CleaverBrooks®

Condensate Return Systems

Installation, Operation, and Maintenance

750-330
03/2011

⚠ WARNING

DO NOT OPERATE, SERVICE, OR REPAIR THIS EQUIPMENT UNLESS YOU FULLY UNDERSTAND ALL APPLICABLE SECTIONS OF THIS MANUAL.

DO NOT ALLOW OTHERS TO OPERATE, SERVICE, OR REPAIR THIS EQUIPMENT UNLESS THEY FULLY UNDERSTAND ALL APPLICABLE SECTIONS OF THIS MANUAL.

FAILURE TO FOLLOW ALL APPLICABLE WARNINGS AND INSTRUCTIONS MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH.

TO: Owners, Operators and/or Maintenance Personnel

This operating manual presents information that will help to properly operate and care for the equipment. Study its contents carefully. The unit will provide good service and continued operation if proper operating and maintenance instructions are followed. No attempt should be made to operate the unit until the principles of operation and all of the components are thoroughly understood. Failure to follow all applicable instructions and warnings may result in severe personal injury or death.

It is the responsibility of the owner to train and advise not only his or her personnel, but the contractors' personnel who are servicing, repairing or operating the equipment, in all safety aspects.

Cleaver-Brooks equipment is designed and engineered to give long life and excellent service on the job. The electrical and mechanical devices supplied as part of the unit were chosen because of their known ability to perform; however, proper operating techniques and maintenance procedures must be followed at all times. Although these components afford a high degree of protection and safety, operation of equipment is not to be considered free from all dangers and hazards inherent in handling and firing of fuel.

Any "automatic" features included in the design do not relieve the attendant of any responsibility. Such features merely free him of certain repetitive chores and give him more time to devote to the proper upkeep of equipment.

It is solely the operator's responsibility to properly operate and maintain the equipment. No amount of written instructions can replace intelligent thinking and reasoning and this manual is not intended to relieve the operating personnel of the responsibility for proper operation. On the other hand, a thorough understanding of this manual is required before attempting to operate, maintain, service, or repair this equipment.

Because of state, local, or other applicable codes, there are a variety of electric controls and safety devices which vary considerably from one boiler to another. This manual contains information designed to show how a basic burner operates.

Operating controls will normally function for long periods of time and we have found that some operators become lax in their daily or monthly testing, assuming that normal operation will continue indefinitely. Malfunctions of controls lead to uneconomical operation and damage and, in most cases, these conditions can be traced directly to carelessness and deficiencies in testing and maintenance.

It is recommended that a boiler room log or record be maintained. Recording of daily, weekly, monthly and yearly maintenance activities and recording of any unusual operation will serve as a valuable guide to any necessary investigation. Most instances of major boiler damage are the result of operation with low water. We cannot emphasize too strongly the need for the operator to periodically check his low water controls and to follow good maintenance and testing practices. Cross-connecting piping to low water devices must be internally inspected periodically to guard against any stoppages which could obstruct the free flow of water to the low water devices. Float bowls of these controls must be inspected frequently to check for the presence of foreign substances that would impede float ball movement.

The waterside condition of the pressure vessel is of extreme importance. Waterside surfaces should be inspected frequently to check for the presence of any mud, sludge, scale or corrosion.

It is essential to obtain the services of a qualified water treating company or a water consultant to recommend the proper boiler water treating practices.

The operation of this equipment by the owner and his or her operating personnel must comply with all requirements or regulations of his insurance company and/or other authority having jurisdiction. In the event of any conflict or inconsistency between such requirements and the warnings or instructions contained herein, please contact Cleaver-Brooks before proceeding.

CONTENTS

Section 1 - Installation, General Operation and Maintenance

⚠ Caution

Waterside care is of prime importance. For specific information or assistance with your water treatment requirements, contact your Cleaver-Brooks service and parts representative. Failure to follow these instructions could result in equipment damage

⚠ Caution

Inspection and maintenance should be performed only by trained personnel who are familiar with this equipment. Failure to follow these instructions could result in equipment damage

⚠ Warning

When replacing a control, be sure to lock out the main power supply switch since the control is “hot”. Failure to follow these instructions could result in serious personal injury or death.

⚠ Warning

Disconnect and lock out electrical power to the equipment before performing any maintenance or service work. Failure to follow these instructions can result in electrical shock and serious personal injury or death.

A. INSTALLING THE UNIT

1. Location

Install the unit in a clean, dry, ventilated, location which is accessible for inspection and care. The receiver inlet should be low enough to permit all return lines to empty by gravity to the receiver. No special foundation is necessary for the unit, although the floor or other surface upon which it is to be installed should be structurally sound and relatively smooth and level.

2. Return Piping

Connect the return line to the receiver tank with a gate valve, strainer, and union installed in the line as close as possible to the tank. The union should be nearest to the tank.

3. Discharge Piping

Connect the discharge piping from the pump discharge connection. A union, pressure gauge, swing check valve, gate valve and flexible connector - in that order - should be installed in the discharge piping, with the union nearest to the pump. If the discharge piping is longer than 50 feet, the pipe diameter should be one or two sizes larger than the pump discharge. All piping should be properly supported independent of the receiver or pump so as to prevent strain on the unit. Do not force pipes or fittings into place. Pipe strain on the pump causes misalignment in the coupling, which is harmful to the coupling and bearings and can eventually cause their failure.

4. Water Level Gauge (Optional)

Water level gauges which are mounted on the tank before shipping should be checked to be sure the glass is in good condition and to be sure the drain petcock in the bottom fitting is closed. Gauges shipped separately should be mounted on the tank after the makeup valve is connected to reduce the possibility of damaging the gauges while working on the valve. Screw the fittings into the end of the tank in the 1/2" pipe connections provided, making sure the fitting with the drain petcock is in the lower position. Remove the compression nut, brass washer, and rubber sleeve from each fitting. Slide each piece onto both ends of the glass in the same order so that at least one inch of the glass sticks out. Then set one end of the glass in place in one of the fittings and carefully fit the other end into the other fitting. Center the glass vertically between the bottoms of the fittings and tighten compression nuts to a snug fit. After the tank is filled, it may be necessary to retighten the compression nuts if the tank leaks. Be sure the petcock is closed. Put the guard rods in place on each side of the glass.

5. Vent

Install the vent pipe in the openings on the top of the receiver. Pipe the vent to a safe point of discharge.

6. Overflow

An overflow pipe should be installed in the top opening in the end of the receiver, or in one of the openings in the top of the receiver, and extended to a suitable drain.

7. Drain

A gate valve should be installed in the bottom of the receiver and should be piped to a suitable drain.

B. WIRING

All wiring should be done in accordance with local code or power company regulations. All units should be wired with a safety switch installed so the entire circuit can be shut off from motor, starter, and/or any other electrical controls or devices which may be installed as part of the unit.

Refer to the appropriate wiring diagram furnished by your local authorized Cleaver-Brooks Representative to assist in connecting electric service to the unit.

C. OPERATING THE UNIT

1. Before Starting Unit

a.Be sure the pump rotates freely when turned by hand.
b.Check the motor nameplate data to be sure voltage and cycle correspond to electric current connected to unit.
c.Be sure the pump control float is released from shipping position.
d.Before placing the unit into regular service, it is advisable to start it without load to determine that the wiring is correct.
e.The check valve in the discharge line must be installed in the proper position to open when pump is in operation. All gate valves in return and discharge lines must be fully opened.
f.The gate valve in the return line must be open.
g.Set the circuit breaker or disconnect switch to the "on" position.

2. Starting

a.Refer to Coolant Pump Section
    i.Air Elimination
    ii.Check the Direction of Rotation
    iii.Starting and Adjusting
b.Check the pressure gauge to see if the pump is operating. Make sure the pressure is set to the appropriate discharge pressure.
c.Check the temperature of the water being pumped. If it is higher than the temperature for which the unit was sold, it might cause a reduction of capacity or it might even stop pumping. If in doubt, consult your dealer or the representative in your area.
d.After the unit has run for some time, check to see that the motor bearings are not overheating. If in doubt as to safe operating temperature, take the temperature of the motor and surrounding air and consult with the local sales office or service station of the motor manufacturer.

D. MAINTENANCE

Cleaver-Brooks Condensate Return Tanks are designed to give long, trouble free service, if installed and operated under suitable conditions and given proper care. However, in time, it may become necessary to service or replace certain parts of the unit to maintain its peak performance. In this event, the following procedures should be followed.

1. Pump

Refer to the pump instruction sheets for complete maintenance instructions.

If it becomes necessary to remove the pump:
1.Break the electrical circuit to the unit by setting the circuit breaker or disconnect switch in the “off” position.
2.Close the gate valve in the return and discharge piping to avoid flooding the receiver or floor while the pump is out of service.
3.Disconnect union in discharge piping.

2. Motor

The only maintenance required by the motor is periodic lubrication, which should be done in accordance with the motor manufacturer's instructions. If repairs are needed, refer to the nearest authorized service station or the motor.

To remove the motor from the unit:

1.Disconnect and lock out the electrical circuit to the unit by setting the circuit breaker or disconnect switch in "off" position; then disconnect all wire connections from the motor manufacturer.
2.Remove the coupling guard screens.
3.Using the proper metric Allen wrench, loosen the four cap screws in the coupling.
4.With the correct size wrench, loosen and remove the four bolts which hold the motor to the discharge section of the pump end.
5.Lift the motor straight up until the shaft is free from the coupling.

3. Inlet Strainer

If the boiler water is maintained in proper condition, the strainer will require little if any maintenance. However, it should be inspected occasionally to be sure the screen is not plugged up with scale or other foreign material. Depending on the individual installation, it may be necessary to clean the strainer screen every month, or only once or twice per year. After a few times, experience will indicate how often it should be cleaned.

To remove the screen for inspection or cleaning:

1.Close the gate valves in the return piping.
2.Remove the drain plug in the bottom cover of the strainer.
3.Remove the cap screws holding the cover on the strainer and take off the cover and gasket.
4.Carefully pull out the screen. Thoroughly clean the screen or replace with a new one if the old one cannot be used. Reassemble the parts and tighten the cap screws evenly for a leak-proof seal.

4. Ordering Repair Parts

Furnish complete information when ordering parts; include the unit number of the packaged feed system as found on the name plate. State the Cleaver-Brooks part number and the name and description of the part required. Also state the quantity desired and specify method of shipment. Indicate date the material is required. If parts are required such as electric motors, etc., be sure to give the complete name plate data from the accessory for which the parts are required.

Repair or replacement parts should be ordered from your Cleaver-Brooks representative.

Section 2 - Pumps

⚠ Warning

A faulty motor or wiring can cause electrical shock that could be fatal, whether touched directly or conducted through standing water. For this reason, proper grounding of the motor frame to the power supply's grounding terminal is required for safe installation and operation.

In all installations, the above-ground metal plumbing should be connected to the power supply ground as described in Article 250-80 of the National Electrical Code.

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

⚠ Warning

The safe operation of this pump requires that it be grounded in accordance with the National Electrical Code and local governing codes or regulations. Connect the ground wire to the grounding screw in the terminal box and then to the acceptable grounding point.

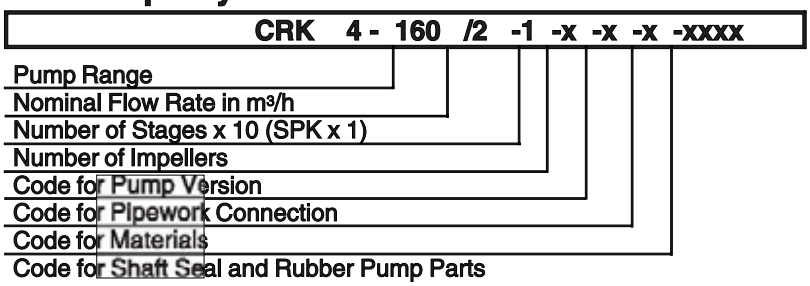
A. Pre-Installation Checklist

1. Confirm you have the right pump

Read the nameplate to ensure the pump is the one you ordered

Compare the pump's nameplate data or its performance curve (for head, GPM, etc.) with the application in which you plan to install it. Will it do what you expect it to do?

1.1 Pump Key for SPK



Code for Pump Version
Type of Pump
A = Standard pump
U = NEMA pump

Physical Changes
B = Oversized motor
P = Undersized motor *(1 flange size smaller)*
T = Oversized motor *(2 flange sizes larger)*
X = Special product

Code for Pipe Work Connection
F = DIN flange
G = ANSI flange
J = JIS flange
W = Internal thread

Code for Materials
A = Standard materials
I = Nonstainless parts converted to SS
K = Intermediate bearings are bronze
X = Special product
D = Graflon® bearing

U - G - A - BUBE

Type of Shaft Seal
A = O-ring seal with fixed seal driver
B = Rubber bellows seal
C = O-ring seal with a spring working as a driver
R = O-ring seal with reduced diameter stationary ring
H = Balanced seal, cartridge
E = O-ring seal, cartridge

Material of Rotating Ring
B = Carbon, plastic impregnated
C = Other types of carbon
U = Tungsten carbide
Q = Silicon carbide
V = Aluminum oxide

Materials of Secondary Seal and other Parts made of Plastic/Rubber
E = EPDM
V = FKM
K = Kalrez
X = Special product

Material of Stationary Ring
B = Carbon, plastic impregnated
C = Other types of carbon
U = Tungsten carbide
Q = Silicon carbide
V = Aluminum oxide
H = Carbon with imbedded Tungsten Carbide (Hybrid)

2. Check the condition of the pump

The shipping carton your pump came in is specially designed around your pump during production to prevent damage. As a precaution, it should remain in the carton until you are ready to install it. At that point, look at the pump and examine it for any damage that may have occurred during shipping. Examine any other parts of the shipment as well (electrical control boxes, etc) for any visible damage. If you find any, contact the transportation company in writing and ask to have it inspected.

B. Electrical Requirements

1. Supply power

The incoming electrical supply should be verified so the voltage, phase and frequency match that of the pump motor. The proper operating voltage and other electrical information can be found on the motor nameplate. These motors are designed to run on ± 10% of the nameplate rated voltage. For dual-voltage motors, the motor should be

internally connected to operate on the voltage closest to the 10% rating, i.e., a 208 voltage motor wired per the 208 volt connection diagram. Wiring connection diagrams can be found on the plates attached to the motor.

If voltage variations are larger than ±10%, do not operate the pump.

2. Field wiring

Wire sizes should be based on the current carrying properties of a conductor as required by the latest edition of the National Electrical Code or local regulations. Direct on line (D.O.L.) starting is approved due to the extremely fast run-up time of the motor and the low moment of inertia of pump and motor. If D.O.L. starting is not acceptable and reduced starting current is required, an auto transformer or resistant starter should be used. It is suggested that a fused disconnect be used for each pump where service and standby pumps are installed.

C. Motor Protection

1. Single-Phase Motors

With the exception of 7-1/2 and 10 HP motors (which require external protection) single- phase SPK pumps are equipped with multi-voltage, squirrel-cage induction motors with built-in thermal protection.

2. Three-Phase Motors

SPK Pumps with three-phase motors must be used with the proper size and type of motor-starter to ensure the motor is protected against damage from low voltage, phase failure, current imbalance and overloads.

A properly sized starter with manual reset and ambient compensated extra quick trip in all three legs should be used. The overload should be sized and adjusted to the full-load current rating of the motor. Under no circumstances should the overloads be set to a higher value than the full load current shown on the motor nameplate. This will void the warranty.

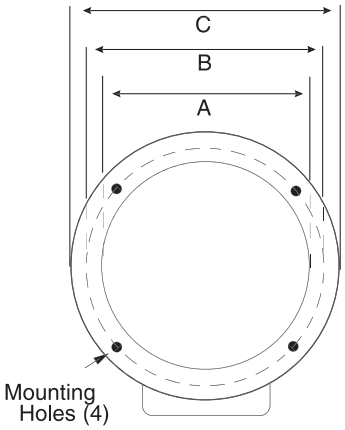
Overloads for auto transformers and resistant starters should be sized in accordance with the recommendations of the manufacturer.

D. Installation Procedures

Even if you are very familiar with the installation of this pump, a quick glance through the remaining sections of this manual may help you avoid a potential problem.

1. Pump location

SPK pumps are designed for tank-mounting and may be installed in either a vertical or horizontal orientation. Where the unit is to be installed so as to position its mounting flange below the liquid level or in a pressurized tank, a gasket must be fitted between the pump's mounting flange and tank.



Pump Model	Ø A	Ø B	Ø C	Discharge	Mounting Hole Dia.
SPK1/2/4/8 (NEMA)	5.5” (140)	6.3” (160)	7.1” (180)	1-1/4” NPT11	0.28” (7)

2. Piping

The discharge ports of SPK pump units which are supplied for use with NEMA motors have 1-1/4 inch female NPT threads. Other discharge pipe sizes must be accommodated via the use of appropriate adapter bushings.

3. Suction conditions

The bottom of the pump strainer must be at least 1.0 inch above the bottom of the tank.

The pumps are designed to provide full performance down to a level of A mm above the bottom of the strainer.

At a liquid level between A and B mm above the bottom of the strainer, the built-in priming screw will protect the pump against dry running.

In general, it is recommended that the pump strainer be located as near as possible to the bottom of the tank. This maximizes first-stage submersion in condensate transfer applications (see Figure 4).

Figure 1: CRK2/4•SPK1/2/4/8

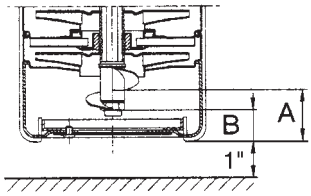


Figure 2: CRK8/16

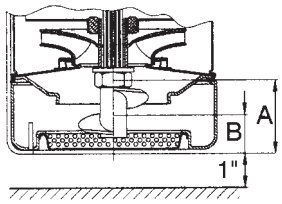
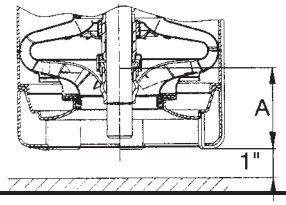
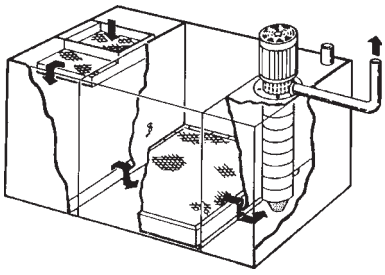


Figure 3: MTR32/45/64



PUMP TYPE	A (IN.)	B (IN.)
SPK1/2/4/8	1- 5/8''	1.0''

Figure 4



4. Bypass

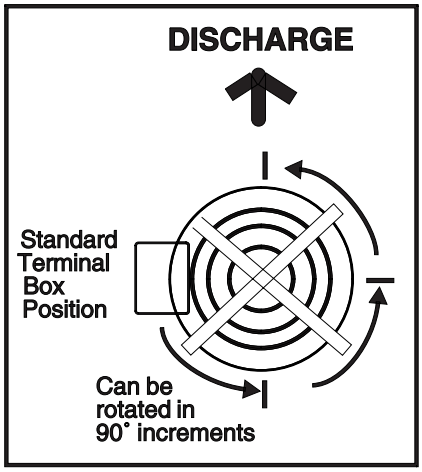
A bypass line or pressure relief valve should be installed in the discharge pipe if there is any possibility the pump may operate against a closed valve in the discha rge line (or in any othe r no flow condition). Flow through the pump is required to ensure adequate cooling and lubrication of the pump is maintained.

The following table shows minimum flow rates:

Pump Type	Minimum Flow Rate
SPK1	1.0 GPM
SPK2	1.2 GPM
SPK4	3.0 GPM
SPK8	5.3 GPM

5. Position of terminal box

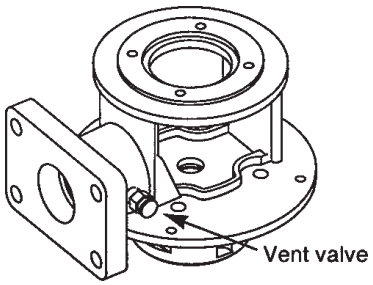
The motor terminal box can be turned to any of four positions in 90 degree steps. To rotate the terminal box, remove the four bolts securing the motor to the pump; turn the motor to the desired location; replace and securely tighten the four bolts.



E. Initial Startup

1. Air elimination

As long as the pump body is partially submerged in fluid, the pump may be started against an open or a closed discharge line. If the discharge line is open, the air will quickly escape through the discharge pipe. If the discharge line is closed, the air will be pressed down through the pump body and out into the tank so that the discharge pressure will quickly reach its maximum (shutoff) level.



If the pump is fitted with a vent valve, this valve must be opened while running the pump against a closed valve.

Once a steady stream of liquid is running out of this vent valve it can be closed.

2. Check the direction of rotation

a. Switch the power OFF.

b. Make sure the pump has been filled and vented.

c. Remove the coupling guard and rotate the pump shaft to be certain it turns freely. Replace the coupling guard.

d. Verify that the electrical connections are in accordance with the wiring diagram on the motor.

e. Switch the power on and observe the direction of rotation. When viewed from the top, the pump should rotate counter-clockwise.

f. To reverse the direction of rotation, first switch OFF the supply power.

g. On three-phase motors, switch any two power leads at the load side of the starter. On single-phase motors, refer to the connection diagram on the nameplate. Change wiring as required.

h. Switch the power ON and check for proper motor rotation.

3. Starting and adjusting

Before starting the pump, make sure that:

1. The pump body is partially submerged in the fluid.
2. The direction of rotation is counter-clockwise when viewed from the top.
3. All piping connections are tight and the pipes are adequately supported.

4. The pump inlet screen is clean and unblocked.

5. Depending on the application, it may be necessary to start the pump against a closed discharge valve in order to prevent system damage due to water hammer. If so, this valve should be opened in a gradual manner after the pump is started. Unless used as a flow throttling device, make sure this valve is completely opened.

6. Check and record the voltage and amperage of the motor. Adjust the motor overloads if required.

7. Check and record operating pressures if pressure gauges have been installed.

8. Check all controls for proper operation. If pump is controlled by a pressure switch, check and adjust the cut-in and cut-out pressures. If low-water-level controls are used be sure the low-level switch is properly adjusted so the pump cannot run if the pump should break suction

⚠ Caution

Under no circumstances should the pump be operated for any prolonged periods of time without flow through the pump.

This can result in motor and pump damage due to overheating. A properly sized relief valve should be installed to allow sufficient water to circulate through the pump to provide adequate cooling and lubrication of the pump bearings and seals.

Pump cycling should be checked to ensure the pump is not starting more than:

20 times per hour on 1/2 to 5 HP models

15 times per hour on 7 1/2 to 15 HP models

10 times per hour on 20 to 40 HP models

Rapid cycling is a major cause of premature motor failure due to increased heat buildup in the motor. If necessary, adjust controls to reduce the frequency of starts and stops.

F. Maintenance

SPK multi-stage centrifugal pumps installed in accordance with these instructions and sized for correct performance will operate efficiently and provide years of service.

The pumps are water-lubricated and do not require any external lubrication or inspection. The motors will require periodic lubrication as noted in the following paragraphs

1. Motor lubrication

Electric motors are pre-lubricated at the factory and do not require additional lubrication at start-up. Motors containing sealed bearings do not require additional lubrication during the first 15,000 hours of operation. Motors with grease fittings should only be lubricated with lithium based grease.

Lubrication schedule: see tables below

Severity of Service	Ambient Temperature (Maximum)	Atmospheric contamination	Approved Types of Grease
Standard	104 ° (40 °C)	Clean, little corrosion	Shell Dolium, Chevron SRI#2 or compatible equivalent type of grease
Severe	122 ° (50° C)	Moderate dirt, corrosion	
Extreme	> 122 ° (50° C) or Class H insulation	Severe dirt, abrasive dust, corrosion	

NEMA (IEC) Frame Size	Standard Service Interval	Severe Service Interval	Extreme Service Interval	Weight of grease to add oz. (grams)	Volume of grease to add in^3 (teaspoons)
Up through 210 (132)	5500 hrs.	2750 hrs.	550 hrs.	0.30 (8.4)	0.6 (2)
Over 210 through 280 (180)	3600 hrs.	1800 hrs.	360 hrs.	0.61 (17.4)	1.2 (3.9)
Over 280 up through 360 (225)	2200 hrs.	1100 hrs	220 hrs.	0.81 (23.1)	1.5 (5.2)
Over 360 (225)	2200 hrs.	1100 hrs.	220 hrs.	2.12 (60.0)	4.1 (13.4)

Do not over grease the bearings. Over greasing will cause increased bearing heat and can result in bearing/motor failure.

2. Periodic safety checks

At regular intervals depending on the conditions and time of operation, the following

checks should be made:

1. Pump meets required performance and is operating smoothly and quietly.
2. There are no leaks, particularly at the shaft seal.
3. The motor is not overheating.
4. Remove and clean all strainers or filters in the system.
5. Verify the tripping of the motor overload protection.
6. Check the operating of all controls. Check unit control cycling twice and adjust if necessary.
7. If the pump is not operated for unusually long periods, the unit should be maintained in accordance with these instructions. In addition, if the pump is not drained, the pump shaft should be manually rotated or run for short periods of time at monthly intervals.

If the pump fails to operate or there is a loss of performance, refer to the Troubleshooting section.

3. Replacing the motor

If the motor is damaged due to bearing failure, burning or electrical failure, the following instructions detail how to remove the motor for replacement. It must be emphasized that motors used on SPK pumps are specially selected to our rigid specifications. Replacement motors must be of the same frame size.

Removing the old motor

1. Remove the coupling guard screens.

2. Using the proper metric Allen wrench, loosen the four cap screws in the coupling.

3. With the correct size wrench, loosen and remove the four bolts which hold the motor to the discharge section of the pump end.

4. Lift the motor straight up until the shaft is free from the coupling.

Installing the new motor

1. Thoroughly clean the surfaces of the motor and pump end mounting flanges. Set the

motor on the pump end.

2. Place the terminal box in the desired position by rotating the motor.

3. Insert the mounting bolts, and then tighten diagonally and evenly.

4. Using a larger screwdriver, raise the pump shaft by placing the tip of the screwdriver under the coupling and carefully elevating the coupling to its highest point.

Note: The shaft can only be raised approximately 0.20 inches (5 mm).

5. Now lower the shaft halfway back down the distance you just raised it (approximately the thickness of a dime), and retighten the metric cap screws in the coupling. Be sure to tighten the top and bottom screws on one side of the coupling and then the other. Torque the coupling screws to the following specifications.

Coupling bolt size	Minimum Torque specifications
M6	10 ft-lbs
M8	23 ft-lbs
M10	46 ft-lbs

6. Check to see that the gaps between the coupling halves are equal. Loosen and re-adjust if necessary.

7. Be certain the pump shaft can be rotated by hand. If the shaft cannot be rotated or it binds, disassemble and check for misalignment.

8. Replace the two coupling guard screens.

G. Troubleshooting

1. Troubleshooting table

Pump Troubleshooting

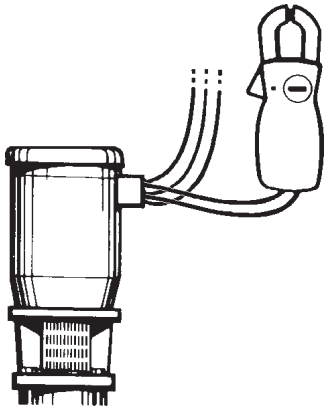
PROBLEM	POSSIBLE CAUSE	CHECK	REMEDY
Pump does not run	No power at pump panel	Check for voltage at panel	If no voltage at pump panel, check feeder panel for tripped circuits
	Fuses are blown or circuit breakers are tripped	Turn off power and remove fuses. Check for continuity with ohmmeter	Replace blown fuses or reset circuit breaker. If new fuses blow or circuit breaker trips, the electrical installation, motor and wires must be checked.
	Motor starter overloads are burned or have tripped out	Check for voltage on line and load side of starter	Replace burned heaters or reset. Inspect starter for other damage. If heater trips again, check the supply voltage and starter holding coil.
	Starter does not energize	Energize control circuit and check for voltage at the holding coil	If no voltage, check control circuit fuses. If voltage, check holding coil for shorts. Replace bad coil
	Defective controls	Check all safety and pressure switches for operation. Inspect contacts in control devices	Replace worn or defective parts or controls
	Motor is defective	Turn off power and disconnect wiring. Measure the lead to lead resistances with ohmmeter (RX-1). Measure lead to ground values with ohmmeter (RX-100K). Record measured values	If an open or grounded winding is found, remove motor and repair or replace
	Defective capacitor. (Single- phase motors)	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K).	When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity. Replace if defective
	Pump is bound	Turn off power and manually rotate pump shaft	If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair.
Pump runs but at reduced capacity or does not deliver water	Wrong rotation	Check wiring for proper connections	Correct wiring.
	Pump body not partially submerged	Turn pump off, close isolation valve(s). Check fluid level	Provide submergence by increasing fluid level in tank or sump; alternatively by repositioning pump at lower level
	Strainers, inlet screen or valves are clogged	Remove strainer, screen or valve and inspect	Clean and replace strainer, screen and/ or valves
	Entrained air	Check tank conditions for cascading fluid or vortexing	Install baffle(s) in tank. Relocate inlet pipe. Decrease pump flow rate
	Fluid cavitating	Compare pump NPSH requirements to available NPSH at pump flow rate	Decrease pump flow rate and/or fluid temperature. Increase first-stage submersion
	Pump worn	Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shutoff	Convert measured pressure (in PSI) to head (in feet): (Measured PSI x 2.31 ft/PSI =_____ft.) Refer to the specific pump curve for shutoff head for that pump model. If head is close to curve, pump is probably OK. If not, remove pump and inspect
	Pump impeller or guide vane is clogged	Disassemble and inspect pump passageways	Remove any foreign materials found

Pump Troubleshooting (Continued)

Fuses blow or circuit breakers or overload relays trip	Low voltage	Check voltage at starter panel and motor	If voltage varies more than ±10%, contact power company. Check wire sizing
	Motor overloads are set too low	Cycle pump and measure amperage	Increase heater size or adjust trip setting to a maximum of motor nameplate (full load) current
	Three-phase current is imbalanced	Check current draw on each lead to the motor	Must be within ±5%. If not, check motor and wiring. Rotating all leads may eliminate this problem
	Motor is shorted or grounded	Turn off power and disconnect wiring. Measure the lead-to-lead resistance with an ohmmeter (RX-1). Measure lead- to-ground values with an ohmmeter (RX-100K) or a megaohm meter. Record values	If an open or grounded winding is found, remove the motor, repair and/ or replace
	Wiring or connections are faulty	Check proper wiring and loose terminals	Tighten loose terminals. Replace damaged wire
	Pump is bound	Turn of power and manually rotate pump shaft	If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair
	Defective capacitor. (Single-phase motors)	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K)	When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity. Replace if defective.
	Motor overloads at higher ambient temperature than motor	Use a thermometer to check the ambient temperature near the overloads and motor. Record these values	If ambient temperature at motor is lower than at overloads, especially where temperature at overloads is above 104°F (40°C), ambient-compensated heaters should replace standard heaters

2. Electrical measurements

SUPPLY VOLTAGE



How to measure: Using a volt meter (set to the proper scale), measure the voltage at the pump terminal box or starter.

On single-phase units, measure between power leads L1 and L2 (or L1 and N for 115 volt units). On three-phase units, measure between:

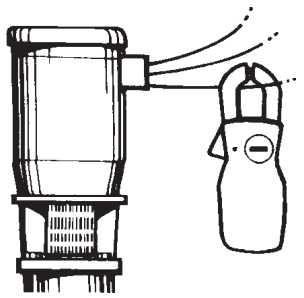
- Power leads L1 and L2
- Power leads L2 and L3
- Power leads L3 and L1

What it means: When the motor is under load, the voltage should be within ±i0% of the nameplate voltage. Largervoltage variation may cause winding damage and indicate a poor electric al supply. The pump should not be operated until these variations have been corrected.

If the voltage constantly remains high or low, the motor should be changed to the correct supply voltage.

CURRENT

How to measure: Using an ammeter (set to the proper scale), measure the current on each power lead at the terminal box or starter. Current should be measured when the pump is operating at constant discharge pressure.



What it means: If the amp draw exceeds the listed ser vice factor amps (SFA) or if the current imbalance is greater than 5% between each leg on three-phase units, check the following:

i. Burned contacts on motor starter.

2. Loose terminals in starter/terminal box or possible wire defect.

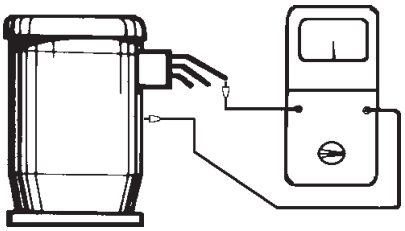
3. Too high or too low supply voltage.

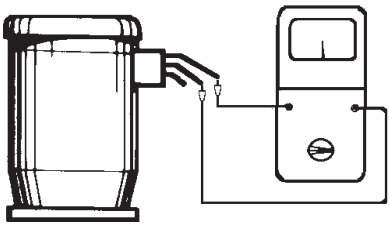
4. Motor windings are shorted or grounded. Check winding and insulation resistances.

5. Pump is damaged causing a motor overload.

LEAD-TO-GROUND RESISTANCE

How to measure: Turn off power and disconnect the supply power leads in the pump terminal box. Using an ohmme ter, set the scale selector to R x l00 and zero adjust the meter by touching the two ohmmeter leads together. Touch one ohmmeter lead to a motor lead and one to ground. Repeat for each lead. If measured resistance does not exceed l,000,000 ohms, motor is bad and in need of replacement.





WINDING RESISTANCE

How to measure: Turn off power and disconnect the supply power leads in the pump terminal box. Using an ohmmet er, set the scale selector to R x l and zero adjust the meter by touching the two ohmmeter leads together.

Next, touch the leads of the ohmmeter to two motor leads:

Single phase motors - touching the leads of the ohmmeter to the two outgoing 'hot' motor leads (either a single motor lead or combination of leads joined together) wi ll measure the main winding's resistance.

Three phase motors - touching the leads of the ohmmeter to any two hot leads will measure that winding's resistance. Repeat for all three possible lead combinations (L1 and L2, L2 and L3, L1 and L3)

What it means: If all ohm values are normal, the motor windings are neither shorted nor open. If any one ohm value is less than normal (-25%), that motor winding may be starting to short. If any one ohm value is greater than normal (+25%), the winding may be starting to open. If some values are high and some are low, the leads may be connected incorrectly, or they may have a break in the insulating jacket.

H. Motor Specifications

Totally Enclosed Fan Cooled (TEFC) Baldor Motors*
60 Hz -Two Pole (3450 RPM)

HP	PH	SERVICE FACTOR	NEMA FRAME	VOLTS	AMPS			EFF.	POWER FACTOR	LINE TO LINE RESISTANCE AT 25 DEG C	INS. CLASS	KVA CODE
					FULL LOAD	LOCKED ROTOR/ START	S.F.					
1/3	1	1.35	56C	115/230	2	24.5/12.2	7.6/3.8	55	68	6.489/7.172	B	K
1/3	3	1.35	56C	208-230/460	1.5-1.4/.7	11/10/5	1.7-1.6/.8	70	65	38.2-42.3	B	K
1/2	1	1.6	56C	115/208-230	7.4/4.1-3.7	36/19.8-18	9.8/5.2-4.9	62	69	3.382/3.738	B	K
1/2	3	1.25	56C	208-230/460	2.1-2/1	12.4-11.3/5.6	2.6-2.4/1.2	68	63	34.06/37.64	B	J
3/4	1	1.25	56C	115/208-230	9.6/5-4.8	51/28-25.5	11.4/6-5.7	66	74	2.332/2.578	B	K
3/4	3	1.25	56C	208-230/460	2.7-2.6/.3	33-30/15	3.1-3/1.5	74	73	23.4-25.88	B	K
1	1	1.25	56C	115/230	11/5.5	77/38.5	14.4/7.2	66	81	2.347/2.594	B	K
1	3	1.25	56C	208-230/460	3.7-3.6/1.8	24.3-22/11	4.1-4/2	75.5	76	15.9-17.5	B	H
1 1/2	1	1.3	56C	115/208-230	17/9.5-8.6	79.8/43.8-39.9	20.4/11.3-10.2	71	79	1.178/1.302	B	K
1 1/2	3	1.15	56C	208-230/460	5.0-4.6/2.3	35.4-32/16	3.3-3/2.5	75.5	76	11.2-12.3	B	G
2	1	1.15	56C	115/230	23/11.5	158.4/79.2	25.4/12.7	74	82	0.872	F	K
2	3	1.15	56C	208-230/460	5.7-5.4/2.7	38.7-35/17.5	6.3-6/3	78.5	93	10.7-11.8	B	H
3	1	1.15	56C	115/208-230	30/16.5-15	172/95.1-86	32.2/16.1	77	87	0.593	F	H
3	3	1.15	56C	208-230/460	7.8-7.4/3.7	59.7-54/27	***	82.5	87	5.5-6.1	F	J
3	1	1.15	182TC	115/208-230	29/16-14.5	170/93.5-85	32.8/18-16.4	75	88	.569/.629	F	H
3	3	1.15	182TC	208-230/460	8.2-7.8/3.9	77.4-70/35	9-8.6/.3	81.5	89	4.9-5.4	F	K
5	1	1.15	213TC	230	22	170	25	80	89	0.29	F	J
5	3	1.15	184TC	208-230/460	13.2-12/6	103.9-94/47	15-13.6/6.8	85.5	93	2.6-2.9	F	K
7 1/2	1	1.15	213TC	208-230	34.3-31	240-217	39.3-35.5	82	91	.2109/.2331	H	F
7 1/2	3	1.15	213TC	208-230/460	19-17.2/8.6	168.1-152/76	21.7-19.6/9.8	87.5	94	1.4-1.5	F	L
10	1	1.15	213TC	230	40	233.5	46	85.5	97	***	F	F
10	3	1.15	215TC	208-230/460	25-24/12	232.2-210/105	28.3-27.2/13.6	85.5	91	1.07-1.18	F	J
15	3	1.15	254TC	208-230/460	38-34/17	376-340/170	43.4-38.8/ 19.4	86.5	94	.62-.69	H	L
20	3	1.15	254TC	230/460	46/23	420/210	52.4/26.2	88.5	92	0.36	F	K
25	3	1.15	284TSC	208-230/460	61-58/29	482.1-436/218	70-66/33	91	89	.30-.33	F	H
30	3	1.15	286TSC	230/460	72/36	444/222	80/40	88.5	88	0.319	F	G
40	3	1.15	286TSC	230/460	94/47	580/290	105.2/52.5	90.2	89	0.176	F	***

Open Drip Proof (ODP) Baldor Motors*
60 Hz - Two Pole (3450 RPM)

HP	PH	SERVICE FACTOR	NEMA FRAME	VOLTS	AMPS			EFF.	POWER FACTOR	LINE TO LINE RESISTANCE AT 25 DEG C	INS. CLASS	KVA CODE
					FULL LOAD	LOCKED ROTOR/ START	S.F.					
1/3	1	1.35	56C	115-230	6-3	28-14	7-3.5	55	68	7.12	B	K
1/3	3	1.35	56C	208-230/460	1.5-1.4/.7	20-10/5	1.7-1.6/.8	70	65	38.20-42.3	B	J
1/2	1	1.25	56C	115/208-230	7.2/4-3.6	30/16.58-15	8/4.4-4	66	66	4.72	B	H
1/2	3	1.25	56C	208-230/460	2.1-2/1	13.27-12/6	2.6-2.4/1.2	68	63	35.1	B	J
3/4	1	1.25	56C	115/208-230	9.6/5.3-4.8	56/30.96-28	11.4/6.3-5.7	66	74	2.5	B	K
3/4	3	1.25	56C	208-230/460	9.6-5.3/4.8	16.81-15.2/7.6	3.1-3/1.5	74	73	24.6	B	K
1	1	1.25	56C	115/208-230	14/7.3-7	92/50.87-46	16/8.8-8	65	65	1.63	B	L
1	3	1.25	56C	208-230/460	3.2-3/1.5	24.33-22/11	4.2-3.8/1.9	75.5	76	16.7	B	H
1 1/2	1	1.15	56C	115/208-230	18/8.7-9.0	120.8/66.8-60.4	19.6/10.8-9.8	68	77	1.24	B	G
1 1/2	3	1.15	56C	208-230/460	4.9-4.6/2.3	40.7-36.8/18.4	5.3-5/2.5	80	74	8.53	B	K
2	1	1.15	56C	115/208-230	24/12	160/88.5-80	26/13	70	75	0.844	B	G
2	3	1.15	56C	208-230/460	5.9-5.6/2.8	77.4-70.4/35.2	6.3-6.2/3.1	81.5	89	10.7	B	H
3	1	1.15	56C	230	13	108	14.8	82.5	93	0.614	B	K
3	3	1.15	56C	208-230/460	8.4-8/4	66.35-60/30	9.5-9/4.5	82.5	89	5.6	B	J
3	1	1.15	182TC	115/208-230	28/14.7-14	148/81.83-74	32/18.3-16	78	88	0.175	B	G
3	3	1.15	182TC	208-230/460	8.4-8/4	66.35-60/30	9.5-9/4.5	82.5	89	5.6	B	J
5	1	1.15	213TC	208-230	28-26	167.2-152	31-28.7	78	82	.3259/.3602	B	G
5	3	1.15	184TCZ	208-230/460	13-12/6	137.8-124.6/62.3	14.7-13.6/6.8	87.5	90	2.83	B	L
7 1/2	1	1.15	213TC	208-230	38-37	212.3-192	42-41	81	82	0.23	B	G
7 1/2	3	1.15	215TC	208-230/460	19-18/9	168.1-152/76	21-20/10	85.5	91	2	B	J
10	1	1.15	215TC	230	46	280	51.7	83	86	0.163	B	G
10	3	1.15	215TC	208-230/460	27-25/13	195.5-176.8/88.4	30-28/14	85.5	91	1.47	B	H
15	3	1.15	254TC	208-230/460	38-36/18	289.7-262/131	43-41/20.5	85.5	92	0.961	F	G
20	3	1.15	254TC	230/460	***	***	***	***	***	***	***	***
25	3	1.15	284TSC	230/460	59/29.5	372/186	67/33.5	92.4	86	0.488	B	G
30	3	1.15	284TSC	230/460	73/36.5	432/216	81.2/40.6	90.2	86	.3373/.3728	F	G
40	3	1.15	286TSC	230/460	100/50	540/270	114.04/57.02	90.2	83	.1919/.2121	B	F

IEC IP55, IM 3611 (V18)*
60 Hz - Two Pole (3450 RPM)

Kw	HP	PH	S.F.	VOLTS	FULL LOAD	LOCKED ROTOR	FULL LOAD EFF.	POWER FACTOR	LINE TO LINE RESISTANCE	INS. CLASS
0.25	1/3	3	1	220-255/380-440	1.10-1.02/0.63-0.59	6.1-7.1/3.5-4.1	73/73	0.86/0.77	23.5	F
0.37	1/2	3	1	220-255/380-440	1.50-1.44/0.87-0.83	8.3-9.4/4.8-5.4	78/79	0.85/0.76	21.2	F
0.55	3/4	3	1	220-255/380-440	2.15-2.05/1.25-1.20	10.8-12.3/6.3-7.2	80.5/82	0.85/0.76	14.8	F
0.75	1	3	1	220-255/380-440	2.85-2.70/1.65-1.55	17.1-18.9/9.9-10.9	82/84	0.85/0.78	10.4	F
1.1	1 1/2	3	1	220-255/380-440	4.15-3.80/2.40-2.20	24.5-27.7/14.1-6.1	82/85	0.86/0.80	6.85	F
1.5	2	3	1	220-277/380-480	5.70-5.00/3.30-2.90	33.6-42.0/19.5-24.4	80.5/82	0.89/0.78	3.8	F
2.2	3	3	1	220-277/380-480	8.05-6.95/4.65-4.00	52.3-66.0/31.0-38.0	83/84.5	0.90/0.81	2.5	F
3	4	3	1	220-277/380-480	10.6-9.00/6.10-5.20	78.4-99.0/45.1-57.2	86/87	0.90/0.83	1.74	F
4	5 1/2	3	1	220-277/380-480	13.6-11.4/7.85-6.60	109-137/63-79	87/88	0.92/0.85	1.64	F
5.5	7 1/2	3	1	220-277/380-480	18.8-15.6/10.8-9.00	154-193/89-112	87.5/89.5	0.92/0.85	1.12	F
7.5	10	3	1	220-277/380-480	25.5-22.6/14.6-13.0	242-262/139-151	88.5/90	0.92/0.80	0.685	F
11	15	3	1	220-277/380-480	37.0-30.2/21.4-17.4	244-290/141-167	89/91	0.90/0.86	.37Ω	F

APPENDIX A — Float Switch

SQUARE D
Instruction Bulletin

Reference No. 9037-891
Bulletin No. 65013-013-90C
Raleigh NC, USA, April, 1995
Supersedes 65013-013-90B dated 10/94

Closed Tank Float Switch
Class 9037 Type HG, Series A

INTRODUCTION

This document contains installation, operation, adjustment and parts replacement information for Class 9037 Type HG Series A Closed Tank Float Switches. These float switches are used to automatically control the liquid level in closed tanks.

⚠CAUTION

EQUIPMENT DAMAGE HAZARD.

Remove shipping bracket from mounting plate before installing switch.

Failure to observe this precaution can result in equipment damage.

EXCESSIVE PRESSURE.

Avoid using the float switch where pressure within the closed tank exceeds 50 psi.

Failure to observe this precaution can result in seal leakage and equipment damage.

MOUNTING

To mount the float switch (refer to Figure 1):

1. The float switch is shipped with a bracket attached to the mounting plate. This bracket prevents the float and rod from moving in the tank during shipment. Remove and discard this clearly-marked shipping bracket before installing the float switch.
2. Loosen the nut (item C) so that the 2-1/2 inch I.P.S. threaded fitting (item D) rotates freely in the switch bracket.
3. Mount the float switch by screwing the threaded fitting directly to the tank.
4. Tighten the threaded fitting so no fluid from the tank leaks past the threads.
5. Rotate the switch case until it is horizontal and tighten the nut.

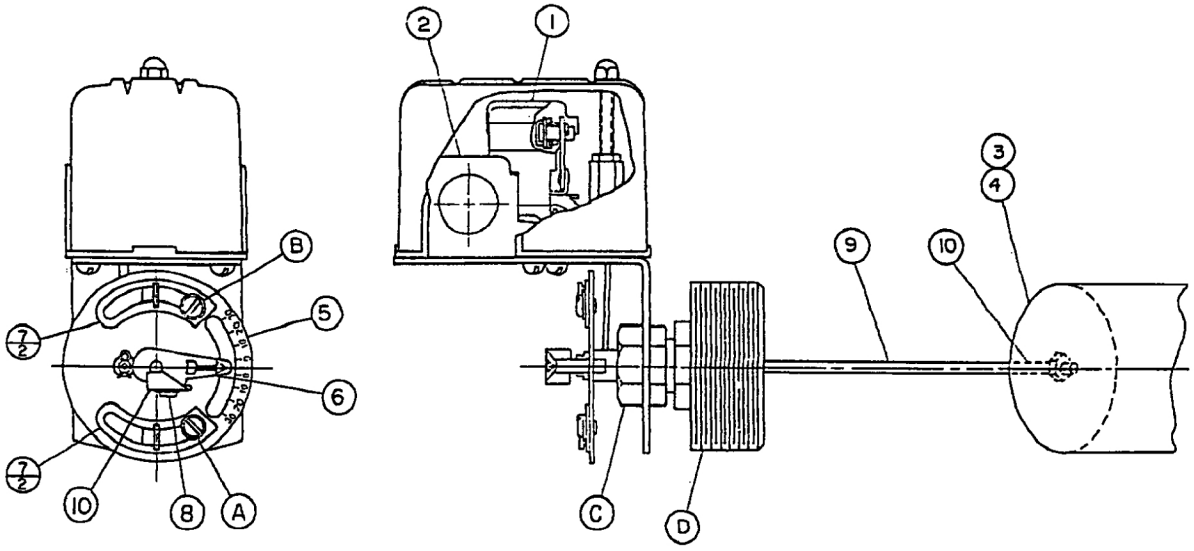


Figure 1 Class 9037 Type HG Series A Float Switch

ENCLOSURE RATING

NEMA 1 enclosures are intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment in locations where unusual service conditions do not exist.

ADJUSTMENT

⚠ DANGER

HAZARDOUS VOLTAGE.
Disconnect all power before working on equipment.
Failure to observe this precaution will result in severe injury or death.

Float switches are shipped from the factory set for a specified float travel. Some adjustment of float travel can be made in the field. Float travel is adjusted by moving one or both of the adjusting strips (item 7 in Figure 1), held in place by screws (items A and B).

To change the upper limit of float travel:

1. Loosen screw (item B).
2. Move the upper adjusting strip (item 7) clockwise to reduce the upper limit or counter-clockwise to increase the upper limit.
3. Tighten the screw (item B).

To change the lower limit of float travel:

1. Loosen screw (item A).
2. Move the lower adjusting strip (item 7) counter-clockwise to reduce the lower limit or clockwise to increase the lower limit.
3. Tighten the screw (item A).

Reverse Action

Standard float switches are shipped from the factory with the float and link positioned for contacts to close on liquid rise. Form R float switches are shipped with the float and operating link positioned for contacts to open on liquid rise. To reverse the switch action, relocate the operating link to the opposite slot in the base plate and to the corresponding hole in the adjusting plate (refer to Figure 2).

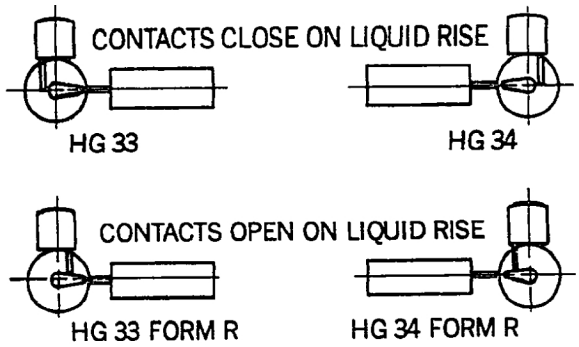


Figure 2 Float and Link Positions

MOTOR PROTECTION

This type of float switch does not provide motor protection but is frequently used as a pilot to operate a motor protective starter. For more information on the complete line of motor protective switches, contact your local Square D Sales Office.

WIRING AND ELECTRICAL RATINGS

Figure 3 shows typical single phase and polyphase wiring diagrams for the float switch. The switch contact control circuit has an A600 rating. Horsepower ratings for the switch contacts are listed in Table 1.

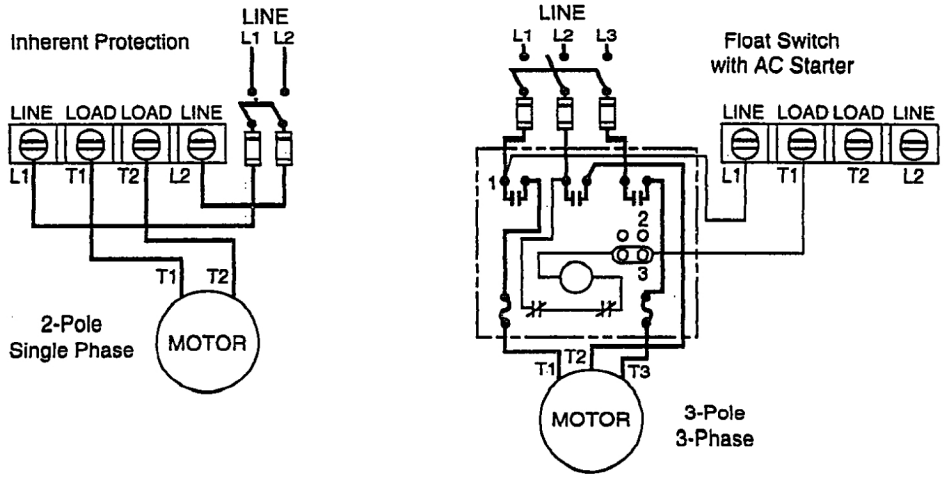


Figure 3 Wiring Diagrams

Table 1 Switch Contact Horsepower Ratings

Voltage	Horsepower Ratings		
	Single Phase AC	Polyphase AC	DC
115	2 hp	3 hp	1/2 hp
230	3 hp	5 hp	1/2 hp
460/575	—	1 hp	—
32	—	—	1/4 hp

REPLACEMENT PARTS

Replacement parts for the Class 9037 Type HG Float Switch are listed in Table 1. For parts locations, see Figure 1 on page 1. When ordering parts, always give Class, Type and Form of switch.

Table 1 Replacement Parts

Item No.	Description			Quan.	Part No.
1	Set of Moveable and Stationary Contacts			2	9998 PC-242
2	Switch Mechanism [1]			1	65079-502-51
3	Float (304 SS)			1	9049 HF3
4	Float (316 SS)			1	9049 HF4
5	Adjusting Plate Assembly			1	2810-D7-G1
6	Operating Lever			1	2810-C4-X2
7	Adjusting Strip			2	2810-X8
8	Screw			1	21911-14161
9	Connector and Rod Assy.	45°	—	1	2810-C3-G9
		90° Offset	3"	1	2810-C3-G15
		90° Offset	4-1/4"	1	2810-C3-G19
		90° Offset	5"	1	2810-C3-G18
		90° Offset	7"	1	2810-C3-G6
10	Clamp			1	2810-D4-X1
—	Seal and Installation Kit (BUNA-N)			1	9998 PC-337
—	Seal and Installation Kit (VITON®)			1	9998 PC-338

[1] Orders for mechanisms must show Class and Type so nameplate on replacement can be correctly stamped.

TRADEMARKS: VITON is a registered trademark of E.I. Dupont De Nemours & Co.

PLEASE NOTE: Electrical equipment should be serviced only by qualified electrical maintenance personnel, and this document should not be viewed as sufficient instruction for those who are not otherwise qualified to operate, service or maintain the equipment discussed. Although reasonable care has been taken to provide accurate and authoritative information in this document, no responsibility is assumed by Square D for any consequences arising out of the use of this material.

APPENDIX B — Level Control

Warrick® Series 16M Controls

Installation and Operation Bulletin

This bulletin should be used by experienced personnel as a guide to the installation of series 16M controls. Selection or installation of equipment should always be accompanied by competent technical assistance. We encourage you to contact Gems Sensors or its representative if further information is required.

Specifications

Control Design: Solid state components enclosed in clear Lexan plug-in style housing. Housing carries no NEMA rating.

Contact Design: SPDT (1 form C): one normally open (N.O.) and one normally closed (N.C.), non-powered contacts.

Contact Ratings: 10A @ 120 or 240 VAC resistive, 1/3 H.P. @120 or 240 VAC.

Contact Life: Mechanical- 5 million operations. Electrical- 100,000 operations minimum at rated load.

Supply Voltage: 24, 120, or 240 VAC models- factory set. Plus 10%, minus 15%, 50/60 Hz.

Supply Current: 120, 240, 24 VAC, Relay energized 4.4 VA.

Secondary Circuit: 12 VAC RMS voltage on probes, 1.5 milli-amp current.

Sensitivity: Models operate from 0-1,000,000 OHM maximum specific resistance- factory set.

Temperature: -40 to 150° F. ambient.

Terminals: All connections #6-32 screw type with pressure clamps.

Time Delays: Standard, 0.5 seconds on rising level. Additional time delays on rising and/or falling available as option.

Listings: U.L. listed, Industrial Motor Control (508).

Installation

1. Install octal socket in appropriate enclosure using two (2) #6 or #8 metal screws.

1A. Install rail mount socket on appropriate rail (DIN mount) in appropriate enclosure if applicable.

2. Wire control per wiring diagram, following N.E.C. and local codes

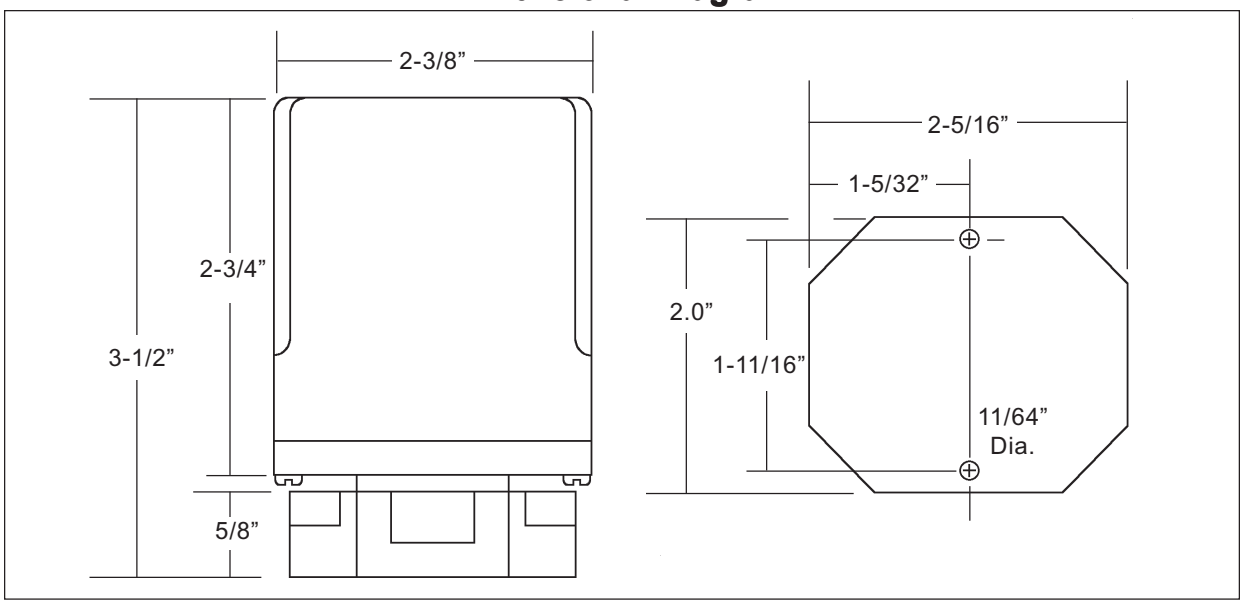
3. Install control module in socket.

Sensitivities vs Maximum Probe Wire Distance*

Sensitivity Character	Sensitivity (K Ohms)	Distance (Ft)
A or K	4.7	10,000
B or L	10	5,700
C or M	26	2,200
D or N	50	1,075
E or P	100	570
F or R	470	270
G or S	1,000	38

* Based on type MTW or THHN wire, #14 or #16 Awg.

Dimensional Diagram



Use copper (60/70° C) wire only. Torque to 20 inch pounds.

Operation

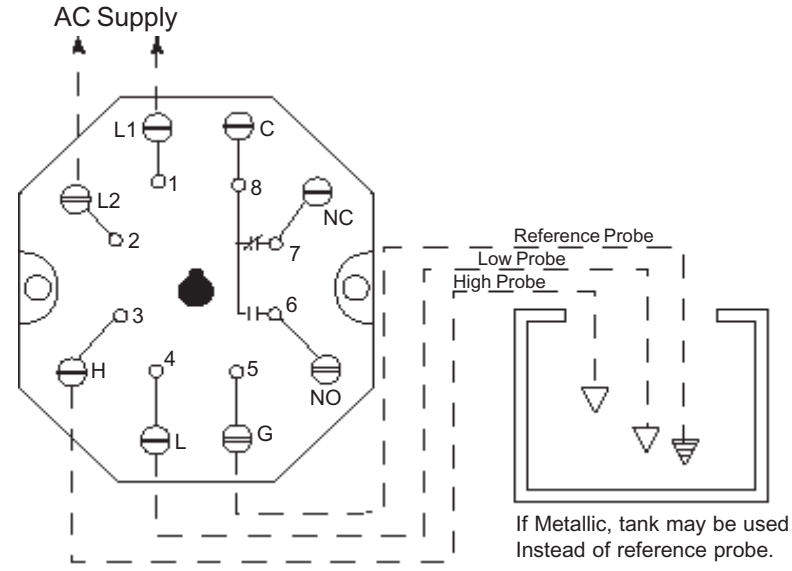
Direct Mode- Single Level Service: When the liquid rises to the electrode on terminal 3, the control energizes, changing state of the load contacts. (LED will be lit) The control remains energized until the liquid level recedes below electrode on terminal 3. The control then de-energizes, (LED will not be lit) returning load to original state.

Inverse Mode- Single Level Service: Control energizes with power, changing state of the load contacts. (LED will be lit) When the liquid rises to the electrode on terminal 3, the control de-energizes, returning the load contacts to shelf state. (LED will not be lit) The control remains de-energized until liquid level recedes below the electrode connected to terminal 3. The control then energizes.

Direct Mode- Differential Service: When the liquid rises to the electrode on terminal 3, the control energizes, changing state of the load contacts. (LED will be lit) The control remains energized until the liquid level recedes below electrode on terminal 4. The control then de-energizes, (LED will not be lit) returning the load contacts to original state.

Inverse Mode- Differential Service: Control energizes with power, (LED will be lit) changing state of the load contacts. When the liquid rises to the electrode on terminal 3, the control de-energizes, returning load contacts to shelf state. (LED will not be lit) The control remains de-energized until the liquid level recedes below the electrode on terminal 4. The control then energizes.

Wiring Diagram



- For Differential Service
- For Single Level Service use “H” and “G” Connections

Optional

Time Delays: With time delay on increasing level, the liquid must be in contact with the short electrode for the full duration of the time delay before control will operate. With delay on decreasing level, the liquid must be below long electrode for the full duration of the time delay before control will operate. In single level service, terminals 3 and 4 must be jumpered together to achieve time delays on both increasing and decreasing levels or just decreasing level.

16M- X-X-X-X-XX-XX

Time Delay: (decreasing level) 1-20 sec.
Time Delay: (increasing level) 1-20 sec.
Enclosure: 0-none, 1-NEMA 1, 4-NEMA 4, 7-NEMA 7, 12-NEMA 12
Socket Style: A- 8 Pin Octal, B- 8 Pin DIN mount, M- None, module only
Supply Voltage: 1- 120 VAC, 2- 240 VAC, 3- 24 VAC, 8- 208/240 VAC*
Mode/Sensitivity:
Direct A- 4.7K, B- 10K, C- 26K, D- 50K, E- 100K, F- 470K, G- 1M
Inverse K- 4.7K, L- 10K, M- 26K, N- 50K, P- 100K, R- 470K, S- 1M

*187 Vmin to 255 Vmax VAC

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