CONTENTS	CODE
50 g	pH Adjustment Powder	4509- H
10 g	Sodium Chloride Reagent	4877-D
2 X 60 mL	*DS Indicator Reagent	*4508-H
1	Spoon, 0.5 g, plastic	0698
1	Spoon, 0.1 g, plastic	0699
1	Pipet, 1.0 mL, plastic	0354

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Aqueous waste from households and industrial laundering operations is the main source of surfactants in waters. Surfactants are found in low concentrations in natural water except in areas of an outfall or other point source.

APPLICATION:	Surface water, wastewater.
RANGE:	0.0–8.0 ppm as Linear Alkyl Sulfonates (LAS)
MDL:	0.75
METHOD:	The presence of LAS in the water sample causes the transfer of bromphenol blue dye from the organic reagent layer to the aqueous layer. The amount of color in the aqueous layer is proportional to the concentration of the LAS in the sample. LAS are Methylene Blue Active Substances (MBAS). This calibration is based on sodium lauryl sulfate (dodecyl sodium sulfate). Some linear alkyl sulfonates may have a slightly different response. Prepare standards of a known concentration and follow the test procedure below to determine a conversion factor.
SAMPLE HANDLING & PRESERVATION:	Analyze samples as soon as possible. May be stored at 4°C for 24 hours. Warm to room temperature before testing.
INTERFERENCES:	Cationic surfactants and nonionic surfactants.

PROCEDURE

1. Press and hold  until colorimeter turns on.
2. Press  to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **094 Surfactants**) from **TESTING MENU**.
4. Scroll to and select **094 Surfactants** from menu.
5. Rinse a tube (0290) with sample water. Fill to 10 mL line with sample.
6. Insert the tube into chamber, close lid and select SCAN BLANK.
7. Remove the tube from colorimeter.
8. Use the 0.5 g spoon (0698) to add 0.5 g pH Adjustment Powder (4509). Cap and mix until powder dissolves.
9. Use the 0.1 g spoon (0699) to add two measures of Sodium Chloride Reagent (4877). Cap and mix until powder disintegrates.
10. Use the 1.0 mL pipet (0354) to add 2.0 mL of *DS Indicator (4508).
11. Cap and shake for 1 minute.
12. Wait 5 minutes. DO NOT MIX. Tap vials to remove reagent from the sides of the tube.
13. Insert tube into chamber, close lid and select SCAN SAMPLE. Record result in ppm LAS.
14. Press  to turn colorimeter off or press  to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

TANNIN

TUNGSTO-MOLYBDOPHOSPHORIC ACID METHOD
CODE 3666-01-SC

QUANTITY	CONTENTS	CODE
30 mL	*Tannin Reagent #1	*7833-G
2 x 60 mL	*Tannin Reagent #2	*7834-H
1	Pipet, plain, plastic	0352
1	Pipet, 1.0 mL, plastic	0354

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Tannin and lignin are examples of hydroxylated aromatic compounds found in discharge wastewater from paper mills, in some boiler water treatment, in natural brackish water, and in wastewater from leather tanning plants. The taste and odor of these compounds is generally offensive so that their control is important in many areas.

APPLICATION:	Industrial wastewater, boiler water, and natural water.
RANGE:	0.0–10.0 ppm Tannic Acid
MDL:	0.1 ppm
METHOD:	The hydroxylated aromatic compounds will reduce a mixture of tungstophosphoric and molybdophosphoric acids to form a blue color in proportion to the concentration of aromatic hydroxyl groups.
SAMPLE HANDLING & PRESERVATION:	Sample should be analyzed as soon as possible after collection.
INTERFERENCES:	Other reducing compounds such as ferrous iron and sulfites. Results may be expressed as tannin like compounds, or aromatic hydroxy compounds.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **096 Tannin**) from **TESTING MENU**.
4. Scroll to and select **096 Tannin** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Use the plain pipet (0352) to add 4 drops of *Tannin Reagent #1 (7833). Cap and mix.
8. Use the 1.0 mL pipet (0354) to add 2.0 mL of *Tannin Reagent #2 (7834). Cap and mix. Wait 30 minutes for full color development.
9. At end of 30 minute waiting period, mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
10. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTES: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

For the most accurate results, the sample and reagents should be at 20 ±2°C.

TURBIDITY

ABSORPTION METHOD • NO REAGENTS REQUIRED

Turbidity is a measure of water clarity and is independent of color. Turbidity is caused by undissolved and suspended solids. Mud, silt, algae, and microorganisms can all cause turbidity. Turbidity is a gross measurement of water quality.

APPLICATION:	Surface and industrial water for non-compliance monitoring. (For compliance monitoring at low turbidity levels, use a commercial nephelometer.)
RANGE:	0–500 FAU (Formazon Attenuation Units)
MDL:	3 FAU
METHOD:	Absorptimetric, 180° detector
SAMPLE HANDLING & PRESERVATION:	Measure sample as soon as possible after collection.
INTERFERENCES:	Check for stray light interference (see page 69).

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **098 Turbidity**) from **TESTING MENU**.
4. Scroll to and select **098 Turbidity** from menu.
5. Rinse a clean tube (0290) with deionized water (turbidity free). Fill to the 10 mL line with deionized water.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Rinse a second clean tube (0290) with sample water. Fill to the 10 mL line with sample. Cap tube. Wipe off excess water and fingerprints. Shake to resuspend particulate matter. Remove all bubbles before measurement.
8. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result. Turbidity measurements should be taken as soon as possible after sample has been collected.
9. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For the most accurate results, the sample should be at 25±4°C.

PREPARING FORMAZIN SOLUTIONS

The turbidity calibration was prepared by using standard formazin solutions as a reference. These solutions can be prepared by carefully following the procedure below.†

1. Dissolve 1.000 g of Hydrazine Sulfate in deionized water and dilute to mark in 100 mL volumetric flask.
2. Dissolve 10.00 g of Hexamethylenetetramine in deionized water and dilute to mark in 100 mL volumetric flask.
3. Mix 5 mL of each solution in a 100 mL volumetric flask and allow to set undisturbed for 24 hours.
4. At the end of the waiting period, dilute to mark with deionized water and mix.
5. The turbidity of the stock solution is 400 FTU. The stock solution is stable for one month. Dilutions from the stock should be prepared fresh daily.

†Alternatively, a prepared concentrated formazin standard of 4000 NTU may be ordered in a 60 mL size by Code 6195-H.

ZINC – LOW RANGE

ZINCON METHOD • CODE 3667-SC

QUANTITY	CONTENTS	CODE
30 mL	*Zinc Indicator Solution	*6314-G
120 mL	*Methyl Alcohol	*6319-J
10 g	Sodium Ascorbate Powder	6316-D
25 g	*Zinc Buffer Powder	*6315-G
15 mL	*Sodium Cyanide, 10%	*6565-E
30 mL	*Formaldehyde Solution, 37%	*5128-G
1	"Dilute Zinc Indicator Solution" Bottle, w/1 pipet assembly	0128-MT
1	Graduated Cylinder, 10 mL, glass	0416
1	Spoon, 0.5 g, plastic	0698
2	Pipets, plain, plastic	0352
1	Spoon, 0.1 g, plastic	0699

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or fax.

Zinc enters the domestic water supply from the deterioration of galvanized iron and brass pipes, and from industrial wastes. Zinc is an essential element for body growth and development and is an important plant nutrient. Concentrations of zinc above 5.0 mg/L in drinking water can cause a bitter astringent taste. In the U.S., zinc concentrations may vary between 0.06 to 7.0 mg/L, with an average value of 1.33 mg/L.

APPLICATION: Drinking and surface waters, domestic and industrial waste water.

RANGE: 0.00–3.00 ppm Zinc

MDL: 0.05 ppm

METHOD: Zinc forms a blue colored complex with Zincon in a solution buffered at pH 9.0. Other heavy metals are complexed by cyanide and the zinc cyanide complex is released by the addition of formaldehyde before the other metal cyanide complexes are destroyed. Sodium ascorbate is added to reduce the interference of manganese.

SAMPLE HANDLING & PRESERVATION: Sample should be analyzed within 6 hours after collection. The addition of hydrochloric acid will help preserve the metal ion content, however the acid should be neutralized before analysis.

INTERFERENCES: The following ions interfere in concentrations greater than those listed.

Ion	mg/L	Ion	mg/L
Cd(II)	1	Cr(III)	10
Al (III)	5	Ni(II)	20
Mn (II)	5	Co (II)	30
Fe (III)	7	CrO4(II)	50
Fe (II)	9		

PROCEDURE

A. PREPARATION OF DILUTE ZINC INDICATOR SOLUTION

1. Use a pipet (0352) to measure exactly 5.0 mL of *Zinc Indicator Solution (6314) into 10 mL graduated cylinder (0416). The bottom of the curved surface (the meniscus) of liquid should be at 5.0 mL mark. Pour this into the bottle labeled “Dilute Zinc Indicator Solution”.
2. Use unrinsed graduated cylinder to add 10.0 mL and then 7.8 mL (total of 17.8 mL) of *Methyl Alcohol (6319) to bottle labeled “Dilute Zinc Indicator Solution”. Cap and mix ingredients in this bottle. Do not leave this bottle uncapped.

B. DETERMINATION OF ZINC

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **099 Zinc LR**) from **TESTING MENU**.
4. Scroll to and select **099 Zinc LR** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**. (See Note)
7. Remove tube from colorimeter. Use 0.1 g spoon (0699) to add one measure of Sodium Ascorbate Powder (6316). Use 0.5 g spoon (0698) to add one measure of *Zinc Buffer Powder (6315). Cap and shake vigorously for 1 minute. Some undissolved buffer may remain in the bottom of the tube.
8. Add 3 drops of *Sodium Cyanide, 10% (6565). Cap and mix.
9. Use the 1 mL pipet assembly to add 1 mL of “Dilute Zinc Indicator Solution”. Cap and mix.
10. Use a second plain pipet (0352) to add 4 drops of *Formaldehyde Solution, 37% (5128). Cap and mix by inverting 15 times.
11. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result.
12. Press ⏻ to turn colorimeter off or press EXIT to exit to a previous menu or make another menu selection.

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

APPENDIX

Ammonia in water occurs in two forms: toxic unionized ammonia (NH_3) and the relatively non-toxic ionized form, ammonium ion (NH_4^+). This test method measures both forms as ammonia-nitrogen (NH_{3+}–N) to give the total ammonia-nitrogen concentration in water. The actual proportion of each compound depends on temperature, salinity, and pH. A greater concentration of unionized ammonia is present when the pH value and salinity increase.

1. Consult the table below to find the percentage that corresponds to the temperature, pH, and salinity of the sample.
2. To express the test result as ppm Unionized Ammonia Nitrogen (NH_3–N), multiply the total ammonia-nitrogen test result by the percentage from the table.
3. To express the test result as ppm Ammonia Nitrogen (NH_{3+}–N), subtract the unionized ammonia-nitrogen determined in step 2 from the total ammonia-nitrogen.

	10°C		15°C		20°C		25°C	
pH	FW1	SW2	FW	SW	FW	SW	FW	SW
7.0	0.19	—	0.27	—	0.40	—	0.55	—
7.1	0.23	—	0.34	—	0.50	—	0.70	—
7.2	0.29	—	0.43	—	0.63	—	0.88	—
7.3	0.37	—	0.54	—	0.79	—	1.10	—
7.4	0.47	—	0.68	—	0.99	—	1.38	—
7.5	0.59	0.459	0.85	0.665	1.24	0.963	1.73	1.39
7.6	0.74	0.577	1.07	0.836	1.56	1.21	2.17	1.75
7.7	0.92	0.726	1.35	1.05	1.96	1.52	2.72	2.19
7.8	1.16	0.912	1.69	1.32	2.45	1.90	3.39	2.74
7.9	1.46	1.15	2.12	1.66	3.06	2.39	4.24	3.43
8.0	1.83	1.44	2.65	2.07	3.83	2.98	5.28	4.28
8.1	2.29	1.80	3.32	2.60	4.77	3.73	6.55	5.32
8.2	2.86	2.26	4.14	3.25	5.94	4.65	8.11	6.61
8.3	3.58	2.83	5.16	4.06	7.36	5.78	10.00	8.18
8.4	4.46	3.54	6.41	5.05	9.09	7.17	12.27	10.10
8.5	5.55	4.41	7.98	6.28	11.18	8.87	14.97	12.40

[1] Freshwater data from Trussel (1972).
[2] Seawater values from Bower and Bidwell (1978).
Salinity for Seawater values = 34% at an ionic strength of 0.701m.

FOR EXAMPLE:

If a fresh water sample at 20°C has a pH of 8.5 and the test result is 1.0 ppm as Total Ammonia-Nitrogen:

1. The percentage from the table is 11.18% (or 0.1118).
2. 1 ppm Total Ammonia-Nitrogen x 0.1118 = 0.1118 ppm Unionized Ammonia-Nitrogen.
3. Total Ammonia-Nitrogen 1.0000 ppm
   Unionized Ammonia-Nitrogen - 0.1118 ppm
   Ionized Ammonia-Nitrogen = 0.8882 ppm

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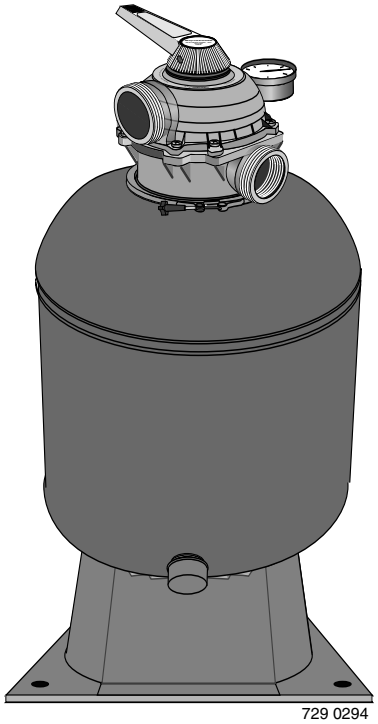

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INSTALLATION, OPERATION & PARTS

MODELS

T-150BP-1 T-170BP-1 T-200BP-1 T-240BP-1 T-300BP-2

MEMBER
NATIONAL SPA & POOL INSTITUTE

This manual should be furnished to the end user of this filter; its use will reduce service calls and chance of injury and will lengthen filter life.

Sta-Rite Pool/Spa Group
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Pentair Pool Products®
*Because **reliability** matters most*

S242 (Rev. B 6/28/06)

HIGH RATE SAND FILTERS

To avoid unneeded service calls, prevent possible injuries, and get the most out of your filter, READ THIS MANUAL CAREFULLY!

The Sta-Rite Top Mounted Series High Rate Sand Filter:

- **Is designed to filter water for swimming pools.**
- **Is an excellent performer; durable, reliable.**

Table of Contents

READ AND FOLLOW SAFETY INSTRUCTIONS!

⚠ This is the safety-alert symbol. When you see this symbol on your valve or in this manual, look for one of the following signal words and be alert to the potential for personal injury.

⚠ DANGER warns about hazards that **will** cause serious personal injury, death or major property damage if ignored.

⚠ WARNING warns about hazards that **can** cause serious personal injury, death or major property damage if ignored.

⚠ CAUTION warns about hazards that **will** or **can** cause minor personal injury or property damage if ignored.

The label **NOTICE** indicates special instructions which are important but not related to hazards.

Carefully read and follow all safety instructions in this manual and on filter.

Keep safety labels in good condition.
Replace missing or damaged safety labels.

⚠WARNING
Hazardous pressure

Incorrectly installed or tested equipment may fail, causing severe injury or property damage. Read and follow instructions in owner's manual when installing and operating equipment. Have a trained pool professional perform all pressure tests.

1. Do not connect system to a high pressure or city water system.
2. Use equipment only in a swimming pool installation.
3. Trapped air in system can cause explosion. BE SURE all air is out of system before operating or testing equipment.

Before pressure testing, make the following safety checks:

- Check all clamps, bolts, lids, and system accessories before testing.
- BE SURE all air is out of system before testing.
- Tighten Sta-Rite trap lids to 30 ft. lbs. (4.1 kg-cm) torque for testing.
- Water pressure for test must be less than 25 PSI (172 kPa).
- Water temperature for test must be less than 95˚ F. (35˚ C).
- Limit test to 24 hours. After test, visually check system to be sure it is ready for operation. Remove trap lid and retighten hand tight only.

NOTICE: These parameters apply to Sta-Rite equipment only. For non-Sta-Rite equipment, consult manufacturer.

⚠ DANGER	BEFORE WORKING ON FILTER:
Hazardous Pressure! Can cause severe injury or major property damage from tank explosion.	1. Stop pump. 2. Open air release valve. 3. Release all pressure from system.

⚠ WARNING	BEFORE WORKING ON PUMP OR MOTOR
Filter pumps require hazardous voltage which can shock, burn, or cause death.	Disconnect power to motor.

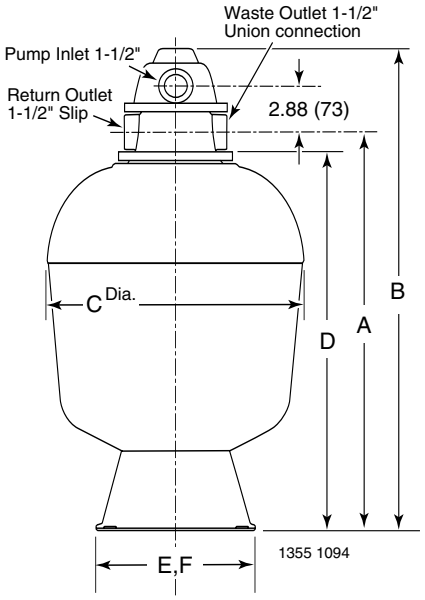


Fig. 1: Dimensions, T-150BP-1, T-170BP-1 T-200BP-1, T240BP-1

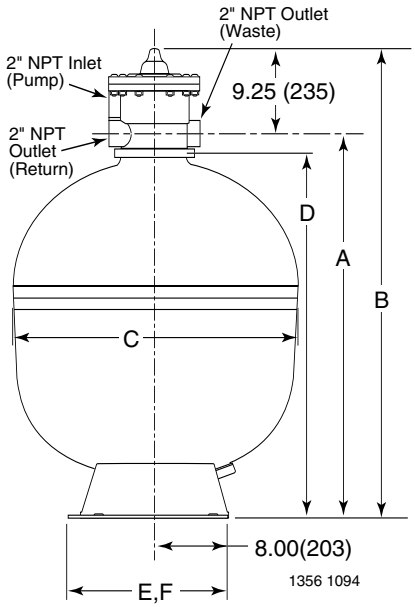


Fig. 2: Dimensions, T-300BP-2, T240BP-2

See Page 14 for Pressure Drop Curve.

RECOMMENDED SAND GRADES:

Use only: #20 Silica Sand, Size Range .40-.55mm., Uniformity Coefficient less than 1.75.

NOTICE: Use of other sands will reduce filter performance, may damage pump, and will void warranty.

Recommended:

1. Wedron Silica/Best Sand Co., Sand Grade: Wedron .45-.55mm., Effective Size .46mm, Uniformity Coefficient 1.22.
2. U.S. Silica - Silurian Filter Sand, Sand Grade.45-.55 mm., Effective Size .48mm, Uniformity Coefficient 1.18.

TABLE I - FILTER OPERATIONAL DATA

Filter Model	Filter Size		Max. Flow Rate in GPM (L/M)
	Dia. in Inches (mm)	Area in Ft² (M²)	
T-150BP-1	15 (381)	1.26 (.117)	25.2 (95)
T-170BP-1	17 (432)	1.57 (.146)	31.5 (123)
T-200BP-1	20 (508)	2.18 (.203)	43.6 (165)
T-240BP-1	24 (610)	3.10 (.288)	62.0 (234.7)
T-240BP-2	24 (610)	3.10 (.288)	62.0 (234.7)
T-300BP-2	30 (762)	4.90 (.455)	98 (371)

Filter Model	Turnover in Hours				Sand Volume in lbs. (kg.)
	6	8	10	12	
	gal. (L)	gal. (L)	gal. (L)	gal. (L)	
T-150BP-1	9,070(34 330)	12,100(45 799)	15,120(57 229)	18,144(68 675)	100 (45.4)
T-170BP-1	11,340(42 922)	15,120(57 229)	18,900(71 536)	22,680(85 844)	150 (68)
T-200BP-1	15,700(59 424)	20,930(79 220)	26,160(99 016)	31,390(118 811)	200 (90.7)
T-240BP-1	22,230(84 481)	29,760(112 642)	37,200(140 802)	44,640(168 962)	300 (136)
T-240BP-2	22,230(84 481)	29,760(112 642)	37,200(140 802)	44,640(168 962)	300 (136)
T-300BP-2	35,280(133 535)	47,040(178 046)	58,800(222 558)	70,560(267 070)	600 (272)

*NOTE: 1 cubic foot of sand weighs approx. 100 lbs. (45.4 kg). Do not use finer or coarser grade than recommended for best performance.

TABLE II - DIMENSIONAL DATA In Inches (mm)

Filter Model No.	A	B	C	D	Base Width (E)	Base Length (F)	Piping Port Size
T-150BP-1	27 (686)	33-13/16 (859)	15-3/4 (400)	24-11/16 (627)	13 (330)	16-1/4 (413)	1-1/2″ SLIP
T-170BP-1	29-9/16 (751)	36-3/8 (924)	17-3/4 (451)	27-1/4 (692)	13 (330)	16-1/4 (413)	1-1/2″ SLIP
T-200BP-1	31-5/8 (803)	38-1/2 (978)	20-3/4 (527)	29-3/8 (746)	13 (330)	16-1/4 (413)	1-1/2″ SLIP
T-240BP-1	35-3/16 (897)	42 (1067)	24-3/4 (629)	32-7/8 (835)	16-7/8 (429)	21 (533)	1-1/2″ SLIP
T-240BP-2	35-1/4 (895)	44-1/2 (1130)	24-3/4 (629)	32-7/8 (835)	16-7/8 (429)	21 (533)	2″ (NPT)
T-300BP-2	42 (1067)	51-1/4 (1302)	31 (787)	39-5/8 (1008)	16-7/8 (429)	21 (533)	2″ (NPT)

GENERAL INFORMATION

- Clean a new pool as well as possible before filling pool and operating filter. Excess dirt and large particles of foreign matter in the system can cause serious damage to the filter and pump.

⚠ **NEVER test this filter with compressed air.**

⚠ **Do not operate filter at water temperatures above 95°F (35°C).**

⚠ **NEVER operate this filter system at more than 50 pounds per square inch (50 PSI/345 kPa) pressure!**

INSTALLATION

Installation of filter should only be done by qualified, licensed personnel.

For assembly and filling instructions, see page 6.

Filter mount must:

- Provide weather and freezing protection.
- Provide space and lighting for easy access for routine maintenance. (See Figures 1 and 2, Table II, Page 4, for space requirements.)
- Be on a reasonably level surface and provide adequate drainage.
- Be as close to pool as possible to reduce line loss from pipe friction.

Piping:

- Piping must conform to local/state plumbing and sanitary codes.
- Use pipe joint sealing compound or teflon tape on all male connections of metal pipe and fittings (except unions). Use teflon tape or Plasto-Joint Stik[1] on all male connections of plastic pipe and fittings. **DO NOT use pipe dope on plastic pipe; it will cause the pipe to crack. Do not use sealant or tape on unions – assemble them dry and hand tight.**
- Do not damage union sealing surfaces and "O" Rings.
- Support pipe independently to prevent strains on filter or valve.
- Use 1-1/2 or 2" pipe to reduce pressure losses as much as possible.

  NOTICE: Filter may be located away from pool, but for adequate flow larger pipe may be needed. Check local codes when considering remote installation.
- Fittings restrict flow; for best efficiency use fewest possible fittings.
- Keep piping tight and free of leaks: pump suction line leaks may cause trapped air in filter tank or loss of prime at pump; pump discharge line leaks may show up as dampness or jets of water.
- When unions are provided, use as follows for leak free connections:
  1. O-Ring and sealing surfaces must be clean.
  2. Assemble hand tight only (**no wrenches**).
  3. No pipe compound or teflon tape on unions.

Valves:

- A check valve installed between filter and heater will prevent hot water from backing up into filter and deforming internal components.
- Use care before assembly not to damage union sealing surfaces or O Ring.

Wastewater:

- Be sure all provisions for waste water disposal meet applicable local, state or national codes. 100 gallons (379 liters) or more of pool water will be discharged during filter backwashing. Do not discharge where water will cause flooding or damage.

[1] Lake Chemical Co., Chicago, IL

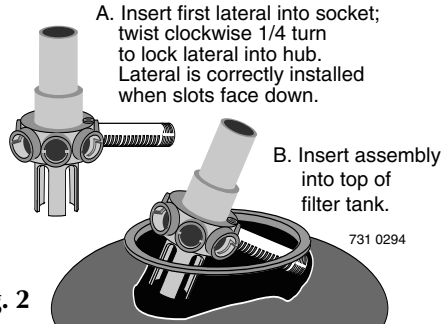


Fig. 2

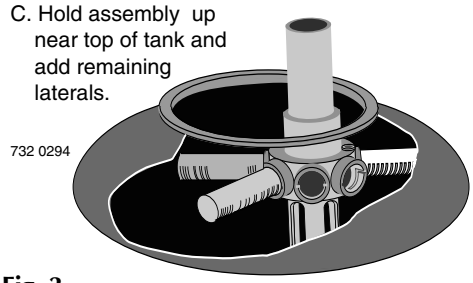


Fig. 3

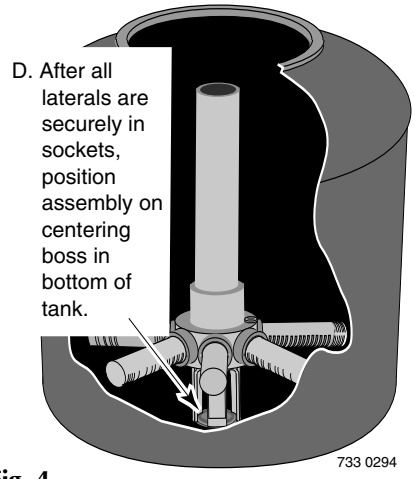


Fig. 4

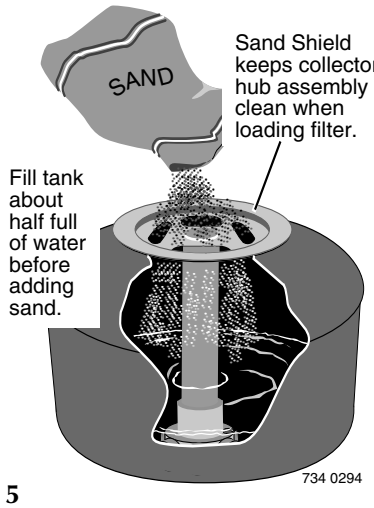


Fig. 5

Filter Setup

Assembly: See Figures 2 through 5 for filter assembly.

Loading Sand Media

1. To keep sand out of collector assembly, place plastic sand shield over top of collector tube before pouring sand into filter (See Figure 5).
2. To support laterals and prevent lateral breakage during loading, fill tank about half full of water before loading sand.
3. Pour sand into filter tank. See Page 4, for correct type and quantity of sand to use.

   NOTICE: Make sure gasket area on top of tank is free of sand before installing valve and clamp.
4. Before installing valve, double-check that correct quantity of sand has been loaded (see Page 4).
5. Remove plastic sand loading shield and keep for future use.

Valve Installation:

See Figures 6, 7, and 8

1. Install O-Ring on valve flange; make sure O-Ring is clean, dry, and has no nicks, tears, or scrapes.
2. Make sure tank and valve flanges are clean and free of sand; put valve on top of tank. Vertical pipe of collector assembly inserts into base of valve.
3. Install clamp; make sure knob is positioned for easy access for filter maintenance. Valve port labeled "PUMP" should point toward pump.
4. Tighten clamp knob until clamp ends (under bolt) are 1/4" (6mm) apart. Tap around outside of clamp with a mallet to help seat clamp.

   ⚠WARNING Hazardous pressure. Clamp will not hold unless it is seated properly! DO NOT START PUMP until clamp ends are 1/4" (6mm) apart or less.
5. If clamp will not pull up to 1/4" (6mm) gap, wait 15-30 minutes and retighten. Tap clamp gently with mallet to help seat clamp.
6. Connect pipe from pump discharge to valve port labeled "PUMP"; use union half provided. Assemble union as follows for leakfree operation:
   A. O-Ring and sealing surfaces must be clean.
   B. Assemble hand tight only (no wrenches).
   C. NO pipe compound or teflon tape on unions.
7. Complete all plumbing connections (see Page 5 for piping requirements).
   A. Pipe from valve RETURN port to pool return.
   B. Pipe from valve WASTE port to waste.
   C. Suction piping from pool to trap inlet on pump.
8. System is ready for startup.
   NOTICE: If there are leaks from beneath valve/clamp area, STOP PUMP, release all pressure, remove clamp and valve and clean sealing surfaces.

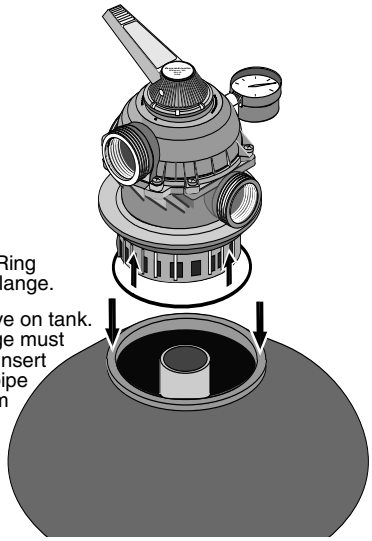


Fig. 6

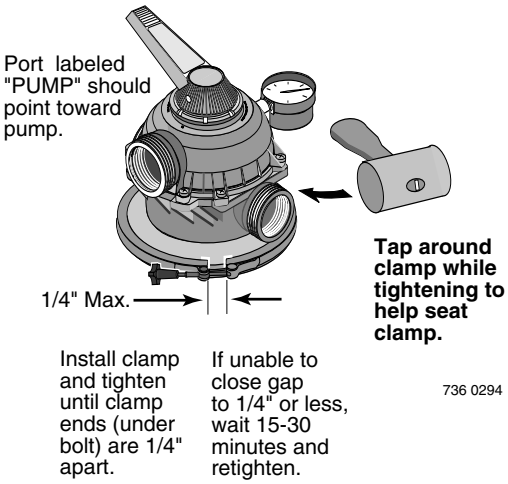


Fig. 7

Startup/Operation (See Figure 9)

⚠WARNING Hazardous pressure. To avoid explosion and possible severe or fatal injury, filter system pressure must not exceed 50 PSI (345 kPa) under any circumstances. NEVER test this filter system with compressed air; never operate system with water temperature above 95° F (35° C).

⚠ CAUTION To prevent equipment damage and possible injury, turn pump OFF before changing valve position.

NOTICE: Do not add chemicals directly into the pool skimmer. Adding undiluted chemicals may damage equipment and void warranty.

1. Open system valves and make sure pump is filled with water. Make sure pool water level is 2″ (51mm) above bottom of skimmer opening.
2. With pump OFF, set valve to 'BACKWASH' position.
3. Start pump, circulating water backwards through filter to waste. Do not install pressure gauge until a steady stream of water runs out of gauge port; then stop pump and install gauge.

   NOTICE: To prevent pump from running dry, be sure water level never drops below bottom of skimmer inlet. Add water to pool if necessary to keep skimmer flooded while backwashing and rinsing.
4. Backwash until water runs clear (3-5 minutes).
5. Stop pump; set valve to 'RINSE' position.
6. Start pump; run pump for one minute.
7. Stop pump; set valve to 'FILTER' position.
8. Filter is now ready for service.
9. Record clean starting filter pressure gauge reading as a reference.
10. When pool is first filled, backwash once a day until pool water is sparkling clear. After that, backwash when pressure gauge shows 5 to 7 PSI (34.5 to 48 kPa) higher than starting pressure.

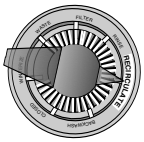
Valve Setting	Purpose/Flow
	**FILTER** Normal filtration and vacuuming; water goes through filter to pool.
	**RINSE** For initial startup cleaning and sand bed leveling after backwash; water goes through filter to waste.
	**RECIRCULATE** Circulates pool water; bypasses filter.

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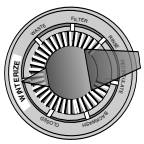
Fig. 8

Valve Setting	Purpose/Flow
	**BACKWASH** Reverses flow for cleaning; water goes through filter to waste.
	**CLOSED** Shuts off all flow to filter and pool.
	**WINTERIZE** Leaves all valve ports partially open for winter storage.

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Valve Setting	Purpose/Flow
	**WASTE** Lowers pool level or drains pool; water bypasses filter, goes to waste.

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Fig. 9: Valve settings for startup. Stop pump before changing valve position.

MAINTENANCE

General:

- Wash outside of filter with a mild detergent and water. Rinse off with hose.

  NOTICE: DO NOT use solvents to clean filter; solvents may damage plastic components in system.

- Inspect sand bed at least once a year to remove foreign material which has not been backwashed out of system.

  NOTICE: When the sand bed gets hard and crusty on top, remove all the old sand and replace it with new sand.

Weekly Pool Equipment Inspection:

1. Check pressure during operation. When pressure is 5 to 7 PSI (34.5 to 48 kPa) higher than initial operating pressure, backwash filter (see instructions under "Startup/Operation", Page 7).
2. Except during hot weather with heavy swimmer loads, operating filter 6 to 12 hours per day should be sufficient. Carefully monitor water chemical balance and follow recommendations of your local pool professional.

Water Maintenance

- Keep water level at least 2" (51mm) above bottom of skimmer opening. Failure to do so can allow air to enter system, causing pump to lose prime and air to enter filter.
- Maintain pH at 7.2 to 7.6 in pool.

⚠ **To prevent damage to system components, keep water temperature below 95° F. (35° C) at all times.**

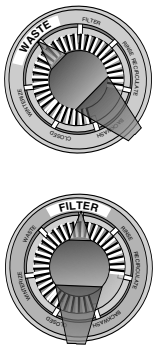


Fig. 10: Valve settings to lower pool water level. Stop pump before changing valve position.

Vacuum Pool:

1. Fill vacuum hose by submerging in water from one end to the other.
2. To vacuum, insert hose into skimmer suction manifold or into vacuum line in pool wall. See instructions provided by pool builder or pool manufacturer. Start pump, making sure it is primed and pumping.
3. After vacuuming, clean pump trap to remove accumulated debris, then check filter pressure gage. If reading is 5 to 7 PSI (34.5 to 48 kPa) higher than initial operating pressure, backwash filter.

Lower or Drain Pool

1. Turn pump 'OFF'; set valve handle to 'WASTE'.
2. Use vacuum cleaner hose and head.
3. Start pump; run until pool is lowered to desired level.
4. Turn pump 'OFF'; set valve handle to 'FILTER'.
5. Start pump.

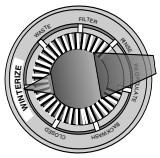


Fig. 11: Valve setting for winter storage. Stop pump before changing valve position.

STORAGE/WINTERIZING

⚠ CAUTION **Pool chemicals may give off corrosive fumes. Store chemicals away from system in a well ventilated area.**

NOTICE: Allowing water to freeze will damage filter and void warranty. If antifreeze is needed, use propylene glycol; it's plastic compatible and non-toxic. Follow manufacturers instructions. Do not use ethylene glycol based antifreeze – it's toxic and it may damage plastic components.

1. Open all system valves. Set multiport valve at 'WINTERIZE' to allow air passage to all ports.

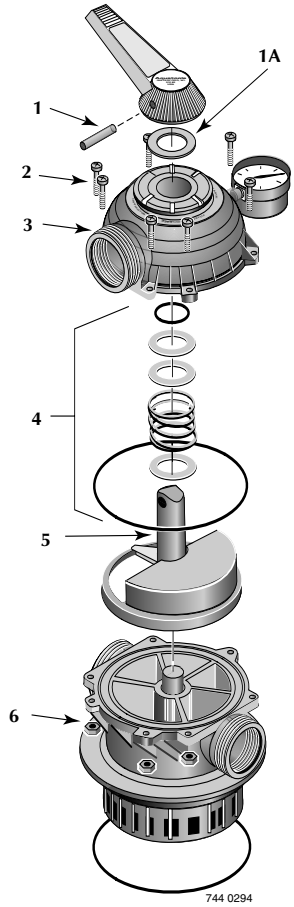


Fig. 12A: Valve Disassembly (1-1/2″ Multiport Valve)

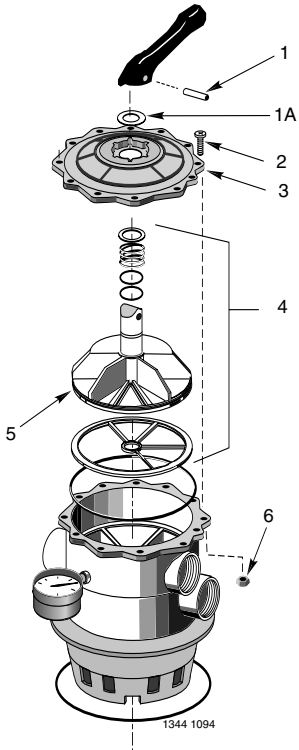


Fig. 12B: Valve Disassembly (2″ Multiport Valve)

2. Remove drain plug from filter.
3. Drain filter tank completely and replace drain cap (Figure 13, Page 10).
4. Cover with plastic or tarpaulin to protect from weather, but do not seal from air circulation.
5. Protect from freezing.

Startup for Winterized Equipment:

1. Remove any temporary weather protection placed around system for shutdown.
2. See "Startup", Page 7, for reactivation of the filter.
3. Inspect all electrical wiring to pump for damage or deterioration over the shutdown period. Have a qualified serviceman repair/replace wiring as needed. Inspect and tighten all watertight connections.
4. Open all valves in suction and return piping.
5. Remove any winterizing plugs in system.
6. Drain all winterizing chemicals (if used) from system; flush system.
7. Close all drain valves and replace all drain plugs in system (see Page 10).
8. Fill pool with water to proper level (see pool manufacturer's instructions).

MULTI-PORT VALVE SERVICE

⚠WARNING **Hazardous pressure. Stop pump and release all pressure from system before working on filter, valve, or clamp**. Filter and valve design allows air to bleed off automatically in normal service. However, always be sure pressure is off system before working on filter, valve or clamp.

NOTICE: if Multi-Port valve is below pool water level, close suction and discharge valves before disassembly to prevent draining pool.

Handle Replacement:

1. Stop pump.
2. Place handle in 'FILTER' position.
3. Remove pin (Key 1, Figures 12A and 12B) to disconnect handle. If it cannot be removed by hand, use a hammer and center punch and lightly tap it out.
4. Remove handle; replace with a new one. Be sure new handle is in 'FILTER' position.
5. Replace pin.

Lid and Plug replacement:

1. **Remove Handle (see 'Handle Replacement' above).**
2. **Remove plug:**
   A. Remove all screws and nuts (Key Nos. 2 and 6, Figures 12A and 12B).
   B. Remove lid (Key No. 3) by pulling straight up while holding plug shaft (Key No. 5) down with thumb.
3. **Inspect Internal Parts:**
   Inspect plug and gasket spring, O-Rings, and internal washers (Key No. 4). Replace if necessary.

4. **Reassemble Valve:**
   A. Replace plug gasket and shaft, mounting spring, washers, and O-Ring on plug shaft. Lubricate O-Ring with Amojel.
   B. Replace lid; match screw holes in lid and body.
   C. Press down on lid to allow screws to engage nuts; tighten each nut securely.
   D. Replace top washer (Key No. 1A) and handle, making sure indexing pin on plug shaft points in same direction as pointer on handle. Replace handle pin.
   E. Tighten all lid screws to 55 inch-lbs. (63.4 kg-cm) torque.

Valve Removal

⚠WARNING Hazardous pressure. Stop pump and release all pressure from system before working on filter, valve, or clamp.

NOTICE: If multi-Port Valve is below pool water level, close suction and discharge valves before disassembly to prevent draining pool.

1. Disconnect piping from pump and pool.
2. Remove clamp.
3. Remove valve from filter top.
4. To reinstall valve, follow instructions, Figures 6 and 7, Page 7. BE SURE to follow clamp tightening instructions.

Drain Fitting Installation/Removal

NOTICE: If pool is above height of filter, first close valves in pump suction and return lines to prevent draining pool. If there are no shutoff valves installed, disconnect suction and return lines and raise ends above pool water level.

1. **Installation:** See Figure 13.
2. **To Drain Filter:**
   A. Remove drain cap. Lateral tube should remain in place inside drain opening to prevent sand from draining out.
   B. Open union coupling on backwash port of Multi-Port valve. This will allow air into filter and allow water to drain from filter tank.
   C. Replace cap when tank is empty.
3. **Removing Sand From Filter:**
   A. Remove both drain cap and slotted lateral tube (see Figure 13). Sand and water will drain from tank.
   B. To completely flush filter tank of sand, remove top clamp and multiport valve and flush the inside of the tank with a hose.
   C. Thoroughly clean sand from all parts and from tank drain opening before reassembling drain fitting.

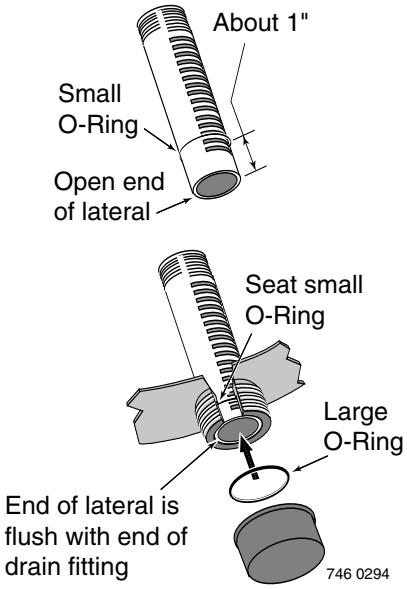


Figure 13: Drain Fitting Assembly.
This assembly allows water to drain without losing the sand out of the filter tank.
Make sure all surfaces are clean and free of sand. Don't cross thread cap; don't overtighten cap.

TROUBLESHOOTING GUIDE

⚠ WARNING

Hazardous pressure. Can cause severe injury or major property damage from tank blow up.

Release all pressure and read instructions before working on filter.

1. Short Cycle between backwashes:

NOTICE: Time between backwashes will vary with each installation and between different areas of the country. Ask installer about normal backwash interval in your area. The following causes and remedies are for cycle times shorter than normal for your area.

A. Flow rate too high or filter too small; consult dealer for system sizing recommendations.

B. Water is chemically out of balance; consult pool serviceman.

C. Excess dirt/dust in pool; vacuum pool directly to waste.

D. Body oil/lotion build-up in filter; consult dealer for chemical filter cleaners and follow cleaner manufacturer's instructions.

E. Filter inadequately backwashed. See instructions under "Startup/Operation", Page 7.

F. Algae in pool. Consult pool professional about proper chemical maintenance.

G. Residual chlorine level too low. Consult pool professional about proper chemical maintenance.

H. Inspect filter sand for solidification caused by dust, calcium, skin oils, of suntan lotions.

2. Low Flow:

A. Pipe blocked downstream from filter; remove obstruction.

B. Piping too small; use larger pipe (consult dealer for sizing).

C. Plugged pump; plugged hair and lint trap or skimmer basket. Clean thoroughly.

3. Pool Water Not Clear:

A. Water is chemically out of balance; consult pool professional.

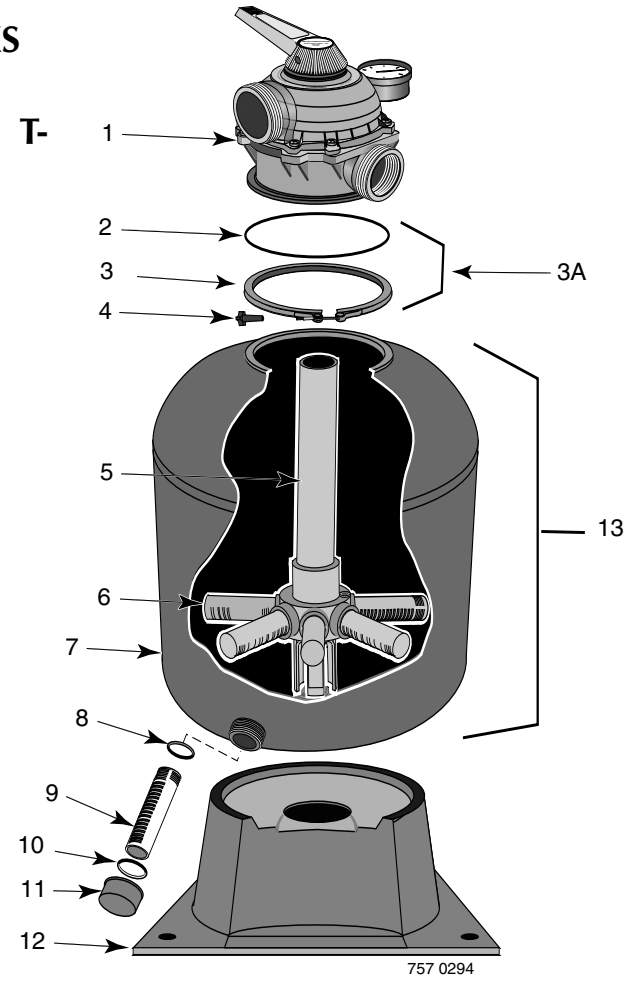
B. Filter is too small; consult dealer about equipment sizing.

C. Sand in pool means broken lateral. Drain both water and sand out of tank. Remove valve; follow procedure under "Filter Setup", Page 6, and instructions with new lateral to replace broken part.

⚠WARNING To avoid severe injury or major property damage, follow instructions under 'Valve Installation', Figures 6 and 7, Page 7).

1. Follow valve removal procedure, Page 10.
2. Replace lateral according to instructions supplied with new lateral.
3. Reassemble filter according to instructions under "Filter Setup", Page 6.

REPAIR PARTS – TANKS T-150BP-1, T-170BP-1, T-200BP-1, T-240BP-1, T-300BP-2

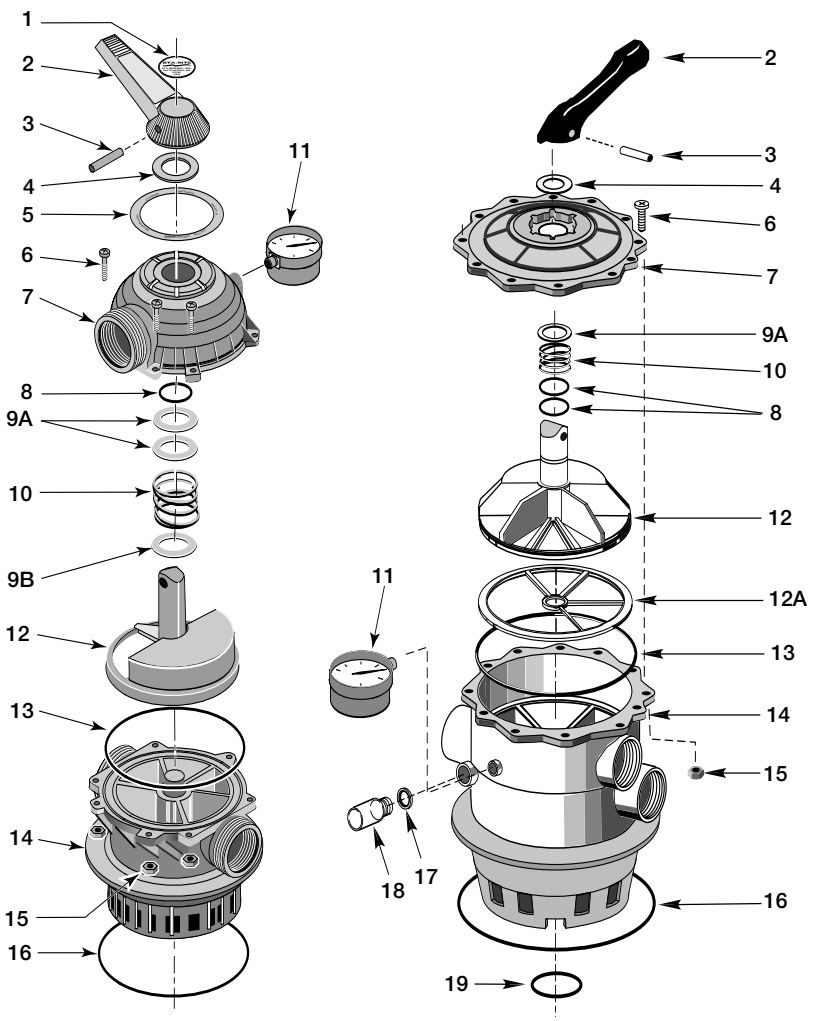


Key No.	Description	No. Used	Model				
			T-150BP-1	T-170BP-1	T-200BP-1	T-240BP-1	T-300BP-2
1	Multiport Valve, Top Mount (Includes Key Nos. 2 and 3)	1	WC112-148A	WC112-148A	WC112-148A	WC112-148A	14971-TM-22-L
2	O-Ring, Valve Flange	1	U9-369	U9-369	U9-369	U9-369	U9-369
3	V-Clamp w/Knob	1	WC119-87A	WC119-87A	WC119-87A	WC119-87A	WC119-87A
4	Clamp Knob	1	WC36-22	WC36-22	WC36-22	WC36-22	WC36-22
5	Collector Hub Assembly	1	24200-0110	WC137-516P	WC137-517P	WC137-519P	24205-0010
6	Lateral	8	24600-0003	24600-0003	24600-0003	24700-0075	21180-1530
7	Filter Tank	1	24200-1000	24201-1000	24203-1000	24204-1000	24205-1000
8	O-Ring, Lateral	1	U9-370	U9-370	U9-370	U9-370	U9-370
9	Drain Lateral	1	24201-0058	24201-0058	24201-0058	24201-0058	24201-0058
10	O-Ring, Drain Cap	1	U9-371	U9-371	U9-371	U9-371	U9-371
11	Drain Cap	1	14965-0025	14965-0025	14965-0025	14965-0025	14965-0025
12	Pedestal	1	23910-0005B	23910-0005B	23910-0005B	23900-0105B	23900-0205
13	Filter Tank Assembly	1	24200-0100	24201-0100	24203-0100	24204-0100	24205-0100
•	Union Coupling Package	3	C198-3M	C198-3M	C198-3M	C198-3M	–
•	Sand Loading Disc	1	24201-0043	24201-0043	24201-0043	24201-0043	24201-0063
•	Model & Instruction Label	1	32155-4115A	32155-4115B	32155-4115C	32155-4115D	90000-1329
•	Clamp Warning Decal	1	32165-4030	32165-4030	32165-4030	32165-4030	32165-4030
•	Information Decal	1	32155-4112	32155-4112	32155-4112	32155-4112	32155-4112

•Not Illustrated.

REPAIR PARTS – MULTI-PORT VALVES

WC112-148A #14971-TM-22-L



Key No.	Part Description	Qty.	WC112-148A	14971-TM-22-L
1	Valve Handle Decal	1	14965-0021	—
2	Handle	1	14962-0032	14971-SM10E1
3	Dowel Pin	1	35857-0021	14971-SM10E2
4	Washer	1	14965-0007	14971-SM10E3
5	Operating Instruction Decal	1	14965-0020	—
6	Screw		37337-3056(7)	14971-SM10E4(10)
7	Valve Cover	1	14965-0011	14971-SM20E6
8	O-Ring	1	35505-1228	14971-SM10E10
9A	Washer	2	14965-0007	14971-SM10E8
9B	Washer	1	14965-0007	—
10	Spring	1	14965-0006	14971-SM10E9
11	Pressure Guage	1	15060-0000T	15060-0000T
12	Plug & Gasket Assembly	1	14965-0028	14971-SM20E11
12A	Gasket	1	—	14971-SM20E12
13	Cover O-Ring	1	35505-1275	14971-SM20E7
14	Valve Body Assembly	1	14965-0013	14971-SM20E13
15	Nut		35407-0071(7)	14971-SM10E14(10)
16	Tank Flange O-Ring	1	U9-369	U9-369
17	Sight Glass Gasket	1	—	14971-SM20E17
18	Sight Glass	1	—	14971-SM10E16
19	Stand Pipe O-Ring (EPDM)	1	—	35505-1243

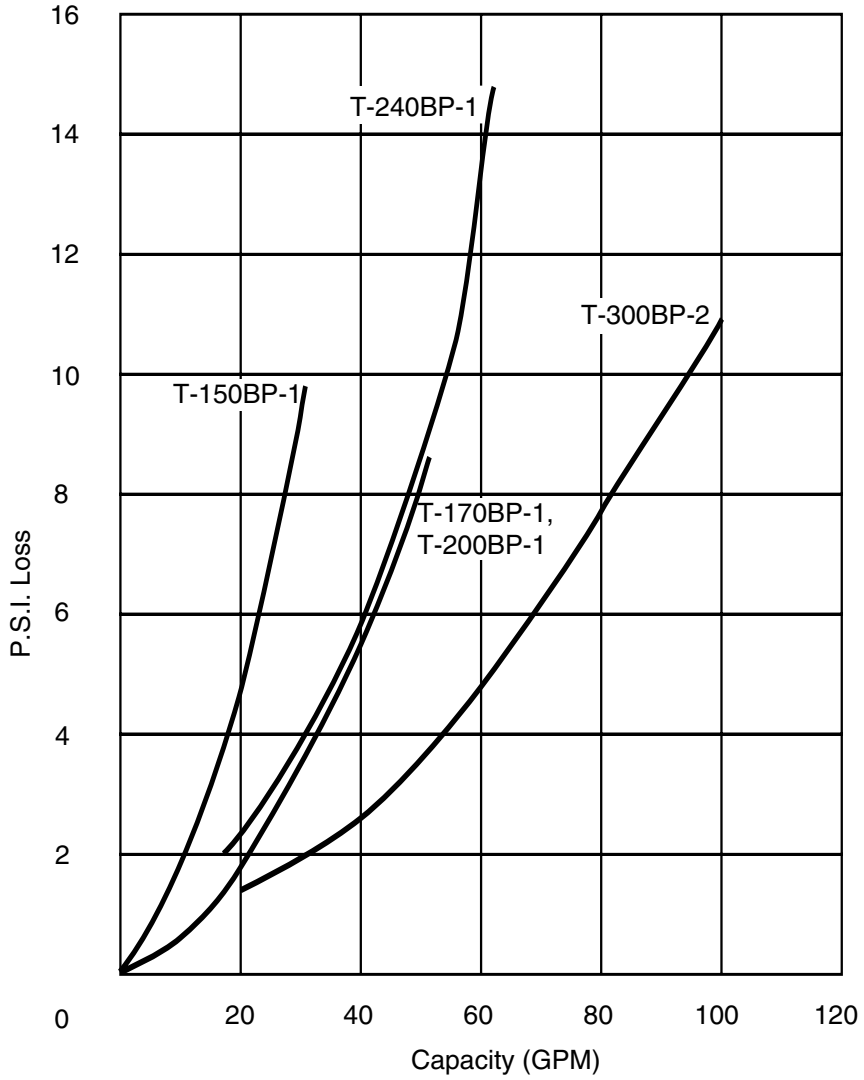


Figure 14 – Pressure Drop Curve - Filter Position

STA-RITE LIMITED WARRANTY

Pumps, filters, skimmers, underwater lights (excluding bulbs), accessories and fittings manufactured by Sta-Rite are warranted to be free of defects in material and/or workmanship for one (1) year from the original date of installation.

The foregoing warranties relate to the original consumer purchaser ("Purchaser") only. Sta-Rite Industries shall have the option to repair or replace the defective product, at its sole discretion. Purchasers must pay all labor and shipping charges necessary to replace the product covered by this warranty. Requests for warranty service must be made through the installing dealer. This warranty shall not apply to any product that has been subject to negligence, misapplication, improper installation or maintenance, or other circumstances which are not in Sta-Rite's direct control. Failure to have product installed by a professional in compliance with local codes will void any and all manufacturers warranty.

This warranty sets forth Sta-Rite's obligation and Purchaser's exclusive remedy for defective products.

STA-RITE SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL OR CONTINGENT DAMAGES WHATSOEVER.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS WARRANTIES. IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, SHALL NOT EXTEND BEYOND THE DURATION OF THE APPLICABLE EXPRESS WARRANTIES PROVIDED HEREIN.

Some states do not allow the exclusion or limitation of incidental or consequential damages or limitations on how long an implied warranty lasts, so the above limitations or exclusion may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

Supersedes all previous publications.

Product Specific Warranties (from date of installation)

Product Family	Limited Warranty	Exceptions
Filters	1 Year	System 3 Tank Bodies - 10 Yrs
Filter Valves	1 Year	
Pumps	1 Year	
Heaters	2 Years	*Commercial Application - 1 Yr
Controls	1 Year	
Above Ground Systems	1 Year	
Lights and Niches	1 Year	Lamps and Bulbs - 90 Days
White Goods	1 Year	
Maintenance Equipment	90 Days	
Drainer/Utility Pumps	90 Days	
Replacement Parts	90 Days	
Cleaners: Lil Shark	1 Year	
Cleaners: Calypso	1 Year	
Cleaners: Pool Shark	2 Years	Footpad and Seal Flaps - 1 Yr
Cleaners: Great White	2 Years	

* Commercial and multi-family application.

Retain this warranty certificate in a safe and convenient location for your records.

For technical information about this product, contact the installer or call Sta-Rite at 262-728-9181.
Visit www.staritepool.com

- **for more information about Sta-Rite products listed above**
- **to locate a Sta-Rite dealer near you**

CREATE A RECORD OF YOUR WARRANTY AT STA-RITE:

• Complete a warranty registration at www.staritepool.com by clicking on "Register Products" and selecting Sta-Rite Pool ***OR***

• Complete bottom portion completely and mail within 10 days of installation to Sta-Rite, Attn.: Pool Warranty Dept., 293 Wright St., Delavan , WI 53115

STA-RITE®

Warranty Registration Card

Name

Address

City State Zip

Installation (or Purchase) Date

Product Purchased

Model Number

☐ New installation ☐ Replacement

Years pool has been in service ☐ less than 1 ☐ 1-3 ☐ 3-5 ☐ 5-10

This product was purchased from:

Company name

Address

City State Zip

Aeration

Canadianpond.ca Etang.ca

« Bubble Tubing® » Linear Diffuser

Bubble Tubing® is a Canadian-made micro bubble linear diffuser tubing that is flexible and resistant to kinking and memory.

With a row of perforations on each side, **Bubble Tubing®** is a highly efficient aeration diffuser for many different applications. The primary tubing format comes with weighted, dense PVC ballast bonded to the perforated tube. Non-weighted formats are also available.

For industrial applications longer lengths of **Bubble Tubing®** are available, and installation is made easy due to the stainless steel rope integrated into the ballast core.

Maintenance and repair are kept to a minimum as **Bubble Tubing®** has no moving parts in the water.

Bubble Tubing® is designed to resist deterioration from exposure to a wide range of chemicals, salinities, pH, and temperatures.

"Overall, the results obtained for the Bubble Tubing® were uniformly excellent and produced some of the highest SOTE values GSEE, Inc. has observed. "

- GSEE, Inc. Environmental Consultants, Lavergne, TN, Sept. 2011

Applications

- Aeration
- Shockwave Attenuation
- Aquatic Barrier
- Mixing
- Pathogen Reduction

Sizes & Formats

- 4 Sizes: 1/2", 3/4", 1" and 1.25" ID
- Self-Weighted or Non-Weighted (Except the 1" ID)
- Coils or Reels available
- Custom lengths available

Markets

- Ponds and Lakes
- Wastewater
- Aquaculture
- Marinas and Ports
- Canal Aeration
- Drinking Water

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