sensia
Rockwell Automation + Schlumberger

+ MEASUREMENT SOLUTIONS

OPERATING, INSTALLATION & MAINTENANCE MANUAL

FOR

MS-53 LABORATORY MIXER

This JISKOOT Product is designed to provide outstanding service if correctly installed, used and maintained recognising the effects of the process conditions (temperature, pressure, wax/pour point, sediment, etc.).

Truly representative sampling of crude oils etc., cannot be achieved by one single product in isolation. A well designed system and operating procedures as laid down in the Sampling Standards ISO 3171*, API 8.2 and* IP Chapter VI section 2 *are mandatory.*

Please consult Sensia for further information and assistance.

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1 Warranty

This product should be supplied with a warranty card. Please complete and return it to register for warranty support.

In the event it is missing, to register for support, please contact us on +44 (0)1892 518000 or support@jiskoot.com, quoting the Jiskoot Order Number or Serial No with the following information:

- Date installed
- Full installation site details, including contact details
- Maintenance and operator contact details (where different from above)
- Product comments/feedback

If the product has been supplied as part of a Jiskoot system or assembly, please complete the warranty card for the system.

2 Introduction

The MS-53 Laboratory Mixer is used to ensure that samples of crude oil or other products extracted from a pipeline or a cargo are thoroughly mixed prior to laboratory analysis, to ensure that the small amount of sample is truly representative of the whole.

The sample is normally collected in Jiskoot Type PR-23 (9 litre) or PR-53 (18 litre) portable Sample Receivers over a period of some hours. It may be many hours before it is analysed and during this time some of the water will fall out and separate.

The standard MS-53 Laboratory Mixer is capable of mixing viscous products of up to 500 Cst (at operating temperature). Alternative motors and pumps may be required for higher viscosity applications.

3 Operating Instructions

The MS-53 Laboratory Mixer is simple to operate.

The Mixer must be firmly located on a suitable bench and connected to a suitable electrical supply.

The 3/4" suction and 1/2" discharge hoses must be connected to the appropriate connections of the Sample Receiver. Ensure that the quick release couplings are connected properly by pulling gently on the hoses.

Apply power to the Mixer. Mixing time is a function of gravity, viscosity and various other factors. Tests have shown that the Laboratory Mixer will successfully mix a variety of oils within 5-10 minutes, however, the optimum mixing time will vary depending on the composition of the oil.

When crude oil is sampled at a high temperature, allowed to cool and then reheated, condensation may form in the Sample Receiver. If this occurs, ensure the can is briefly shaken by hand to remove water droplets from the top of the receiver.

In some instances the pump may need assistance in priming. To do this lift the receiver up with the mixer running until the pump primes.

NOTE: To avoid damage to the pump, the Laboratory Mixer should not be operated for periods exceeding 3 minutes if no product available.

When the oil is thoroughly mixed, draw off a sample from the needle valve into laboratory glassware for analysis. Alternatively, a septum may be fitted to the Mixer to enable the sample to be taken using a syringe. It is recommended that the initial 10-20ml of sample be discarded, to ensure all equipment is thoroughly flushed.

When sufficient sample has been obtained, switch off the mixer and thoroughly clean all equipment to prevent cross contamination.

4 Full Functional Description

The MS-53 Laboratory Mixer consists of a loop drawing oil from the lowest point in the Sample Receiver through the electric motor driven gear pump. The oil is discharged from the pump through the static mixer and returned to the receiver. The return pipe of the Sample Receiver is pointed down, tangentially towards the wall of the receiver to promote extra mixing.

The Laboratory Mixer is fitted with a needle valve to enable the sample to be drawn off into laboratory glassware. In addition, a septum may be fitted to enable a sample to be drawn off via a syringe.

The MS-53 Laboratory Mixer is normally supplied with an electric motor, but is also available with a pneumatic motor for applications where electricity is not an available power source.

5 Utilities Reference

Electrical Requirements	100/110 or 240/220 Volts, 50 or 60 Hz to suit motor supplied.
Power Requirement	0.5KW
Pneumatic Option	3Barg/45psig lubricated air supply.

6 Installation Details

The Laboratory Mixer must be installed and operated in compliance with any applicable electrical hazardous area regulations. The electrical supply should be connected to the motor isolating switch via a suitably certified M20 cable gland, ensuring that earth continuity across the switch is maintained.

7 Maintenance & Troubleshooting

Other than cleaning after use, the MS-53 Laboratory Mixer requires minimal maintenance.

The septum rubbers are self-sealing, however if a leakage is noted, they must be replaced with new rubbers.

Both Laboratory Mixer and Sample Receiver must be cleaned to prevent cross-contamination of samples.

The recommended method for cleaning this equipment is to use a solvent and an inert gas (e.g. Nitrogen) as follows:-

1) Remove Sample Receiver from Laboratory Mixer and empty.
2) Re-connect Sample Receiver and run Laboratory Mixer for approximately 15 seconds.
3) Disconnect and empty Sample Receiver.
4) Add 2 litres of solvent (Toluene or Kerosene).
5) Turn on Laboratory Mixer and circulate for one minute.
6) Turn off and remove pump suction hose (3/4" connector)
7) Connect suction to inert gas source (Nitrogen) **NOT** compressed air.
8) Carefully blow out Laboratory Mixer with inert gas. NOTE: The gas pressure will relieve through the Sample Receiver relief valve.
9) Remove Sample Receiver. Clean with solvent and leave inverted with cover removed to drain.

DO NOT UNDER ANY CIRCUMSTANCES:-

1) Use compressed air for purging.
2) Run the Laboratory Mixer with the discharge hose disconnected or shut off - high pressures will build up and may cause the hose to rupture.
3) Run the Laboratory Mixer unprimed or with solvent for long periods

8 Sub Supplier Information

8.1 Electric motor

The electric motor requires no routine maintenance. In the event of a fault, the motor should be replaced or fully overhauled by a qualified repair shop.

8.2 Gear Pump Overhaul

The gear pump has minimal serviceable components. A replacement seal kit is available for site replacement if required, but as any wear on the gears and body faces causes loss of performance, a replacement pump is recommended.

8.3 Pneumatic Motor

Before dismantling the pump, using a broad felt tip marker pen, draw a line on the pump outer casing from the foot/flange casting across the centre body casting to the end cover casting.

1) Slacken and remove the 4 socket head set pins.
2) Remove end cover casting.

3) Remove centre body casting.
4) Remove gears and shafts.
5) Remove dowels.
6) Clean components, removing traces of paint, and/or gasket material from body sides.

8.3.1 Examine:

1) Shafts for signs of wear (a maximum reduction of .002" difference from diameter of unworn part of shaft is acceptable).
2) Gears, tooth form and gear end faces for wear, scuffing or damage, and replace if necessary.
3) Lip Seal/s for damage caused by dirt or metal particles, etc. and replace if necessary.

NOTE: With double lip seal arrangements, ensure that the seals are re-fitted facing exactly the same direction as the seals they replaced.

8.3.2 Reassembly

1) Ensure that all components are clean and free from dirt and paint etc.
2) Measure the body width and gear width and fit paper gaskets to allow a maximum of 0.002" running clearance.
3) Fit dowels.
4) Align the components to the felt marker line and re-assemble in reverse order to the dismantling procedure.
5) Tighten the 4 socket head set pins evenly and diagonally whilst rotating the driveshaft by hand. Ensure that the pump rotates evenly for the full 360^{o} without tightness. Should tightness occur, slacken set pins and try again.
6) If the pump cannot be assembled as indicated, examine gears for damage and, if satisfactory, fit an extra gasket to one face and repeat from 5 above.

9 Product Specific Drawings

9.1.1 Laboratory Mixer Type MS53-E (Electrically Driven)

General Arrangement Drawing B18103

Septum Assembly Drawing E16473

9.1.2 Laboratory Mixer Type MS53-P (Pneumatically Driven)

General Arrangement Drawing B18602

Septum Assembly Drawing E16473

10 Recommended Spares List

Part/Sub- Assembly	Item No's	Commissioning	1 Year Operation	2 Year Operation
3/4" Quick Release Coupling	48-0476-00	-	1	1
1/2" Quick Release Coupling	48-0516-00	-	1	1
Septum Seals (Quantity required will be determined by degree of usage)	48-0641-00	-	10	10

11 Disclaimer

Whilst Jiskoot Limited has taken every care in the preparation of this document, it cannot accept responsibility for printing errors or omissions and does not warrant that it is correct and comprehensive in every particular. Persons with an appropriate level of skill and training should operate equipment supplied only.

Jiskoot Limited shall not be liable for incidental or consequential damages resulting from the furnishing, performance or use of this material.

Jiskoot pursues a policy of continuous improvement, and information given herein may be updated without notice. Further, this information is proprietary to Jiskoot Limited, and must not be disclosed to any third party except as may be required to operate the equipment supplied in accordance with the purposes for which it was sold by the persons properly licensed to operate it.

6	Recommended Spares List corrected	P.Whittle	N.McGee	07/01/2009
5	Company name updated	P.Whittle	M.A.Jiskoot	02/02/2006
4	Note added regarding maximum product viscosity for standard unit	P.Whittle	M.A.Jiskoot	27/08/2003
3	Rewritten in MS Word format	M.Doust	P.Whittle	02/06/2003
2	Drawing and Parts List references updated	P.Whittle	P.Whittle	25/04/2000
1				
Issue	**Revision History**	**Issued**	**Approved**	**Date**

Notes

Notes

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The Jiskoot Lab Mixer MS-53E

1. Baldor Explosion Proof Motor Installation & Operating Manual
2. Viking Pump Technical Service Manuals
3. Koflo Six Element Static Mixer
4. Appleton Switch Housing
5. Cutter-Hammer Single Phase Switch w/ Plug-in Heater
6. Hazardous Area Electrical Certifications

BALDOR®

Integral Horsepower
AC Induction Motors
ODP, WPI, WPII Enclosure
TEFC Enclosure
Explosion Proof

Installation & Operating Manual

5/04 **MN400**

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Section 1
General Information

Overview This manual contains general procedures that apply to Baldor Motor products. Be sure to read and understand the Safety Notice statements in this manual. For your protection, do not install, operate or attempt to perform maintenance procedures until you understand the Warning and Caution statements. A Warning statement indicates a possible unsafe condition that can cause harm to personnel. A Caution statement indicates a condition that can cause damage to equipment.

Important: **This instruction manual is not intended to include a comprehensive listing of all details for all procedures required for installation, operation and maintenance. This manual describes general guidelines that apply to most of the motor products shipped by Baldor. If you have a question about a procedure or are uncertain about any detail, Do Not Proceed. Please contact your Baldor distributor for more information or clarification.**

Before you install, operate or perform maintenance, become familiar with the following:

- NEMA Publication MG-2, Safety Standard for Construction and guide for Selection, Installation and Use of Electric Motors and Generators.
- The National Electrical Code
- Local codes and Practices

Limited Warranty

1. Most Baldor products are warranted for 18 months from the date of shipment to Baldor's customer from Baldor's district warehouse or, if applicable, from Baldor's factory. Baldor Standard–E® standard efficient motors are warranted for 24 months. Standard–E is limited to three phase, general purpose, 1–200 HP ratings that fall under the Energy Policy Act (EPAct). Baldor Super–E® premium efficient motors are warranted for 36 months. Baldor IEEE841 motors are warranted for 60 months. All warranty claims must be submitted to a Baldor Service Center prior to the expiration of the warranty period.
2. Baldor will, at its option repair or replace a motor which fails due to defects in material or workmanship during the warranty period if:
   a. the purchaser presents the defective motor at or ships it prepaid to, the Baldor plant in Fort Smith, Arkansas or one of the Baldor Authorized Service Centers and
   b. the purchaser gives written notification concerning the motor and the claimed defect including the date purchased, the task performed by the Baldor motor and the problem encountered.
3. Baldor will not pay the cost of removal of any electric motor from any equipment, the cost of delivery to Fort Smith, Arkansas or a Baldor Authorized Service Center, or the cost of any incidental or consequential damages resulting from the claimed defects. (Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply to you.) Any implied warranty given by laws shall be limited to the duration of the warranty period hereunder. (Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.)
4. Baldor Authorized Service Centers, when convinced to their satisfaction that a Baldor motor developed defects in material or workmanship within the warranty period, are authorized to proceed with the required repairs to fulfill Baldor's warranty when the cost of such repairs to be paid by Baldor does not exceed Baldor's warranty repair allowance. Baldor will not pay overtime premium repair charges without prior written authorization.
5. The cost of warranty repairs made by centers other than Baldor Authorized Service Centers **WILL NOT** be paid unless first authorized in writing by Baldor.
6. Claims by a purchaser that a motor is defective even when a failure results within one hour after being placed into service are not always justified. Therefore, Baldor Authorized Service Centers must determine from the condition of the motor as delivered to the center whether or not the motor is defective. If in the opinion of a Baldor Authorized Service Center, a motor did not fail as a result of defects in material or workmanship, the center is to proceed with repairs only if the purchaser agrees to pay for such repairs. If the decision is in dispute, the purchaser should still pay for the repairs and submit the paid invoice and the Authorized Service Center's signed service report to Baldor for further consideration.
7. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Safety Notice:

This equipment contains high voltage! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt installation, operation and maintenance of electrical equipment.

Be sure that you are completely familiar with NEMA publication MG-2, safety standards for construction and guide for selection, installation and use of electric motors and generators, the National Electrical Code and local codes and practices. Unsafe installation or use can cause conditions that lead to serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.

WARNING: Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.

WARNING: Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury. National Electrical Code and Local codes must be carefully followed.

WARNING: Avoid extended exposure to machinery with high noise levels. Be sure to wear ear protective devices to reduce harmful effects to your hearing.

WARNING: This equipment may be connected to other machinery that has rotating parts or parts that are driven by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt to install operate or maintain this equipment.

WARNING: Do not by-pass or disable protective devices or safety guards. Safety features are designed to prevent damage to personnel or equipment. These devices can only provide protection if they remain operative.

WARNING: Avoid the use of automatic reset devices if the automatic restarting of equipment can be hazardous to personnel or equipment.

WARNING: Be sure the load is properly coupled to the motor shaft before applying power. The shaft key must be fully captive by the load device. Improper coupling can cause harm to personnel or equipment if the load decouples from the shaft during operation.

WARNING: Use proper care and procedures that are safe during handling, lifting, installing, operating and maintaining operations. Improper methods may cause muscle strain or other harm.

WARNING: Before performing any motor maintenance procedure, be sure that the equipment connected to the motor shaft cannot cause shaft rotation. If the load can cause shaft rotation, disconnect the load from the motor shaft before maintenance is performed. Unexpected mechanical rotation of the motor parts can cause injury or motor damage.

WARNING: Disconnect all electrical power from the motor windings and accessory devices before disassembly of the motor. Electrical shock can cause serious or fatal injury.

WARNING: Do not use non UL/CSA listed explosion proof motors in the presence of flammable or combustible vapors or dust. These motors are not designed for atmospheric conditions that require explosion proof operation.

Safety Notice Continued

WARNING: **Motors that are to be used in flammable and/or explosive atmospheres must display the UL label on the nameplate along with CSA listed logo.**

Specific service conditions for these motors are defined in NFPA 70 (NEC) Article 500.

WARNING: **UL rated motors must only be serviced by authorized Baldor Service Centers if these motors are to be returned to a flammable and/or explosive atmosphere.**

Caution: **To prevent premature equipment failure or damage, only qualified maintenance personnel should perform maintenance.**

Caution: **Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load from the motor shaft before moving the motor.**

Caution: **If eye bolts are used for lifting a motor, be sure they are securely tightened. The lifting direction should not exceed a 20° angle from the shank of the eye bolt or lifting lug. Excessive lifting angles can cause damage.**

Caution: **To prevent equipment damage, be sure that the electrical service is not capable of delivering more than the maximum motor rated amps listed on the rating plate.**

Caution: **If a HI POT test (High Potential Insulation test) must be performed, follow the precautions and procedure in NEMA MG-1 and MG-2 standards to avoid equipment damage.**

If you have any questions or are uncertain about any statement or procedure, or if you require additional information please contact your Baldor distributor or an Authorized Baldor Service Center.

Receiving

Each Baldor Electric Motor is thoroughly tested at the factory and carefully packaged for shipment. When you receive your motor, there are several things you should do immediately.

1. Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered your motor.
2. Verify that the part number of the motor you received is the same as the part number listed on your purchase order.

Storage

If the motor is not put into service immediately, the motor must be stored in a clean, dry and warm location. Several precautionary steps must be performed to avoid motor damage during storage.

1. Use a "Megger" periodically to ensure that the integrity of the winding insulation has been maintained. Record the Megger readings. Immediately investigate any significant drop in insulation resistance.
2. Do not lubricate bearings during storage. Motor bearings are packed with grease at the factory. Excessive grease can damage insulation quality.
3. Rotate motor shaft at least 10 turns every two months during storage (more frequently if possible). This will prevent bearing damage due to storage.
4. If the storage location is damp or humid, the motor windings must be protected from moisture. This can be done by applying power to the motors' space heater (if available) while the motor is in storage.

Unpacking

Each Baldor motor is packaged for ease of handling and to prevent entry of contaminants.

1. To avoid condensation inside the motor, do not unpack until the motor has reached room temperature. (Room temperature is the temperature of the room in which it will be installed). The packing provides insulation from temperature changes during transportation.
2. When the motor has reached room temperature, remove all protective wrapping material from the motor.

Handling

The motor should be lifted using the lifting lugs or eye bolts provided.

1. Use the lugs or eye bolts provided to lift the motor. Never attempt to lift the motor and additional equipment connected to the motor by this method. The lugs or eye bolts provided are designed to lift only the motor. Never lift the motor by the motor shaft or the hood of a WPII motor.
2. When lifting a WPII (weatherproof Type 2) motor, do not lift the motor by inserting lifting lugs into holes on top of the cooling hood. These lugs are to be used for hood removal only. A spreader bar should be used to lift the motor by the cast lifting lugs located on the motor frame.
3. If the motor must be mounted to a plate with the driven equipment such as pump, compressor etc., it may not be possible to lift the motor alone. For this case, the assembly should be lifted by a sling around the mounting base. The entire assembly can be lifted as an assembly for installation. Do not lift using the motor lugs or eye bolts provided.

   If the load is unbalanced (as with couplings or additional attachments) additional slings or other means must be used to prevent tipping. In any event, the load must be secure before lifting.

Section 2
Installation & Operation

Overview

Installation should conform to the National Electrical Code as well as local codes and practices. When other devices are coupled to the motor shaft, be sure to install protective devices to prevent future accidents. Some protective devices include, coupling, belt guard, chain guard, shaft covers etc. These protect against accidental contact with moving parts. Machinery that is accessible to personnel should provide further protection in the form of guard rails, screening, warning signs etc.

Location

It is important that motors be installed in locations that are compatible with motor enclosure and ambient conditions. Improper selection of the motor enclosure and ambient conditions can lead to reduced operating life of the motor.

Proper ventilation for the motor must be provided. Obstructed airflow can lead to reduction of motor life.

1. **Open Drip–proof/WPI** motors are intended for use indoors where atmosphere is relatively clean, dry, well ventilated and non–corrosive.
2. **Totally Enclosed and WPII** motors may be installed where dirt, moisture or dust are present and in outdoor locations.

Chemical Duty enclosed motors are designed for installations with high corrosion or excessive moisture conditions. These motors should not be placed into an environment where there is the presence of flammable or combustible vapors, dust or any combustible material, unless specifically designed for this type of service.

Mounting

The motor must be securely installed to a rigid foundation or mounting surface to minimize vibration and maintain alignment between the motor and shaft load. Failure to provide a proper mounting surface may cause vibration, misalignment and bearing damage.

Foundation caps and sole plates are designed to act as spacers for the equipment they support. If these devices are used, be sure that they are evenly supported by the foundation or mounting surface.

After installation is complete and accurate alignment of the motor and load is accomplished, the base should be grouted to the foundation to maintain this alignment.

The standard motor base is designed for horizontal or vertical mounting. Adjustable or sliding rails are designed for horizontal mounting only. Consult your Baldor distributor or authorized Baldor Service Center for further information.

Alignment

Accurate alignment of the motor with the driven equipment is extremely important.

1. **Direct Coupling**
   For direct drive, use flexible couplings if possible. Consult the drive or equipment manufacturer for more information. Mechanical vibration and roughness during operation may indicate poor alignment. Use dial indicators to check alignment. The space between coupling hubs should be maintained as recommended by the coupling manufacturer.
2. **End-Play Adjustment**
   The axial position of the motor frame with respect to its load is also extremely important. The motor bearings are not designed for excessive external axial thrust loads. Improper adjustment will cause failure.
3. **Pulley Ratio**
   The pulley ratio should not exceed 8:1.
4. **Belt Drive**
   Align sheaves carefully to minimize belt wear and axial bearing loads (see End-Play Adjustment). Belt tension should be sufficient to prevent belt slippage at rated speed and load. However, belt slippage may occur during starting.

Caution: Do not over tension belts.

5. Sleeve bearing motors are only suitable for coupled loads.

Doweling & Bolting

After proper alignment is verified, dowel pins should be inserted through the motor feet into the foundation. This will maintain the correct motor position should motor removal be required. (Baldor motors are designed for doweling.)

1. Drill dowel holes in diagonally opposite motor feet in the locations provided.
2. Drill corresponding holes in the foundation.
3. Ream all holes.
4. Install proper fitting dowels.
5. Mounting bolts must be carefully tightened to prevent changes in alignment. Use a flat washer and lock washer under each nut or bolt head to hold the motor feet secure. Flanged nuts or bolts may be used as an alternative to washers.

Power Connection

Motor and control wiring, overload protection, disconnects, accessories and grounding should conform to the National Electrical Code and local codes and practices.

Conduit Box

For ease of making connections, an oversize conduit box is provided. The box can be rotated 360° in 90° increments. Auxiliary conduit boxes are provided on some motors for accessories such as space heaters, RTD's etc.

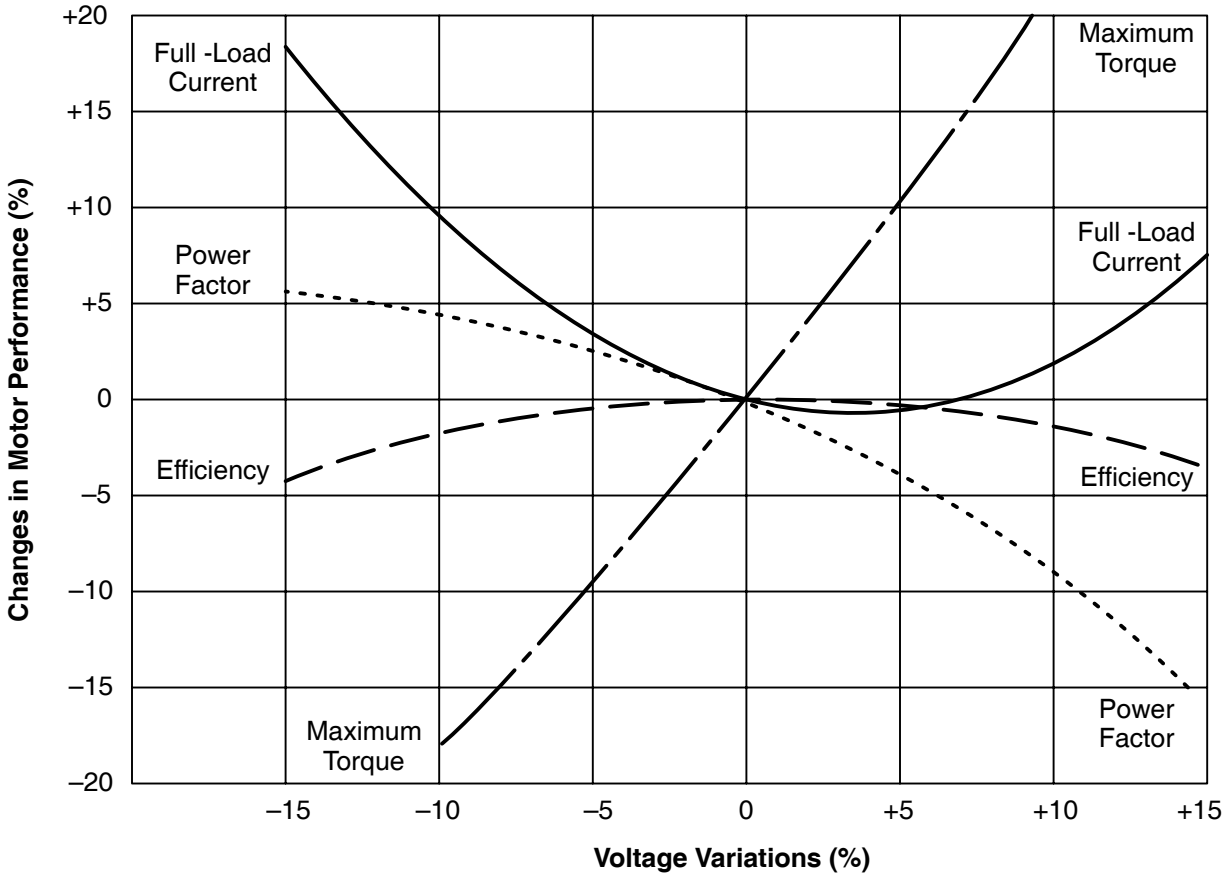
AC Power

Connect the motor leads as shown on the connection diagram located on the name plate or inside the cover on the conduit box. Be sure the following guidelines are met:

1. AC power is within ±10% of rated voltage with rated frequency. (See motor name plate for ratings).
   OR
2. AC power is within ±5% of rated frequency with rated voltage.
   OR
3. A combined variation in voltage and frequency of ±10% (sum of absolute values) of rated values, provided the frequency variation does not exceed ±5% of rated frequency.

Performance within these voltage and frequency variations are shown in Figure 2-1.

Figure 2-1 Typical Motor Performance VS Voltage Variations



First Time Start Up

Be sure that all power to motor and accessories is off. Be sure the motor shaft is disconnected from the load and will not cause mechanical rotation of the motor shaft.

1. Make sure that the mechanical installation is secure. All bolts and nuts are tightened etc.
2. If motor has been in storage or idle for some time, check winding insulation integrity with a Megger.
3. Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity.
4. Be sure all shipping materials and braces (if used) are removed from motor shaft.
5. Manually rotate the motor shaft to ensure that it rotates freely.
6. Replace all panels and covers that were removed during installation.
7. Momentarily apply power and check the direction of rotation of the motor shaft.
8. If motor rotation is wrong, be sure power is off and change the motor lead connections. Verify rotation direction before you continue.
9. Start the motor and ensure operation is smooth without excessive vibration or noise. If so, run the motor for 1 hour with no load connected.
10. After 1 hour of operation, disconnect power and connect the load to the motor shaft. Verify all coupling guards and protective devices are installed. Ensure motor is properly ventilated.

Coupled Start Up

This procedure assumes a coupled start up. Also, that the first time start up procedure was successful.

1. Check the coupling and ensure that all guards and protective devices are installed.
2. Check that the coupling is properly aligned and not binding.
3. The first coupled start up should be with no load. Apply power and verify that the load is not transmitting excessive vibration back to the motor though the coupling or the foundation. Vibration should be at an acceptable level.
4. Run for approximately 1 hour with the driven equipment in an unloaded condition.

The equipment can now be loaded and operated within specified limits. Do not exceed the name plate ratings for amperes for steady continuous loads.

Jogging and Repeated Starts

Repeated starts and/or jogs of induction motors generally reduce the life of the motor winding insulation. A much greater amount of heat is produced by each acceleration or jog than by the same motor under full load. If it is necessary to repeatedly start or jog the motor, it is advisable to check the application with your local Baldor distributor or Baldor Service Center.

Heating - Duty rating and maximum ambient temperature are stated on the motor name plate. Do not exceed these values. If there is any question regarding safe operation, contact your local Baldor distributor or Baldor Service Center.

Section 3
Maintenance & Troubleshooting

WARNING: UL rated motors must only be serviced by authorized Baldor Service Centers if these motors are to be returned to a flammable and/or explosive atmosphere.

General Inspection

Inspect the motor at regular intervals, approximately every 500 hours of operation or every 3 months, whichever occurs first. Keep the motor clean and the ventilation openings clear. The following steps should be performed at each inspection:

WARNING: Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.

1. Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Oily vapor, paper pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Use a “Megger” periodically to ensure that the integrity of the winding insulation has been maintained. Record the Megger readings. Immediately investigate any significant drop in insulation resistance.
3. Check all electrical connectors to be sure that they are tight.

Lubrication & Bearings

Bearing grease will lose its lubricating ability over time, not suddenly. The lubricating ability of a grease (over time) depends primarily on the type of grease, the size of the bearing, the speed at which the bearing operates and the severity of the operating conditions. Good results can be obtained if the following recommendations are used in your maintenance program.

Type of Grease

A high grade ball or roller bearing grease should be used. Recommended grease for standard service conditions is Polyrex EM (Exxon Mobil).

Equivalent and compatible greases include:
Texaco Polystar, Rykon Premium #2, Pennzoil Pen 2 Lube and Chevron SRI.

– Maximum operating temperature for standard motors = 110° C.
– Shut–down temperature in case of a malfunction = 115° C.

Lubrication Intervals

Recommended lubrication intervals are shown in Table 3-1. It is important to realize that the recommended intervals of Table 3-1 are based on average use.

Refer to additional information contained in Tables 3-2 and 3-3.

Table 3-1 Lubrication Intervals *

NEMA / (IEC) Frame Size	Rated Speed - RPM					
	10000	6000	3600	1800	1200	900
Up to 210 incl. (132)	**	2700 Hrs.	5500 Hrs.	12000 Hrs.	18000 Hrs.	22000 Hrs.
Over 210 to 280 incl. (180)			3600 Hrs.	9500 Hrs.	15000 Hrs.	18000 Hrs.
Over 280 to 360 incl. (225)			* 2200 Hrs.	7400 Hrs.	12000 Hrs.	15000 Hrs.
Over 360 to 5800 incl. (300)			*2200 Hrs.	3500 Hrs.	7400 Hrs.	10500 Hrs.

* Lubrication intervals are for ball bearings. For vertically mounted motors and roller bearings, divide the lubrication interval by 2.

** For 6205 and 6806 bearings. For 6807 bearings, consult oil mist lubrication (MN401).
Relubrication interval for 6205 bearing bearing is 1550Hrs. (using grease lubrication).
Relubrication interval for 6806 bearing bearing is 720Hrs. (using grease lubrication).

Table 3-2 Service Conditions

Severity of Service	Hours per day of Operation	Ambient Temperature Maximum	Atmospheric Contamination
Standard	8	40° C	Clean, Little Corrosion
Severe	16 Plus	50° C	Moderate dirt, Corrosion
Extreme	16 Plus	>50° C* or Class H Insulation	Severe dirt, Abrasive dust, Corrosion, Heavy Shock or Vibration
Low Temperature		<–30° C **	

* Special high temperature grease is recommended (Dow Corning DC44). Note that Dow Corning DC44 grease does not mix with other grease types. Thoroughly clean bearing & cavity before adding grease.

** Special low temperature grease is recommended (Aeroshell 7).

Table 3-3 Lubrication Interval Multiplier

Severity of Service	Multiplier
Standard	1.0
Severe	0.5
Extreme	0.1
Low Temperature	1.0

Table 3-4 Bearings Sizes and Types

Frame Size NEMA (IEC)	Bearing Description (These are the "Large" bearings (Shaft End) in each frame size)					
	Bearing	OD D mm	Width B mm	Weight of Grease to add * oz (Grams)	Volume of grease to be added	
					in^3	tea-spoon
56 to 180 incl. (63 to 112)	6206	62	16	0.19 (5.0)	0.3	1.0
210 incl. (132)	6307	80	21	0.30 (8.4)	0.6	2.0
Over 210 to 280 incl. (180)	6311	120	29	0.61 (17)	1.2	3.9
Over 280 to 360 incl. (225)	6313	140	33	0.81 (23)	1.5	5.2
Over 360 to 449 incl. (280)	6319	200	45	2.12 (60)	4.1	13.4
Over 5000 to 5800 incl. (355)	6328	300	62	4.70 (130)	9.2	30.0
Over 360 to 449 incl. (280)	NU319	200	45	2.12 (60)	4.1	13.4
Over 5000 to 5800 incl. (355)	NU328	300	62	4.70 (130)	9.2	30.0
Spindle Motors						
76 Frame	6207	72	17	0.22 (6.1)	0.44	1.4
77 Frame	6210	90	20	0.32 (9.0)	0.64	2.1
80 Frame	6213	120	23	0.49 (14.0)	0.99	3.3

* Weight in grams = .005 DB

Note: Not all bearing sizes are listed. For intermediate bearing sizes, use the grease volume for the next larger size bearing.

Lubrication Procedure

Be sure that the grease you are adding to the motor is compatible with the grease already in the motor. Consult your Baldor distributor or an authorized service center if a grease other than the recommended type is to be used.

Caution: To avoid damage to motor bearings, grease must be kept free of dirt. For an extremely dirty environment, contact your Baldor distributor or an authorized Baldor Service Center for additional information.

With Grease Outlet Plug

1. With the motor stopped, clean all grease fittings.
2. Remove grease outlet plug.
3. Add the recommended amount of grease.
4. Re-install grease outlet plug.

Without Grease Provisions

Note: Only a Baldor authorized and UL or CSA certified service center can disassemble a UL/CSA listed explosion proof motor to maintain it's UL/CSA listing.

1. Disassemble the motor.
2. Add recommended amount of grease to bearing and bearing cavity. (Bearing should be about 1/3 full of grease and outboard bearing cavity should be about 1/2 full of grease.)
3. Assemble the motor.

Sample Lubrication Determination

Assume - NEMA 286T (IEC 180), 1750 RPM motor driving an exhaust fan in an ambient temperature of 43° C and the atmosphere is moderately corrosive.

1. Table 3-1 list 9500 hours for standard conditions.
2. Table 3-2 classifies severity of service as "Severe".
3. Table 3-3 lists a multiplier value of 0.5 for Severe conditions.
4. Table 3-4 shows that 1.2 in^3 or 3.9 teaspoon of grease is to be added.

Note: Smaller bearings in size category may require reduced amounts of grease.

Accessories

The following is a partial list of accessories available from Baldor.
Contact your Baldor distributor for availability and pricing information.

Note: Space heaters and RTD's are standard on some motors.

Bearing RTD
RTD (Resistance Temperature Detector) devices are used to measure or monitor the temperature of the motor bearing during operation.

Bearing Thermocouples
Used to measure or monitor bearing temperatures.

Bearing Thermostat
Temperature device that activates when bearing temperatures are excessive. Used with an external circuit to warn of excessive bearing temperature or to shut down a motor.

Conduit Boxes
Optional conduit boxes are available in various sizes to accommodate accessory devices.

Cord & Plug Assembly
Adds a line cord and plug for portable applications.

Drains and Breathers
Stainless steel drains with separate breathers are available.

Drip Covers
Designed for use when motor is mounted in a vertical position. Contact your Baldor distributor to confirm that the motor is designed for vertical mounting.

Fan Cover & Lint Screen
To prevent build-up of debris on the cooling fan.

Nameplate
Additional stainless steel nameplates are available.

Roller Bearings
Recommended for belt drive applications with a speed of 1800 RPM or less.

Rotation Arrow Labels
Rotation arrows are supplied on motors designed to operate in one direction only. Additional rotation arrows are available.

Space Heater
Added to prevent condensation of moisture within the motor enclosure during periods of shut down or storage.

Stainless Hardware
Stainless steel hardware is available. Standard hardware is corrosion resistant zinc plated steel.

Winding RTD
RTD (Resistance Temperature Detector) devices are used to measure or monitor the temperature of the motor winding during operation.

Winding Thermocouples
Used to measure or monitor winding temperatures.

Winding Thermostat
Temperature device that activates when winding temperatures are excessive. Used with an external circuit to warn of excessive winding temperature or to shut down a motor.

Note: On some motors, leads for accessory devices are brought out to a separate conduit box located on the side of the motor housing (unless otherwise specified).

Table 3-5 Troubleshooting Chart

Symptom	Possible Causes	Possible Solutions
Motor will not start	Usually caused by line trouble, such as, single phasing at the starter.	Check source of power. Check overloads, fuses, controls, etc.
Excessive humming	High Voltage.	Check input line connections.
	Eccentric air gap.	Have motor serviced at local Baldor service center.
Motor Over Heating	Overload. Compare actual amps (measured) with nameplate rating.	Locate and remove source of excessive friction in motor or load. Reduce load or replace with motor of greater capacity.
	Single Phasing.	Check current at all phases (should be approximately equal) to isolate and correct the problem.
	Improper ventilation.	Check external cooling fan to be sure air is moving properly across cooling fins. Excessive dirt build-up on motor. Clean motor.
	Unbalanced voltage.	Check voltage at all phases (should be approximately equal) to isolate and correct the problem.
	Rotor rubbing on stator.	Check air gap clearance and bearings.
		Tighten “Thru Bolts”.
	Over voltage or under voltage.	Check input voltage at each phase to motor.
	Open stator winding.	Check stator resistance at all three phases for balance.
	Grounded winding.	Perform dielectric test and repair as required.
	Improper connections.	Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity. Refer to motor lead connection diagram.
Bearing Over Heating	Misalignment.	Check and align motor and driven equipment.
	Excessive belt tension.	Reduce belt tension to proper point for load.
	Excessive end thrust.	Reduce the end thrust from driven machine.
	Excessive grease in bearing.	Remove grease until cavity is approximately $^3/_4$ filled.
	Insufficient grease in bearing.	Add grease until cavity is approximately $^3/_4$ filled.
	Dirt in bearing.	Clean bearing cavity and bearing. Repack with correct grease until cavity is approximately $^3/_4$ filled.
Vibration	Misalignment.	Check and align motor and driven equipment.
	Rubbing between rotating parts and stationary parts.	Isolate and eliminate cause of rubbing.
	Rotor out of balance.	Have rotor balance checked are repaired at your Baldor Service Center.
	Resonance.	Tune system or contact your Baldor Service Center for assistance.
Noise	Foreign material in air gap or ventilation openings.	Remove rotor and foreign material. Reinstall rotor. Check insulation integrity. Clean ventilation openings.
Growling or whining	Bad bearing.	Replace bearing. Clean all grease from cavity and new bearing. Repack with correct grease until cavity is approximately $^3/_4$ filled.

Suggested bearing and winding RTD setting guidelines

Most large frame AC Baldor motors with a 1.15 service factor are designed to operate below a Class B (80°C) temperature rise at rated load and are built with a Class H winding insulation system. Based on this low temperature rise, RTD (Resistance Temperature Detectors) settings for Class B rise should be used as a starting point. Some motors with 1.0 service factor have Class F temperature rise.

The following tables show the suggested alarm and trip settings for RTDs. Proper bearing and winding RTD alarm and trip settings should be selected based on these tables unless otherwise specified for specific applications.

If the driven load is found to operate well below the initial temperature settings under normal conditions, the alarm and trip settings may be reduced so that an abnormal machine load will be identified.

The temperature limits are based on the installation of the winding RTDs imbedded in the winding as specified by NEMA. Bearing RTDs should be installed so they are in contact with the outer race on ball or roller bearings or in direct contact with the sleeve bearing shell.

Winding RTDs – Temperature Limit In °C (40°C Maximum Ambient)

Motor Load	Class B Temp Rise ≤ 80°C (Typical Design)		Class F Temp Rise ≤ 105°C		Class H Temp Rise ≤ 125°C	
	Alarm	Trip	Alarm	Trip	Alarm	Trip
≤ Rated Load	130	140	155	165	175	185
Rated Load to 1.15 S.F.	140	150	160	165	180	185

Note: • Winding RTDs are factory production installed, not from Mod–Express.
• When Class H temperatures are used, consider bearing temperatures and lubrication requirements.

Bearing RTDs – Temperature Limit In OC with 40°C Max Ambient

Bearing Type Oil or Grease	Anti–Friction		Sleeve	
	Alarm	Trip	Alarm	Trip
Standard*	95	100	85	95
High Temperature**	110	115	105	110

Note: * Bearing temperature limits are for standard design motors operating at Class B temperature rise.
** High temperature lubricants include some special synthetic oils and greases.

Greases that may be substituted that are compatible with Polyrex EM (but considered as “standard” lubricants) include the following:
– Texaco Polystar
– Rykon Premium #2
– Chevron SRI #2

See the motor nameplate for replacement grease or oil recommendation. Contact Baldor application engineering for special lubricants or further clarifications.

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MN400

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Understanding UL Classifications, Groups and Divisions

Classifications

UL classification for hazardous location motors is based on the atmosphere in which the motor will be operating under normal conditions. There are three major classifications, each with unique atmospheric conditions:

- **Class I** for gases, vapors and/or flammable liquids
- **Class II** for combustible dusts
- **Class III** for ignitable fibers and/or filings

Groups

Each classification and atmosphere is broken into various groups. Groups are determined by ignitable volatility or explosiveness, and the concentration of the material present. The highest combustible atmosphere is Group A. Subsequent alphabetical Group designations are progressively less volatile, i.e. Group B, then Group C, etc. Following is a partial listing of atmospheres that relate to each Group:

- **Group A:** Acetylene
- **Group B:** Hydrogen, butadiene, ethylene oxide and propylene oxide, and equivalent hazardous material
- **Group C:** Cyclopropane, ethyl ether, ethylene and equivalent hazardous materials
- **Group D:** Acetone, alcohol, ammonia, benzene, benzol, butane, gasoline, hexane, lacquer solvent vapors, naphtha, natural gas, propane and equivalent hazardous materials
- **Group E:** Metal dusts including aluminum, magnesium and their alloys, and other equivalent hazardous materials
- **Group F:** Carbon black, charcoal, coal or coke dusts
- **Group G:** Flour, starch, grain, combustible plastics and chemical dusts

Divisions

Divisions are determined by the atmosphere that is present under normal operating conditions. **Division 1** relates to an atmosphere that normally contains highly combustible material. **Division 2** involves a normal atmosphere that is non-combustible, but can change due to an accident or equipment malfunction.

CAUTION

Motors misapplied in hazardous environments can cause a fire or explosion resulting in destruction of property, serious injury or death. Only the end user or a qualified underwriter is to identify and select the proper class, group, division, and temperature code motor to meet the requirements of each installation. Baldor personnel, agents and distributors can advise what listings and approvals Baldor motors carry, but cannot evaluate nor recommend what motors may be suitable for use in hazardous environments.

Temperature Ratings and Code Numbers:

The circled code numbers below are used to identify the explosion-proof motor's Class, Group and Temperature Rating for which the motor is approved. You will find these numbers next to motor catalog numbers in this brochure.

Surface temperatures of Baldor Explosion-Proof Motors will not exceed the following UL and CSA maximums under fault conditions.

A. Class I Group D listings only.

① Motors with Class B insulation will not exceed surface temperatures of 230°C (446°F) equivalent Code T2C.

⑥ Motors with Class F insulation 1.0 S.F. will not exceed surface temperatures of 260°C (536°F) equivalent to Code T2B.

⑨ Motors with Class F insulation and 1.15 S.F. will not exceed surface temperatures of 260°C (500°F) equivalent to Code T2B.

B. Class I, Group C & D listings only.

⑤ Motors with Class F insulation and 1.15 S.F. will not exceed surface temperatures of 260°C (500°F) equivalent to Code T3C.

⑨ Motors with Class F insulation and 1.15 S.F. will not exceed surface temperatures of 160° (320°F) equivalent to Code T3C.

C. Class I Group D, Class II Group F & G listings.

③ Shunt wound DC motors, 182 through 215 frame sizes, 1/2 through 3 hp, will not exceed surface temperature of 165°C (329°F), equivalent to Code T3B.

⑦ Fractional hp motors in Baldor type 35 will not exceed surface temperatures of 135°C (275°F) equivalent to Code T4.

⑦ Frames 364T through 449T will not exceed surface temperatures of 135°C (275°F) equivalent to Code T4.

⑧ Fractional hp motors in Baldor type 34, and 1 hp motors and greater built in Baldor type 35, frames 143T through 326T will not exceed surface temperature of 160°C (320°F) equivalent to Code T3C.

⑧ Fractional hp AC motors in Baldor type 34, and permanent magnet DC motors in Baldor type 34 and 35, will not exceed surface temperature of 160° (320°F) equivalent to Code T3C.

D. Class I, Group C & D, Class II, Group F & G listings.

② Baldor frames 182T through 449T will not exceed surface temperatures of 160°C (320°F) equivalent to Code T4.

Contact your local Baldor office for other Class and Group listings.

Explosion-Proof C-Face Motors

These motors carry the same explosion-proof specs as Baldor's rigid base motors, with NEMA C-face mounting configurations. Available from stock in single and three phase, 1/3 hp through 50 hp, in NEMA frames 56C through 326TC. All motors are UL and CSA approved for Class I – Group D and Class II – Group F and G, and are rated at a 1.0 Service Factor.

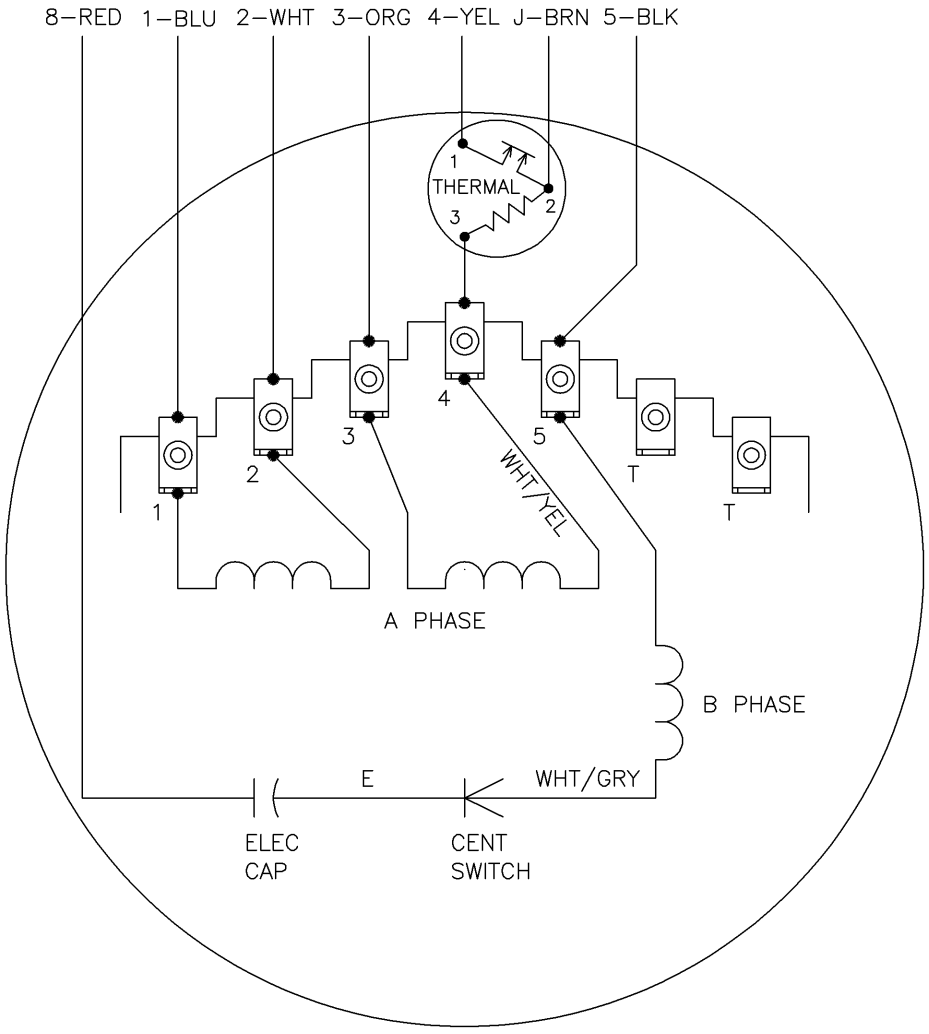
Performance Data, Single Phase

Hp	kW	RPM	Frame	Catalog No.	Amps @ High V Full Load	Amps @ High V Locked Rotor	Full Load Torque Lb. Ft.	Efficiency % 1/2	Efficiency % 3/4	Efficiency % Full Load	Power Factor % 1/2	Power Factor % 3/4	Power Factor % Full Load	Bearings DE	Bearings ODE	Volt Code	"C" Dim.	Conn. Diag. No.
0.33	0.25	1725	56C	CL5001A⑧	3.0	13.0	1.0	41.0	52.0	60.0	41	52	60	6203	6203	A	13.22	CD0565
0.33	0.25	1725	56C	VL5001A⑧	3.0	13.0	1.0	41.0	52.0	60.0	41	52	60	6203	6203	A	13.22	CD0008
0.33	0.25	1140	56C	VL5002A⑦	3.4	26.0	1.5	41.5	50.1	54.0	42	50	56	6205	6203	B	14.30	CD0008
0.50	0.37	3450	56C	CL5003A⑧	3.7	18.5	0.75	49.7	57.4	57.0	49	61	71	6203	6203	B	13.22	CD0565
0.50	0.37	3450	56C	VL5003A⑧	3.7	18.5	0.75	49.7	57.4	57.0	49	61	71	6203	6203	B	13.22	CD0565
0.50	0.37	1725	56C	CL5004A⑧	3.7	19.41	1.5	55.2	62.0	64.0	48	59	66	6203	6203	A	14.22	CD0565
0.50	0.37	1725	56C	VL5004A⑧	3.7	19.41	1.5	55.2	62.0	64.0	48	59	66	6203	6203	A	14.22	CD0008
0.50	0.37	1140	56C	VL5005A⑦	4.0	19.0	2.25	57.0	62.3	59.0	41	49	63	6205	6203	B	15.17	CD0008
0.75	0.56	3450	56C	VL5006A⑦	4.9	28.3	1.13	50.0	58.0	62.0	60	70	75	6205	6203	B	14.30	CD0008
0.75	0.56	1725	56C	CL5007A⑦	5.3	34.0	2.25	58.2	65.4	66.0	45	56	68	6205	6203	B	15.17	CD0008
0.75	0.56	1725	56C	VL5007A⑦	5.3	34.0	2.25	58.2	65.4	66.0	45	56	68	6205	6203	B	15.17	CD0008
1	0.75	3450	56C	CL5009A⑦	6.0	35.0	1.5	65.0	67.0	66.0	64	75	81	6205	6203	B	15.17	CD0008
1	0.75	3450	56C	VL5009A⑦	6.0	35.0	1.5	65.0	67.0	66.0	64	75	81	6205	6203	B	15.17	CD0008
1	0.75	1725	56C	CL5023A①	6.5	37.0	3.0	63.0	66.8	67.0	53	65	73	6205	6203	B	15.17	CD0008
1	0.75	1725	56C	VL5023A①	6.5	37.0	3.0	63.0	66.8	67.0	53	65	73	6205	6203	B	15.17	CD0008
1.5	1.1	3450	143TC	CL5030T⑧	7.5	42.0	2.3	65.3	68.4	70.0	64	73	82	6205	6203	A	16.10	CD0001
1.5	1.1	1725	184C	CL5013⑧	9.5	68.0	4.5	66.9	72.6	70.0	50	61	70	6206	6205	B	16.94	CD0001
1.5	1.1	1725	56C	VL5024A①	8.0	47.0	2.2	73.9	77.8	75.0	59	72	78	6205	6203	B	17.42	CD0008
2	1.5	3450	143TC	CL5031T⑧	11.5	77.5	1.5	64.2	70.5	74.0	65	75	82	6205	6203	A	16.10	CD0001
2	1.5	1725	182TC	CL5027T①	11.0	61.0	6.0	72.3	74.3	75.0	58	69	81	6206	6205	B	18.87	CD0001
2	1.5	1725	184C	VL5027①	11.0	61.0	6.0	72.3	74.3	75.0	58	69	81	6206	6205	A	16.94	CD0001
3	2.2	3450	184TC	CL5028T①	14.5	86.0	4.5	71.0	73.5	76.0	83	88	87	6206	6205	B	18.87	CD0001
3	2.2	1725	215C	CL5018①	15.0	90.0	4.5	75.0	79.1	79.0	61	72	77	6307	6206	B	19.56	CD0076
5	3.7	1725	215C	CL5020①	21.0	139	15.1	84.1	85.7	84.0	87	91	92	6307	6206	C	20.69	CD0017A02

Performance Data, Three Phase

Hp	kW	RPM	Frame	Catalog No.	Amps @ High V Full Load	Amps @ High V Locked Rotor	Full Load Torque Lb. Ft.	Efficiency % 1/2	Efficiency % 3/4	Efficiency % Full Load	Power Factor % 1/2	Power Factor % 3/4	Power Factor % Full Load	Bearings DE	Bearings ODE	Volt Code	"C" Dim.	Conn. Diag. No.
0.33	0.25	1725	56C	VM7002A⑧	0.8	4.4	1.0	59.0	65.0	67.0	40	50	57	6203	6203	E	13.22	CD0007
0.50	0.37	3450	56C	CM7005A⑧	1.1	6.0	0.75	56.3	64.0	68.0	44	56	63	6203	6203	E	13.22	CD0007
0.50	0.37	3450	56C	VM7005A⑧	1.1	6.0	0.75	56.3	64.0	68.0	44	56	63	6203	6203	E	13.22	CD0007
0.50	0.30	1725	56C	CM7006A⑧	1.0	6.7	1.5	65.0	71.7	74.0	39	51	63	6203	6203	E	13.22	CD0007
0.50	0.37	1725	56C	VM7006-5⑧	0.9	5.5	1.5	59.0	66.7	74.0	41	52	60	6205	6203	H	14.30	CD0006
0.50	0.37	1725	56C	VM7006A⑧	1.0	6.7	1.5	65.0	71.7	74.0	39	51	63	6203	6203	E	13.22	CD0007
0.50	0.37	1140	56C	VM7007A⑦	1.2	5.8	2.25	57.0	64.0	70.0	37	47	55	6205	6203	E	14.30	CD0007
0.75	0.56	3450	56C	CM7009A⑧	1.3	7.6	1.2	70.6	73.6	75.0	58	67	73	6203	6203	E	13.22	CD0007
0.75	0.56	3450	56C	VM7009A⑧	1.3	7.6	1.2	70.6	73.6	75.0	58	67	73	6203	6203	E	13.22	CD0007
0.75	0.56	1725	56C	CM7010A⑧	1.5	10.0	2.25	69.7	74.7	73.0	42	55	58	6203	6203	E	14.22	CD0007
0.75	0.56	1725	56C	VM7010-5⑧	1.2	6.7	2.3	64.0	70.4	76.0	46	58	69	6205	6203	H	14.30	CD0006
0.75	0.56	1725	56C	VM7010A⑧	1.5	10.0	2.25	69.7	74.7	73.0	42	55	58	6203	6203	E	14.22	CD0007
0.75	0.56	1140	56C	VM7031A⑦	1.4	8.0	3.4	71.0	75.0	77.0	42	55	63	6205	6203	E	15.17	CD0007

Volt Code: A=115/208-230, B=115/230, C=230, E=208-230/460, H=575 volts.
Circled number next to Catalog number indicates the motor's temperature rating, approval class and group. See page 10
Contact Baldor for certified data.
See page 18 for layout drawing
See pages 29-31 for Connection Diagrams.

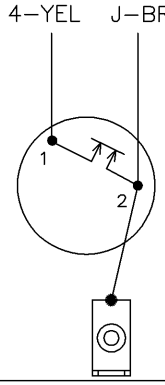


	LINE A	LINE B	JOIN	JOIN
HIGH STD	1	4	2,3,8	J,5
HIGH OPP	1	4	2,3,5	J.8
LOW STD	1,3,8	4	–	2,J,5
LOW OPP	1,3,5	4	–	2,J,8

NOTES:

1. STANDARD ROTATION IS CCW FACING END OPPOSITE SHAFT EXTENSION.
2. MULTIPLE CAPACITORS ARE CONNECTED IN PARALLEL UNLESS OTHERWISE SPECIFIED.
3. LEAD COLORS ARE OPTIONAL. LEADS MUST ALWAYS BE NUMBERED AS SHOWN.

CONNECTIONS FOR TWO–TERMINAL THERMAL



REV. DESC: REVISE TO SHOW OPTIONAL COLORS			
REV. LTR: C	BY: JLP	REVISED: 04/08/99 3:25	TDR: 0178636
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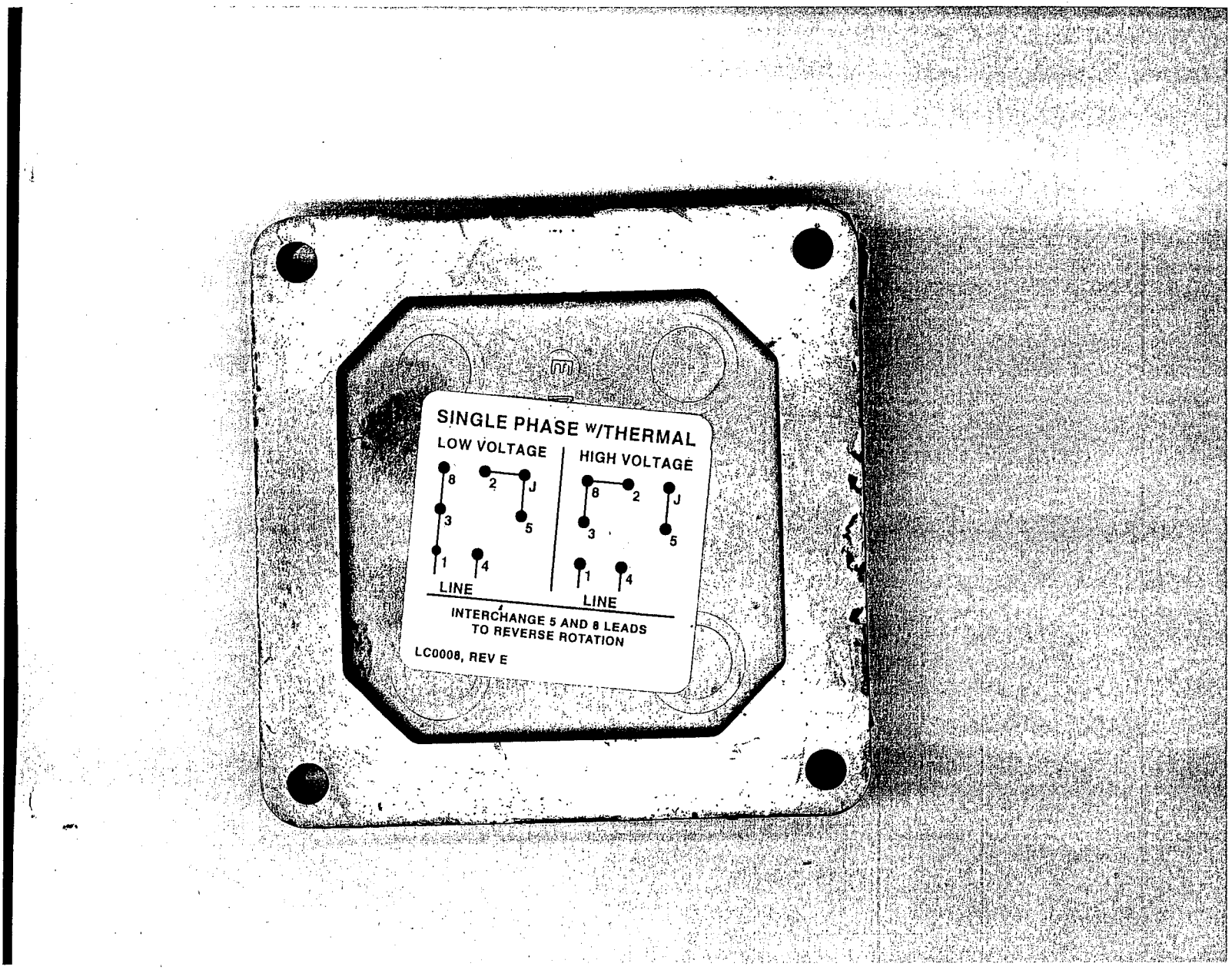
		MTL: –	

BALDOR ELECTRIC Co.

TYPE L, DV, REV, THERMAL, 7 LD, 34XP

CD0565



Motor Wiring Diagram

CONTENTS

INSTALLATION

GENERAL

Before installation is started a few items of a general nature should be considered.

1. *Location* - always locate the pump as close as possible to the supply of liquid to be pumped. Locate it below the liquid supply if at all practical. Viking pumps are self priming but the better the suction conditions the better the performance.

2. *Accessibility* - the pump should be located where it is accessible for inspection, maintenance, and repair. For large pumps, allow room to remove the rotor and shaft without removing the pump from the base.

3. *Port Arrangement* - since the pumps have different port arrangements depending on the model, port location should be checked before starting the installation. The ports may be upright, opposite or at right angles to each other, see Figure 1. The right angle ports are normally right-hand, see Figure 2; some models are available with left-hand arrangements; still other models are available with the right angle ports located in any one of eight positions including right-hand and left-hand.

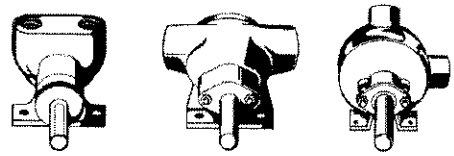


FIGURE 1

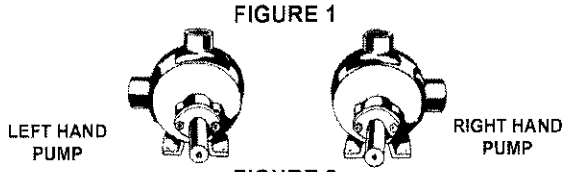


FIGURE 2

4. *Suction/Discharge* - shaft rotation will determine which port is suction and which is discharge. A look at Figure 3 will show how rotation determines which port is which; as the pumping elements (gears) come out of mesh, point "A" on Figure 3, liquid is drawn into the suction port; as the gears come into mesh, point "B", the liquid is forced out the discharge port. Reversing the rotation reverses the flow through the pump. When determining shaft rotation, always look from the shaft end of the pump. Unless otherwise specified, rotation is assumed to be clockwise (CW), which makes the suction port on the right side of the pump. The idler pin, which is offset in the pump head, should be properly positioned toward and an equal distance between the port connections.

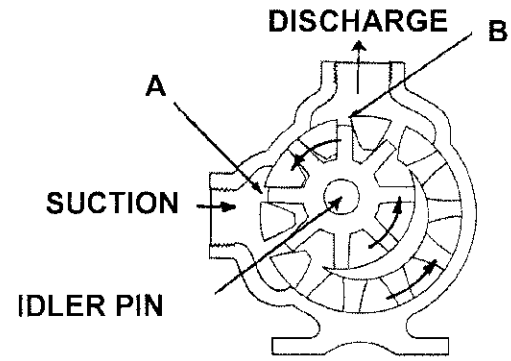
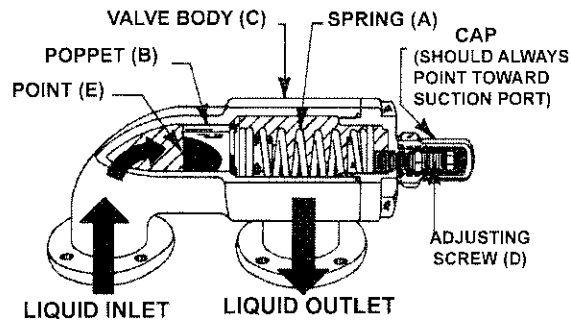


FIGURE 3

5. *Pressure Protection* - Viking pumps are positive displacement. This means that when the pump is rotated, liquid will be delivered to the discharge side of the pump. If there is no place for this liquid to go - discharge line is blocked or closed - pressure can build up until the motor stalls, the drive equipment fails, a pump part breaks or ruptures, or the piping bursts. Because of this, some form of pressure protection must be used with a positive displacement pump. This may be relief valve mounted directly on the pump, an inline relief valve, a torque limiting device or a rupture disk



CUT-AWAY OF VIKING INTERNAL PRESSURE RELIEF VALVE

FIGURE 4

The pressure relief valve mounted on Viking pumps and most in-line valves are of the spring loaded poppet design See Figure 4. The spring (A) holds poppet (B) against the seat in the valve body (C) with a given force determined by the spring size and by how tightly it is compressed by the adjusting screw (D). The pump discharge pressure pushes

against the underside of the poppet at point (E). When the force exerted by the liquid under the poppet exceeds that exerted by the spring, the poppet lifts and liquid starts to flow through the valve. As the discharge pressure builds up, more and more of the liquid flows through until a pressure is reached at which all of the liquid being pumped is going through the valve. This is pressure is the relief valve setting.

CAUTION !

Internal type relief valves mounted on Viking pumps should always have the cap or bonnet pointed toward the suction side of the pump. Return-to-tank-type relief valves should always be mounted on the discharge side of the pump. If pump rotation is reversed, change the relief valve. Turn the internal type end for end; move the return-to-tank type to the other port. If, on a particular installation rotation is reversed, e.g., *using one pump to fill a tank and then by use of a reversing switch or other means changing the rotation to permit the same pump to circulate the liquid through a heater or to load out)* **then pressure protection must be provided on both sides of the pump for both rotations. This may be a combination of relief valves, torque limiting devices or rupture disks.**

Pumps or systems without relief valves should have some form of pressure protection e.g. Torque limiting devices or rupture disks.

Viking pumps can be furnished with either an internal pressure relief valve - one which directs the flow from the valve back to the suction side of the pump - or a return-to-tank valve which directs the flow through piping back to the supply tank. See Figures 5A and 5B. An inline relief valve mounted in the discharge piping also directs the flow back to the supply tank. This type of valve should be mounted close to the pump so that the pressure drop through the piping between the pump and the valve is at a minimum. Be sure there are no shutoff valves between the pump and relief valve. Piping from a return-to-tank or an in-line valve to the supply tank should also be as short and large as possible.

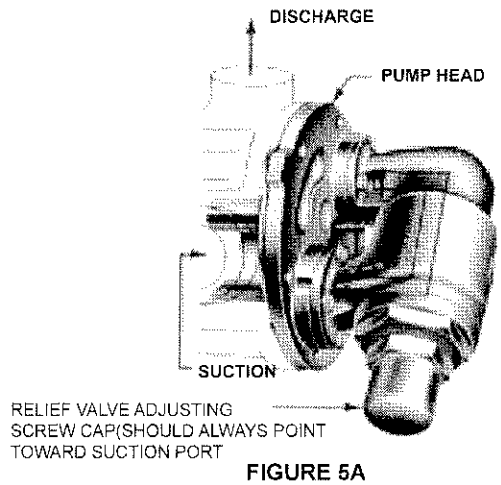


FIGURE 5A
INTERNAL PRESSURE RELIEF VALVE

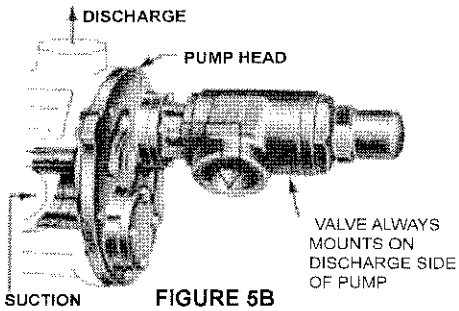


FIGURE 5B
RETURN-TO-TANK PRESSURE RELIEF VALVE

NOTE: on some models the relief valve is mounted on the pump casing instead of the pump head.

The spring loaded poppet-type valve is strictly a differential valve, sensing only those pressures on each side of the poppet. It should **not** be used as a pressure or flow control device. **It is intended strictly as a relief valve.**

The pressure at which either the return-to-tank or internal relief valve bypasses can be changed by turning the adjusting screw. Do not back the adjusting screw all the way out. Stop when spring tension is off the screw (the screw starts to turn easily). For details on maintenance of the relief valve see Technical Service Manual covering your model series.

6. Motor - follow local electrical codes when booking up motors.

FOUNDATION

Every pump should have a solid foundation. It may be any structure sufficiently strong to hold the pump rigid and to absorb any strain or shock that may be encountered.

A certified print of the pumping unit should be used in preparing the foundation. If a separate foundation is provided, make it at least four inches wider and longer than the base of the unit.

When the unit is placed on the foundation it should be leveled and checked for position against the piping layout and then fastened down.

ALIGNMENT

CHECK ALIGNMENT AFTER MOUNTING

For detailed coupling alignment procedures see Viking service bulletin ESB-61.

The pump, drive, and motor were properly aligned at the time they were assembled. During shipping and mounting the alignment is often disturbed. **BE SURE TO RECHECK ALIGNMENT AFTER THE PUMP UNIT IS INSTALLED!**

1. Check pump ports to be sure they are square and in proper position; shim or move pump as required. Do not force piping to line up with the ports.

2. If the pump is driven by a flexible coupling(s) either direct connected to the motor or through a reducer, remove any coupling guards or covers and check alignment of the coupling halves. A straightedge (a piece of key stock works nicely) across the coupling must rest evenly on both rims at the top, bottom, and sides. See Figure 6.

3. If the pump is driven by V-belts, check the alignment by using a long straightedge or tightly drawn string across the face of the sheaves. See Figure 6A.

4. Make a final check on alignment after piping is hooked up.

   See item 13 under "Installation - Piping".
   Figures 7,8, and 9 show typical units - direct, gear reducer and V-belt drive.

5. For high temperature applications (those above 300°F) allow pump to reach operating temperature, then recheck alignment.

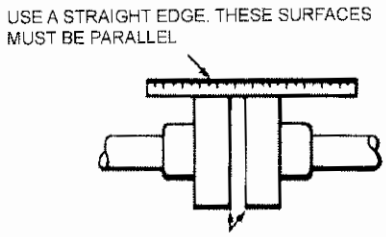


FIGURE 6

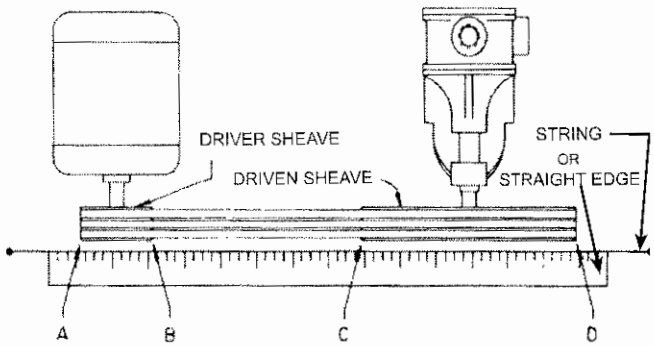


FIGURE 6A

PIPING

The cause of many pumping problems can be traced to suction piping. It should always be as large and short as practical. For help in selecting the proper size piping, both suction and discharge, refer to Viking General Catalog Section 510.

Before starting layout and installation of your piping system, consider the following points:

1. Never use piping smaller than the pump port connections.

2. Be sure the inside of the pipe is clean before hooking it up.

3. *Foot valve* - When pumping a light liquid with a suction lift, a foot valve at the end of the suction piping or a check valve in the first horizontal run will hold the liquid in the line and make it easier for the pump to prime. Be sure the foot or check valve is big enough so that it doesn't cause excessive line loss.

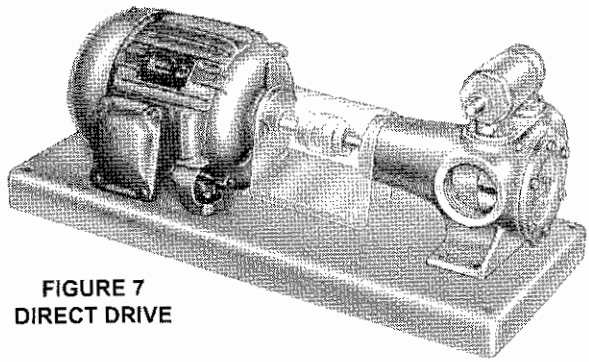


FIGURE 7
DIRECT DRIVE

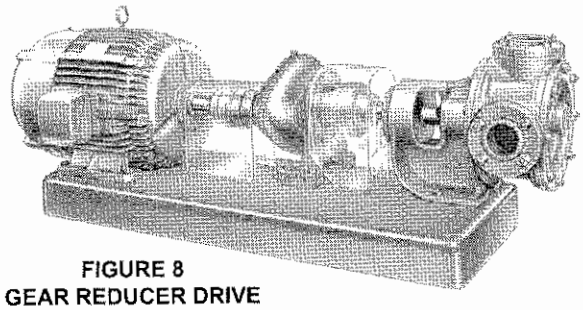


FIGURE 8
GEAR REDUCER DRIVE

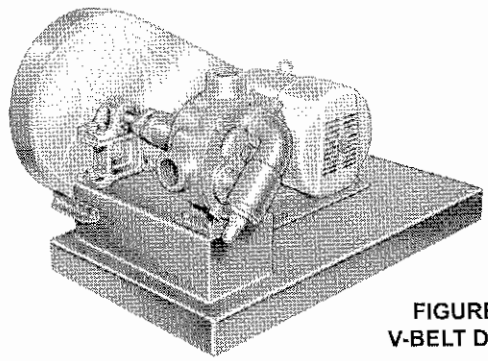


FIGURE 9
V-BELT DRIVE

4. When approaching an obstacle in the suction or discharge line, go around the obstacle instead of over it. Going over it creates an air pocket. See Figure 10.

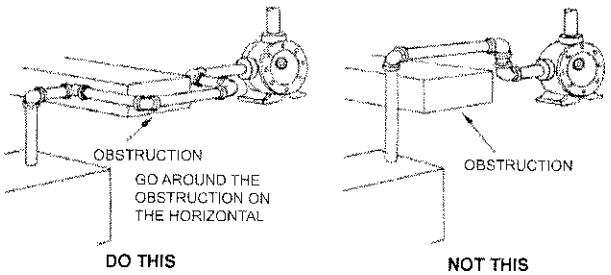


FIGURE 10

5. Where practical, slope the piping so no air or liquid pockets will be formed. Air pockets in the suction line make it hard for the pump to prime.

6. For a suction line with a long horizontal run keep the horizontal portion below the liquid level if possible. This keeps the pipe full so the pump does not have to remove so much air when starting; this is most helpful when there is no foot valve. See Figure 11.

7. When piping a hot or cold system (liquid being handled is at a temperature different from the air surrounding the pump), be sure allowance is made for expansion and contraction of the piping. Loops, expansion joints, or unsecured (this does not mean unsupported) runs should be used so the pump casing is not distorted or put into a bind.

8. **STRAINER** - It is always good practice to consider a strainer on the suction side of a positive displacement pump. The strainer will keep foreign objects from going into the pump; without a strainer some would go through; others would cause a jammed pump, a broken part, or a torn up drive. The strainer basket mesh or perforation size should be big enough so that it does not cause excessive pressure drop, but it should be fine enough to protect the pump. When in doubt as to the proper size, check with the manufacturer, giving him pipe size, flow rate, and viscosity involved. Provision should be made for cleaning the strainer. If the pump operates continuously, a bypass should be built around the strainer or two strainers should be put in parallel with proper valving so they can be isolated for cleaning. Use of a strainer is particularly important at start up to help clean the system of weld beads, pipe scale, and other foreign objects. For additional information, refer to TSM640.

9. If the pump is not equipped with a relief valve, consideration should be given to mounting one in the discharge line. See discussion on relief valves under START UP.

10. The pump should not be used to support the piping. The weight of the pipe should be carried by hangers, supports, stands, etc.

11. When fastening the piping to the pump it should not be necessary to impose any strain on the pump casing. "Springing" or "drawing" the piping up to the pump will cause distortion, possible misalignment, and probable rapid wear of the pump. Do not use the pump to correct errors in piping layout or assembly.

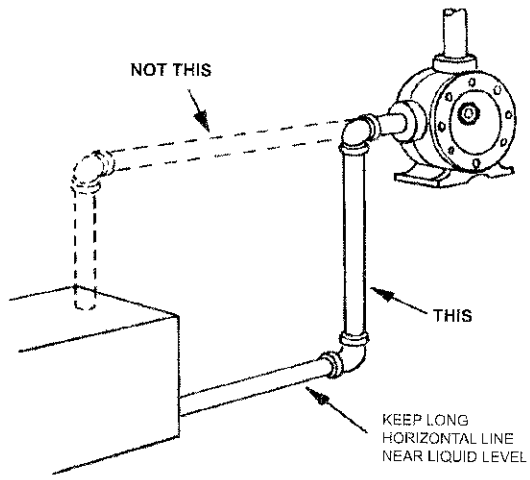


FIGURE 11

12. All joints of the piping system should be tight; pipe sealer or teflon tape will help assure leak-free threaded joints. Leaks in the suction line permitting air to be drawn in may cause a noisy pump, or a reduction in capacity.

13. **ALIGNMENT** - Check the alignment of the drive after the piping is hooked up. As a final check on pump alignment remove the head of the pump and with a feeler gauge determine if there is clearance all the way around between the rotor and casing. Because of manufacturing tolerances, bushing clearances, etc., the rotor may not be centered in the casing, but it should not drag; dragging would indicate unit misalignment or casing distortion from piping strain. Making this check is most desirable on installations involving Q, M and N size standard duty pumps.

14. The auxiliary piping hooked to jackets, glands, etc. for heating, cooling, quenching, or for other purposes should receive the same attention as the piping handling the liquid pumped.

15. Provide a pressure relief device in any part of a pump and piping system that can be valved off and, thus, completely isolated. This is particularly important:

    a). When handling a cold liquid such as refrigeration ammonia that can warm up to ambient temperatures when the pump is shut off or

    b). When handling a liquid such as asphalt or molasses that has to be heated before it can be pumped.

    The rise in temperature causes the liquid to expand; if there is no provision for pressure relief in the closed off section, there is a chance that the pump or piping will rupture.

START UP

Before pushing the "start" button, check the following:

1. Are there vacuum and pressure gauges on or near the pump? These gauges are the quickest and most accurate way of finding out what is happening in the pump.

2. Check alignment - See suggestions under "Installation - Alignment" in this manual.

3. Check piping to be sure there is no strain on the pump casing.

4. Rotate the pump shaft by hand to be sure it turns freely. **MAKE SURE THE PUMP DRIVER IS LOCKED OUT OR CANNOT BE ENERGIZED BEFORE DOING THIS.**

5. Jog motor to be sure it is turning in the right direction; see discussion on pump rotation under "Installation - General" item 4 in this manual.

6. Check any relief valves to be sure they are installed correctly. See discussion on relief valves under "Installation - General".

7. Check suction piping to be sure (a) it is all connected and tight, (b) valves are open, and (c) end of pipe is below liquid level.

8. Check discharge piping to be sure (a) it is connected and tight, (b) valves are open, and (c) there is a place for the liquid to go.

9. Lubricate any grease fitting on the pump using a good, general purpose #2 ball bearing grease. Check any gear reducer, motor, coupling, etc. for instructions and lubricate as recommended. See Engineering Service Bulletin ESB-515.

10. For packed pumps, loosen packing gland nuts so gland can be moved slightly by hand. Adjust gland to reduce leakage only after pump has run long enough to reach constant temperature. Packing should weep a little to keep it cool and lubricated.

11. Do **not** use the Viking pump to flush, pressure test or prove the system with water. Either remove the pump or run piping around it while flushing or testing. Pumping water, dirty or otherwise, can do more damage in a few minutes than months of normal service.

12. Check to be sure all guards are in place.

13. Now you are ready to push the "start" button - gently.

If the pump begins to deliver liquid within 60 seconds, you're in business. If it does not, push the "stop" button. Do **not** run the pump longer than one minute without liquid in it; you may damage it. Review the steps just outlined, consider what the suction and discharge gauges indicate, see page 6; if everything appears to be in order, put some liquid in the pump, a lubricating liquid is best. This will help it prime.

Push the "start" button again. If nothing is flowing within two minutes, stop the pump. The pump is not a compressor, it will not build up much air pressure; it may be necessary to vent the discharge line until liquid begins to flow.

If the pump still does not deliver, the cause may be one or more of the following:

1. Suction line air leaks; vacuum gauge reading should help determine if this is the problem.

2. End of suction pipe not submerged deep enough in liquid.

3. Suction lift is too great or the suction piping is too small.

4. Liquid is vaporizing in the suction line before it gets to the pump.

If after consideration of these points it still does not pump, suggest you review again all points given under START UP; read through Troubleshooting in this manual and try again. If it still does not pump, contact your Viking representative.

TROUBLESHOOTING

A Viking pump that is properly installed and maintained will give long and satisfactory performance.
NOTE: Before making any pump adjustment or opening the pump liquid chamber in any manner, make sure that:

1) any pressure in the pumping chamber has been vented through the suction or discharge lines or other openings provided for this purpose,
2) the driver has been "locked out" so that it cannot inadvertently be started while work is being done on the pump and
3) the pump has been allowed to cool down to the point where there is no chance of anyone being burned.

If trouble does develop, one of the first steps toward finding the difficulty is to *install a vacuum gauge in the suction port and a pressure gauge in the discharge port.* Readings on these gauges often will give a clue as to where to start looking for the trouble.

Vacuum Gauge - Suction Port

1. High reading would indicate -
   - **a).** Suction line blocked - foot valve stuck, gate valve closed, strainer plugged.
   - **b).** Liquid too viscous to flow through the piping.
   - **c).** Lift too high.
   - **d).** Line too small.

2. Low reading would indicate -
   - **a).** Air leak in suction line.
   - **b).** End of pipe not in liquid.
   - **c).** Pump is worn.
   - **d).** Pump is dry - should be primed.

3. Fluttering, jumping, or erratic reading -
   - **a).** Liquid vaporizing.
   - **b).** Liquid coming to pump in slugs, possibly an air leak insufficient liquid above the end of the suction pipe.
   - **c).** Vibrating from cavitation, misalignment, or damage parts.

Pressure Gauge - Discharge Port

1. High reading would indicate -
   - **a).** High viscosity and small and/or long discharge line.
   - **b).** Gate valve partially closed.
   - **c).** Filter plugged.
   - **d).** Vertical head did not consider a high specific gravity liquid.
   - **e).** Line partially plugged from build up on inside of pipe.
   - **f).** Liquid in pipe not up to temperature.
   - **g).** Liquid in pipe has undergone a chemical reaction and has solidified.
   - **h).** Relief Valve set too high.

2. Low reading would indicate -
   - **a).** Relief valve set too low.
   - **b).** Relief valve poppet not seating properly.
   - **c).** Bypass around the pump partially open.

d). Too much extra clearance.
e). Pump worn.

3. Fluttering, jumping, or erratic reading -
a). Cavitation.
b). Liquid coming to pump in slugs.
c). Air leak in suction line.
d). Vibrating from misalignment or mechanical problems.

Some of the following may also help pinpoint the problem:

A). Pump does not pump.
1. Lost its prime - air leak, low level in tank, foot valve stuck.
2. Suction lift too high.
3. Rotating in wrong direction.
4. Motor does not come up to speed.
5. Suction and discharge valves not open.
6. Strainer clogged.
7. Bypass valve open, relief valve set too low, relief valve poppet stuck open.
8. Pump worn out.
9. Any changes in the liquid system, or operation that would help explain the trouble, e.g. new source of supply, added more lines, inexperienced operators, etc.
10. Too much end clearance.
11. Head position incorrect. See Fig. 3.

B). Pump starts, then loses its prime.
1. Supply tank empty.
2. Liquid vaporizing in the suction line.
3. Air leaks or air pockets in the suction line; leaking air through packing or mechanical seal.
4. Worn out.

C). Pump is noisy.
1. Pump is being starved (heavy liquid cannot get to pump fast enough). Increase suction pipe size or reduce length.
2. Pump is cavitating (liquid vaporizing in the suction line). Increase suction pipe size or reduce length; if pump is above the liquid, raise the liquid level closer to the pump; if the liquid is above the pump, increase the head of liquid.
3. Check alignment.
4. May have a bent shaft or rotor tooth. Straighten or replace.
5. Relief valve chatter; increase pressure setting.
6. May have to anchor base or piping to eliminate or reduce vibration.
7. May be a foreign object trying to get into the pump through the suction port.

D). Pump not up to capacity.
1. Starving or cavitating - increase suction pipe size or reduce length.
2. Strainer partially clogged.
3. Air leak in suction piping or along pump shaft.
4. Running too slowly; is motor the correct speed and is it wired up correctly.
5. Bypass line around pump partially open.
6. Relief valve set too low or stuck open.
7. Pump worn out.
8. Too much end clearance.
9. Head position incorrect. See Fig. 3.

E). Pump takes too much power.
1. Running too fast - Is correct motor speed, reducer ratio, sheave size, etc. being used?
2. Is liquid more viscous than unit sized to handle; heat the liquid, increase the pipe size, slow the pump down, or get a bigger motor.
3. Discharge pressure higher than calculated, check with pressure gauge. Increase size or reduce length of pipe, reduce speed (capacity), or get bigger motor.
4. Packing gland drawn down too tight.
5. Pump misaligned.
6. Extra clearance on pumping elements may not be sufficient for operating conditions. Check parts for evidence of drag or contact in pump and increase clearance where necessary.

F). Rapid Wear.
On most applications the pump will operate for many months or years before it gradually loses its ability to deliver capacity or pressure. Examination of such a pump would show a smooth wear pattern on all parts. Rapid wear, occurring in a few minutes, hours or days, shows up as heavy grooving, galling, twisting, breaking or similar severe signs of trouble. SEE CHART PAGE 7.

PREVENTATIVE MAINTENANCE

Performing a few preventative maintenance procedures will extend the life of your pump and reduce the overall cost of ownership.

A). Lubrication - Grease all grease fittings after every 500 hours of operation or after 60 days, whichever occurs first. If service is severe, grease more often. Do it gently with a hand gun. Use a NLGI #2 grease for normal applications. For hot or cold applications use appropriate grease. See Engineering Service Bulletin ESB-515.

B). Packing Adjustment - Occasional packing adjustment may be required to keep leakage to a slight weep; if impossible to reduce leakage by gentle tightening, replace packing or use different type. See Technical Service Manual on particular model series for details on repacking.

C). End Clearance Adjustment - After long service the running clearance between the end of the rotor teeth and the head may have increased through wear to the point where the pump is losing capacity or pressure. Resetting end clearance will normally improve pump performance. See TSM on particular model series for procedure on adjusting end clearance for pump involved.

D). Examine Internal Parts - Periodically remove the head, examine idler and bushing and head and pin for wear. Replacing a relatively inexpensive idler bushing and idler pin after only moderate wear will eliminate the need to replace more expensive parts at a later date. See TSM on particular model series for procedure in removing head of the pump. Be sure idler does not slide off idler pin as head is removed and drop and hurt someone or damage the part.

E). Cleaning the Pump - A clean pump is easier to inspect, lubricate, adjust, and runs cooler; plus, it looks better.

F). Storage - If pump is to be stored, or not used for six months or more, pump must be drained and a light coat of non-detergent SAE 30 weight oil must be applied to all internal pump parts. Lubricate fittings and apply grease to pump shaft extension. Viking suggests rotating pump shaft by hand one complete revolution every 30 days to circulate the oil. Retighten all gasketed joints before using the pump.

RAPID WEAR

	CAUSE	EVIDENCE	POSSIBLE SOLUTION
1.	ABRASIVES	Gouges or marks made by large, hard particles; a rapid wearing away of bushings from very small abrasives similar to pumice; or anything in between.	Flush the system with the pump removed. Install strainer in suction line. Oftentimes after a system has run for a few cycles or a few days the dirt is pretty well cleaned out and if the pump is rebuilt into good condition it will then last for a long time.
2.	CORROSION	Rust, pitting or metal appears to be "eaten" away.	Check the Viking General Catalog Liquid List for materials of construction recommendation. Consider whether all of the materials used in pump construction were attacked; consider other materials used in the system to determine how they resisted the liquid. Check to see whether or not the liquid has been contaminated to make it more corrosive than anticipated.
3.	EXCEEDING OPERATING LIMITS	Noisy operation, broken bushings, twisted shaft, parts show evidence of high heat (discoloration).	Review General Catalog for operating limits on particular model involved.
4.	INSUFFICIENT EXTRA CLEARANCE	Pump may stall. Evidence of heavy contact between end of rotor teeth and head or other parts.	Increase end clearance and/or contact your distributor or the factory with details of the application so that information regarding proper extra clearance may be provided.
5.	LACK OF LUBRICATION	Noisy bearings, localized heating at bearings or lip seal, smoke, rapid bushing wear.	Be sure all grease fittings are greased before starting and instructions for lubrication of drive equipment are followed; consider use of auxiliary lubricating equipment.
6.	MISALIGNMENT	Wear on only one part of a surface, e.g., one side of the casing, one side of the packing gland, only a portion of the face of the head.	Double check alignment of drive equipment and piping. Check the alignment under conditions as close to operating conditions as possible.
7.	RUN DRY	Pump stalls because parts have uneven expansion caused by frictional heat; galling between surfaces having relative motion; seal seats and idler pins changing colour because of high heat.	Be sure there is liquid in the system at the time of start up. Provide some kind of automatic alarm or shut-off if supply tank runs dry.

DO'S AND DON'TS -

Do's and Don'ts for installation, operation, and maintenance of Viking pumps to assure safe, long, trouble-free operation.

INSTALLATION -

1. Do install pump as close to supply tank as possible.
2. Do leave working space around the pumping unit.
3. Do use large, short, and straight suction piping.
4. Do install a strainer in the suction line.
5. Do double check alignment after the unit is mounted and piping is hooked up.
6. Do provide a pressure relief valve for the discharge side of the pump.
7. Do cut out the center of gaskets used as port covers on flanged port pumps.
8. Do record pump model number and serial number and file for future reference.

OPERATION -

1. Don't run pump at speeds faster than shown in the catalog for your model.
2. Don't require pump to develop pressures higher than those shown in the catalog for your model.

3. Don't operate pumps at temperatures above or below limits shown in the catalog for your pump.
4. Don't operate pumps without all guards being in place.
5. Don't operate pump without a relief valve on the pump or in the discharge piping; be sure valve is mounted and set correctly.
6. Don't exceed catalog limits for temperature and pressures of fluids in jacketed areas of pump.
7. Don't use the pump in a system, which includes a steam blow or an air or vapour blow or purge **without** provision for over-speed shutdown in case the pump starts to act as a turbine and over-speeds the drive.
8. Don't operate the pump with all of the liquid bypassing through a pump mounted internal type relief valve or without any flow of liquid going through the pump for more than a couple of minutes. Operation under either of these conditions may result in a heat build-up in the pump, which could cause hazardous conditions or happenings.

MAINTENANCE -

1. Do make sure any pump that has residual system pressure in it or that has handled high vapour pressure liquids, e.g., LP-gas, ammonia, Freons, etc. has been vented through the suction or discharge lines or other openings provided for this purpose.
2. Do make sure that if the pump is still hooked to the driver while maintenance is being performed that the driver has been "locked out" so that it cannot be inadvertently started while work is being done on the pump.
3. Do make sure any pump that has handled a corrosive, flammable, hot, or toxic liquid has been drained, flushed, vented and/or cooled before it is disassembled.
4. Don't drop parts during disassembly, e.g., idler can slip from the pin as the head is removed from the pump; it may drop on your foot, plus, it may get nicked or gouged.
5. Don't stick fingers in the ports of a pump! Serious injury may result.
6. Don't spin the idler on the idler pin! Fingers may be jammed between teeth and crescent.
7. Do remember that a few simple preventative maintenance procedures such as periodic lubrication, adjustment of end clearance, examination of internal parts, etc., will extend the service life of your pump.
8. Do **obtain**, read and keep maintenance instructions furnished with your pump.
9. Do have spare parts, pumps or standby units available, particularly if the pump is an essential part of a key operation or process.

VIKING PUMP

IDEX CORPORATION

WARRANTY

Viking warrants all products manufactured by it to be free from defects in workmanship or material for a period of one (1) year from date of startup, provided that in no event shall this warranty extend more than eighteen (18) months from the date of shipment from Viking. If, during said warranty period, any products sold by Viking prove to be defective in workmanship or material under normal use and service, and if such products are returned to Viking's factory at Cedar Falls, Iowa, transportation charges prepaid, and if the products are found by Viking to be defective in workmanship or material, they will be replaced or repaired free of charge, FOB. Cedar Falls, Iowa.

Viking assumes no liability for consequential damages of any kind and the purchaser by acceptance of delivery assumes all liability for the consequences of the use or misuse of Viking products by the purchaser, his employees or others. Viking will assume no field expense for service or parts unless authorized by it in advance.

Equipment and accessories purchased by Viking from outside sources which are incorporated into any Viking product are warranted only to the extent of and by the original manufacturer's warranty or guarantee, if any.

THIS IS VIKING'S SOLE WARRANTY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, WHICH ARE HEREBY EXCLUDED, INCLUDING IN PARTICULAR ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. No officer or employee of IDEX Corporation or Viking Pump, Inc. is authorized to alter this warranty.

TECHNICAL SERVICE MANUAL

VIKING PUMP

GENERAL PURPOSE SPECIAL MOUNTED PUMPS
SERIES 75 AND 475
SIZES G-HL

CONTENTS

INTRODUCTION

The illustrations used in this manual are for identification purposes only and *should not be used for ordering parts.* Secure a parts list from the factory or a Viking representative. Always give complete name of part, part number and material, with the model number and serial number of the pump when ordering repair parts. This model number and serial number can be found on the nameplate attached to the pump casing. This is important identification for ordering parts or a replacement pump. It is positive assurance you will receive the correct pump parts.

Your pump is composed of four major parts. Only two of these are moving parts, the rotor and idler.

An exploded parts drawing and list of parts is included to help you identify each part correctly. However to disassembly and reassemble the pump you will be covered step by step. Refer to pages 2 to 9.

UNMOUNTED PUMP MODELS	
WITH LIP SEAL	WITH MECHANICAL SEAL
G75	G475
GG75	GG475
H75	H475
HJ75	HJ475
HL75	HL475

MOUNTED PUMP MODELS			
WITH LIP SEAL	WITH MECHANICAL SEAL	NORMAL GPM @ 2000 RPM	NORMAL GPM @ 1800 RPM
G75M	G475M	5	7
GG75M	GG475M	7	10
H75M	H475M	10	15
HJ75M	HJ475M	13	20
HL75M	HL475M	20	30

INTERCHANGEABILITY

These pumps are furnished with either a mechanical seal or lip seal.
All models of the mechanical seal pumps and lip seal pumps are dimensionally interchangeable on any NEMA "C" flange motor. The mechanical seal is interchangeable with the lip seal in all pump sizes.

INSTALLATION

The suction line should be air tight and at least as large as the pump section port connections to prevent loss of prime or capacity. It should also be equipped with a strainer and if pumping light liquids at a high suction lift, a foot or check valve should be used. Always avoid high spots and obstructions in the suction line as these may cause noise, loss of capacity or air lock. Since these pumps are the positive displacement type, be sure there is no obstruction in the discharge line and all valves are in operating position before starting the pump. Be sure the adjusting screw of the relief valve on the pump point towards the suction port. Factory assembled pumps will have right hand port suction and left hand port discharge unless otherwise specified. Port location is determined by looking at mounting flange end of pump. The relief valve on the pump is excellent insurance against a clogged discharge line or closed valves in the discharge line.

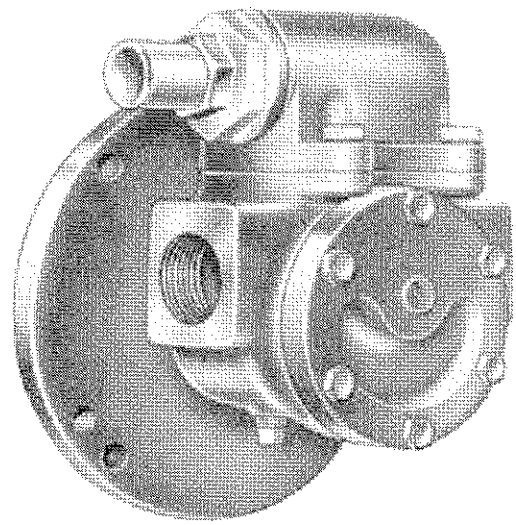


FIGURE 1
UNMOUNTED PUMP SHOWING FRONT VIEW OF G AND GG SIZE

SPECIAL INFORMATION

ROTATION: Viking pumps operate equally well in a clockwise or counterclockwise rotation. Shaft rotation determines which port is suction and which is discharge. Port in area where pumping elements (gear teeth) come out of mesh is suction port.

PRESSURE RELIEF VALVES:

1. Viking pumps are positive displacement pumps and must be provided with some sort of pressure protection. This may be a relief valve mounted directly on the pump, an inline pressure relief valve, a torque limiting device or a rupture disk.
2. This series of pumps may be equipped with an integral pressure relief valve. Standard configuration is for clockwise rotation (suction on the right viewing the shaft end of the pump) but it also may be ordered for counter clockwise rotation. The valve cannot be reversed for opposite rotation.
3. If pump rotation is reversed during operation, pressure protection must be provided on *both* sides of pump.
4. Relief valve adjusting screw cap must *always* point towards suction side of pump.
5. Pressure relief valves cannot be used to control pump flow or regulate discharge pressure.

For additional information on pressure relief valves, refer to Technical Service Manual TSM000 and Engineering Service Bulletin ESB-31.

NOTE: Lip seal pumps, Model G75, GG75, H75, HJ75, HL75, G75M, GG75M, H75M, HJ75M and HL75M are equipped with an internal suckback arrangement. A small suckback screw (self-locking) is inserted in a hole on the discharge side of the pump. This can be seen through the port opening and behind the rotor, (refer to figure 3). *The hole on the suction side must be left open* to prevent damage to the lip seals. Both holes are plugged in the mechanical seal pump Model G475, GG475, H475, HJ465, HL475, G475M, GG475M, H475M, HJ475M, and HL475M. Since these pumps have only two moving parts and are all performance tested at the factory, they seldom cause trouble. If trouble does occur we always advise investigating all other possible causes before disassembling the pump. Most troubles are caused by air leaks and obstruction in the suction line.

MAINTENANCE

The Series 75 and 475 pumps are designed for long trouble free life under a wide variety of application conditions, with minimum maintenance, however the following should be considered.

1. *LUBRICATION* – External lubrication not required for this series of pumps. The liquid being pumped lubricates the internal bearings in the pump.
2. *END CLEARANCE ADJUSTMENT* – After long term operation it is sometimes possible to improve the performance of the pump, without major repair, by adjusting the end clearance. Refer to instructions under assembly of the pump for information regarding this procedure.
3. *SAFETY RELIEF VALVE* – If your pump is equipped with a safety relief valve, adjustment can be made as follows. Remove the adjusting screw cap, turn in the adjusting screw to increase the pressure and turn-out to decrease the pressure. If the pump is not producing the rated capacity adjustment of the safety relief valve may be necessary. Be sure adjusting screw cap is re-installed before pump is started.
4. *CLEANING THE PUMP* - It is good practice to keep the pump as clean as possible. This will facilitate inspection, adjustment and repair work.
5. *STORAGE* - If the pump is to be stored or not used for any appreciable length of time it should be drained and a light coat of lubricating and preservative oil should be applied to the internal parts

SUGGESTED REPAIR TOOLS: The following tools must be available to properly repair Series 75 and 475 pumps. These tools are in addition to standard mechanics' tools such as open end wrenches, pliers, screw drivers, etc. Most of the items can be obtained from an industrial supply house.

1. Soft Headed hammer
2. Allen wrenches (some mechanical seals and set collars)
3. Mechanical seal installation sleeve
4. Brass bar
5. Arbor press

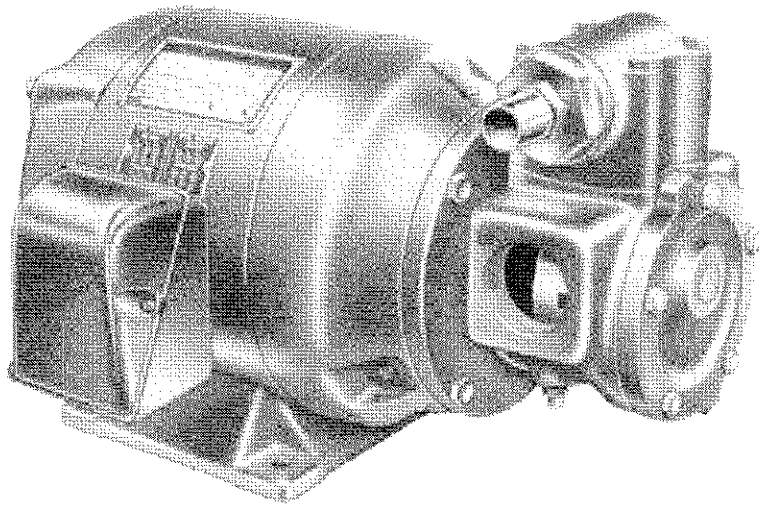


FIGURE 2
MOTOR MOUNTED PUMP SHOWING
H, HJ AND HL SIZE

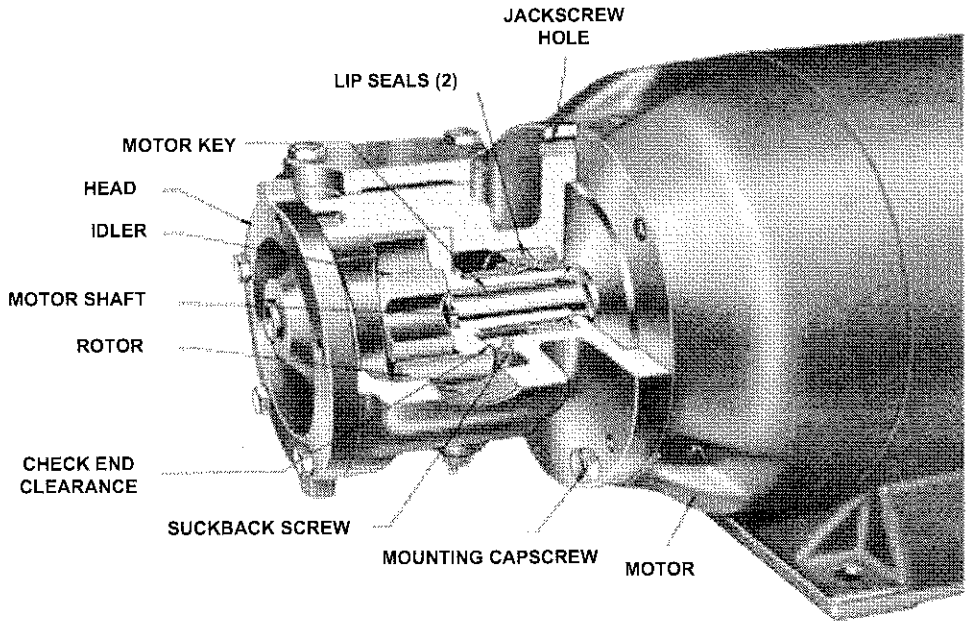


FIGURE 3
CUTAWAY OF H, HJ AND HL 75
LIP SEAL PUMP

DISASSEMBLY

DANGER

BEFORE OPENING ANY VIKING PUMP LIQUID CHAMBER (PUMPING CHAMBER, RESERVOIR, RELIEF VALVE ADJUSTING CAP FITTING ETC.) BE SURE:

1. THAT ANY PRESSURE IN CHAMBER HAS BEEN COMPLETELY VENTED THROUGH SUCTION OR DISCHARGE LINES OR OTHER APPROPRIATE OPENINGS OR CONNECTIONS.
2. THAT THE DRIVING MEANS (MOTOR, TURBINE, ENGINE, ETC.) HAS BEEN "LOCKED OUT" OR MADE NON-OPERATIONAL SO THAT IT CANNOT BE STARTED WHILE WORK IS BEING DONE ON PUMP.
3. THAT YOU KNOW WHAT LIQUID THE PUMP HAS BEEN HANDLING AND THE PRECAUTIONS NECESSARY TO SAFELY HANDLE THE LIQUID. OBTAIN A MATERIAL SAFETY DATA SHEET (MSDS) FOR THE LIQUID TO BE SURE THESE PRECAUTIONS ARE UNDERSTOOD.

FAILURE TO FOLLOW ABOVE LISTED PRECAUTIONARY MEASURES MAY RESULT IN SERIOUS INJURY OR DEATH.

1. REMOVE THE PUMP FROM THE MOTOR. Remove the four capscrews and use three as jackscrews in the threaded holes of the pump from motor shaft.
   NOTE: If the pump has a valve it must be removed first to have room for the jackscrews.
2. REMOVE PUMP HEAD.
   NOTE: Mark the head and casing before disassembly to make sure they are reassembled properly. The idler pin, which is offset in the pump head, should be properly positioned toward and equal distance between the port connections to allow for proper flow of liquid through the pump.
   If it is necessary to disassemble the pump for inspection or repair, first remove the head capscrews and remove head by tapping the head removing lugs lightly.

CAUTION

WHEN THE HEAD IS BEING REMOVED, THE IDLER USUALLY STAYS ON THE IDLER PIN. AVOID TILTING THE INSIDE OF THE HEAD DOWNWARD, AS THE IDLER MAY SLIDE OFF THE IDLER PIN AND FALL. A FALL ON A HARD SURFACE CAN DAMAGE THE IDLER. IF THE IDLER SHOULD FALL, CHECK CAREFULLY AND FILE OR STONE ALL NICKED OR ROUGH PLACES BEFORE REASSEMBLY.

3. REMOVE THE HEAD GASKETS. If a new set is not available, the original gaskets may be reused provided they are not damaged.
4. REMOVE THE IDLER FROM THE IDLER PIN. If idler pin is worn, both the head, idler pin and idler bushing should be replaced.
   If the idler bushing is worn, a new bushing is needed.
   If the new bushing is carbon graphite, special care must be taken when pressing it into the idler. An arbor press should always be used; be sure the bushing is started straight. DO NOT STOP the pressing operation until bushing is in its proper location. Carbon graphite is brittle; starting and stopping the pressing operation frequently results in a cracked bushing. If cracked in the idler, the bushing, will quickly disintegrate.
5. REMOVE THE ROTOR FROM THE CASING. The rotor of the two smaller pumps (G & GG sizes) can be removed by pressing of the end of hollow drive end of the rotor. It will be necessary on the models with mechanical seals (G475 & GG475) to use an arbor press and an arbor of approximately 1.375" diameter. The seal will remain in the casing.
   The rotor of the three larger size pumps (H, HJ, HL sizes) can also be removed by pushing on the hollow drive end of the rotor. The spring and rotary member of the mechanical seal will come out with the rotor in these pumps.
6. REMOVE THE MECHANICAL SEAL OR LIP SEALS. (See figure 4) Remove the snap ring in the casing of the two smaller pumps (G and GG sizes) and the complete seal can be removed out of the large flanged end of the casing.
   Remove the spring and rotary member from the rotor and the seal seat or lip seals from the pump end of the casing of the three larger size pumps (H, HJ, HL).

REASSEMBLY

Reassembly of these pumps is explained by one of the following sets of instructions. Follow the instructions for the proper pump model.
Before starting to reassemble the pump, clean all parts thoroughly and replace those, which show signs of excessive wear or damage.

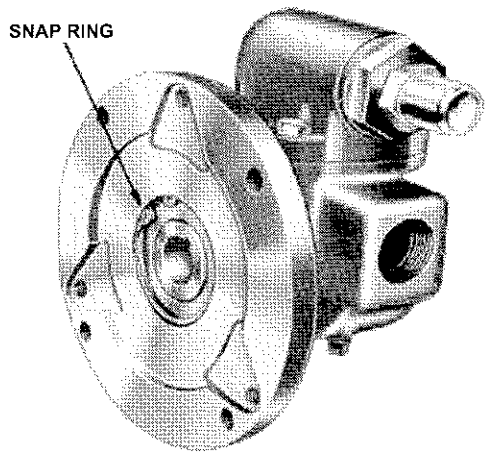


FIGURE 4
VIEW OF FLANGE END OF G AND GG475 MECH. SEAL PUMPS

To Reassemble Model G75 or GG75 Lip Seal Pumps: (see Figure 7)

1. INSTALL THE LIP SEALS. The lip seals should be installed in the casing one at a time from the large flanged end. The sealing lips must face away from each other.
   NOTE: Use an arbor press with an arbor of 2.188 diameter and press the lip seals in the casing as far as the will go. See figures 7, 8, 9, and 10 for a cross section of your pump models.
2. LUBRICATE THE LIP SEALS. Fill the area between the lips of the lip seals with grease.
3. INSTALL THE ROTOR. Flush the rotor hub with light oil (not grease) and insert the rotor in the casing with the hub through the lip seals.

CAUTION

TURN THE ROTOR BACK AND FOURTH AS YOU EXERT ENOUGH FORCE TO PUSH IT THROUGH THE LIP SEAL AND TO THE BOTTOM OF THE CASING. BE CAREFUL NOT TO FOLD UNDER THE LIP OF THE INNER SEAL.

4. INSTALL THE IDLER. Put the idler with the bushings on the idler pin.
5. PLACE HEAD GASKETS ON THE PUMP HEAD. The proper amount of gaskets should be used to provide necessary end clearance within the pump so it turns freely with no appreciable end play. Gasket table 1 gives the normal amount of gaskets used.

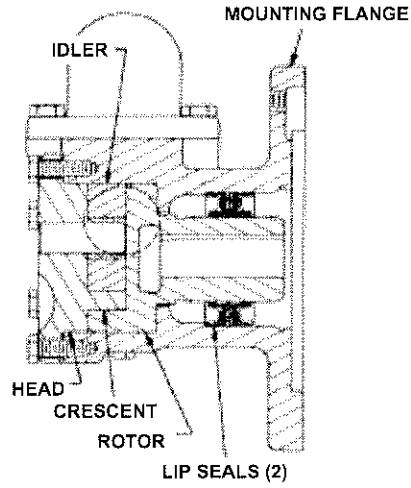


FIGURE 7
SECTIONAL DRG. OF MODELS G75, GG75
LIP SEAL PUMPS

6. THE HEAD CAN NOW BE ASSEMBLED ON THE PUMP. Tilt the top of the head away from the pump slightly until the crescent enters the inside diameter of the rotor and rotate the idler until its teeth mesh with the rotor teeth. Do not damage the head gaskets. Note correct position of idler and crescent (See figure 7 and Disassembly step 2). Tighten the head capscrews and then check the end clearance.

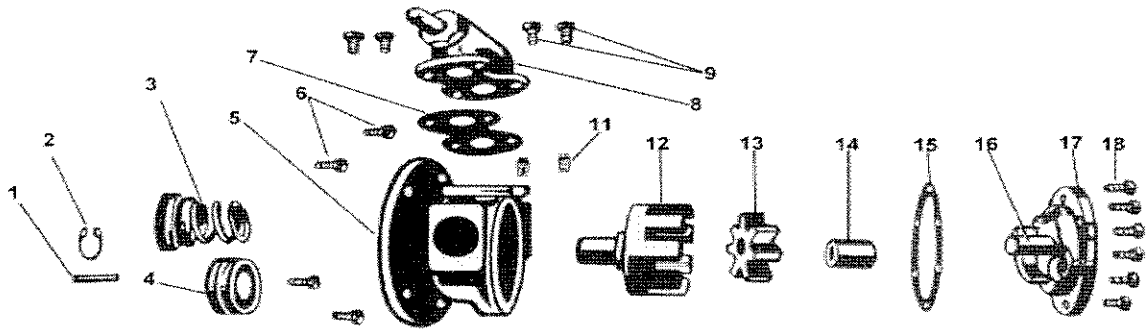


FIGURE 5
EXPLODED VIEW SERIES 75 & 475 PUMPS (G AND GG SIZE)

ITEM	NAME OF PART	ITEM	NAME OF PART
1	Key for Motor Shaft (Full Length)	10	Pipe Plugs-1/8"
2	Snap Ring (Used with Mech. Seal Pumps Only)	11	Machine Screw (2 for Mech. Seal Pump, 1 for Lip Seal Pump)
3	Mechanical Seal (Complete)	12	Rotor
4	Lip Seal (2)	13	Idler
5	Casing	14	Idler Bushings
6	Capscrews (Pump on Motor)	15	Gasket (for Head)
7	Gasket For Relief Valve or Cover Plate)	16	Idler Pin
8	Relief Valve	17	Head
9	Capscrews (For Relief Valve or Cover Plate)	18	Capscrews (For Head)

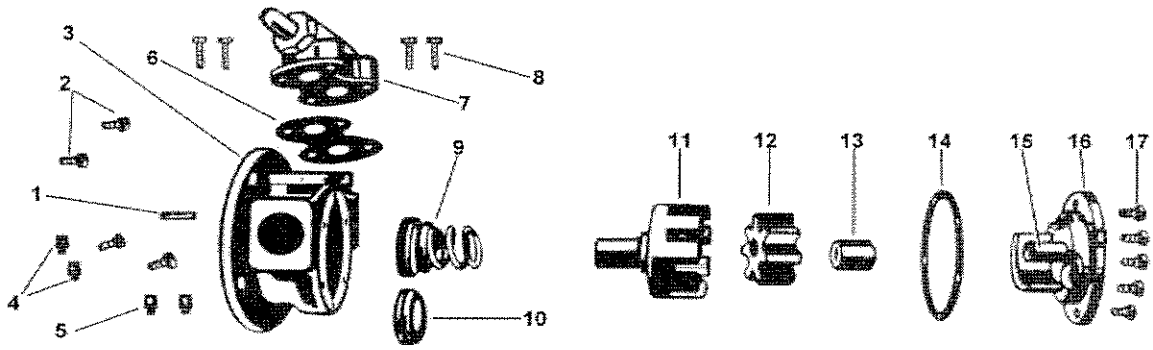


FIGURE 6
EXPLODED VIEW SERIES 75 & 475 PUMPS (H, HJ AND HL SIZE)

ITEM	NAME OF PART	ITEM	NAME OF PART
1	Key for Motor Shaft (Full Length)	10	Lip Seal (2)
2	Capscrew (Pump to Motor)	11	Rotor
3	Casing	12	Idler
4	Machine Screw (2 for Mech. Seal Pump, 1 for Lip Seal Pump)	13	Idler Bushing
5	Pipe Plugs-1/8"	14	Gasket (For Head)
6	Gasket (For Relief Valve or Cover Plate)	15	Idler Pin
7	Relief Valve	16	Head
8	Capscrews (For Relief Valve or Copper Plate)	17	Capscrews (For Head)
9	Mechanical Seal (Complete)		

7. CHECK PUMP END CLEARANCE. Measure clearance between the back of the rotor and the mechanical surface in the bottom of the casing by inserting a feeler gauge through the port opening. This is the end clearance; normal amount is 0.003" to 0.005". Add or remove gaskets until the figure is reached.

GASKET TABLE 1

PUMP MODELS	NORMAL AMOUNT USED (Inch)	ONE SET OF GASKETS CONSISTS OF THE FOLLOWING
G75 AND GG75 Lip Seal Pumps	.010" - .015"	2 - .005" Plastic 3 - .002" Plastic

8. BOLT THE VALVE INTO CASING. Place the valve gasket and valve or cover-plate on the pump and fasten securely with the four capscrews.

CAUTION

BE SURE THE ADJUSTING SCREW OF THE RELIEF VALVE POINTS TOWARD THE SUCTION PORT.

9. ASSEMBLE THE PUMP ON THE MOTOR. Install the full length key in the keyway of the motor shaft.
NOTE: Key must be full length to avoid misalignment of the pump rotor, which could cause serious damage to the pump. Slide the pump on the motor shaft and fasten securely with the four capscrews.

To Reassemble Model H75, HJ75, or HL75 Lip Seal Pumps: (See Figure 8)

1. INSTALL THE LIP SEALS. The lip seals should be installed in the casing one at a time from the head end. The sealing lips must face away from each other.

   NOTE: Use an arbor press of 2.188 diameter and press the lip seals in the casing as far as they will go.

2. LUBRICATE THE LIP SEALS. Fill the area between the lips and the lip seals with grease.

3. INSTALL THE ROTOR. Flush the rotor hub with light oil (not grease) and insert the rotor in the casing with the hub through the lip seals.

CAUTION

TURN THE ROTOR BACK AND FOURTH AS YOU EXERT ENOUGH FORCE TO PUSH IT THROUGH THE LIP SEAL AND TO THE BOTTOM OF THE CASING. BE CAREFUL NOT TO FOLD UNDER THE LIP OF THE INNER SEAL.

4. INSTALL THE IDLER. Put the idler with bushing on the idler pin.

5. PLACE THE HEAD GASKETS ON THE PUMP HEAD. The proper amount of gaskets should be used to provide the necessary end clearance within the pump so it turns freely with no appreciable end play. Gasket Table 2 gives the normal amount of gaskets used.

6. THE HEAD CAN NOW BE ASSEMBLED ON THE PUMP. Tilt the top of the head away from the pump slightly until the crescent enters the inside diameter of the rotor and rotate the idler until its teeth mesh with the rotor teeth. Do not damage the head gaskets. Note correct position of idler and crescent. (See Figure 8 and Disassembly Step 2). Tighten the head capscrews and then check the end clearance.

7. CHECK PUMP END CLEARANCE. Measure the clearance between the back of the rotor and the machined surface in the bottom of the casing by inserting a feeler gauge through the port opening. This is the end clearance. Normal amount is 0.003" to 0.005". Add or remove gaskets until the figure is reached.

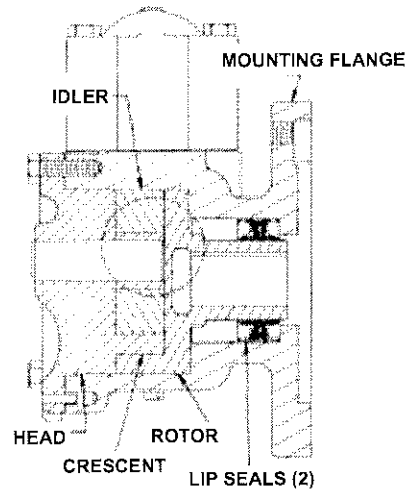


FIGURE 8
SECTIONAL DRG. OF MODELS H75, HJ75 AND HL75 LIP SEAL PUMPS

GASKET TABLE 2

PUMP MODELS	NORMAL AMOUNT USED (Inch)	ONE SET OF GASKETS CONSISTS OF THE FOLLOWING
H75, HJ 75 And HL75 Lip Seal Pumps	.010" - .015"	2 - .002" Plastic 2 - .006" Paper

8. BOLT THE VALVE TO THE CASING. Place the valve gasket and valve or coverplate on the pump and fasten securely with the four capscrews.

CAUTION

BE SURE THE ADJUSTING SCREW OF THE RELIEF VALVE POINTS TOWARD THE SUCTION PORT.

9. ASSEMBLE THE PUMP ON THE MOTOR. Install the full length key in the keyway of the motor shaft.
NOTE: Key must be full length to avoid misalignment of the pump rotor, which could cause serious damage to the pump. Slide the pump on the motor shaft and fasten securely with the four capscrews.

To Reassemble Model G475 or GG475 Mechanical Seal Pumps: (see figure 9)

1. INSTALL THE ROTOR IN THE CASING.

2. INSTALL THE IDLER. Put the idler with bushing on the idler pin.

3. PLACE THE HEAD GASKET ON THE HEAD. The proper amount of gaskets should be used to provide the necessary end clearance within the pump so it turns freely with no appreciable end play. Gasket Table 3 gives the normal amount of gaskets used.

GASKET TABLE 3

PUMP MODELS	NORMAL AMOUNT USED (Inch)	ONE SET OF GASKETS CONSISTS OF THE FOLLOWING
G475 And GG475 Mech. Seal Pumps	.010" - .015"	2 - .005" Plastic 3 - .002" Plastic

4. THE HEAD CAN NOW BE ASSEMBLED ON THE PUMP. Tilt the top of the head away from the pump slightly until the crescent enters the inside diameter of the rotor and rotate the idler until its teeth mesh with the rotor teeth. Do not damage the head gaskets.
Note correct position of idler and crescent (see figure 9 and Disassembly Step 2). Tighten the head capscrews and the check the end clearance.

5. CHECK PUMP END CLEARANCE. Measure the clearance between the back of the rotor and the machined surface in the bottom of the casing by inserting the feeler gauge through the port opening. This is the end clearance. Normal amount is 0.003" to 0.005". Add or remove gaskets until the figure is reached.

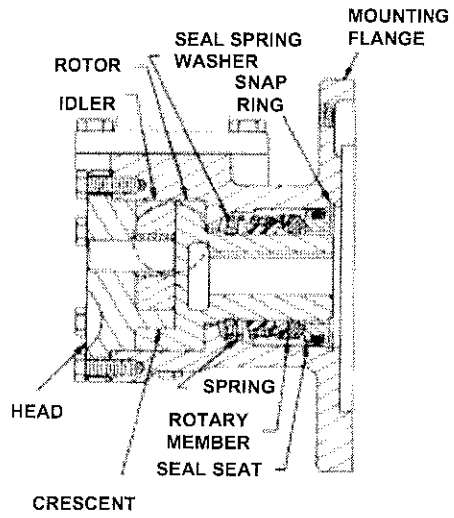


FIGURE 9
SECTIONAL DRG. OF MODELS G475 & GG475 MECH. SEAL PUMPS

6. INSTALL THE MECHANICAL SEAL. Slide the seal spring washer over the rotor hub as far as it will go. Flush the rotor hub and seal housing bore with light oil (not grease) and assemble spring, rotary member and seat of the mechanical sea; in position, refer to figure 9.

CAUTION

NEVER TOUCH THE SEALING FACES OF THE MECHANICAL SEAL WITH ANYTHING EXCEPT FINGERS OR A CLEAN CLOTH.

7. INSTALL THE SNAP RING. Install the snap ring in the groove in the casing. This will hold the seal at its proper working length.

8. BOLT THE VALVE TO THE CASING. Place the valve gasket and valve or coverplate on the pump and fasten securely with the four capscrews.

CAUTION

BE SURE THE ADJUSTING SCREW OF THE RELIEF VALVE POINTS TOWARD THE SUCTION PORT.

9. ASSEMBLE THE PUMP ON THE MOTOR. Install the full length key in the key way of the motor shaft.
NOTE: Key must be *full* length to avoid misalignment of the pump, which could cause serious damage to the pump. Slide the pump on the motor shaft and fasten securely with the four capscrews.

To Reassemble Model H475, HJ475, or HL475 Mechanical Seal Pumps: (See Figure 10)

1. INSTALL THE SEAL SEAT. Lubricate the outside diameter of the seal seat and the inside of the seal seat and the inside of the seal housing bore with the light oil (not grease). Start the seal seat in the casing and press into place.

CAUTION

NEVER TOUCH THE SEALING FACES OF THE MECHANICAL SEAL WITH ANYTHING EXCEPT FINGERS OR A CLEAN CLOTH.

2. INSTALL THE ROTARY MEMBER OF SEAL. Flush the rotor hub and the inside of the rotary member with light oil. Slide the spring and rotary member over the rotary hub only far enough to hold the spring in position. Do not compress the spring at this time.

3. INSTALL THE ROTOR IN THE CASING.

4. INSTALL THE IDLER. Put the idler with the bushing on the idler pin.

5. PLACE THE HEAD GASKETS ON THE HEAD. The proper amount of gaskets should be used to provide the necessary end clearance within the pump so it turns freely with no appreciable end play. Gasket Table four gives the normal amount of gaskets used.

6. THE HEAD CAN NOW BE ASSEMBLED ON THE PUMP. Tilt the head away from the pump slightly until the crescent enters the inside diameter of the rotor and rotate the idler until its teeth mesh with the rotor teeth. Do not damage the head gaskets. Note correct position of idler and crescent. Refer to figure 10 and disassembly step 2.

GASKET TABLE 4

PUMP MODELS	NORMAL AMOUNT USED (Inch)	ONE SET OF GASKETS CONSISTS OF THE FOLLOWING
H475, HJ475 & HL475 Mechanical Seal Pumps	.010" - .015"	2 - .002" Plastic 2 - .006" Paper

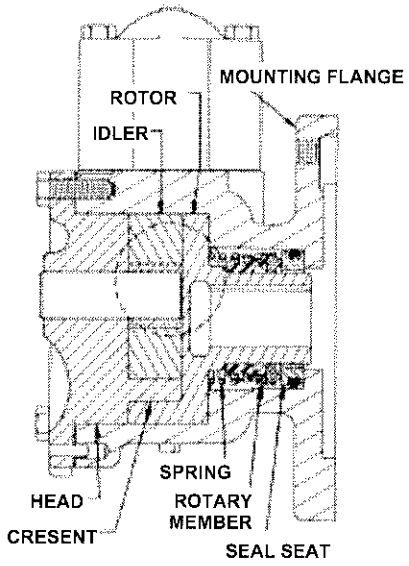


FIGURE 10
SECTION DRG. OF MODELS H475, HJ 475 AND HL 475 MECH. SEAL PUMPS

7. CHECK PUMP END CLEARANCE. Measure the clearance between the back of the rotor and the machined surface in the bottom of the casing by inserting a feeler gauge through the port opening. This is the end clearance; normal amount is 0.003" and 0.005". Add or remove gaskets until the figure is reached.
8. BOLT THE VALVE INTO THE CASING. Place the valve gasket and valve or coverplate on the pump and fasten securely with the four capscrews.

CAUTION

BE SURE THE ADJUSTING SCREW OF THE RELIEF VALVE POINTS TOWARD THE SUCTION PORT.

9. ASSEMBLE THE PUMP ON THE MOTOR. Install the length key in the keyway in the motor shaft.
   NOTE: Key must be *full* length to avoid misalignment of the pump, which could cause serious damage to the pump. Slide the pump on the motor shaft and fasten securely with the four capscrews.

SAFETY RELIEF VALVE INSTRUCTIONS

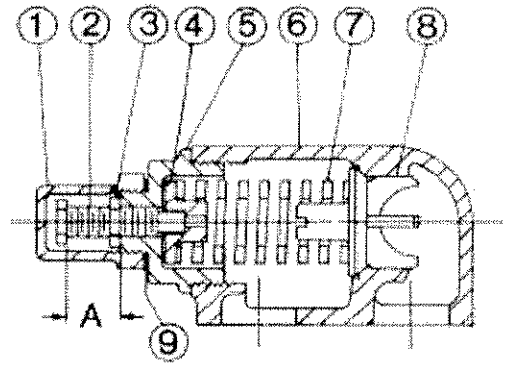


FIGURE 11
VALVE – G, GG, H, HJ AND HL SIZE

LIST OF PARTS	
1. Valve Cap	6. Valve Body
2. Adjusting Screw Cap	7. Valve Spring
3. Lock Nut	8. Poppet
4. Spring Guide	9. Cap Gasket
5. Bonnet	

DISASSEMBLY

NOTE: Mark valve and head to be sure they are reassembled in the same relative position.

1. Remove valve cap.
2. Measure and record the length of extension of the adjusting screw. See "A" on figure 11.
3. Loosen the lock nut and back out adjusting screw until spring pressure is released.
4. Remove bonnet, spring guide, spring and poppet from valve body. Clean and inspect all parts for wear or damage and replace as necessary.

ASSEMBLY

Follow the procedure outlined under disassembly.
If valve is removed for repairs, be sure to replace in same position. The valve cap should point towards the suction port.

PRESSURE ADJUSTMENT

If the pressure setting of the safety relief valve is to be changed from that which the factory has set, the following instructions should be carefully followed:

1. Remove the valve cap, which covers the adjusting screw, and loosen the lock nut that locks the adjusting screw so pressure setting will not change during operation of pump.
2. A pressure gauge somewhere in the discharge line must be used for actual adjustment operation.
3. The adjusting screw should be turned in for increasing the pressure or turned out for decreasing the pressure.
4. With the discharge line closed at a point beyond the pressure gauge, the gauge will show the maximum pressure the valve will allow while pump is in operation.

IMPORTANT

In ordering parts for pressure relief valve, always give model number and serial number of pump as it appears on nameplate and name of part wanted. When ordering springs, be sure to give pressure settings desired.

VIKING PUMP

WARRANTY

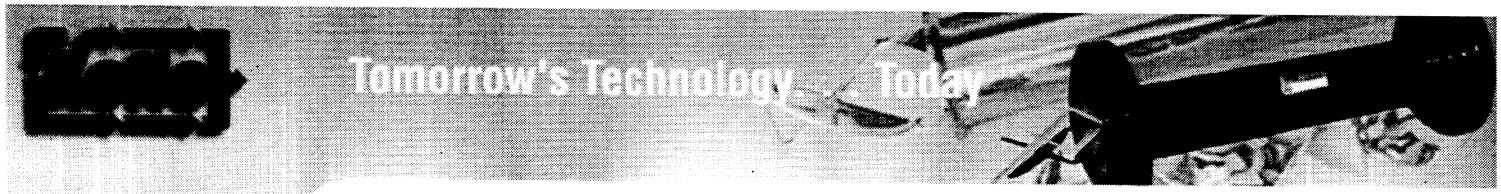
Viking warrants all products manufactured by it to be free from defects in workmanship or material for a period of one (1) year from date of startup, provided that in no event shall this warranty extend more than eighteen (18) months from the date of shipment from Viking. If, during said warranty period, any products sold by Viking prove to be defective in workmanship or material under normal use and service, and if such products are returned to Viking's factory at Cedar Falls, Iowa, transportation charges prepaid, and if the products are found by Viking to be defective in workmanship or material, they will be replaced or repaired free of charge, F.O.B. Cedar Falls, Iowa.

Viking assumes no liability for consequential damages of any kind and the purchaser by acceptance of delivery assumes all liability for the consequences of the use or misuse of Viking products by the purchaser, his employees or others. Viking will assume no field expense for service or parts unless authorized by it in advance.

Equipment and accessories purchased by Viking from outside sources which are incorporated into any Viking product are warranted only to the extent of and by the original manufacturer's warranty or guarantee, if any.

THIS IS VIKING'S SOLE WARRANTY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, WHICH ARE HEREBY EXCLUDED, INCLUDING IN PARTICULAR ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. No officer or employee of IDEX Corporation or Viking Pump, Inc. is authorized to alter this warranty.

IDEX



HOME
ABOUT KOFLO
STATIC MIXERS
Clear PVC
Stock Stainless Steel
Drawing
Gray PVC
Flanged Mixers
Ductile Iron
Sanitary
High Viscosity
Stratos Tube Mixers
Sludge(Non-Clog)
Teflon
Kynar
Fiberglass
CALIBRATION COLUMNS
INJECTION QUILLS
CUSTOM/OEM
CONTACT US
REQUEST A QUOTE

Stock Stainless Steel Static Mixers

Series 275

View Drawing | Request A Quote

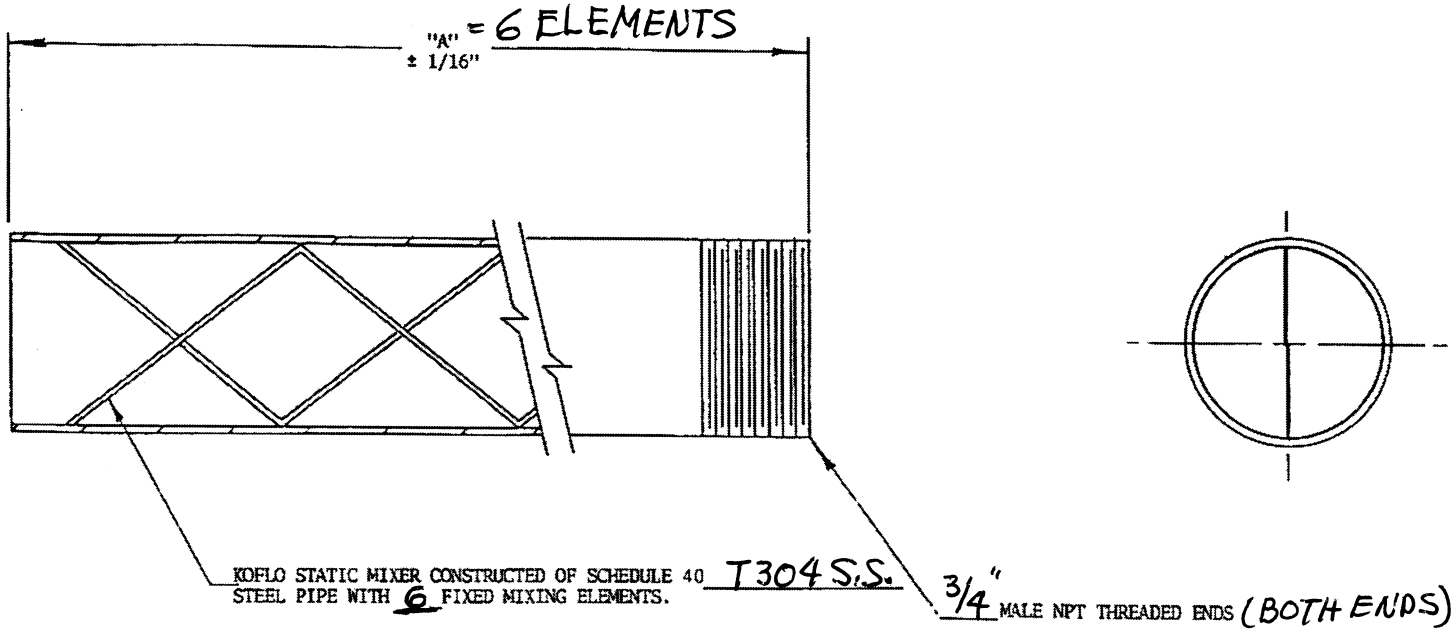
Koflo carries a complete line of stainless steel static mixers, in stock for immediate delivery. Stainless steel static mixers in sizes 3/8" - 2" are available in both 304L & 316L stainless steel with either 6 or 12 mixing elements. All mixers are welded into a schedule 40 housing and come complete with male NPT threaded ends.

Applications
- Polymer dilution
- Chemical blending
- Water Treatment
- Oil blending

Options
- Removable elements
- Low-pressure design elements
- Helical elements
- British standard threads (BSP)
- Seamless pipe

Threaded Static Mixer Series 275

Drawing



NOM PIPE SIZE	"A" NUMBER OF ELEMENTS					
	2	3	4	5	6	12
3/8"	2	2	3	3.5	4	8
1/2"	2	3	3.5	4	5	10
3/4"	2.5	3.5	5	6	7"	13
1"	3	4	6	7	9	17
1-1/4"	4	6	8	10	12	22
1-1/2"	5	7	9	11	13	26
2"	6	8	11	14	17	33
2-1/2"	10	13	15	18	20	39
3"	11	14	18	23	25	49
4"	14	19	24	29	33	65

SERIES 275

Koflo Corporation
309 CARY POINT DR.
CARY, IL 60013

SCALE: NONE	APPROVED BY	DRAWN BY ARF
DATE: 9/11/85		REVISED 12/11/98
CUSTOMER:		REVISED 1/24/00
		REVISED
MODEL NO: THREADED STEEL MIXER		DRAWING NUMBER KD-1015

EGS Electrical Group

Appleton®

An Emerson/General Signal Joint Venture

INSTRUCTION SHEET
501581-000

EFS-EFD EDS SERIES CONTROL ASSEMBLIES FOR USE IN CLASS I, GROUP C AND D, CLASS II, GROUP E, F, AND G, AND CLASS III, DIV. 1 AND 2 HAZARDOUS LOCATION

CAUTION: Care must be taken to prevent the ground surface of the bodies and covers from becoming scratched, dented, or otherwise damaged as this could affect the explosion-proof features of these assemblies.

ASSEMBLY: Check ground surfaces of all components for foreign material prior to assembly. Surfaces must be clean and undamaged. Install the desired cover and device assembly on the body. Secure the cover assembly to the body by tightening the screw provided with the cover.

WARNING: Electrical power must be turned OFF before and during installation and maintenance. Failure to follow safety instructions may cause ignition of hazardous atmospheres resulting in serious personal injury and/or property damage.

The following cover with device and combination of cover and device are UL Listed control assemblies when assembled to Appleton Electric Co. listed control assembly bodies. These combinations are suitable for use in hazardous locations as indicated in the metal nameplate of each cover assemblies.

COMBINATION OF †† COVER	DEVICE	FACTORY SEALED	ELECTRICAL †† RATING
EFK-MS-Q	EFS-2MS-Q	NO	2P 30A-250VAC, 20A-600VAC 2HP-230VAC, 3HP-575VAC
EFK-MS-Q	EFS-3MS-Q	NO	3P 30A-250VAC, 20A-600VAC 3HP-125VAC-30, 15HP-600VAC-30
EFK-F34W-Q	EFS-FR3W-Q	NO	3W 20A-120VAC, 20A-277VAC 1HP-120VAC, 2HP-240VAC
EFK-F34W-Q	EFS-FR4W-Q	NO	4W 20A-120VAC, 20A-277VAC 1HP-120VACM, 2HP-240VAC
EFK-F34W-Q	EFS-FR3W-Q	NO	3W 30A-120VAC, 30A-277VAC 2HP-120VAC, 2HP-240VAC
EFK-F12-Q	EFS-FR1-Q	NO	1P 20A-120VAC, 20A-277VAC 1HP-120VAC,2HP-240VAC
EFK-F12-Q	EFS-FR2-Q	NO	2P 20A-120VAC, 20A-277VAC 1HP-120VAC, 2HP-240VAC
EFK-F12-Q	EFS-FR13-Q	NO	1P 30A-120VAC, 30A-277VAC 2HP-120VAC, 2HP-240VAC
EFK-F12-Q	EFS-FR23-Q	NO	2P 30A-120VAC, 30A-277VAC 2HP-120VAC, 2HP-240VAC
EFK-R34W-Q	EFS-FR3W-Q	NO	3W 20A-120VAC, 20A-277VAC 1HP-120VAC, 2HP-240VAC
EFK-R34W-Q	EFS-FR4W-Q	NO	4W 20A-120VAC, 20A-277VAC 1HP-120VAC, 2HP-240VAC
EFK-R34W-Q	EFS-FR3W-Q	NO	3W 30A-120VAC, 30A-277VAC 2HP-120VAC, 2HP-240VAC
EFK-R12-Q	EFS-FR1-Q	NO	1P 20A-120VAC, 2HP-240VAC 2HP-230VAC, 3HP-575VAC
EFK-R12-Q	EFS-FR2-Q	NO	2P 20A-120VAC, 20A-277VAC 1HP-120VAC, 2HP-240VAC
EFK-R12-Q	EFS-FR13-Q	NO	1P 30A-120VAC, 30A-277VAC 2HP-120VAC, 2HP-240VAC
EFK-R12-Q	EFS-FR23-Q	NO	2P 30A-120VAV, 30A-277VAC 2HP-120VAC 2HP-240VAC

* With or without suffix -TR2, -TR3, -TR4, -TR5

** Heater Table Supplied with these device must be affixed in or near the enclosure for future use

† Blank cover for use single with 2-Gang Body only

†† Device rating must match rating stamped on cover

1-GANG BODY		2-GANG BODY	
EFD150-NL-Q	EFDC150-NL-Q	EFDD250-NL-Q	EFDC250-NL-Q
EFD175-NL-Q	EFDC175-NL-	EFD275-NL-Q	EFDC275-NL-Q
EFD110-NL-Q	EFDC110-NL-Q	EFD210-NL-Q	EFDC210-NL-Q
EFD150A-NL-Q	EFDC150-A-NL-Q	EFD250A-NL-Q	EFDC250A-NL-Q
EFD175A-NL-Q	EFDC175A-NL-Q	EFD275A-NL-Q	EFDC275A-NL-Q
EFD110A-NL-Q	EFDC110A-NL-Q	EFD210A-NL-Q	EFDC210A-NL-Q

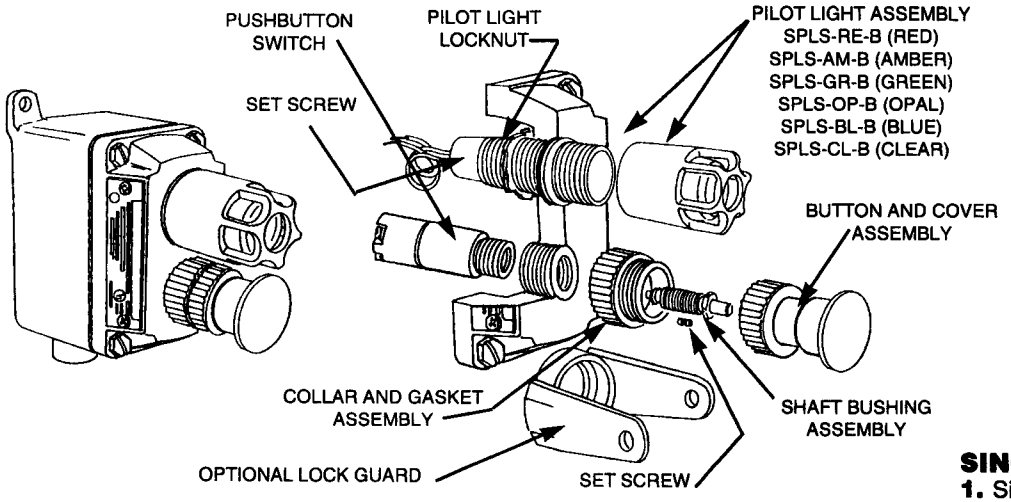
3 DEVICE BODY		2 -GANG TANDEM BODY ***	
EFDL50-Q	EFDCL50-Q	EFDT50-NL-Q	EFDCT50-NL-Q
EFDL75-Q	EFDCLO75-Q	EFDT75-NL-Q	EFDCT75-NL-Q
EFDL10-0	EFDCL10-Q	EFDT10-NL-Q	EFDCT10-NL-Q

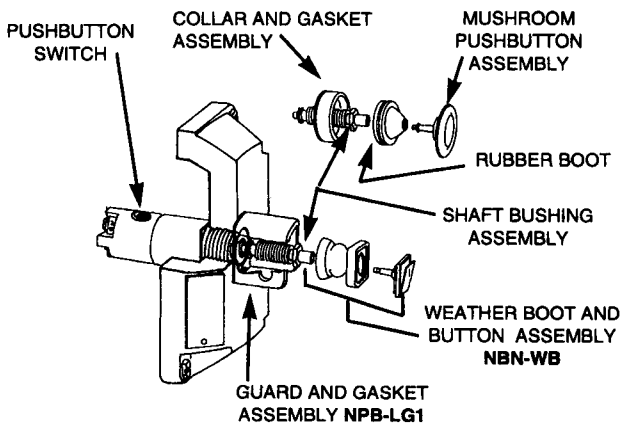
*** **WARNING:** To prevent ignition of Group C and D atmospheres, seals must be installed within five (5) feet on each conduit opening.

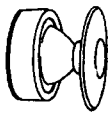
FACTORY SEALED COVER WITH DEVICE	ELECTRICAL RATING ††
EFKB-12	PUSH BUTTON SWITCH 600 VAC MAX HVY. PILOT DUTY PILOT LIGHT 125 VAC MAX 60 HZ
EFKB-35	
EFKB-102	
EFKB-345	
EFJB-DU1	
EFKB-DU2	
EFKB-JI *	
EFKB-J1DU1	
EFKB-J1U1	
EFKB-J1U2	
EFKB-J2	
EFKB637-SRC	
EFKB-U1	
EFKB-U2	
ESKB-B-Q†	
EFKB-SMPB	
EFKL-U3	
EFKL-J3	
EFKL-J1U2	
EFKL-J2U1	
EFKL-J1DU2	
EFKB-PC120	125VAC-60HZ 100VA-LOAD
EFKB-PC277	277VAC-60HZ 100VA-LOAD
EDK-F23W-Q	3W 20A-120VAC, 20A-277VAC 1HP-120VAC, 2HP-240VAC
EDK-F24W-Q	4W 20A-120VAC, 20A-277VAC 1HP-120VAC, 2HP-240VAC
EDK-F33W-Q	3W 30A-120VAC, 30A-277VAC 2HP-120VAC, 2HP-240VAC
EDK-F21-Q	1P 20A-120VAC, 20A-277VAC 1HP-120VAC, 2HP-240VAC
EDK-F22-Q	2P 20A-120VAC, 20A-277VAC 1HP-120VOAC, 2HP-240VAC
EDK-F31-Q	1P 30A-120VAC, 30A-277VAC 2HP-120VAC, 2HP-240VAC
EDK-F32-Q	2P 30A-120VAC, 30A-277VAC 2HP-120VAC 2HP-240VAC
EDK-R23W-Q	3W 20A-120VAC, 20A-277VAC 1HP-120VAC, 2HP-240VAC
EDK-R24W-Q	4W 20A-120VAC, 20A-277VAC 1HP-120VAC, 2HP-240VAC
EDK-R33W-Q	3W 30A-120VAC, 301A-277VAC 2HP-120VAC, 2HP-240 VAC
EDK-R21-Q	1P 20A-120VAC, 20A-277VAC 1HP-120VAC, 2HP-240VAC
EDK-R22-Q	2P 20A-120VAC, 2HP-240VAC 1HP-120VAC, 2HP-240VAC
EDK-R31-Q	1P 30A-120VAC, 30A-277VAC 2HP-120VAC, 2HP-240VAC
EDK-R32-Q	2P 30A-120VAC, 30A-277VAC 2HP-120VAC, 2HP-24-VAC
EDK-1MSAB-Q **	1P 1HP-115230VAC
EDK-1MSW-Q **	1P 1HP-115/230VAC. 1/4HP-32VDC 1/4HP-250VDC
EDK-2MSAB-Q**	2P 1HP-115/230VAC, 1/4HP-32VDC 3/4HP-250VDC
EDK-2MSW-Q **	2P 1HP-115/23VAC, 1/4HP-32VDC 1HP-125VDC, 1HP-250VDC
EFK-RU1-Q	600 VAC MAX HVY. PILOT DUTY
EFK-RU2-Q	

Installation of Pushbutton Switch and Pilot Light in ESKB Series Covers Explosion-Proof and Dust-Ignition-Proof

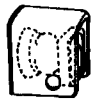
501581-000







MUSHROOM PUSH BUTTON ASSEMBLY
NMRB-BL (BLACK)
NMRB-GR (GREEN)
NMRB-RE (RED)



GUARD AND GASKET ASSEMBLY **NPB-LG1**

MAINTAINED CONTACT PUSHBUTTON SWITCH AND PILOT LIGHT

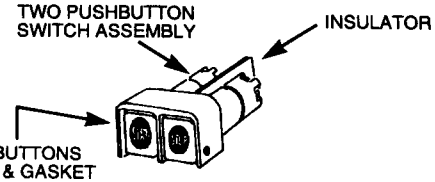
1. Pilot light must be installed in 3/4"-14NPSM opening.
2. Assemble a 3/4" to 1/2" reducer (see note) onto Pushbutton switch (when using 3/4"-14NPSM opening) and proceed with step 3 thru 5
3. Unscrew button and cover assembly from collar. Remove set screw from collar. Use a 1/2" nut driver to remove shaft bushing and shaft from push assembly. (Set these parts aside for later reassembly in step 5.)
4. Thread Push Button from inside of cover until front of pushbutton is flush with face of cover.
5. Insert shaft into bushing. Put shaft bushing assembly thru hole in collar and thread bushing into pushbutton opening. Hold pushbutton from inside of cover to prevent it from turning. If a Lockout Guard is used, put shaft bushing assembly thru collar and lockout.
6. Tighten shaft bushing with 1/2" nut driver to "lock" pushbutton in place, thread set screw onto collar along side of hex flat of shaft bushing.
7. Thread Button and cover assembly onto collar until fully seated.
8. Check pushbutton switch and pilot light electrically and mechanically for proper operation.

CAUTION: WHEN CHECKING PUSHBUTTON ELECTRICALLY GUARD OR COLLAR MUST BE INSTALLED IN THE INTENDED MANNER AS SHOWN.

SINGLE PUSHBUTTON SWITCH WITH ONE BUTTON GUARD

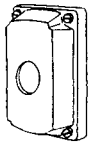
1. Single pushbutton with one button guard must be installed in 3/4"-14NPSM opening using 3/4" to 1/2" reducer.
2. Assemble a 3/4" to 1/2" reducer onto Pushbutton switch (when using 3/4"-14NPSM opening) and proceed with step 3 thru 5
3. Remove set screw from guard, use a 1/2" nut driver to remove shaft bushing and shaft from pushbutton assembly (set aside for later assembly).
4. Thread pushbutton from inside of cover until front of pushbutton is flush with face of cover
5. Insert shaft into bushing. Put shaft bushing assembly thru hole in guard and thread bushing into pushbutton opening. Hold pushputton from inside of cover to prevent it from turning.
6. Tighten shaft bushing with a 1/2" nut driver to "lock" pushbutton switch in place. Thread setscrew onto collar along side of hex flat on shaft bushing.
7. Press Weather Boot and Button assembly in shaft hole until fully seated.
8. Check pushbutton switch electrically and mechanically for proper operation.

DOUBLE PUSHBUTTON WITH TWO BUTTON GUARD



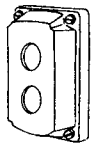
1. Double Pushbutton assembly, with two button guard must be installed into two 1/2" - 14 NPSM openings (approximately 1-1/6" apart).
2. Proceed as in steps (2) through (6) above. Be sure insulator is in place.

One Pushbutton Switch Cover or one Pilot Light
ESKB-1PB

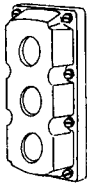


3/4" 14 NPSM Tapped Hole

Two Pushbutton Switch Cover or Two Pilot Light Cover
ESKB-2PB

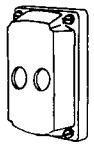


3/4" 14 NPSM Tapped Holes



Three Pushbutton Switch Cover or Pilot Light Two P. B. Switch Cover
EFKL-3HQ

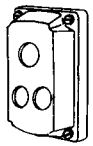
Two Pushbutton Switch Cover



ESKB-2SP

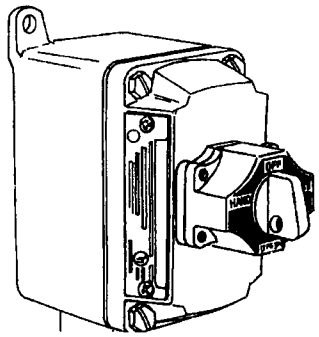
1/2" 14 NPSM Tapped Holes

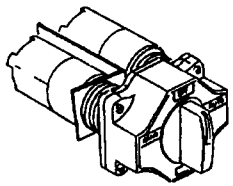
One Pilot Light Two Pushbutton Switch Cover
ESKB-3JPB

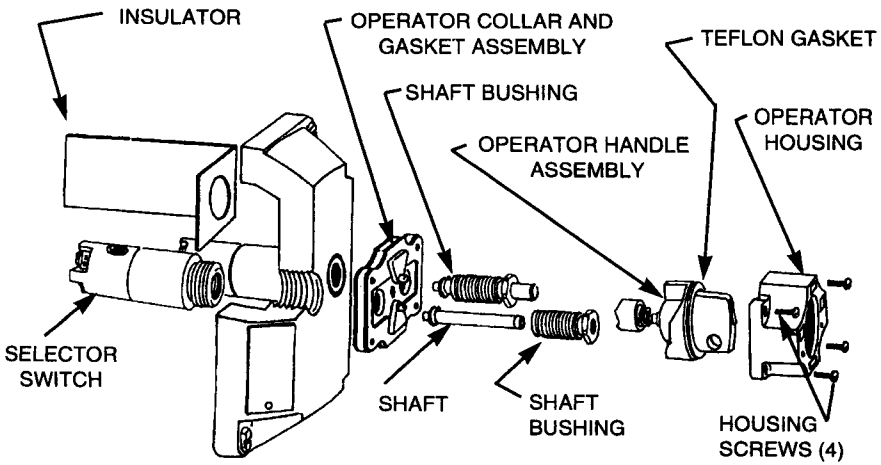


3/4" 14 NPSM Tapped Hole
1/2" 14 NPSM Tapped Holes

Installation of Selector Switch in ESKB Series Covers Explosion-Proof and Dust-Ignition-Proof

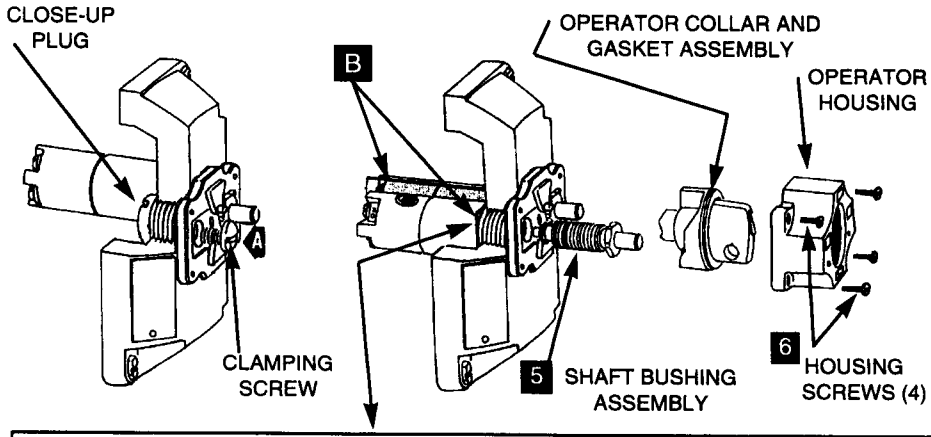






A. If one Selector Switch is to be installed, close up remaining 1/2" opening from inside of cover with close-up plug provided. Tighten securely with screwdriver. Tighten clamping screw to insure water tightness.

B. If two Selector Switches are to be installed, make sure insulator is in place.



NOTE: Threaded aluminum shell of Selector Switch Assembly **MUST TOUCH** the under side of operator collar gasket for proper operation of mechanism.

SELECTOR SWITCH

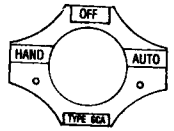
1. Selector Switch must be installed in 1/2"-14NPSM opening(s).
2. Remove four housing screws, operator housing and handle assembly.
3. Use 1/2" nut driver to remove shaft bushing.
4. Place operator collar and gasket assembly on face of cover and line up openings with the two 1/2" threaded holes in cover. Thread in Selector Switch from inside of cover. (See Note)
5. Insert shaft through shaft bushing. While holding Selector Switch, thread shaft/bushing assembly through collar into Selector Switch and tighten bushing securely.
6. Insert operator handle and teflon gasket in operator housing. With arrow in operator handle pointing to "OFF" marking on nameplate, press operator housing down firmly on operator collar and fasten in place with (4) housing screws.
7. Check Selector Switches electrically and mechanically for proper operation.

TWO POSITION NAMEPLATE

START - STOP

AUTO	OFF	**SLNP-AO**
AUTO	HAND	**SLNP-AH**
OFF	REM	**SLNP-OR**
RUN	JOG	**SLNP-RJ**
START	STOP	**SLNP-SS**
ON	OFF	**SLNP-OO**
UP	DOWN	**SLNP-UD**
FWD	REV	**SLNP-FR**
HAND	AUTO	**SLNP-HA**
BLANK	BLANK	**SLNP-B**

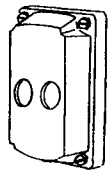
THREE POSITION NAMEPLATE



HAND - OFF -AUTO

LOCAL	OFF	REM	**SLNP-LOR**
HAND	OFF	REM	**SLNP-HOR**
REV	OFF	FWD	**SLNP-ROF**
AUTO	OFF	HAND	**SLNP-AOH**
JOG	OFF	RUN	**SLNP-JOR**
STOP	RUN	START	**SLNP-SRS**
–	–	–	**SLNP-B3**
1	OFF	2	**SLNP102**
FWD	OFF	REV	**SLNP-FOR**
HAND	OFF	AUTO	**SLNP-HOA**
RUN	OFF	JOG	**SLNP-ROJ**

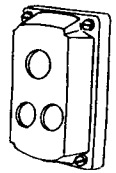
SELECTOR SWITCH COVERS



ESKB-2SP

Two 1/2" tapped holes

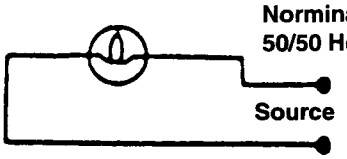
PILOT LIGHT AND SELECTOR SWITCH COVERS



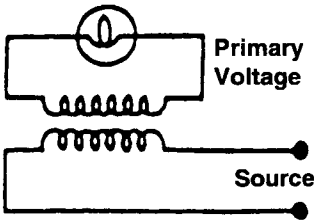
ESKB-3JPB

One 3/4" tapped hole on top
Two 1/2" tapped holes on bottom

PILOT LIGHTS



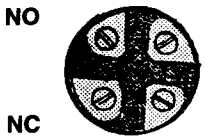
Pilot Light Transformer Voltages above 125 volts	
Nominal Volts 50/60 Hertz Transformer	Primary Voltage Range
220-110	220-240
440-110	440-480
550-110	550-600



SELECTOR SWITCHES

Style	Left Position	Center Position	Right Position
2 Position 2 Circuit		None	
2 Position 4 Circuit		None	
3 Position 2 Circuit			
3 Position 4 Circuit			

Pushbutton Stations and Selector Switches Screw Terminals



NC= Normally Closed
NO= Normally Open

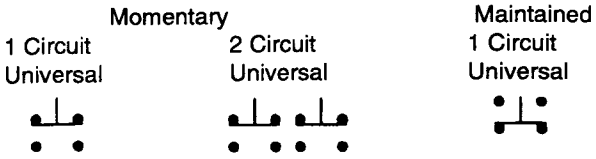
Factory Sealed Pushbutton Switch is supplied with optional Crimp-Type Terminal

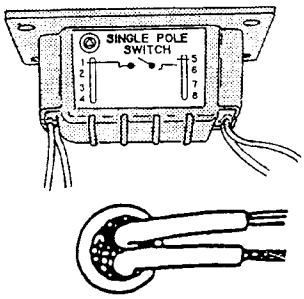
Strip the insulation on each conductor wire back 3/8"

Use a slotted head screwdriver to loosen the field wiring terminal screws the required 3 or 4 turns.

Insert the bare wire conductor(s) on either side of the terminal screw(s), under the terminal wire screw(s), and securely tighten the screw(s). **NOTE: Do Not** exceed 15 in, lbs of torque.

PUSHBUTTON STATIONS



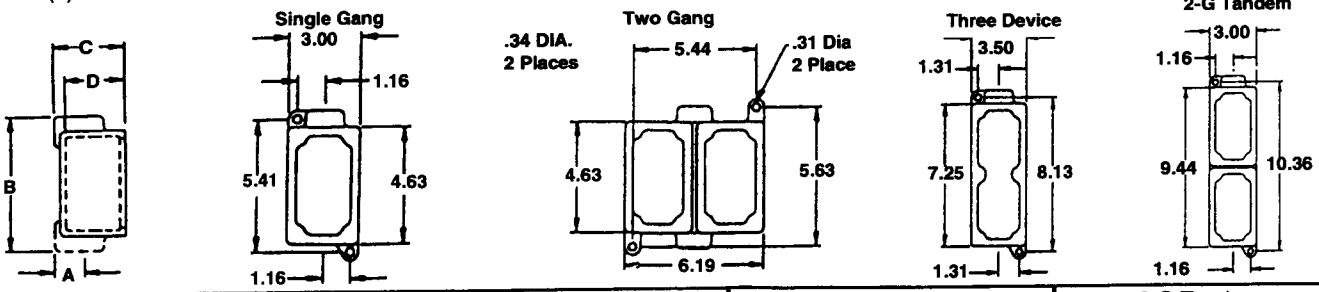


EDS snap switch (loggle) sealing well with wiring diagram.

Pilot lights and sealing wells are furnished with pigtail leads for field connection by use of wire nuts.

WARNING
Always disconnect primary power source before opening the enclosure for inspection or service.

1. Frequent inspection should be made. A schedule for maintenance checks should be detrmined by the environment and frquency of use. It is recommended that inspection should occur at least once a year.
2. Perform visual, electrical and mechanical checks on all components on a regular base.
3. Visually check for undue heating evidenced by discoloration of wires or other components, damaged or worn parts or leakage evidenced by water or corrosion in the interior.
4. Electrical check to make sure that all connections are clean and tight, and that contacts in the components make or break as required.
5. Mechanically check that all parts are properly assembled, and that operating mechanisms move freely.



Hub (in.)	Single Gang Dim. A	Dim. B	Dim. C	Dim. D	Two Gang Dim. A	Dim. B	Dim. C	Dim. D	Three Device Dim. A	Dim. B	Dim. C	Dim. D	2-G Tandem Dim. A	Dim. B	Dim. C	Dim. D
1/2	.76	6.13	2.50	2.25	.76	6.13	2.50	2.31	.88	9.00	2.50	2.34	.76	11.06	2.50	2.34
3/4	.76	6.13	2.50	2.25	.76	6.13	2.50	2.31	.88	9.00	2.50	2.34	.76	11.06	2.50	2.34
1	.94	6.31	2.50	2.34	.94	6.31	2.50	2.31	1.00	9.00	2.50	2.34	.94	11.06	2.50	2.34

EGS Electrical Group

Appleton®

503023
INSTRUCTION SHEET

EFD SERIES 1 & 2 GANG, TANDEM AND THREE DEVICE CONTROL ASSEMBLIES FACTORY SEALED DEVICE

The following UL Listed components can be assembled to create UL Listed control assembly devices. Appleton covers are designed for use in Class I, Groups B, *** C and D, Class II, Groups E, F and G, and Class III, Division 1 and 2 hazardous locations, and are UL Listed only when used with UL Listed Appleton devices. The cover and device must then be assembled to an appropriate body from the list below to form a complete assembly.

Device** (Pushbuttons)	Covers
SPBBU1Q SMPBU1Q SPBBDU1Q	ESKB - 1PBQ ESKB - 2PBQ EFKL - 3HQ ESKB - 3JPBQ*

Device** (Pilot Lights)		Covers
SPLSGRB	SPLSREB	ESKB - 1PBQ
SPLSBLB	SPLNSAMB	ESKB - 2PBQ
SPLSCLB	SPLNSGRB	EFKL - 3HQ
SPLSOPB	SPLNSREB	ESKB - 3JPBQ*
SPLSAMB		

Device** (Selector Switch Operator/ Switch Assembly)		Covers
SSBA12Q	SSBAS13	ESKB - 2SPQ
SSBA22Q	SSBAS23	ESKB - 3JPBQ*
SSBA13Q	SSBASL13	
SSBA23Q	SSBASL23	
	SSBASRA23	

* Use in combination: one pilot light/two pushbutton or one pilot light/one selector switch or three pushbutton switches.

** See device installation instruction sheet 501581.

The following UL Listed control assembly bodies are designed for use in hazardous locations and must be used in conjunction with appropriate device and cover assemblies listed above, when assembled, constitute a UL Listed control assembly with factory sealed devices.

Class I, Groups B***, C and D D Class II, Groups E, F and G Class III, Division 1 and 2	
ONE-GANG BODIES	
EFD150 - NL - Q	EFDC150 - NL - Q
EFD175 - NL - Q	EFDC175 - NL - Q
EFD110 - NL - Q	EFDC110 - NL - Q
EFD150A - NL - Q	EFDC150A - NL - Q
EFD175A - NL - Q	EFDC175A - NL - Q
EFD110A - NL - Q	EFDC110A - NL - Q

***WARNING: To prevent ignition of Group B atmospheres, sealing fittings must be installed within two inches from each conduit opening. **For Group B applications, completely assembled box, cover and device must be ordered from Appleton Electric Company.**

Class I, Groups C and D Class II, Groups E, F and G Class III, Division 1 and 2	
TWO-GANG BODIES	
EFD250 - NL - Q	EFDC250 - NL - Q
EFD275 - NL - Q	EFDC275 - NL - Q
EFD210 - NL - Q	EFDC210 - NL - Q
EFD250A - NL - Q	EFDC250A - NL - Q
EFD275A - NL - Q	EFDC275A - NL - Q
EFD210A - NL - Q	EFDC210A - NL - Q

TANDEM BODIES****	
EFDT50 - NL - Q	EFDCT50 - NL - Q
EFDT75 - NL - Q	EFDCT75 - NL - Q
EFDT10 - NL - Q	EFDCT10 - NL - Q

THREE DEVICES BODIES (For use with EFKL - 3HQ cover)	
EFDL50 - Q	EFDCL50 - Q
EFDL75 - Q	EFDCL75 - Q
EFDL10 - Q	EFDCL10 - Q

****WARNING: To prevent ignition of Groups C and D atmospheres, sealing fittings must be installed within five (5) feet on each conduit opening.

Instructions for Type MS Motor Starter 1 or 2 Pole Single-Phase, Toggle Operated

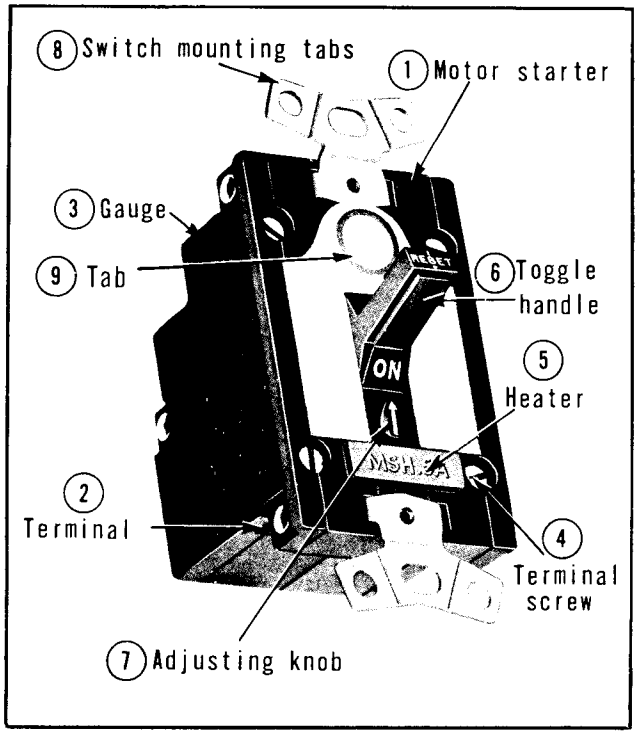


Fig. 1 *Type MS Motor Starter, Toggle Operated*

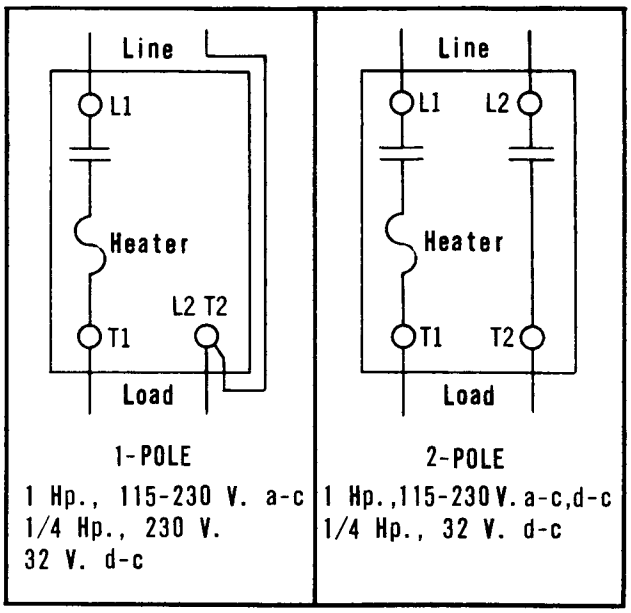


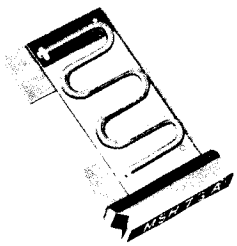
Fig. 2 *Wiring Diagrams. Recommended Driving Torque of Power Connections is 18-20 Lb-In. Wire Range is #14 to #10 AWG Copper Only.*

Installation, Toggle Operated Type MS Motor Starter

1. Strip connecting wires to depth indicated by gauge (3) on side of switch. (See Fig. 1) Insert stripped wires straight into terminals (2) and tighten terminal screws (4). See wiring diagrams (Fig. 2) or on sides of switch.

2. Mount starter switch to enclosure base tabs with 2 screws furnished.

Heater



Heater is of the plug-in type which is keyed for proper positioning and requires no screws. Heater (5) is inserted in rectangular opening in front of switch directly below the adjusting knob (7). (See Fig. 1.) Heater can easily be installed by hand, no tools required. Heater rating is clearly marked on heater for easy identification. See Table 1.

Adjustments–Adjustment Knob

Adjustment knob (7) is located directly below the toggle handle (6) on the front of the switch. (See Fig. 1.)

Switch is calibrated for 115% to 125% of full load motor current range indicated in Table 1. For closer protection, turn knob clockwise toward low. Depending on motor characteristics, this setting may be less than full load motor current. If switch opens, turn counterclockwise until satisfactory operation is obtained.

If ambient conditions or motor characteristics result in nuisance tripping, turn toward high until condition is corrected.

TABLE 1. HEATER RATING
(Wire With 60/75°C Wire)

Motor Full Load Current	Cat. No.	Heater Rating in Amps at 40°C Ambient Which Offers Approx. 115%-125% Protection	
.4 - .43	MSH .5A	.5	Suitable for use on a circuit capable of delivering not more than 1000 rms symmetrical amperes, 250 volts maximum.
.44- .48	MSH .55A	.55	
.49- .53	MSH .61A	.61	
.54- .58	MSH .67A	.67	
.59- .64	MSH .74A	.74	
.65- .71	MSH .81A	.81	
.72- .78	MSH .89A	.89	
.79- .87	MSH .98A	.98	
.88- .95	MSH 1.1A	1.10	
.96- 1.03	MSH 1.2A	1.20	
1.04- 1.15	MSH 1.3A	1.30	
1.16- 1.27	MSH 1.45A	1.45	
1.28- 1.35	MSH 1.6A	1.60	
1.36- 1.51	MSH 1.7A	1.70	
1.52- 1.67	MSH 1.9A	1.90	
1.68- 1.83	MSH 2.1A	2.10	
1.84- 1.99	MSH 2.3A	2.30	
2.00- 2.23	MSH 2.5A	2.50	
2.24- 2.47	MSH 2.8A	2.80	
2.48- 2.71	MSH 3.1A	3.10	
2.72- 2.95	MSH 3.4A	3.40	
2.96- 3.27	MSH 3.7A	3.70	
3.28- 3.59	MSH 4.1A	4.10	
3.60- 3.99	MSH 4.5A	4.50	
4.00- 4.39	MSH 5.0A	5.00	
4.40- 4.79	MSH 5.5A	5.50	
4.80- 5.26	MSH 6.0A	6.00	
5.27- 5.83	MSH 6.6A	6.60	
5.84- 6.39	MSH 7.3A	7.30	
6.40- 7.03	MSH 8.0A	8.00	
7.04- 7.74	MSH 8.8A	8.80	
7.75- 8.46	MSH 9.7A	9.70	
8.47- 9.35	MSH10.6A	10.60	
9.36-10.30	MSH11.7A	11.70	
10.31-11.35	MSH12.9A	12.90	
11.36-12.47	MSH14.2A	14.20	
12.48-13.67	MSH15.6A	15.60	
13.68-15.12	MSH17.1A	17.10	
15.13-16.00	MSH18.6A	18.60	

TABLE 2. MS STARTERS

Description	Volts	H.P.	Poles	Catalog Number
TOGGLE OPERATED open unit	120/240 a-c	1	1	MST01
	120/240 a-c	1	2	MST02
	240 d-c	1/4	1	MST01
	120/240 d-c	1	2	MST02
	32 d-c	1/4	1	MST01
	32 d-c	1/4	2	MST02
INDICATING LIGHT KIT for Toggle Unit				MSPT

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Motors, For Use In Hazardous Locations

Guide Information

BALDOR ELECTRIC CO E6951
5711 R S BOREHAM, JR ST
FT SMITH, AR 72908 USA

Class I, Group C and D; Class II, Groups E, F and G.

Class I, Group D; Class II, Groups E, F, and Gmotors with Listed brakes. The brakes in these explosion-proof and dust ignition proof assemblies are intended essentially for holding purposes and may be used for stopping light inertia loads.

Class I, Group D; Class II, Groups F and Gmotors for use with pulse width modulated variable frequency inverter drives over the frequency range of 6 to 90 HZ .

Class I, Group Dmotors for use with voltage source, current source and pulse width modulated variable frequency inverter drives over the frequency range of 0 to 120 HZ .

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Control Panels and Assemblies for Use in Hazardous Locations

Guide Information

APPLETON ELECTRIC L L C E81751
7770 N FRONTAGE RD
SKOKIE, IL 60077 USA

Class I, Groups B, C and D; Class II, Groups E, F and G.

Cover/sealing chamber assembly, Cat. No. EFSR-GFI.

Body assemblies, Cat. Nos. EFD, EFDC followed by 110, 150 or 175, with or without suffix letter A, followed by NL, may be followed by Q.

Cover assembly, Cat. No. EFK followed by F12Q, F34WQ, L3HQ, R12Q or R34WQ.

Cover assembly, Cat. No. ESKB followed by 1PBQ, 2PBQ, 2SPQ or 3JPBQ.

Class I, Groups B, C and D; Class II, Groups F and G.

Cover assembly, Cat. No. EFSR followed by 2023 or 20232, with or without M, may be followed by Model B.

Class I, Groups C and D; Class II, Groups E, F and G.

Cover assemblies, Cat. No. EDK followed by F12, F34W, R12 or R34W, RU1, RU2 or ROC, with or without A, may be followed by Q, with or without A; Cat. No. EFK followed by F12, R12, F34W or R34W, with or without A, , may be followed by Q; Cat. No. EDK or EFK followed by OMS, with or without A, , may be followed by Q; Cat. No. EFK followed by MOHC, MU, MU2, RU1, RU2 or ROC, may be followed by Q; Cat. No. EFK followed by 12, 35, 102, 345, U1, U2, J1, J1-TR2, J1-TR4, J1-TR5, J2, JU2, J1U1, J1U2, J17W, OC, DU1 or DU2, may be followed by Q; Cat. No. EFKB followed by -12, -35, -102, -102ML, -102MR, -102SRC, -345, -345ML, -345MR, -345SRC, -637, -DU1, -DU2, -J1, -J1DU1, -J1U1, -J1U2, -J2, -OC, -PC120, -PC277, -U1, -U2 or -UM1; Cat. No. ESK followed by B, may be followed by Q; Cat. No. EFKL followed by J1DU2, J1U2, J2U1, J3 or U3.

Cover/sealing chamber assemblies, Cat. Nos. EDK-F21, -F22, -F23W, -F24W, -F31, -F32, -F33W, -R21, -R22, -R23W, -R24W, -R31, -R32 or -R33W with or without A, may be followed by Q.

Cover/factory sealed snap switches, Cat. Nos. EDK-F21, -F22, -F23W, -R21, -R22, -R23W with or without A, may be followed by Q.

Cover assemblies: Cat. No. EDK followed by -DPB, -MOC, -MU or -MU2, may be followed by A; Cat. Nos. EDK-2MS, -2MSA, -3MS or 3MSA followed by -Q; Cat. No. EDKB followed by -PC120 or -PC277, may be followed by A; Cat. No. EDSK followed by -1J, -1JSS, -2J, -2SP, -B, -MS, -RU1, -RU2, -ROC, may be followed by A; Cat. No. EDSKL-3PB may be followed by suffix letter A; Cat. No. EFDL followed by J1U2, J2U1, J3, U3, may be followed by suffix letter A.

Body assemblies: Cat. No. EDS or EDSC followed by -147, -171, -172, -177, -247, -271, -272, -277, -347, -371, -372 or -377, may be followed by SA; Cat. No. EFS, EFSC, EFD or EFDC followed by 110, 150, 175, 210, 250 or 275, with or without A, may be followed by NL, may be followed by Q; Cat. No. EFDL or EFDCL followed by 10, 50 or 75, may be followed by Q. Series EFDCT, EFDT, Cat. Nos. EFDCT or EFDT followed by -10, -50 or -75; may be followed by -NL and/or -Q.

Sealing chambers: Cat. No. EDS-F followed by 21-Q, 22-Q, 23W-Q, 24-W-Q, 31-Q, 32-Q or 33W-Q; Cat. No. EDSK followed by -1MSAB-Q, -2MSAB-Q, -1MSW-Q, or -2MSW-Q; Cat. No. SW followed by FR1, FR2, FR13, FR23, FR3W, FR4W or FR3W3, may be followed by Q; Cat. No. SW followed by 1MSAB, 1MSW, 2MSAB or 2MSW.

Cat. No. SW followed by RU1, RU2 or ROC, may be followed by Q; Cat. No. GFS-1.

Blank covers: Cat. Nos. ESK-B-Q, ESKB-B-Q.

Cover assembly non-factory sealed: Cat. No. EDS-F followed by -12-A or -34W-A; Cat. No. EFS-FR followed by 1, 2, 3W or 4W, followed by -Q.

Cover assembly: factory sealed, Cat. No. EDS-F, followed by 21-Q, 22-Q or 23W-Q.

Class I, Groups C and D.

Cover assembly: Cat. No. N1K followed by -1PL, -2PL, -2SP, -3JPB, -12, -35, -102, -345, -F12Q, -F34WQ, -G37SRC, -J1, -J1U1, -J2, -J12, -J35, -J102, -J345, -JG37SRC, -JU2, -U1, -U2, -U3 OR -UM1.

Class I, Groups B, C and D, Division 2; Class II, Groups E, F and G; Class III.

Cover assembly: Cat. No. N2K followed by -1PL, -2PL, -2SP, -3JPB, -12, -35, -102, -345, -G37SRC, -J1, -J1U1, -J2, -J12, -J35, -J102, -J345, -JG37SRC, -JU2, -U1, -U2, -U3 or -UM1.

Cover assembly with push buttons and/or selector switches and pilot lights: Cat. No. ED2KB or ED2SK followed by one or more suffixes 12, 35, 102, 345, B, DC, J1, J2, PLG, U1, U2, UD1, UDM1, UM1, may be followed by ALT, JGBA, JGBB, JGBG, NMRBBL, NMRBBU, NMRBGR, NMRBGY, NMRBMBL, NMRBMBU, NMRBMGR, NMRBMGY, NMRBMRE, NMRBMWT, NMRBMYL, NMRBRE, NMRBWT, NMRBYL, PBBU, PBGR, PBGY, PBRE, PBWT, PBYL, SLC, SRC or SRL, may be followed by UCLP or UCPLP.

Cover assembly with push buttons and/or selector switches: Cat. No. ED2KB or ED2SK followed by

one or more suffixes 12, 35, 102, 345, B, U1, U2, UD1, UDM1 or UM1, may be followed by ALT, NMRBBL, NMRBBU, NMRBGR, NMRBGY, NMRBMBL, NMRBMBU, NMRBMGR, NMRBMGY, NMRBMRE, NMRBMWT, NMRBMYL, NMRBRE, NMRBWT, NMRBYL, PBBU, PBGR, PBGY, PBRE, PBWT, PBYL, SLC, SRC or SRL, may be followed by UCLP.

Cover assembly with pilot lights: Cat. No. ED2KB or ED2SK followed by one or more suffixes B, DC, J1, J2 or PLG, may be followed by JGBA, JGBB or JGBG, may be followed by UCPLP.

Cat. No. EDS or EDSC followed by 1, 2 or 3, followed by 71, 72 or 77, may be followed by SA.

Blank cover: Cat. No. ED2SK followed by 1 or 2.

Mounting body: Cat. No. EDS or EDSC followed by 1, 2 or 3, followed by 71, 72 or 77, may be followed by SA.

Cover assembly with push buttons and/or selector switches and pilot lights: Cat. No. UCSK followed by one or more suffixes DC, HSW, HSWNC, HSWNO, J1, J2, J3, J4, PLG, U1, U2, U3, U4, UD1, UDM1, UM1, may be followed by ALT, JGBA, JGBB, JGBG, NMRBBL, NMRBBU, NMRBGR, NMRBGY, NMRBMBU, NMRBMDD, NMRBMGR, NMRBMGY, NMRBMWT, NMRBMYL, NMRBRE, NMRBWT, NMRBYL, PBBU, PBGR, PBGY, PBRE, PBWT, PBYL, SLC, SRC, or SRL, may be followed by UCLP or UCPLP.

Cover assembly with push buttons and/or selector switches: Cat. No. UCSK followed by one or more suffixes 12, 35, 102, 345, HSW, HSWNC, HSWNO, PLG, U1, U2, U3, U4, UD1, UDM1 or UM1, may be followed by ALT, NMRBBL, NMRBBU, NMRBGR, NMRBGY, NMRBMBL, NMRBMBU, NMRBMGR, NMRBMGY, NMRBMWT, NMRBMYL, NMRBRE, NMRBWT, NMRBYL, PBBU, PBGR, PBGY, PBRE, PBWT, PBYL, SLC, SRC, SRL, may be followed by UCLP.

Cover assembly with pilot lights: Cat. No. UCSK followed by one or more suffixes DC, J1, J2, J3, J4 or PLG, may be followed by JGBA, JGBB or JGBG, may be followed by UCPLP.

Cover only (without devices): Cat. No. UCC followed by 1, 2, 3 or 4.

Mounting body: Cat. No. UCBB or UCBBC followed by 2, 3 or 4, followed by 10, 50 or 75, may be followed by U.

Class I, Groups C and D; Class II, Groups E, F and G; Class I, Group B, Division 2.

Cover assemblies: Cat. No. EDKB followed by -12, -35, -102, -345, -637-SRC, -DU1, -DU2, -J1, -J1DU1, -J1TR2, -J1TR3, -J1TR4, -J1TR5, -J1U1, -J1U2, -J2, -ML2, -ML4, -MR2, -MR4, -OC, -U1, -U2, DPB, DPBM, RU1, RU2 or -SMPB, may be followed by A.

Cat. No. EDSK followed by -B, -SMPB, may be followed by A.

Cat. No. EDSKN followed by DPB, DPBM, RU1, RU2, may be followed by suffix letter A.

Class I, Division 2, Groups B, C, D; Class II, Division 2, Groups F and G; Class III, Type 3, 3R, 4, 4X (Aluminium version only), 12.

Cover assemblies with snap switches: Cat. No. FDK2 followed by -F1, -F2, -F3W, -F1A, -F2A or -

F3WA.

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