

OPERATORS MANUAL

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I. INTRODUCTION

A. Warnings

When drying combustible material with heated air, there is a fire hazard.

Warning. Avoid pulling particles through the burner or heat exchanger. The heat source can ignite the particles and send sparks into the drying chamber.

Warning. Product left in and around the machine can ignite and start a fire. Clean the air chamber and the area around the machine daily or more often, if necessary

Warning. Check the high limit safety switches. These switches should be set about 20°F above the air temperature of the zone it is located in. These switches will shut off the fan and the burner to prevent overheating.

Warning. Immediately stop the burner and all fans in case of fire. Shutting off **all** airflow will reduce the size and temperature of the fire. Interlock all exhaust fans with the high limit safety switches.

Warning. Machines equipped with an auto fines clean out system need to run at all times to reduce the threat of fire.

Warning. Lock out and tag out power before opening and entering any access panel or inspection door.

Warning. Close and secure all access and inspection doors before operating the machine.

Warning. Maintain all safety guards and warning stickers.

B. Equipment ID

Each Belt-o-matic machine has a frame number for identification. The number is welded on the bottom left-hand corner of the frame next to the product discharge. The left-hand corner is determined by facing the product discharge. Each unit also has an ID tag on the electric control panel. This tag gives the model, serial number, voltage, amps, cycles, phase, fuel type, fuel pressure, maximum CFM, and fan horsepower. If the machine did not come equipped with an electric control panel, the tag is located above the bottom conveyor drive motor and gearbox.

C. Warranty

The Belt-o-matic has a one-year warranty which covers B.N.W. Industries manufactured parts and workmanship. Other component warranties are based on the manufacture warranty and may vary. Check with B.N.W. Industries on all other component warranties. The warranty begins on the day of delivery. Warranty parts must be returned to B. N. W. Industries for replacement.

D. Disclaimer

Improper installation, operation, handling, or unauthorized modifications of the Belt-o-matic constitutes loss of warranty. B.N.W. Industries is not responsible for loss if not all warnings and recommendations of this manual are observed.

II. SAFETY

A. Fire Safety

When drying combustible product with heated air there is a threat of fire. With certain products that are flammable and have a high amount of fines, the fines material can be ignited as it passes through the burner.

In a direct fire situation, the first source of fire comes from moving combustible product through the burner. The flame can ignite the product sending sparks into the drying chamber. These sparks may ignite product that is being dried or product that has not been cleaned out of the air plenum. Product left in the air plenum becomes very dry and can easily ignite.

To reduce the risks of fire and avoid sparks, maintain clean air to the burner. A clean air duct can supply fresh air supply to the fan and burner. This is necessary with certain products that have a high fire risk.

When heating air with a steam coil or other various heat exchangers, the danger of fire occurs when combustible product accumulates in and around the heat exchanger. The product will eventually ignite and send sparks into the drying chamber. Heat exchangers need to be inspected and cleaned daily. The frequency of cleaning and the extent of modification to avoid a fire depend on the flammability of the product, the amount of fines in the product being dried, and the air quality of the installation.

In many Belt-o-matic dryers and coolers, the vacuum side of the burner fan pulls the air through the cooling section. With certain products that are very flammable and have a high amount of fines, the fine material can be ignited as it passes through the burner. Observe the air chamber, while in operation, to see if there is a high amount of sparks. To reduce the amount of fines being pulled through the fan and decrease the amount of sparks, open the sliding fresh air intake doors as far as possible and yet achieve a cool product at the discharge. If you still observe sparks in the air chamber, it may be necessary to use a separate fan to do the cooling.

Fire safety starts with these prevention steps:

1. Cleanliness. Daily, if not more, clean heat exchangers, air plenums, and air ducts.
2. Provide clean air to the heat source. If needed install a fresh air duct to the heat source. Find the best and cleanest air to supply the heat source.
3. Observe the air chamber while in operation to see if there is a high amount of sparks.

B. Fire Safety Equipment on all New Belt-o-matic Dryers

1. **Burner control power interlock.** Power for the gas burner controls originates from the interlock with the fan starter. Turning the burner switch on without the fan running and the hand gas valve closed can check this interlock. If interlocked properly, the burner controller display will not illuminate. Older models without the external display will have a small light for indicating power to the burner controller.
2. **Airflow switch.** An airflow switch senses air movement at the fan. The fan must be running before the burner will light. This switch must send a signal to the burner controller before the burner will light. You can check this safety by disconnecting the copper or plastic tube at the airflow switch. The burner controller should not advance to trial for ignition (TFI).
3. **High limit safety switches.** High limit safety switches are located in the air chamber and on the top cover by the exhaust opening. The switches are normally closed. The two high limit switches

in the air chamber are wired in series with the burner controller. If these switches overheat, they will automatically shut the burner off. The fan will remain running. Once the switches cool and reset, the burner controller will once again light the burner. These switches are usually set at 250°F, but may vary. You can take a wire off one of the switches to test. The burner should not light. You can also take a switch out and place it in an oven at the temperature of the setting on the switch. The switch should open once it reaches the set temperature.

The other high limit by the exhaust opening is wired in series with the burner fan thermo overload. It is usually set at 210°F, but may vary. If this switch overheats, it will shut the fan off. This will interrupt the power to the burner controller shutting the burner off. The burner controller will go into lock out and will need to be reset before the burner can be lit again. It can be tested in the same manner as the other high limit switches. This switch is usually the first detection of a fire. The high heat from a fire will be first detected in the exhaust opening by this switch. It is very important to stop all airflow, if a fire occurs. Interlock all auxiliary fans to this high limit switch.

There are several safety features that are not standard Belt-o-matic components. Please contact B.N.W. Industries for further information.

- Automatic Sprinklers placed in the top cover of the dryer are a very good safety measure. These sprinklers can detect high temperatures and spray the dryer in case of a fire.
- Infrared spark detectors are also a good safety measure. These detectors can extinguish a spark before it enters the drying chamber.
- CO2 fire suppression systems are available. This system will release CO2 on the product bed, air plenums, and air ducts, if a fire is detected. This system is available for new and used units.

C. Emergency Fire Shut Down Procedure

Inspection and good housekeeping are one of the best fire preventions. In case of fire, follow these procedures:

1. Stop all airflow. All fans including exhaust fans should be shut down. Be sure to interlock exhaust fans with the high limit by the exhaust opening. Cover all air intakes and outlets to prevent any drafts. This is very important to contain a fire.
2. Unload the product into a noncombustible container or area so the product on fire can be extinguished.

D. General Safety

All OSHA safety practices need to be observed. Employee safety training is recommended.

III. GENERAL INFORMATION

A. Manufacturer Information

B.N.W. Industries takes pride in personal support of all clients and potential clients. If any questions occur, please feel free to contact Lee Norris (President), Dan Norris (Vice-President), or Aaron Norris (Sales Manager) at the following address and telephone number:

Mail/Shipping address – B.N.W. Industries
7930 N 700 E
Tippecanoe, IN. 46570 USA

B. Servicing Statement

It is the customer's responsibility to maintain the equipment as written in this manual.

C. Using the Manual

Due to B.N.W. Industries involvement with different applications and customizations, parts of this manual may or may not apply to your specific machine. This manual is designed to give basic instruction on how to operate, maintain, and troubleshoot. Specific information on your machine can be obtained from B.N.W. Industries at the address or telephone number listed under manufacturer information. Miscellaneous parts manuals for various components on your machine are included with this manual. In many cases, refer to these manuals for more detailed instructions.

IV. RECEIVING AND HANDLING

A. Inspection

As soon as the equipment is received, it should be carefully inspected to make certain the machine is in good condition and all items are listed on the delivery receipt.

B. Damages

Even though the equipment is secure at our factory for shipment, it is possible for it to be damaged in shipment. All damages or shortages should be noted on the bill of lading. Purchasers should take immediate steps to file reports and damage claims with the carrier. All damages to the equipment in transit are the responsibility of the common carrier since it is the manufacturer's policy to make shipment F.O.B. Tippecanoe, IN. USA i.e., ownership passes to the purchaser when the unit is loaded and accepted by the carrier. The purchaser must make claims for damage or shortage, which occurs during transit, against the carrier.

C. Handling

All Belt-o-matic machines must be lifted and supported from the bottom frame. Lift and tie down hooks are provided on the four corners of this frame. Equipment placed in containers for overseas shipments will have braces welded to the bottom frame. These braces help prevent damage to the machine when taking it out of the container. When removing the machine from the container, do so with caution. Tight clearances of the container make it very easy to damage the equipment.

D. Packaging

Whenever possible, Belt-o-matic machines are shipped as complete as possible. In some cases, guards, air ducts, covers, and valves must be assembled. Check the machines air chamber, conveyors and electric control panel for the disassembled and stowed items. The maintenance manual and fasteners are usually located in the electric control panel. Machines with steam coils will have a metal or wooden protector over the face of the steam coils. Remove the protector before operating.

V. INSTALLATION

A. Installation Site

Place the machine on a level concrete pad with supports at each corner of the bottom frame. Additional supports are recommended every 10' along the frame of machines 20' or longer, but may vary. The machine should be supported at least one foot off the floor for maintenance purposes. Machines with auto fines clean out need space under the frame to discharge fines material.

Proper support is necessary for the machine to run correctly. Improper support will allow the machine to twist and cause the conveyors to not track properly. It is necessary for the machine to be level side to side. Level end to end is not as crucial.

For outside installations, it is also important that every machine be protected from weather. A shed roof over the machine works well.

B. Electric Hook Up

Connect proper voltage and amperage at the main disconnect in the electric control panel. The serial tag on the electric control panel gives recommended voltage and amperage. It is very important to isolate the electric supply on all models with AC inverters. The voltage must be maintained as follows: 200 volt (+10% -15%), (400 volt +10% -15%), 480 to 500 volt (+10% -15%). Improper voltage constitutes a loss in warranty. Some components must be wired on-site after assembly. Junction boxes are provided to accommodate this. Always match colored wires for proper connection. Change power wires at main disconnect for proper rotations.

The electric control panels on new production models are bolted to the machine's sidewall and have a removable backer plate. These electric control panels can be removed and installed in a new location. All wires must be extended to reach the new location. A general wiring diagram is provided in the appendix. It is not an exact electrical schematic of your machine. Specific wiring diagrams are available on new equipment at an additional charge.

Be sure that any auxiliary fan is interlocked with the machines high limit safeties. This will help reduce the intensity of a fire, if one should occur

C. Gas Hook Up

Proper pressure and size plumbing should be installed at the inlet of the provided gas plumbing train. The serial tag on the electric control panel gives the proper pressure range and maximum BTU's per hour. A proper size gas line must be engineered on a case-by-case basis. Contact B.N.W. Industries for consultation.

Natural or vapor LP gas hook up: Connect to supplied vapor gas line with proper pressure and volume. Refer to serial tag for minimum and maximum gas pressure as well as maximum BTU of the burner. The pressure needed depends on the amount of BTU's needed. The supplied gas line size might vary depending on the application.

Steam models: The line size varies with a maximum of 150 P.S.I. The temperature control valve, strainers, and traps must be installed before operating. The appendix shows a general diagram of how to install the steam plumbing valves. Uncover the protective shield over the steam coils before operating. Steam models have an air snorkel on the fan motor. This air snorkel provides fresh air to the motor. The air snorkel will receive air from under the machine. The machine must be off the floor to not restrict the airflow to the air snorkel.

Liquid LP models: Connect to the provided 1/2" inch liquid LP line with tank pressure. Frost may be seen before the internal vaporizer. If frost appears after the internal vaporizer, loss in heat will occur. You must reduce the flow or pressure into the vaporizer to eliminate this frost.

Alternate fuel sources: (i.e. electric coils, oil burners etc.) Refer to the manufacturer for specifications and requirements.

D. Assembly of Parts

1. **Top cover and inlet hopper.** In some cases, the top cover and inlet hopper may be removed for shipping or installation. In these cases, the top cover is made out of several pieces. Each piece is numbered along with a corresponding number on the sidewall of the machine. Match numbers for proper position. Bolts or screws are generally provided in the electric control panel. If an electric control panel is not provided, check boxes stowed in the air chamber.
2. **Shaft-mounted gearboxes with C-face motors.** Current production models have shaft-mounted gearboxes with C-face motors for the conveyor drives. No assembly is required.
3. **Removed drive plate.** Previous production models may have a removed drive plate that contains these components. Each drive plate is marked for proper installation. Properly line up the belt drive and chains for correct operation.
4. **Air intake duct.** Assembly of the air intake duct is required on models with removed fan and burner. The size and shape of this duct will vary with each machine. The air duct is numbered for correct assembly. Be sure to securely mount all fans and burners to a solid concrete pad. In most cases, the customer provides the exhaust air duct.

E. Air Ducts

The purpose of the air duct is to provide space between the burner and the product. With many combustible products, the air intake could have a 20' long or longer air duct. It is important to properly plan the design and installation of all air ducts. These ducts are marked for proper assembly.

Air intake ducts should be designed with few or no turns. A bouncing effect of the air must be avoided. If a turn is necessary, it should be designed with a large and gradual sweep for best airflow. The size of the air duct should be no smaller than the fan housing.

The exhaust air duct provides a path to remove water and poisonous gases out of the building. Connect the duct at the provided exhaust opening. This duct can be screwed or bolted to the opening. The construction material depends on the composition of the product. With a corrosive product, it may be necessary to construct this duct out of 304SS.

A powered exhaust is required if the air duct creates backpressure. A powered exhaust will result in a very clean operation. **If the exhaust air duct creates backpressure, due to an insufficient size or designed air duct, product and dust will blow out every place possible including the inlet hopper and out the discharge.** Four factors will determine backpressure: the volume of air, size of the air duct, length of the air duct, and the number and size of turns in the air duct.

In general, the size of your air duct should not be smaller than the size of the provided exhaust air opening on the machine. On powered exhaust systems, the air duct needs to start at the exhaust opening size and gradually transition down to the cyclones air intake size. This will help improve cyclone efficiency and air movement. Be sure to match the cyclone CFM with that of the machines or manufacturers recommended CFM. Insufficient duct size and improper design will result in loss of warranty and capacity. Many problems can and will result if the air ducts are not designed and sized properly.

F. Rotations and Alignments

Check the rotation of all motors. Check and clean the fan housing of any debris before operating the fans and conveyors. Check the air chamber and the conveyors for any parts stowed there. The fan should rotate counter clockwise. With multiple fans, the rotation should alternate, with the fan next to the burner rotating counter clockwise. Also, run the conveyor belts and all other auxiliary equipment and check rotation. Running the conveyor belts backwards could destroy the conveyor belts and air locks. This will result in the loss of warranty.

In all cases, run the conveyor belts for a period of time before initial start-up. This will help insure the conveyor belts are tracking true. A conveyor belt is centered when a ½” of clearance exists between the edges of the belt and the sidewall of the machine. The belts are aligned at the factory but may shift during transit. For instructions on aligning the conveyor belt, see “Maintaining the Conveyor Belt”.

G. Motors

All motors on the Belt-o-matic are TEFC and have thermo protection. All fan motors must be Lincoln or Leeson brand motors. Other motors can be of various types. Current machines use Leeson brand motors on the conveyor drives and all auxiliary equipment. These motors are inverter duty. Motors are protected and interlocked through the thermo protection in the motor windings.

VI. OPERATIONS

A. Start-up Procedure

Before starting the machine remove all parts and debris, close all doors and panels, and clear all personnel away from equipment.

1. Start the fan at the start/stop station. In some models, the fan is started with the AC inverter. The AC inverter is programmed at the factory and does not require customer programming. The fan next to the heat source must be started first. Models with a gas burner will not light, if this fan is not running. Fans are always numbered according to airflow direction. Fan #1 is by the entering air. For cooling applications start all fans and skip to step 3.
2. Light the burner or turn on the heat source. Refer to the burner manufacturer manual for heat sources other than the Belt-o-matic design gas burners. Turn the burner toggle switch to the ON position. The inlet hand gas valve must be open and have gas pressure. An adjustable orifice hand valve must be closed to slightly open. This valve is the last hand valve before the burner. Once the burner toggle is on, the burner controller will be powered. The burner controller will begin a 30-second purging of the air chamber. The burner controller must sense airflow through the Dwyer airflow switch to achieve further progression.

Next, the burner controller will go into trial for ignition. The safety gas valves will open and a current will be sent to the burner spark plug. After ignition has taken place, the burner controller inferred or UV eye scans the burner to assure ignition (Fireye is inferred, Honeywell is UV). Once the eye senses a flame, the burner controller will go into continuous operation. If the eye does not see a flame, the burner controller will go into lock out. The burner controller will need to be physically reset. On older models with a Fireye controller, push the reset button once for a description of flame failure. Push the button twice to reset the burner controller. Some older Fireye systems give a display pattern of lights with a code to determine failure. Some newer Fireye systems have a readout display. The Honeywell burner controller provides a reset button on the display module. This reset button offers instant reset after one push.

On newer systems, the burner controller readout gives a signal reading from the inferred or UV eye. This signal reading must be five or stronger for the Fireye and 3.5 to 7.5 for the Honeywell to run the burner. Older Fireye models have a run check switch. When placed in the check mode, the burner will stay lit and a DC volt tester can check the voltage at the test ports. Five volts or more is needed to run the burner. If a lower signal reading is a problem, go to the burner troubleshooting section.

3. Use the start/stop station to start all auxiliary equipment. This includes stirrers, rotary air locks and drops, cyclone fans, spreaders, discharge equipment, auto fines, etc. Start discharge equipment before starting the machine conveyors. It might be necessary to install alarms or interlock conveying equipment to the machine conveyors. This will help prevent plugging the machine or running the machine empty in cases of motor failure.
4. Next, start the conveyors. All new models use an AC inverter to control motor frequency. Some previous models use start/stop stations.
5. Finally, start inlet-conveying equipment to fill the machine.

B. Shut Down Procedure

At shut down, the machine may be left full or empty of product. Start-up time for an empty machine will take longer.

Product left in the machine must be cooled before shutting the fan off. Upon start-up, run the fan and burner to get the product and machine hot.

To empty the machine of product let the fan and burner run until all product discharges. Product temperature and moisture will vary as it discharges. Start-up time for an empty machine will take longer. At that point, you can proceed through the normal start-up.

1. Shut off the inlet conveyors, conveyor belts, auxiliary equipment, and discharge conveyor in this order. If equipped with the auto fines clean out, let this feature run until the very end.
2. Shut off the burner or other heat source in drying applications. You may either shut off the incoming gas flow or move the toggle switch to the OFF position. If you shut the gas flow off, be sure to switch the burner toggle off once the burner flame goes out.
3. Turn off all fans and the auto fines. Allow time for the machine and the product to cool.
4. Turn the main disconnect to the OFF position.

C. Filling the Machine, Product Depth

When filling the machine for the first time, start at a low capacity. Once full, it can be increased to a higher capacity.

An even depth is very important. The surface area of the conveyor belts **MUST** be completely covered for even drying and/or cooling and maximum capacity. The depth of the product greatly differs from one product type to another. Depth thickness depends on the particle size and integrity. A large product may run very deep (6" to 2'), whereas a small pellet (1 mm) may run very shallow (2" to 6"). This is because larger particle sizes leave larger air voids. There must be enough air space for the air to pass through, but yet not too much, which will waste fuel. In some cases, we allow the sides of the bed layer to run as much as 10% higher than the middle. This helps accommodate drag due to the sidewall friction.

The percentage of fine material will also determine the depth. A lower depth may be needed for a product with a high amount of fine material. Fines will tend to block the air causing an air restriction.

Be sure to spread all fine material evenly throughout the layer of product for even drying and/or cooling.

The product depth can change between levels on multiple pass machines. As the product dries and/or cools, the depth may be increased. This will help accommodate for product shrinkage. The speed ratio between the top and lower passes will determine the depth thickness. Each Belt-o-matic is designed to reach a certain range of depth. Typically, you need to run the product depth as deep as possible depending on the capacity and the product. A product depth too shallow will not give you the full energy potential. Running the product depth too deep might give you a wide variety of moisture and temperature between the top and bottom portion of the layer. Contact B.N.W. Industries for your machine's depth specification.

On machines with an inlet hopper and adjustable leveling gate, the inlet hopper must be flooded fuller than the bed layer. This will keep the sides of the conveyor belt completely full and will air lock steam, dust, and heat from escaping out of the hopper. In some cases, visible steam may be noticed above the hopper. The hopper top must be left uncovered to allow the steam to escape and not condense on the product. A high amount of air and dust blowing out of the hopper is the first sign of an air restriction in the exhaust air duct.

Machines with spreading devices such as the oscillating inlet spreader and the wiper belt spreader are fully adjustable to achieve an even depth. These spreading devices need a metered rate of product to work properly.

D. Adjustments and Controls

All Belt-o-matic machines have a wide range of adjustments and controls. This makes it very easy to adjust the machine to different products and capacities. Special attention is necessary to properly adjust and control your Belt-o-matic efficiently.

1. Depth

- a. **Inlet hopper and level gate.** Either a side handle or jacks perform the level gate and hopper depth adjustment. Jacks have level indicating rods to insure the bottom edge is level. The hopper and gate system not only levels the depth but also meters the rate of feed based on the conveyor belt speed.
- b. **Inlet spreaders.** Machines with spreading devices control the depth by the speed of the conveyor belts. These systems must have a metered feed rate to work. These spreaders will provide an even bed depth. The conveyor belt speed at the metered rate will determine the product depth.

The oscillating spreader should be fed from top center. The product should never be loaded from the sides or at a diagonal. The swing tube of this spreader moves back and forth to distribute product. The stroke length of the swing tube can be adjusted to provide more or less travel. This will change the product distribution to help achieve an even depth.

Two adjustments can be made to determine the travel of the swing tube. An adjustment can be made where the connecting link arm is bolted to the swing tube. More travel will happen when the connecting link arm is moved up and less travel when moved down. Another adjustment can be made where the crank arm and the connecting link arm meet. When adjusted down more travel will occur and less travel when moved up. Travel of the swing tube should be adjusted so it will fill the corners of the belt slightly deeper than the center. There needs to be no more than 10% variation in depth. This ensures an even flow of product on the bed due to the drag of the sidewall.

The wiper belt spreader distributes product on a belt across the machine's conveyor belt. When the spreader belt is full of product a wiper disperses the product evenly onto the

machines conveyor belt. To have a consistent bed depth the spreader needs to be fed evenly at a metered rate. It will control the evenness in the machine but not the volume or depth. The machine's conveyor belt speed will control the depth.

The cross belt of the spreader is one speed whereas the wiper is variable speed. Once in operation, use the variable speed of the wiper to control the evenness of the bed depth. Time the wiper so the wiper cleans the belt as the product reaches the opposite sidewall of the machine.

- 2. Conveyor belt speed.** Current machines incorporate an AC inverter to control the motor frequency. The C-face motor is connected to multipliers, which are attached to a shaft mount gearbox. The ratio of the gearbox, multiplier ratio, and the frequency of the motor determine the belt speed. A chart with various overall drive ratios is provided in the appendix. This chart indicates the belt foot per minute speed at a specific drive ratio and motor frequency. Multiply the ratios of the multipliers and the gearbox to find the correct ratio on the chart. Example: a 4:1 and a 5:1 multipliers with a 250:1 gearbox equals 5000:1. Locate the correct foot per minute belt speed by intersecting to ratio column with the motor hertz row. Once you have the correct foot per minute speed, divide the speed by the conveyor length to get the total resident time.

The multipliers can be changed to achieve a new speed range. Every time a multiplier is added or deleted, the direction of the belt must be changed. The direction can be changed in the AC inverter program menu. Running the conveyor backwards will damage the belt and air locks and will void all warranty.

Former production machines use a mechanical variable speed on the motor and gearbox. Manually adjust the crank arm to speed or slow the belt. In some cases, an AC inverter was also used to adjust motor frequency. The foot per minute speed is determined by the ratio of the gearbox and the ratio of the drive sprocket in relation to the position of the belt on the variable speed pulleys. Measure a foot of distance on the machine's sidewall and time the conveyor belt at different pulley settings to determine belt foot per minute speed. Some machines come equipped with an encoder and decoder that measure this time. Change the gearbox ratio or the sprocket sizes to achieve different speed ranges. It is essential that the drive plate rod be threaded through the eyelet of the hand crank pulley rod. The pulley rod holds the pulley in place so that it can be adjusted. The rod needs to slide freely.

- 3. Flame Adjustment.** (Dryers with Belt-o-matic manufactured gas burners only) - Once the temperature of the burner is set and the machine is full of product, the flame may be adjusted. A blue flame with small yellow tips is desired. If this is not the case, the fuel air mixture needs to be adjusted. A yellow flame is a rich mixture. Older machines with ring style burners cannot be adjusted.

The air sweeps on the burner have four adjustable plates to allow more or less air into the mixing tube. Two of the plates are preset at the factory at approximately 1/2" open, but may vary. These plates will give you the proper range of fuel to air mixture. The other two plates can be manually adjusted from the exterior by throttle cable or a rod adjuster. These plates will fine-tune the burner flame. Close the plates for a richer mixture and open for a leaner mixture.

Older machines incorporate the adjustable plates and a slide sleeve in the mixing tube. The adjustable plates offer the proper mixing range while the slide tube fine tune the flame from the exterior.

- 4. Temperature Adjustment.** (Dryers with Belt-o-matic manufactured gas burner only) - Standard production dryer's use a Partlow modulating gas valve to control gas flow and temperature. This valve has a dial with temperature indicating marks. Once in operation, this dial needs calibrated. After the machine is full of product, and the temperature is set, loosen the allen screws on the dial and turn the dial to the mark that corresponds with the plenum thermometer reading.

The Partlow minimum setting is set at the factory. If this needs to be changed, or adjusted, refer to the Partlow manual provided.

The orifice valve is the last ball valve downstream of the gas controller. This valve has a small hole drilled in the ball to act like an adjustable orifice. This valve will allow you to set different firing ranges of the burner. The orifice is open when the handle is parallel to the gas train and closed when perpendicular to the gas train. This valve should be closed when firing the burner. If the burner does not light, the orifice may be opened slightly until providing enough gas volume to light the burner. On start-up the Partlow valve is fully open. If the orifice valve is fully open, you will have full line pressure going to the burner. The plenum temperature may increase rapidly and hit the safety limit shutting the burner down. Keeping this valve closed allows the temperature to increase gradually.

Once the burner is to the set temperature, maintain one-half gas pressure at the pressure gauge by the orifice valve in relation to the pressure gauge by the inlet hand valve. For example, if the inlet pressure gauge reads ten PSI, the pressure gauge by the orifice valve should read five PSI. This will allow room for the Partlow valve to adjust the pressure up or down maintaining a constant flame. If the burner flame fails due to low gas volume and proper pressure and volume have been supplied adjustment of the orifice valve or Partlow valve minimum flame setting is required.

Machines provided with steam coils usually have a temperature control valve, traps, and strainers. The temperature control valve will vary the steam pressure to increase or decrease the temperature. Due to a wide range of coil sizes and steam quality, consult B.N.W. Industries for further information. Maximum steam pressure is listed on the serial tag.

- 5. Airflow.** The fan blade size, pitch, horsepower, and static pressure determine airflow volume. More or less airflow can be achieved by altering any of these factors. All machines with vane axial fans have adjustable pitch fan blades. The blade can be pitched to achieve higher or lower airflow. Measure the amp draw of the motor before the fan is re-pitched. Full load amp figures can be obtained by contacting B.N.W. Industries. Some models will have an AC inverter to control the frequency of the fan motor. In these cases, only change the hertz on the AC inverter's program pad to change the airflow. These fans have been pitched at full load amps when running at 60 Hz.

The fan blades are attached to a center hub with bolts. To change the pitch, loosen the bolts and turn the blades one at a time. Open the blades for more airflow and close for less airflow. More horsepower is needed, if pitching the blade open causes the motor to over amp. Change the pitch of each blade equally. A caliper consisting of a bolt and nut will work. Gauge the trailing edge of the blade and the back machined edge of the hub.

Air is the vehicle used to remove moisture from the product. For most products use the maximum amount of airflow possible, but do not increase the airflow to the point that the product becomes fluid. A high airflow may not be good for product quality in some cases.

Models that are dryer/coolers and use the burner fan to do the cooling have adjustable doors to adjust the cooling air to fresh air ratio. These doors need to be open as far as possible while maintaining proper cooling. The product should be cool and the conveyor belt should be warm to the hand. **Never restrict the air intake more than is provided by the adjustable doors.** Too much restriction of the fresh air inlet may cause an extreme amount of fines to be pulled through the burner which creates a fire hazard. Inspect for sparks in the air plenum. The cooling air in these cases enters above the product at the product discharge. Do not enclose this area. A hinge plate air lock separates the heat and cool sections.

Models that have a separate cooling fan may have the cooling air intake between the upper and lower portions of the conveyor belt on the machine's sidewall. Do not restrict this area. Vacuum

coolers use the same air intake. Control the airflow by increasing or decreasing the fan pitch, motor hertz, or horsepower of the cooling fan.

E. Controlling Capacity

Capacity is adjusted through the product depth, airflow, and conveyor belt speed. The amount of time each process requires depends on the product temperature, moisture, size, and drying characteristics. Contact B.N.W. Industries for recommended speeds and depths.

Enough airflow must be introduced to remove the needed BTU's in cooling applications. Enough airflow and BTU's must be present to evaporate the required amount of water in drying applications. We use the factor of 18 to figure this. Take the fan cfm (in thousands) x 18 x heat rise °F x 60 minutes = BTU's produced. For example, if your fan is producing 20,000 cfm it will figure as followed: $20 \times 18 = 360$. $360 \times 150^{\circ}\text{F} = 54000$. $54000 \times 60 = 3,240,000$ BTU per hour. In this example heat rise is based on 70°F ambient air temperature. A 150°F heat rise would equal 220°F plenum air temperature.

Altitude, humidity, air temperature, and barometric pressure will vary the required energy. We calculate 1,500 BTU's to evaporate one pound of water. Some products will take more while others take less. Multiply 1,500 BTU's by the total pounds of water per hour to be removed. This will give you the total BTU's required per hour. Vapor LP gas has 92,000 BTU's per gallon, natural gas has 1,000 BTU's per cubic foot, and steam has 950 BTU's per one pound.

Adjust the airflow and heat rise to produce the required energy based on the moisture removal. Maximum capacity will be reached when the depth, time, airflow, and temperature are correct. When cooling a product you need only enough airflow and time at a correct depth to remove the required BTU.

F. Controlling Efficiency

Efficiency of a machine is very important. Maximum efficiency is reached when the exhaust air is saturated. The air must be adjusted and/or recycled if it is not saturated. Correct airflow and bed depth are vital for good efficiency. Efficiency in drying applications is gauged by measuring the gas consumption and/or reading the machine's thermometers. Thermometers are placed in the bottom air plenum, between each conveyor belt, and at the provided exhaust opening. Generally, the lower the temperature reading at the exhaust opening the more efficient the process. This is due to evaporation cooling. Belt-o-matic dryers incorporate a bottom or top air chamber design. This design produces a gradient exhaust temperature. Exhaust air temperature can be measured at various points down the conveyor belt. The best air quality can be captured and recycled to produce better efficiency. Consult B.N.W. Industries for more information.

Changing the plenum air temperature, airflow, bed depth, and conveyor belt speed will vary the efficiency. For instance, increasing the bed depth will allow more energy to be absorbed. However, this can produce a slight variation in moisture content from the top of the bed depth to the bottom of the bed depth. Stirrers and multiple pass configurations lessen moisture variation. Contact B.N.W. Industries for best settings.

VII. MAINTENANCE

Belt-o-matic machines should be properly maintained to ensure years of continual service. The following guidelines need to be observed.

A. Housekeeping

As covered in various sections of this manual, it is very important to perform housekeeping functions daily, if not more often. The machine must be kept free of debris. Belt-o-matic machines have specific built-in features that promote cleanliness. It is important to maintain these features.

Most units have an auger style idle roller. This roller helps clean away the debris that might accumulate between the upper and lower portions of the conveyor belt. A small inspection door is provided at each auger roller to physically inspect and clean this roller as needed.

The optional cleaning features include: auto fines clean out system, belt wash downs, air pipe belt cleaners, and belt brushes. Although each Belt-o-matic is manufactured with few dust ledges, it is necessary to inspect and clean any accumulation of debris.

B. Bearing Service

Bearing service is minimal because of the slow speed of the conveyors. Bearings are found on the drive, wrap, tail rollers, and optional equipment. The bearings may need to be greased periodically. Use premium all-purpose grease.

New production models use cast bearings in removable framing. When replacing the bearing, remove the lock collar first, then take the framing bolts out. Next, support the roller shaft and slide the framing and bearing off of the shaft. Reverse procedure to install a new bearing.

Older models use non-serviceable bearings that may be installed on the drive and tail pulleys. These bearings consist of flanges with bearing inserts. To replace these bearings, unbolt the flange from the bearing framing, remove the flange, and insert bearing from the motor shaft. Remove the gearbox or sprockets on the drive side of the drive roller before replacing bearings.

C. Gearboxes

Service is needed periodically to check the oil level. Refer to gearbox manual for oil levels, service schedule, and oil type recommendations. The vent plug should always be located at the top of the gearbox.

D. Chain Adjustments

Older production models use sprockets and chains from the gearbox to drive the conveyor belt. These systems use a wooden block or a small sprocket to maintain tension on the drive chain. This wooden block or sprocket should be above the chain pushing downward. Provide enough tension so the chain does not ride off the sprockets.

E. Maintaining the Woven Wire Conveyor Belt

A standard feature on all new production models is the woven wire conveyor belt specification B-60-48-16. This belt will hold all products 1/8" or larger. An optional finer weave compound belt specification CB2-120-96-18 is available for smaller products. The belt B-30-30-14 is available for larger products. This belt has better cleaning characteristics than other specifications. These belts are made of either 304 stainless steel or galvanized steel wire. Some older machines have the course weave belt with filler wire inserts while others have a B-72-70-18 belt with filler wire inserts. These older belts are discontinued. Older machines may be retrofitted with the new style belts.

At initial start-up, allow the belt to run for several revolutions before loading the machine.

- 1. Belt maintenance.** Cleaning the belt is important in many drying applications. A continuous wash down area or high-pressure washer works well. Work at the face of the tail pulley when cleaning the belt. Particles that are stuck in the belt are usually not a factor in reducing airflow. These particles will often fall out on the return portion of the belt or as the belt flexes around the rollers. Even though the belt may look plugged, it probably is not. Some products, especially extruded oil-seeds before oil extraction, may plug balanced weave belts. The oils may form a gum that will stop airflow. We recommend using a solid tray conveyor belt, especially for coolers.
- 2. Belt traction.** Belt traction is achieved by the lagging on the drive roller and the tension of the spring loaded wrap roller. Adjust the wrap roller for more traction if the belt is slipping. The wrap roller is compressed against the drive roller with a coil spring. Tighten the spring for more traction. **Do not completely compress this spring.** A gap about 1/16" is needed between each coil to compensate for any debris that might travel between the wrap and drive rollers. **Do not tighten the belt to achieve better traction.** In many cases, this will decrease the traction. Remove a section of belt or slightly increase the distance of the tail pulley to take up extra slack.
- 3. Belt adjustments.** Proper tracking will increase the life of the belt. The belt has a maximum of 1/2" clearance between the edge of the belt and the machine's sidewall. A belt that tracks to one side needs to be adjusted back to the center. All belts are squared within 1/8". This means that the belt could travel as much as 1/4" while running. Adjust the belt if it moves to one side and stays in that position.

If a belt is not tracking properly, either the drive and tail rollers are not square or the product load on the belt is not uniform. Although the belts are aligned at the factory, it is possible for them to become unaligned during transit. Check both ends of the belt to see if it is cross-cornered or to one side. If it is cross-cornered, both drive and idle pulley may need to be adjusted to make them parallel, but always correct by first adjusting the idle pulley. Run the belt while making these adjustments. Remove the bearing covers and expose the roller bearings. New production models use cast bearings and threaded rods with adjusting nuts. Be sure to loosen any locking nut before making adjustments. On older production models adjust the roller position by loosening the bearing framing bolts and sliding the bearing in the slots.

To adjust belt tracking tighten the adjusting nut on the side that the belt is close to. Adjust the rollers in small increments (1/4"). Allow the belt to run for two revolutions before making another adjustment. Measure the space between the belt and the sidewall to determine correct alignment. If after adjustment the belt travels to the other side, decrease your adjusting increments.

In the rare case the drive roller needs adjusting, only adjust the side opposite the motor and the gearbox. If the drive roller is moved backward, the spring loaded wrap roller must be loosened to move the drive roller. Always adjust the tension of the wrap roller after moving the drive roller. The spring should not be compressed more than a 1/16" gap between each coil.

If the drive and tail rollers are square, check the product bed for uniform depth. To achieve uniform product depth refer to "Filling the Machine" and "Adjustments and Controls."

- 4. Belt removal and replacement.** When removing the belt always work at the face of the drive roller. The belt must be removed in the same direction that it travels. Lock the bottom side of the belt to the drive roller by pinching the belt against the roller. More tension with the wrap roller or a wooden block with a floor jack might accomplish this. You must then tie or wire a piece of iron or wood to the top side of the belt above the drive roller. With this you must pull the belt toward you to achieve slack at the face of the drive roller. Once you have slack, clip the welds off at the edge of the belt and remove the splice wire that holds the coils together. The newer compound belts require removing two splice rods to be fully disconnected. Belts that have filler rod inserts must have the rods taken out in front and behind the splice. Once disconnected, be sure to hold the bottom side of the belt from falling back into the machine and remove tension.

If the belt is being completely replaced, attach the new belt to the old belt. As you pull the old belt out, the new belt will be installed. A long cable tied to the belt and a vehicle of some sort will help with this process. Be sure to properly insert the new belt over pipe hangers and through all airlocks. Be careful not to catch and tear the belt and/or airlocks. Once you have the belt in place, pull slack at the drive roller and pinch the bottom side of the belt. Rejoin the belt by inserting a new wire to mate the coils. Notice that the coils are left and right-handed. For easy assembly use a straight wire of the same size for the splice. A crimped wire must be used to splice the CB2-120-96-18 belt. Either weld the edge or thread the end of the wire back into the belt to secure it. Release the tension. Remember to check the belt tracking before loading.

F. Maintaining the Solid Tray Conveyor Belt

The solid conveyor belt is used in applications where the woven wire belt might plug or not appropriately handle the application. This design is a positive drive and not a traction driven system. Run the belt for several revolutions upon initial start-up.

1. **Belt maintenance.** The belt should have regular inspections for proper operation and alignment. Clean the belt periodically to reduce particle build-up on the trays. Use a wire brush to scrap or brush off the build-up. Removing the build-up will insure good airflow.

Periodically, check the drive sprocket teeth for proper fit into the flat wire belt opening. These teeth must drive against the splice rod of the flat wire belt. Be sure that the teeth are in the correct spaces.

2. **Belt tension.** Enough tension is needed to prevent the belt from slipping off the drive sprockets. If the belt is not aligned or tensioned correctly, the belt will climb onto the sprocket teeth.
3. **Belt adjustments.** Adjust the drive and tail pulley in the same manner as stated in the woven wire belt aligning section of this manual. A 1/2" clearance between the belt and the sidewall of the machine should be observed
4. **Belt removal and replacement.** Remove the solid tray conveyor belt at the face of the drive roller. First, loosen the adjusting bolts at the bearings to allow the drive sprocket to slide back and loosen the tension. For more slack, loosen the tail pulley. Next, remove the splice rod that connects the flat wire belt under the s-shaped trays. At this point, remove the belt as explained in the section about woven wire belt removal. Reverse all procedures to reinstall the belt. Remember this belt is directional. The top edge of the tray is the leading edge.

G. Conveyor Racks

The conveyor rack supports the belt and consists of gravity spring-loaded rollers that can be popped in and out. The conveyor belt is carried on the roller rack and encases the roller rack. The conveyor belt may need to be removed to replace these rollers. Be careful not to damage these rollers when working at the topside of the conveyor belt. Some models have a slider rack instead of the roller rack. The slider rack consists of an iron structure in a herringbone layout. These racks do not require any maintenance.

H. Drive Roller Lagging

Lagging on the drive roller provides traction between the conveyor belt and the drive roller. Different types of lagging are used depending on the application. Previously, a grip top lagging was used on non-heat applications. A spiraled hot belt lagging is used in heat application. A vulcanized lagging is used in high heat and corrosive applications. Currently, asphalt belt lagging is used on all applications except food grade. Asphalt belt is rated for 300°F to 350°F and is excellent against oils.

The lagging consists of a rubber compound that will need replaced after time. An indication that the lagging need replaced is a loss of traction. Pre-lagged drive rollers are available at B.N.W. Industries for purchase. To replace the lagging the conveyor belt and drive roller will need to be removed. Remove the old lagging from the roller and scrape the roller clean. We recommend buying precut lagging from B.N.W. Industries for the best results.

If the lagging is spiraled onto the roller, start from the center of the roller and work out. It takes two 3" wide strips of lagging to accomplish this. Several rivets at each end and every quarter turn will help hold the lagging on to the roller. Contact cement will help in applying the lagging to the drum. Vulcanized lagging is adhered in quarters onto a metal backing. A cutout is provided to weld the metal backing to the roller. To disassemble, grind the welds off and remove the quarter pieces of lagging.

VIII. OPTIONAL EQUIPMENT

A. Auto Fines Clean Out Systems

This system provides automatic clean out of fine material in the air chamber. The auto fines clean out system must run at all times while the machine is in operation. Typically, there are three types of auto fines clean out systems.

1. Most machines with auto fines clean out systems have a v-shaped air chamber with a 12" drag chain in the center. The v-shaped floor allows any fine material to fall down to the 12" drag chain. The drag chain conveys the material toward the discharge opening. Metal airlocks are provided at both ends of the drag chain to prevent air from escaping. The fine material falls out of the machine under the machine's frame. The tail end of the drag chain also has an opening to allow fines to escape. The chain should convey all material in the direction of airflow.

The drag chain will stretch over time and will need more tension to prevent it from jumping on the drive sprockets. The tail end provides tightening capabilities. Two threaded rods on the outside of the frame tighten the chain. Before tightening, loosen the bearing bolts on the tail sprockets. Thread the adjusting bolts in to tighten the belt. This will slide the bearings back in the slotted holes. Tighten the chain until the slack is taken out of the chain under the drive sprockets. Once the chain is tight, tighten the tail bearing bolts.

Links may need to be removed if the chain is still loose. Links are removed by removing the rod that connects each link. The rod is bent over at each side to hold it in. Straighten the rod and pull it out. Slide the tail bearing forward to see how much chain needs to be removed. Remove the excess chain and reconnect. Periodically check the chain before starting to ensure proper operation and that it is free of any objects.

Some older styles of auto fines clean out systems incorporate a chain and sprocket to drive the chain. Be sure to keep good tension on these chains. Periodically grease all bearings for proper service.

2. Some machines incorporate the return portion of the bottom conveyor belt as the clean out mechanism. The belt drags the flat bottom floor and discharges the fine material below the tail pulley of the conveyor. No adjustments are made except those mentioned in the woven wire belt maintenance section. These systems are most common on the vacuum style coolers (PC models).
3. Some smaller machines incorporate an opening in the bottom floor of the machine to allow fines to discharge. This opening is located at the end opposite the fan. The short air chamber allows the fan to push all fine material out of the opening. A rotary air lock prevents air escaping out of this opening. A paddle style wheel continuously cleans fine particles out of the air chamber. The

paddle wheel is driven by a shaft mounted gearbox and a c-face motor. Be sure to frequently inspect the fines opening in the air chamber for blockage of the opening.

B. Stirring Equipment

Rotating stirrers help mix the product at various locations as the product travels on the conveyor belt. Mixing the product will provide better consistency in the moisture level of the product as well as reestablish the airflow. As the product mixes it will blow clean under the stirrers. This allows a good complete stir, but yet will not allow too much air to escape. Generally, the teeth of the stirrers are spiraled and travel the same direction as the conveyor belt. While most stirrers are stationary, some stirrers hinge up for varying products.

New production stirrers use a c-face motor and a shaft mounted gearbox on each stirrer. Most of the older production stirrers used chain and sprockets for the drive. One motor and gearbox runs multiple stirrers. Be sure to always keep proper tension of the chain on these stirrers.

The bearing framing on the stirrers are slotted so the stirrer can be removed, if necessary. **Always run the stirrers before the product enters the machine to prevent plugging.**

C. Cyclones

The HV high efficiency cyclone is an air cleaning system used for the exhaust air exiting off a dryer or cooler. Proper air ducts should be installed from the dryer or cooler to the cyclone. All air ducts should start out the size of the exhaust opening of the machine and gradually reduce until it fits the provided inlet size of the cyclone.

A rotary air lock should be installed in the cyclone at the bottom of the cone. This will prevent air from bypassing the exhaust duct. The two counter rotating vane axial fans are set on top of the cyclone roof mounted to the vent opening. Mount the fan to move air upward. The air direction is marked on the fan housing. Fans are numbered in the order of the airflow. Install angle braces from the cyclone roof to the fan housing to ensure firmness. A fan silencer is available to reduce noise in sensitive areas. Leg stands are optionally provided as well as rotary air locks.

Pitch the fan blades so the exhaust air plenum of the dryer or cooler is under a slight vacuum. Adjust the fan pitch only when in full operation and the machine's fan is precisely set. Generally, the cyclone only has a 10% dynamic range. Therefore, the fans must be running near full load. To adjust air volume, it is recommended that a baffle be installed in the exhaust air duct so air can by-pass the dryer or cooler. This will adjust the draw on the dryer or cooler if lower airflow is needed than what the cyclone is providing. The discharged fine material can be placed into an air conveying system or into a barrel drum. This fine material is typically dry and cool. The particle reduction chart of the HV cyclone is provided in the appendix.

D. Stainless Steel Contact Points and Construction

Stainless steel contact points are used in food grade and corrosive applications. This term usually refers to all points that may touch the product, which are made of 304 or 316 stainless steel. Total stainless construction is available.

E. Steam Heat Exchangers

Steam heat can be used as an alternative to gas heat. Traps, strainers, and a self-operating temperature control valve are usually provided with the steam package but are not installed.

The amount of BTU's needed determine whether one or two coils will be mounted at the air intake on the vacuum side of the fan. If there are two steam coils, the inlets will be plumbed together and the outlets separated.

An air snorkel is used to prevent heat damage to the motor. It draws fresh air from under the floor of the machine to the cooling fan on the fan motor. A bracket on the air snorkel of the fan motor will mount the sensor to the self-operating temperature control valve. A general diagram of the steam plumbing is provided in the appendix.

Steam coils on vacuum coolers are mounted to the air intake openings. A fan at the exhaust opening pulls the air through the coils, then through the product, and out the exhaust opening. No air snorkel is necessary.

Be sure to always keep the coils clean. Dirty coils will reduce capacity and **create a fire hazard**. These coils work on 0 to 150 PSI of steam pressure. The amount of heat rise is determined by the amount of air passing the coil, steam quality, and pressure.

F. AC Inverters

AC inverters are installed as an option on fans of all new equipment. All conveyor drives on new machines have a standard AC inverter. The program pad allows you to set different motor speeds. Special attention needs to be observed when installing power to an AC inverter. The inverters need to have a separate power supply, and voltage should not fluctuate. The voltage range is covered in the electric hook up section.

G. Inlet Level Beater

The inlet level beater is an option that may be used with the standard inlet hopper and leveling gate. It is positioned down stream from the hopper gate. The inlet level beater levels the top of the product layer of products that clump and bulge as they flow under the gate. Adjust the inlet level beater slightly lower than the gate. Indicating rods on top of the machine indicate the height of the gate and the beater. Crank jacks raise and lower both the hopper gate and the inlet level beater individually. The inlet level beater rotates opposite the product flow. A C-face motor and a shaft-mounted gearbox drive the inlet level beater.

H. Rotary Air Locks

Rotary air locks mechanically move the product where plugging and/or clumping of the product might occur. The paddles of the air lock pick the product up off of the conveyor belt and drop it onto the conveyor pass below establishing a level depth. Rotary air locks are also used at a conveyors discharge to help insure a good air lock in certain applications.

A C-face motor and a shaft-mounted gearbox drive the air lock. It is very important that the rotary air lock be electrically locked with the conveyor drives. This will help prevent the machine from plugging if a motor were to overheat. Older machines used chain and sprocket systems.

I. Auger Discharge

The auger discharge is a cross auger that removes the product as it falls off the conveyor at the discharge. This auger varies in size and has a C-face motor with a shaft-mounted gearbox. This auger drive should be interlocked with the conveyor drives. This prevents the machine from plugging should a motor overheat. Be sure the auger is running before starting the conveyor.

IX. TROUBLESHOOTING

A. The burner will not stay lit. (B.N.W. Industries manufactured gas burners)

1. If the burner lights but goes out before it enters continuous operation, the infrared or UV eye is not sending a good signal to the burner controller. Clean the lens of the infrared or UV eye then check the signal of the eye. Older burner controller systems have a run check switch. The check option holds the flame on. This will isolate the problem to the eye and eliminate other problems. Some burner controller systems have a (+) and (-) terminal on the burner controller. A DC voltage meter checks the signal when the flame is on. New burner controller systems have a readout that gives you the signal reading. You need five volts or more of signal to maintain a constant flame.
2. If the burner controller goes into continuous operation, but the flame goes out quickly.
 - a) The high limit switches might be opening. This indicates too high of heat. The orifice valve needs to be closed. The orifice valve is the last hand valve before the gas burner. This valve controls the gas orifice size to the burner. Closing the valve will reduce the gas flow and will reduce the flame size. Once the flame continues for some time and product is flowing through the machine, you can calibrate the Partlow valve so the temperature can be controlled.
 - b) This situation can also indicate that the burner is being starved for gas. Upon start-up the Partlow valve is completely open until the sensor throttles back at the set temperature. The orifice valve needs to be shut down to maintain pressure against the burner. Once the Partlow valve throttles back, the gas pressure gauge at the orifice valve should read one-half the pressure of the incoming line pressure at the inlet on/off valve. Adjust the orifice valve to achieve this reading.

The Partlow valve minimum flame setting may need to be increased to maintain enough gas volume when the valve is at the minimum setting. Refer to the Partlow manual to increase this setting.

B. The flame is very yellow. (B.N.W. Industries gun gas burners)

This indicates a very rich fuel air mixture. Older machines have a handle on the outside of the machine that operates a center slide sleeve in the mixing tube. Move this handle to increase the air coming into the burner. New machines have two throttle cables that control butterfly plates over the air pickup tubes. Open the adjustable plates to increase the amount of air entering the burner. You need to achieve a blue flame with a small yellow tip.

C. The burner controller will not come on when the heat switch is on.

Push the reset button twice to reset the burner controller. Older burner controllers have the reset button located on the main chassis. New burner controllers have a remote reset button on the exterior of the control panel or on the burner control display module.

D. The airflow light on the burner controller does not come on.

Check the airflow switch and the hose for particles that might be stuck inside.

E. Product is blowing out of the inlet hopper and/or out of the product discharge.

Check for level product depth. The inlet hopper should be filled higher than the depth of product. This will help maintain an air lock in the hopper.

Check the exhaust air duct for restriction. If the exhaust duct size is too small or restricted, a high amount of pressure will be evident in the top cover of the machine. This will cause product to blow out of the hopper and the discharge.

Also, check the hinge plate air locks at the discharge of the conveyor or at the separation of the heat and cool section. The air lock may need more tension to provide a better seal. Unlevel depth can also cause a problem with these airlocks.

F. The moisture is uneven from side to side.

This is an air distribution problem. This problem can result from modification made to the machines air intake ducts, fan, and heat sources. Check the levelness of the product bed. The bed should be full and level all the way across. Another cause may be a plugged conveyor belt.

G. The moisture greatly varies from the top to the bottom of the product.

This usually means that more airflow is needed. Reducing the depth of the product can help solve this. Less depth will decrease the static pressure and increase the airflow. Airflow can be increased by loading the motor to full amp draw by the pitch of the blade, increasing motor horsepower, and increasing fan diameter. Restriction of airflow either by the exhaust or intake air ducts or by a plugged conveyor belt will cause this problem. The adjustable fresh air doors on dryer / cooler models may need to be adjusted open to help reduce this problem.

H. The conveyor belt is slipping.

Check the tension of the wrap roller against the drive roller. The wrap roller spring should be compressed to 1/16" between each coil. The overall tension of the belt should not be too great. Some slack will enhance traction. If this does not solve the problem, inspect the conveyor to see if the belt might be bound up against something. Also, the lagging on the drive roller may be worn to the point where it needs to be replaced.

I. The fan and burner both shut off.

This may happen if the machine is empty and the temperature is running close to the preset temperature on the high limit safety switch by the exhaust opening. Reduce the temperature until you have product in the machine so this switch will not shut the fan off.

This can be an indication of a fire or hot spot within the machine. Observe the emergency fire shut down procedure. Another indication may be a hole in the bed of product.

J. The product is not cool enough (for cooling and dryer/cooler applications).

On dryer / cooler models the air intake doors need to be shut down to draw more air into the cool section. Before doing this check the bed for levelness. Correct the uneven bed, if this applies. Be sure that the air intake to the cool section has not been restricted in any way. The air intake for the cool section is above the product layer at the discharge. Also, be sure that the hinge plate door that separates the heat from the cool section is not leaking air or blowing open. More tension may need to be applied on the airlock to provide a better seal. An unlevelled depth can also cause this problem.

In all cool applications, this is an airflow problem. Either more air is needed or a disruption of the air has occurred. Check the bed levelness. Also, check the air intake and exhaust for restriction. Inspect the machine for any possible air leakage that will allow the air to bypass the product.

K. The burner controller signal from the scanner is too low.

The scanner eye is either dirty or has moisture on it. Remove the scanner eye from the mounting pipe. Clean and dry the eye. If the photo lens is cracked, a poor signal will result. If this does not improve the signal, check the mounting pipe for proper alignment. The scanner should be directed at the flame. A new scanner eye may be needed, if all else fails.

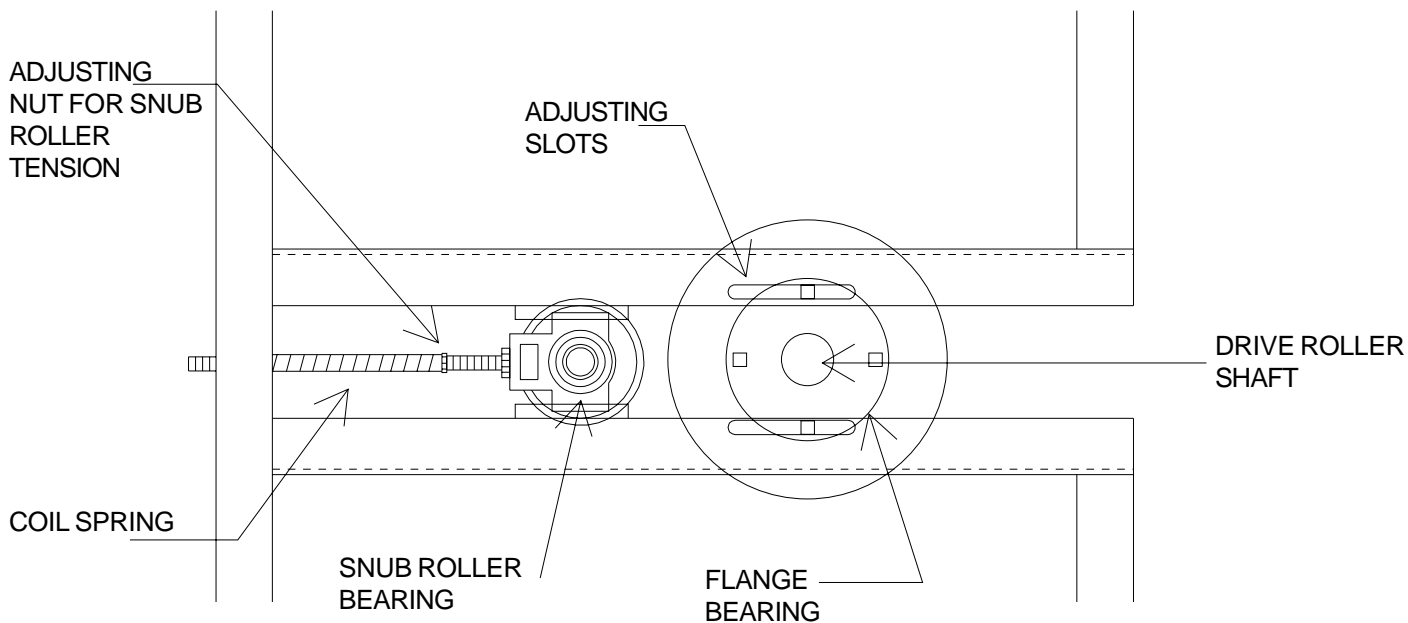
L. The air temperature will not go low enough even when the Partlow temperature dial is on the lowest setting.

The minimum flame setting needs to be adjusted. Reduce the Partlow temperature dial to the lowest setting. While watching the burner flame (to insure it does not go out), reduce the minimum flame setting until the air temperature drops. If flame fails prior to reaching the desired air temperature, airflow into the burner may need to be reduced. Close the burner adjustable plates further for less burner airflow.

Roller Adjustment for Discharge Drive

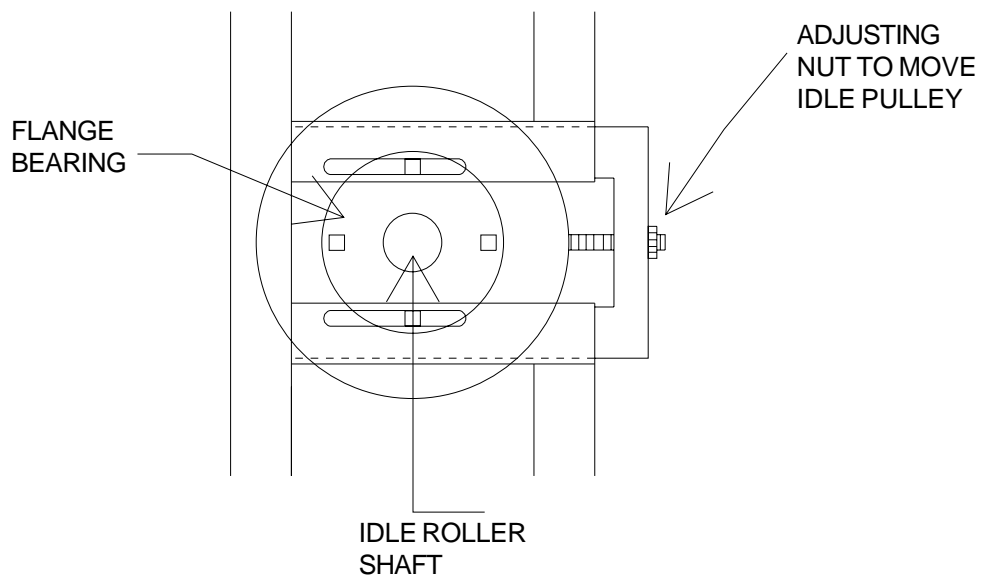
most units frame # 500 or lower

Discharge End of Conveyor (Drive Roller)



Side View

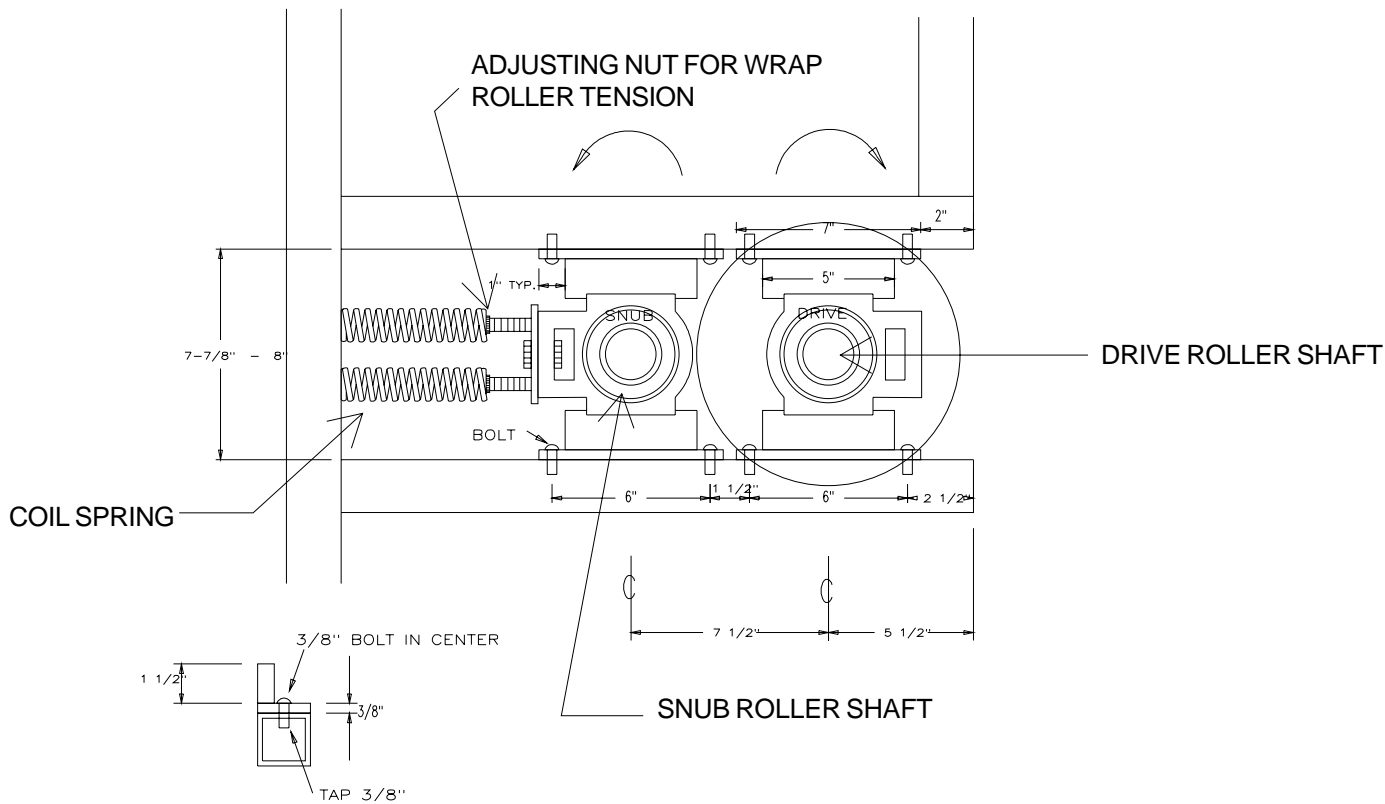
Inlet End of Conveyor (Idle Pulley)



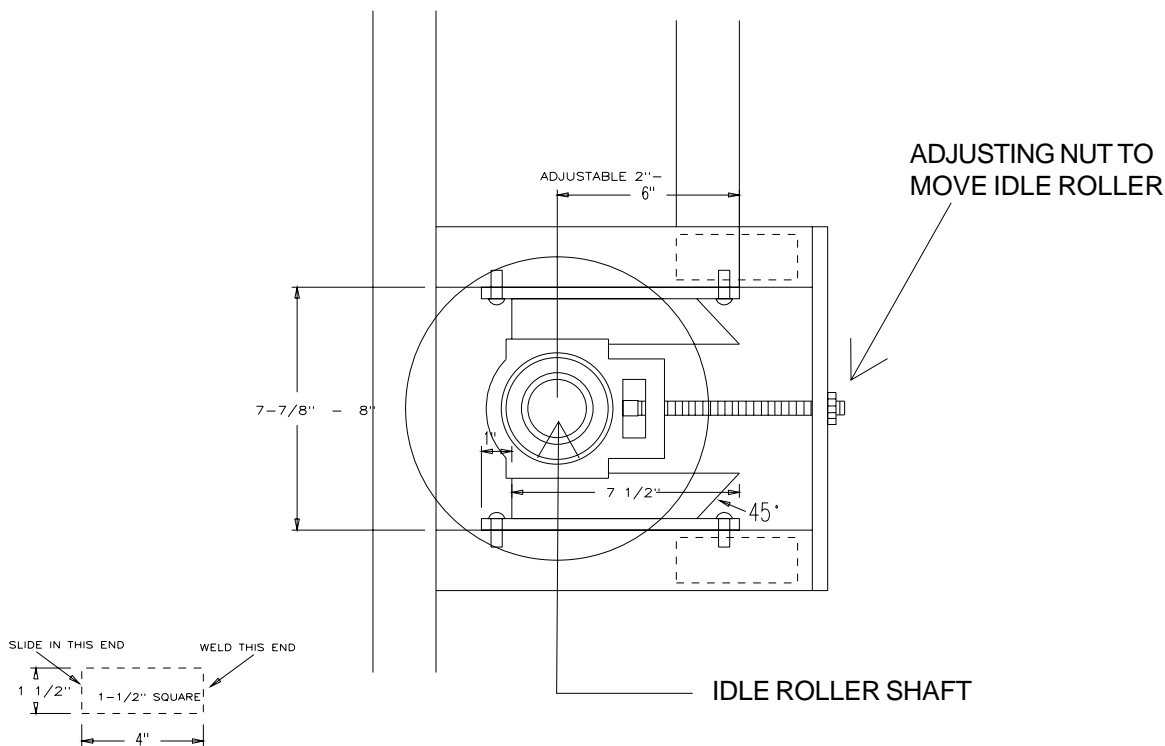
Roller Adjustment for Discharge Drive

most units frame # 500 or higher

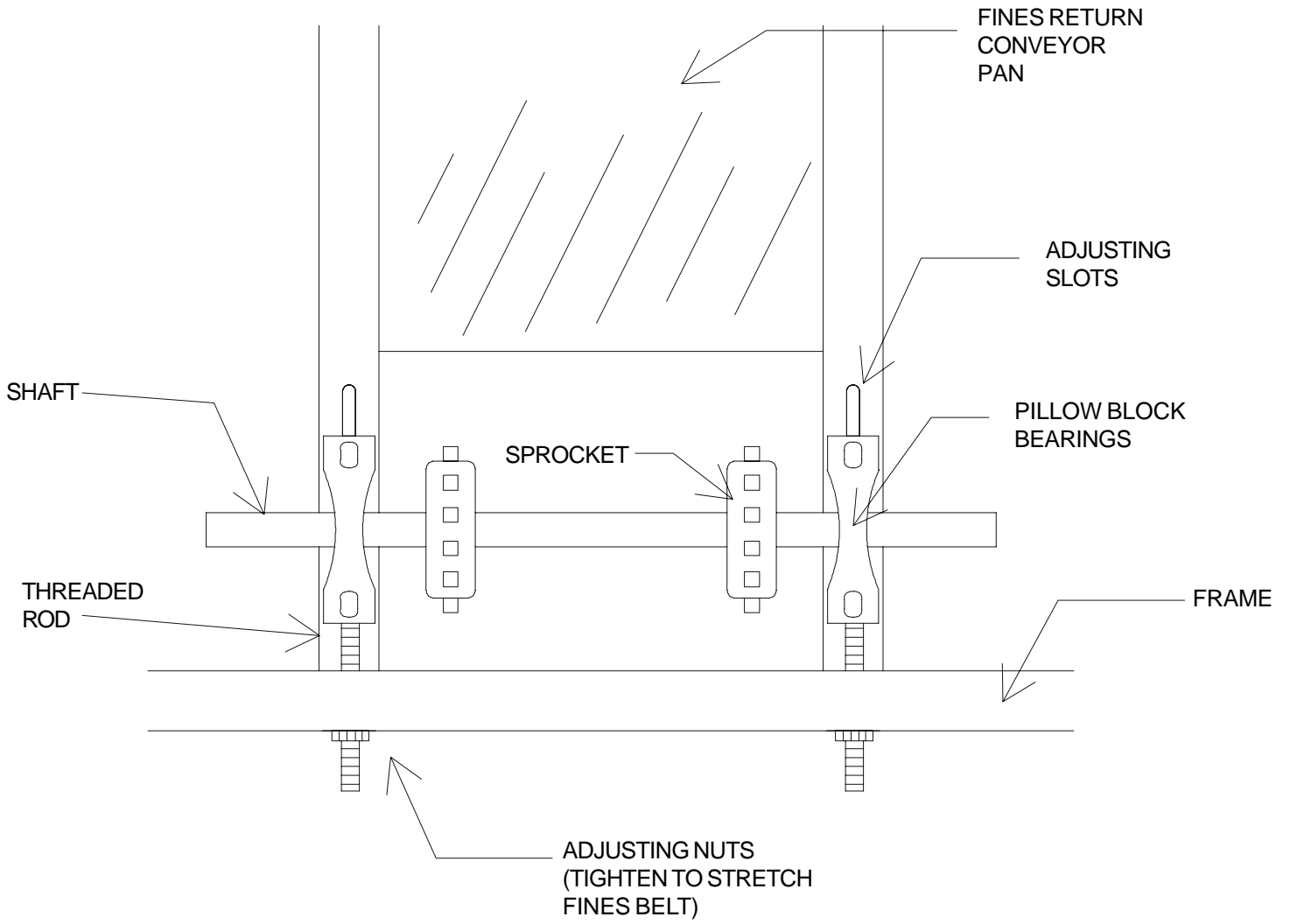
Discharge End of Conveyor (Drive Roller)



Inlet End of Conveyor (Idle Roller)



Fines Conveyor Adjustment

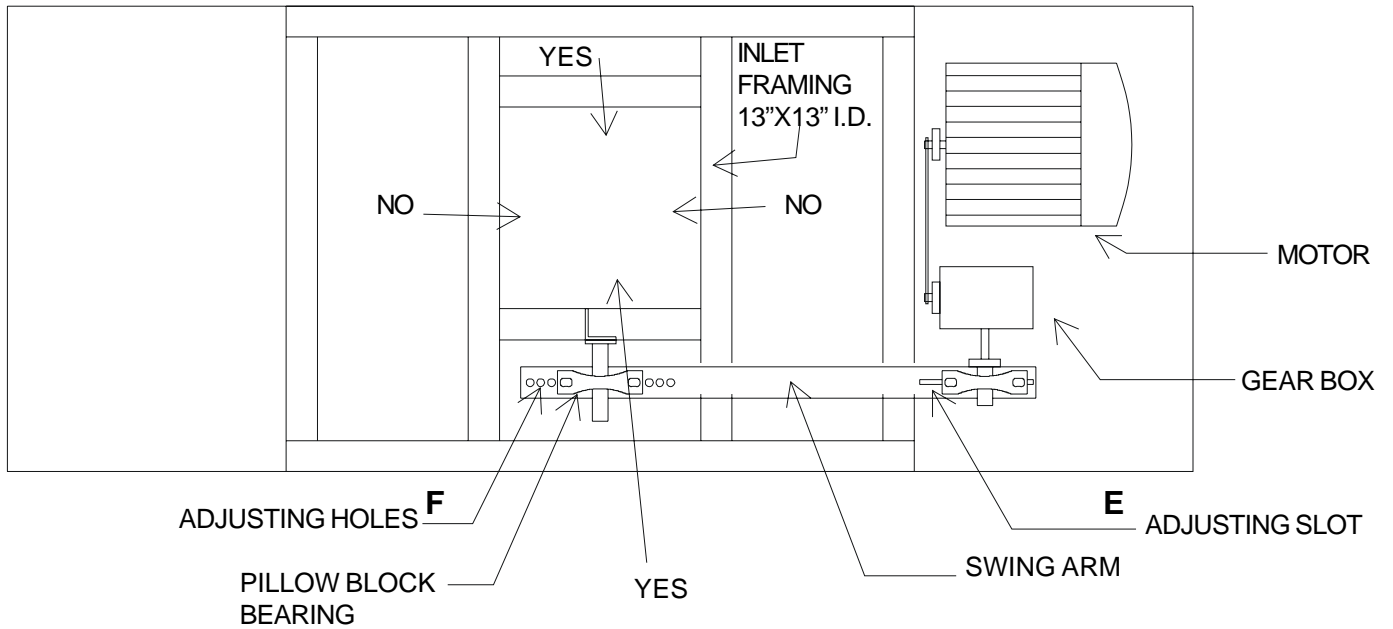


Top View

* Note - Idle End of Conveyor is Diagrammed

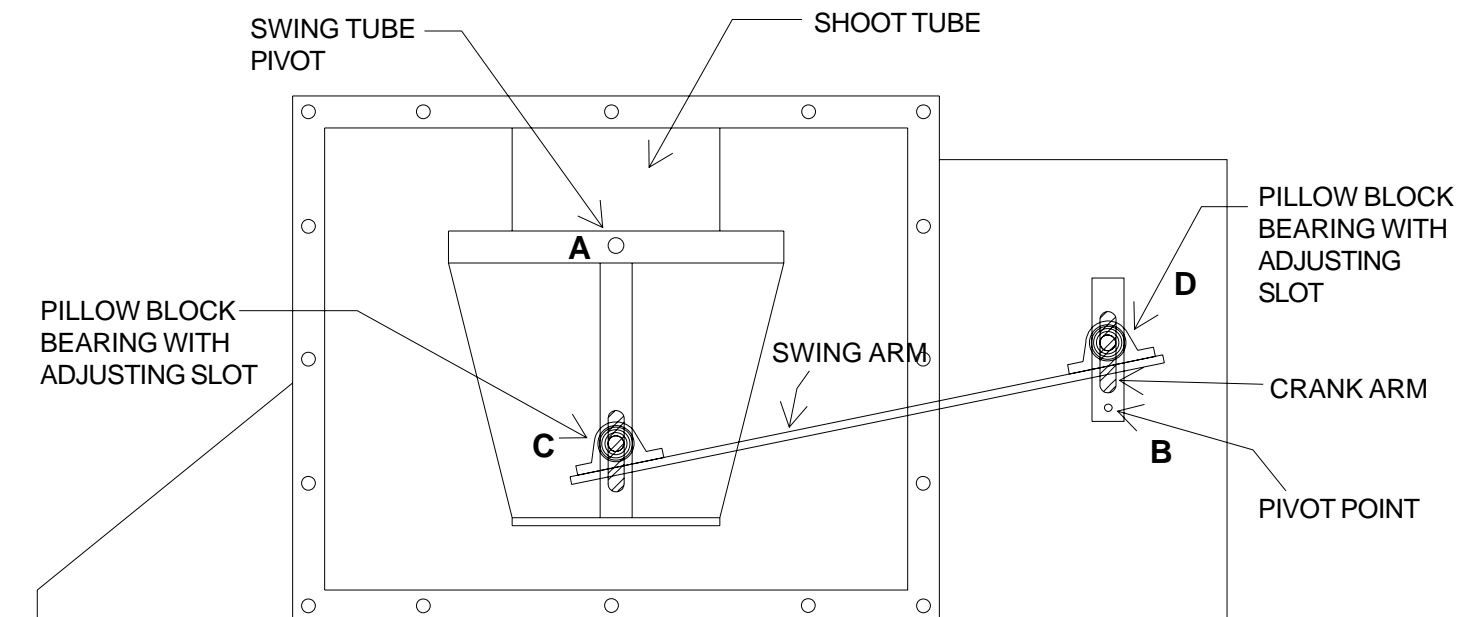
Oscillating Inlet Spreader

Top View

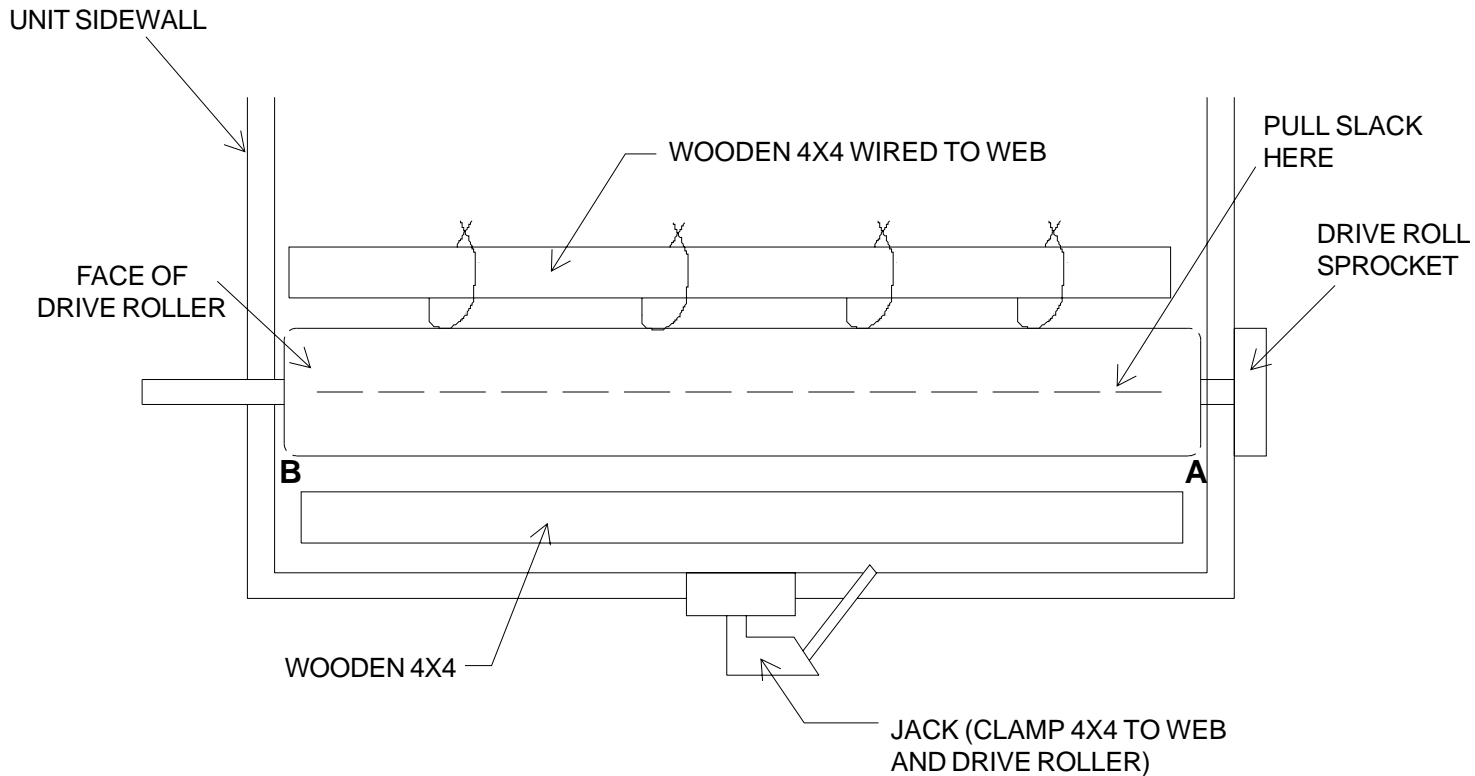


- ◆ Obtain more swing tube travel by moving bearing C closer to pivot A
- ◆ Obtain less swing tube travel by moving bearing D closer to pivot B
- ◆ The reverse is true for both adjustments
- ◆ Give swing tube more right throw by making swing arm shorter at point F & E
- ◆ Give swing tube more left throw by making swing arm longer at point F & E
- ◆ Always bring product in inlet tube from the front or rear; never the side; yes and no arrows show proper direction

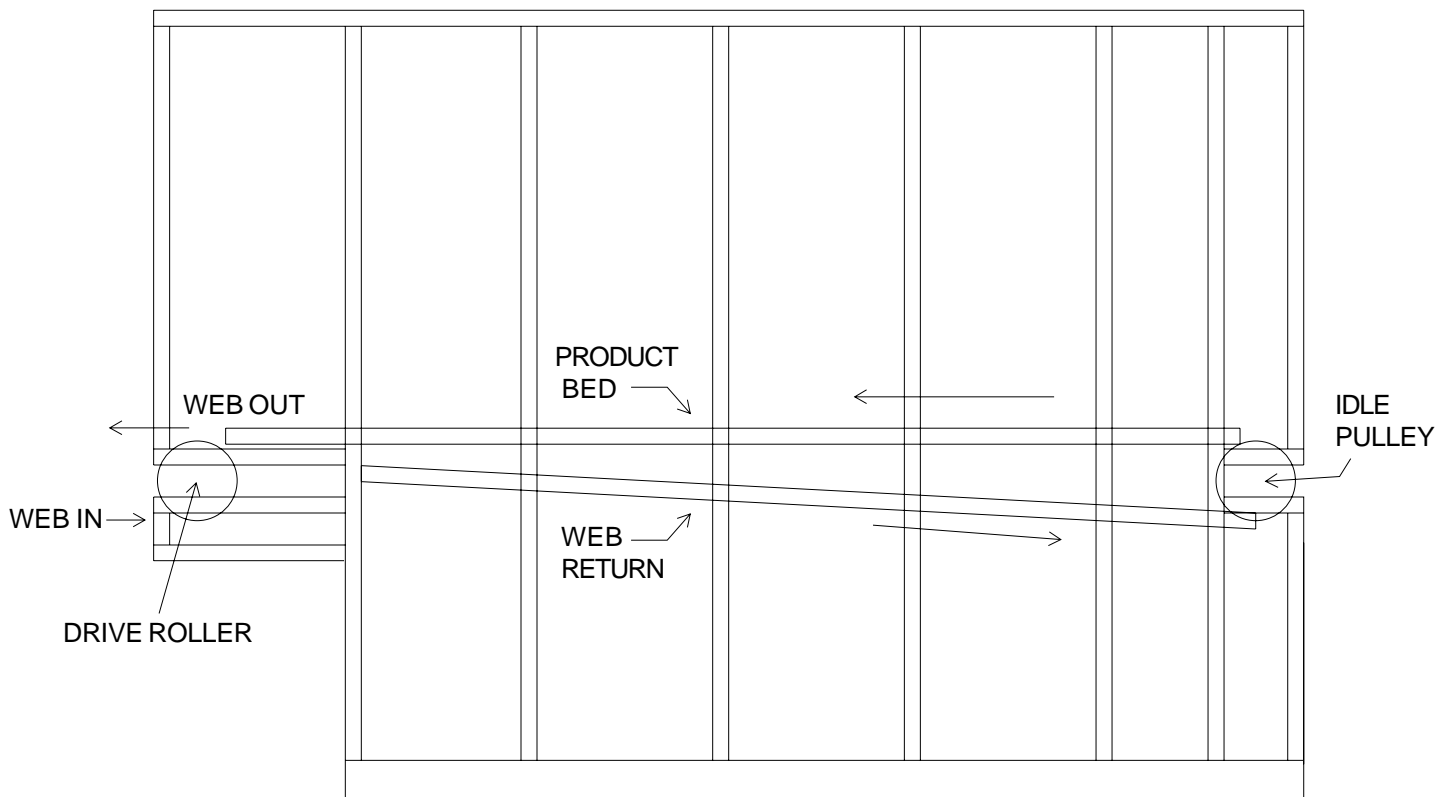
Side View



Web Disassembly



Side View

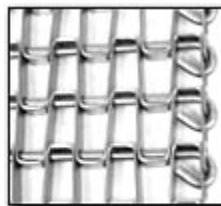


Measure distance between web and sidewall at point A & B for tracking purposes.

HEAVY DUTY CLINCHED SELVAGE BELTING



H4 - 1" x 1" Mesh
Clinched Selvage



H5 - 1/2" x 1" Mesh
Clinched Selvage

Heavy duty clinched selvage belts are available in two different mesh sizes and four different materials: low carbon galvanized steel, C-1045 bright high carbon steel, T-304 stainless steel and T-316L stainless steel. Clinched selvage belts can be ordered in any width from 10" to 192". These belts feature a better wearing edge surface than welded selvage for misaligned conveyor systems and they mechanically prevent the belt from narrowing under heavy loads. Additionally, heavy duty clinched selvage belts are just as flexible as those with welded selvage.

Sprockets driving heavy duty clinched selvage belts CANNOT be placed on the first drive opening on either side of the belt.

CLINCHED SELVAGE BELT SPECIFICATIONS

DESIGN	MESH	MIN. WIDTH	MAX. WIDTH	MAX. TENSION* (lbs./ft. of width)	APPROX. WGT. (lbs./sq. ft.)
H4	1" x 1"	10"	192"	1350	3.55
H5	1/2" x 1"	10"	192"	1750	3.95

* Maximum working tension per foot of belt width given for drum driven applications only. **All heavy duty belts have the following dimensions:**

Flat strip = 1/2" wide x .062" thick round edge

Connector rod = 6 gauge (.192" diameter) - high tensile strength

Flat Wire Belt Tracking

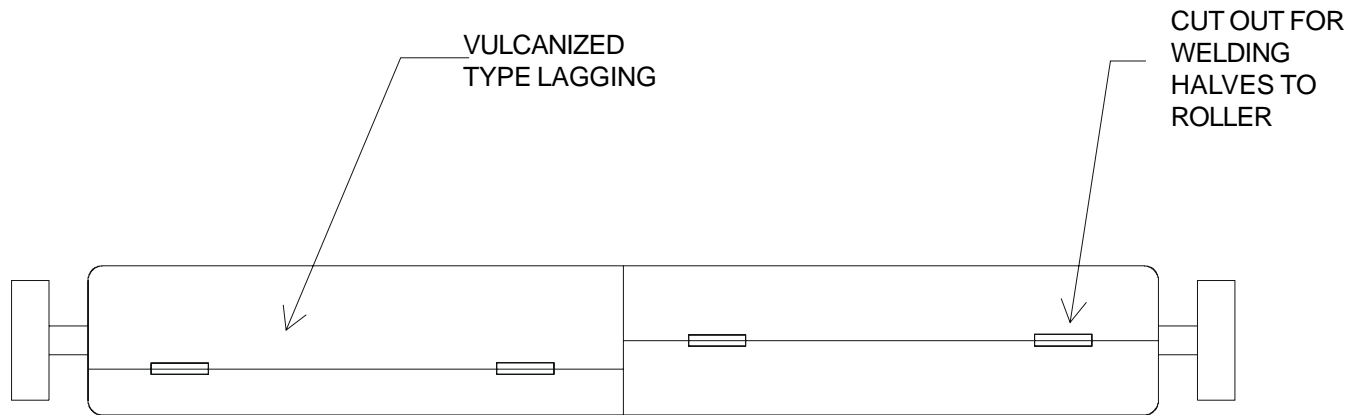
Since the majority of belting problems are alignment related, it is extremely important to have all shafts parallel to each other and perpendicular to the conveyer bed. If a good alignment is not completed before using a flat wire belt, longitudinal pitch can be distorted causing the belt to track to one side

Flat Wire Belt Assembly

Clinched Selvage connector rods are supplied with a pre-formed hook on one end and straight wire on the other. Bring together the two sections of belt to be spliced, and insert the connector rod. Close the hook using pliers. On the other side, bend the straight wire back through the hole in the edge of the belt and form a hook, then close it.

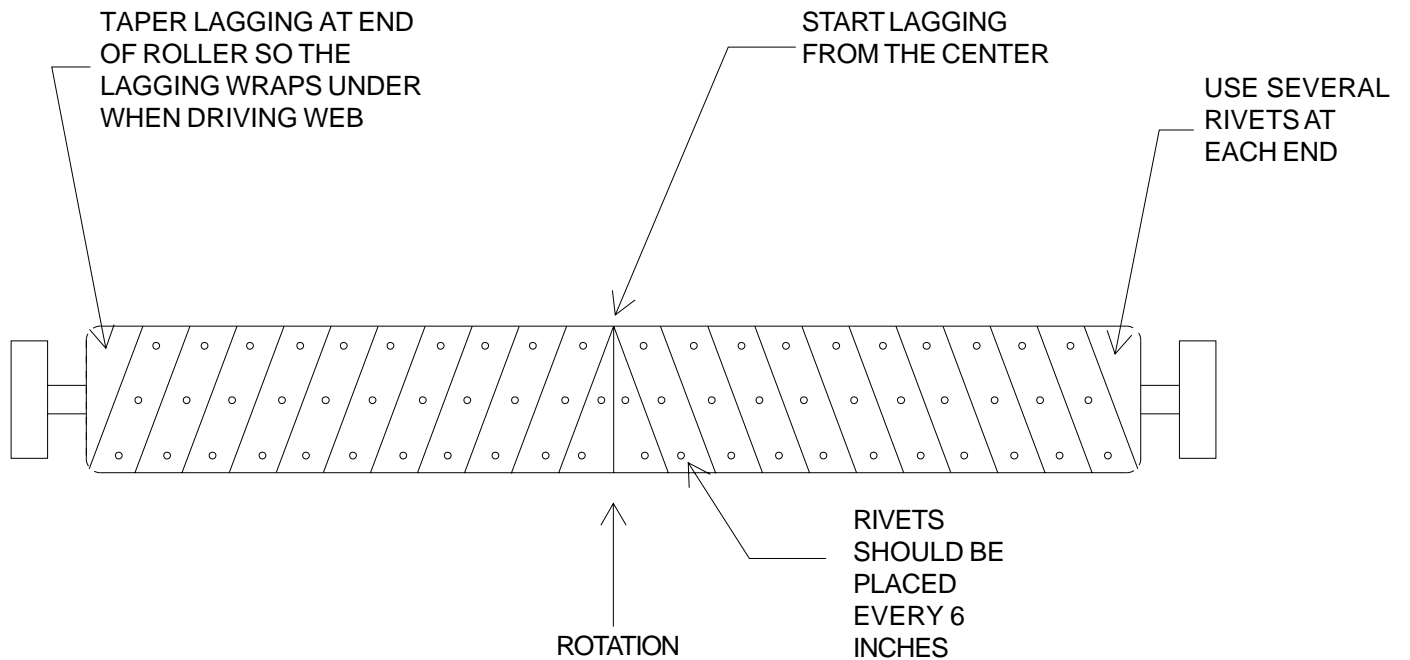
Roller Lagging

Vulcanized Style Lagging

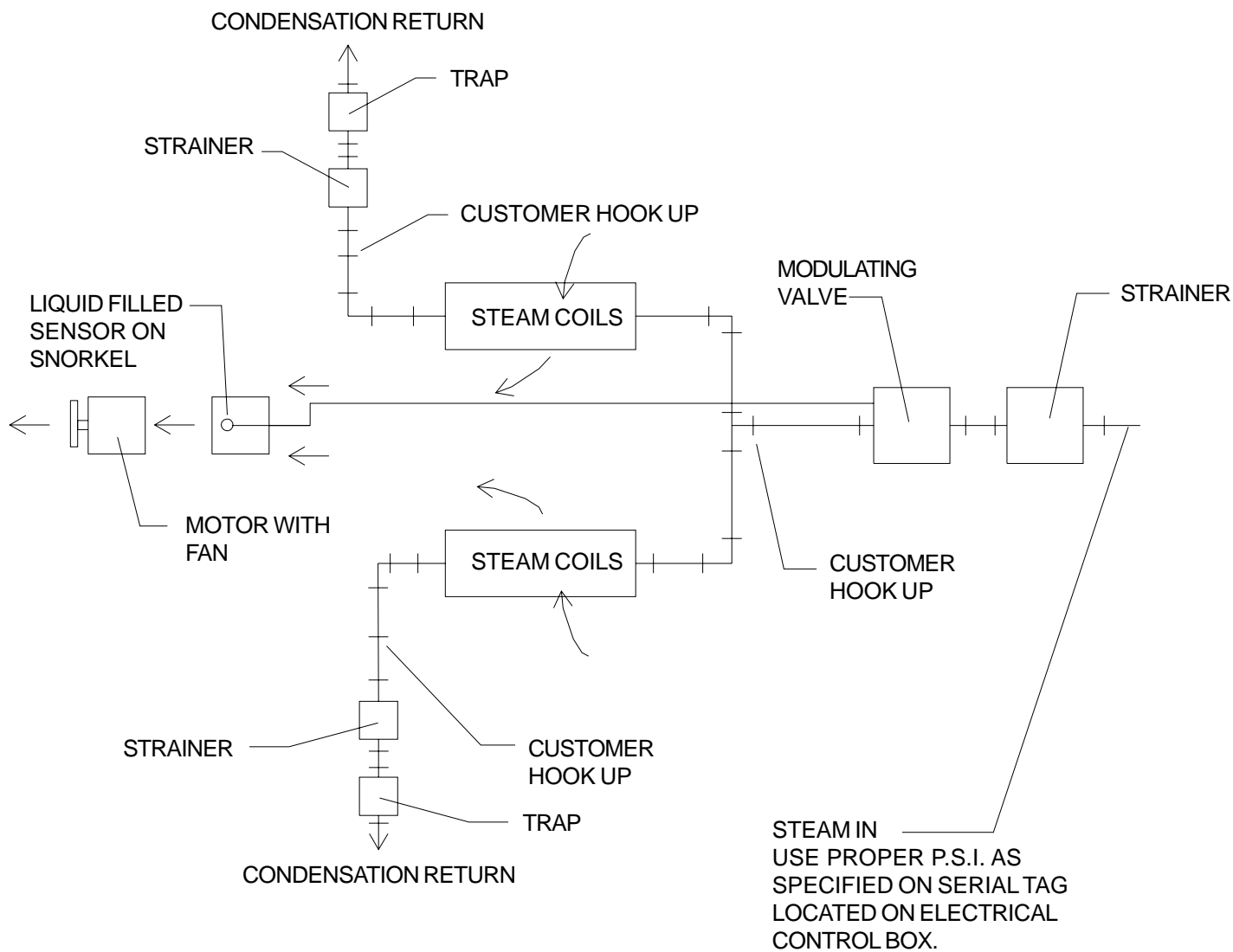


- ◆ Vulcanized type lagging is in halves which weld to the roller at the cutouts. Stagger the splits in the halves.

Asphalt Belt Lagging



Schematic Steam Piping Diagram



- Pipe sizes vary with the size of the coil and unit.
- Traps, Strainers, and Valve come with the steam package but are not assembled. Coils are assembled from factory.
- Arrows show air flow direction.

REGULATOR/PILOT COMBINATIONS

DT & HDT

Pilot-Operated Temperature Regulating Valve

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D & HD Regulating Valve with "T" Temperature Pilot

- Temperature Control Range: 60 – 260° F
- Inlet Pressure Max: 300 psig
Inlet Pressure Min: 5 psig



TYPICAL APPLICATIONS

The **D-Series** and **HD-Series** Regulator equipped with the **"T" Temperature Pilot** are used for controlling temperature in various processes and systems, such as Oil Heaters, Ovens, Process Heaters, Vats, Driers, and Jacketed Kettles.

FEATURES

- Temperature adjustment made simple and easy by rotating an adjustment knob to the desired temperature setting
- Thermostatic sensing bulb comes with 8-ft. or 15-ft. capillary. Additional lengths up to 25-ft. max.
- Capillary is armored to protect against damage
- Optional stainless steel sensing bulb and capillary
- Overheat protection bellows is incorporated into sensing bulb. 200°F overheat protection up to 350°F
- Can be used with Pressure Pilots for simultaneous control of pressure and temperature
- Hardened stainless steel trim on regulator for extended service life
- Full port strainer and blow-down valve on pilot adapter to eliminate failure caused by contaminated steam systems

OPTIONS

- Temperature Pilot can be combined with Pressure and Solenoid pilots.
- Additional capillary lengths can be ordered in 5-ft. increments; up to 25-ft. maximum length.
- Wells are available in 316 stainless steel.
- Longer wells can be supplied.
- Consult factory for other options.

TEMPERATURE-ADJUSTING RANGES

Temperature	Identifying Colors
60 - 120°F (16 - 49°C)	yellow
100 - 160°F (38 - 71°C)	black
120 - 180°F (49 - 82°C)	blue
160 - 220°F (71 - 104°C)	red
200 - 260°F (93 - 127°C)	green

* Other ranges available; consult Factory.

MATERIALS

	D-SERIES	HD-SERIES
Body	Cast Iron	Ductile Iron
Cover	Cast Iron	Ductile Iron
Gasket	Garlock 3400	Garlock 3400
Cover Screws	Steel	Steel
Pilot Adapter	Cast Iron	Ductile Iron
Screen	Stainless Steel	Stainless Steel
Tubing	Copper	Copper
Valve Seat	Hardened SST (55 Rc)	Hardened SST (55 Rc)
Valve Disc	Hardened SST (55 Rc)	Hardened SST (55 Rc)
Diaphragm	Phosphor Bronze	Phosphor Bronze

REGULATOR/PILOT COMBINATIONS

DT & HDT

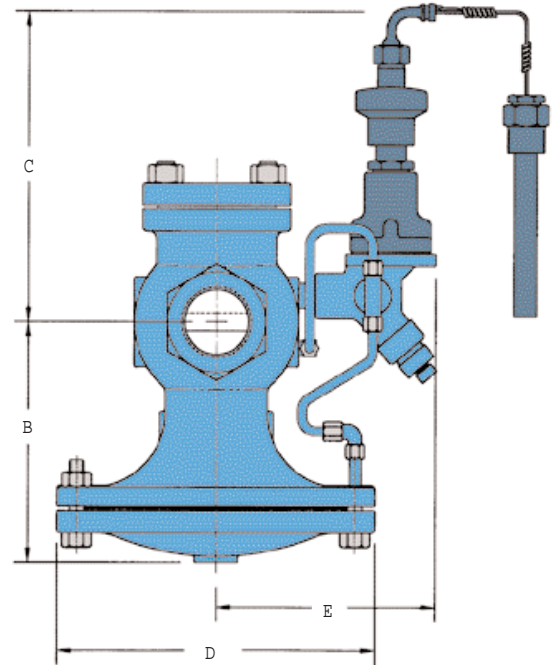
Pilot-Operated Temperature Regulating Valve

DIMENSIONS D-Series – inches / pounds

Size	Face-To-Face			Weight (lbs)				NPT	FLG
	NPT	125#	250#	B	C	D	E		
1/2"	5-1/8			5-1/8	8-1/4	5-7/8	6-1/8	18	
3/4"	5-1/2			5-1/2	8-1/4	6-1/2	6-3/8	21	
1"	6-1/8			6-1/8	8-1/4	7	6-5/8	25	
1-1/4"	8-1/2			7	9-1/4	8-3/4	7-1/8	45	
1-1/2"	9-1/2			7-1/8	9-1/4	8-3/4	7-5/8	55	
2"	9-3/4	9-1/2	9-5/8	7-1/8	9-1/4	10-7/8	8-1/4	90	105
2-1/2"		10	10-5/8	8-3/4	9-1/4	11-3/4	8-5/8		135
3"		11	11-3/4	9-1/8	9-1/4	13-1/4	9-1/8		180
4"		13-3/8	13-7/8	10-3/8	9-1/4	14-3/4	10-1/8		290
6"		18-1/8	19	16	9-3/4	19-3/4	11-1/8		590

DIMENSIONS HD-Series – inches / pounds

Size	Face-To-Face			Weight (lbs)				NPT	FLG
	NPT	150#	300#	B	C	D	E		
1/2"	4-3/8			5-1/2	9-1/4	6-1/2	6-1/2	18	
3/4"	4-3/8			5-1/2	9-1/4	6-1/2	6-1/2	18	
1"	5-3/8			6-1/4	9-1/4	7	8-1/4	23	
1-1/4"	7-1/4			7-3/8	9-1/4	8-3/4	7-1/4	43	
1-1/2"	7-1/4			7-3/8	9-1/4	8-3/4	7-1/4	43	
2"	7-1/2	8-1/2	9	8-1/4	9-1/4	10-7/8	7-1/2	65	85
2-1/2"		9-3/8	10	9	9-1/4	11-3/4	7-3/4		105
3"		10	10-3/4	8-7/8	9-1/4	13-1/4	8-1/2		145
4"		11-7/8	12-1/2	10-7/8	9-1/4	14-3/4	9-1/2		235
6"		15-1/8	16	14-1/8	9-3/4	19-3/4	10-3/4		470



REGULATORS

HOW TO ORDER

"T" TEMPERATURE PILOT

Specify:

- Temperature range from the chart or indicate the set temperature of the process you wish to control.
- The length of capillary required. 8-ft. or 15-ft. standard. Maximum length: 25-ft. in 5-ft. increments.
- Bulb type needed: T, TU, TUBW, TUSW, TBW & TSW.

REGULATOR BODY

Specify:

- **D** or **HD** regulator body.
- Regulator size or capacity.
- End connections (threaded, 125/150/250/300# flanged).

RECOMMENDED PRESSURE

Differential Pressure: 10 psig minimum

Minimum Inlet Pressure: 5 psig*

OPTION –

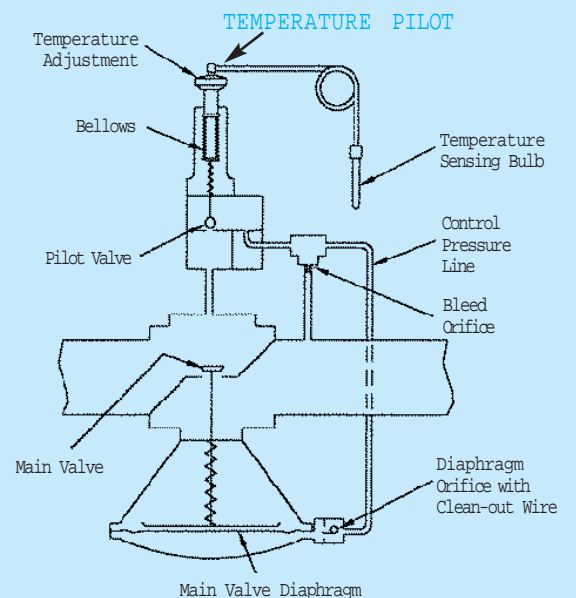
With Standard Pilot: 15 psig minimum

With Low Pressure Pilot: 5 psig minimum

*Minimum Inlet Pressure for Temperature Regulator: 5 psig

HOW IT WORKS

The purpose of the temperature pilot is to control the operation of the temperature regulating valve. A sensing bulb filled with liquid is used as a thermostat to monitor the temperature of whatever is being heated. The sensing bulb is connected to the temperature pilot by a length of capillary tubing. When the sensing bulb is heated the liquid inside expands and in turn expands a bellows inside the temperature pilot. The expansion and contraction of this bellows is what controls the operation of the temperature regulating valve.



PILOTS

"T" Pilot

Temperature Pilot for D & HD Regulating Valves

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Revised 7/2002

Temperature Pilot

- **Temperature Control Range:**
60 – 260° F



TYPICAL APPLICATIONS

The **D-Series** and **HD-Series** Regulators used with the **"T" Temperature Pilot** are used for controlling temperature in various processes and systems. Some examples are:

- Oil heaters
- Process heaters
- Driers
- Ovens
- Vats
- Jacketed Kettles

FEATURES

- **Temperature adjustment is made simple and easy by rotating an adjustment knob to the desired temperature setting**
- **Thermostatic sensing bulb comes with an 8-ft. or 15-ft. length capillary**
- **Capillary is armored to protect and resist damage**
- **Overheat protection bellows is incorporated into sensing bulb. 200° F overheat protection up to 350° F**
- **For steam supply pressure 12 psig or under, our low pressure temperature pilot must be used**
- **Full port strainer and blow-down valve on pilot adapter to eliminate failure caused by contaminated steam systems**

OPTIONS

- Temperature Pilot can be combined with Pressure and Solenoid pilots
- Additional lengths can be ordered in 5-ft. increments; up to 25-ft. maximum length
- Wells are available in 316 stainless steel or brass
- Longer wells can be supplied
- 316 Stainless Steel Sensing Bulb
- Other options available; consult Factory

Note: Watson McDaniel's **Low Pressure Temperature Pilot** must be used for steam supply pressure less than **12 PSIG**

TEMPERATURE-ADJUSTING RANGES

Temperature	Identifying Colors
60 - 120°F (16 - 49°C)	yellow
100 - 160°F (38 - 71°C)	black
120 - 180°F (49 - 82°C)	blue
160 - 220°F (71 - 104°C)	red
200 - 260°F (93 - 127°C)	green

* Other ranges available; consult Factory.

MATERIALS

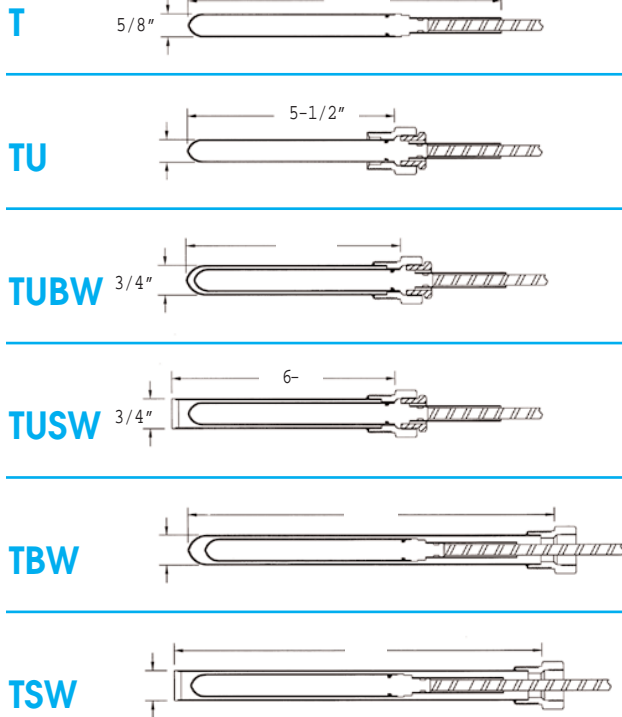
	Ductile Iron
Body	Ductile Iron
Head & Guide Assembly	Stainless Steel
Seat	Stainless Steel
Sensing Bulb:	
T	Copper
TU	Brass with Union Nut
TUBW	Copper/Brass Well
TUSW	Copper/Stainless Steel Well
TBW	Copper/Brass Well with Gromet
TSW	Copper/Stainless Steel Well with Gromet

"PT"
Pressure & Temperatur
Pilot
(optional)

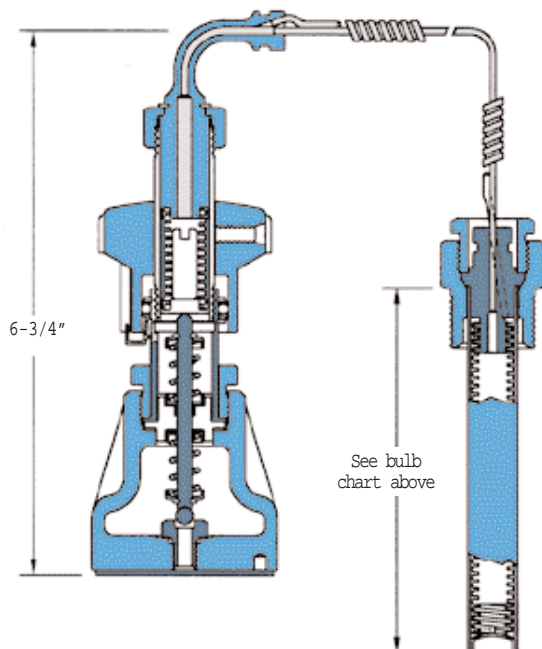


"T" Pilot

Temperature Pilot for D & HD Regulating Valves

SENSING BULBS AVAILABLE

All Union Connections are 3/4" NPT



T	Plain copper bulb
TU	Union connected copper bulb that can be screwed into the side of tank
TUBW	Type TU bulb with a brass well. The well can be placed in the side of a tank allowing the sensing bulb to be removed without having to drain the tank of liquid
TUSW	Type TU bulb with a corrosion resistant stainless steel well. The well allows the sensing bulb to be removed from tank without draining the liquid.
TBW	Type T bulb with an extended length brass well. The extended well allows deeper insertion of sensing bulb into tanks.
TSW	Type T bulb with extended stainless steel well. The extended well allows deeper insertion of sensing bulb into tanks.

Other options available; consult factory.

HOW TO ORDER**"T" TEMPERATURE PILOT**

Specify:

- Temperature range from the chart or indicate the temperature of the process you wish to control.
- The length of capillary required. 8-ft. is standard.
- Bulb type needed:
T, TU, TUBW, TUSW, TBW & TSW.

REGULATOR BODY

Specify:

- **D** or **HD** regulator body.
- Regulator size or capacity of steam required.
- End connections
(threaded, 125/150/250/300# flanged).

RECOMMENDED PRESSURE

Minimum Inlet Pressure: 5 psig*



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 Norristown, PA 19403
 Phone: (610)666-5711 Fax: (610)666-0404
 http://www.watsonmcdaniel.com

SERIES 1031-1032, 1033-1034
 1041-1042, 1044, 1038S
 INVERTED BUCKET STEAM TRAP
 INSTALLATION INSTRUCTIONS

INSTRUCTION PART NO. 2230200

REVISION 0

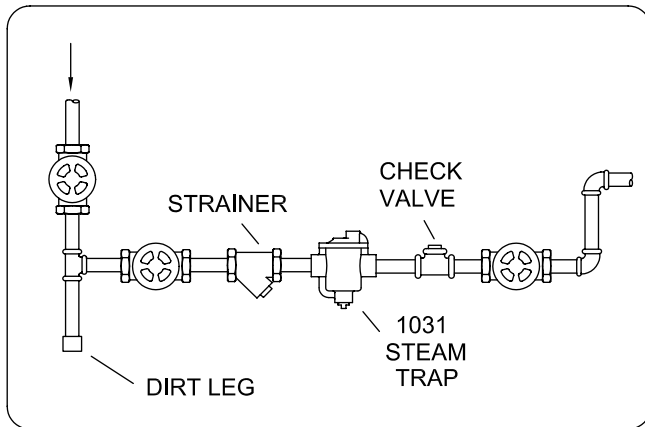
INSTALLATION INSTRUCTIONS

Before installing the Watson McDaniel Inverted Bucket Steam Trap, blow down the piping that leads to the trap's inlet. Use full line pressure to remove all scale, chips, debris, etc. Be sure the trap differential pressure rating is adequate for the installation. The maximum pressure differential (the difference between the trap's inlet and outlet pressures) the trap will open against is stamped on the trap cover.

Install the trap with the inlet below the liquid level of the equipment to be drained. A sketch of a recommended hook-up arrangement is shown below. Make inlet piping as short as possible with a minimum of elbows and other restrictions. Install a dirt leg in the line ahead of the trap. To allow for maintenance, install a valve on each side of the trap and a strainer ahead of the trap inlet. All valves should be of the full ported type to avoid restricted flow.

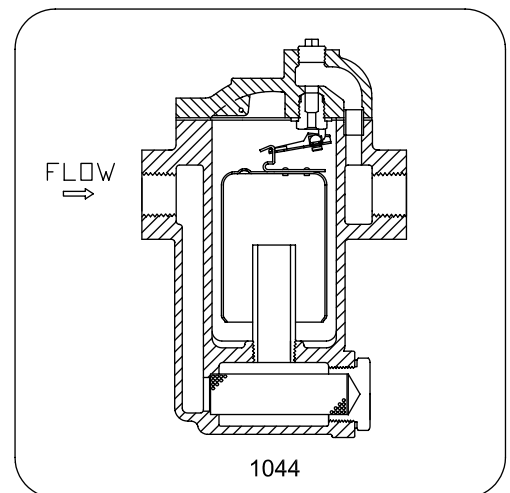
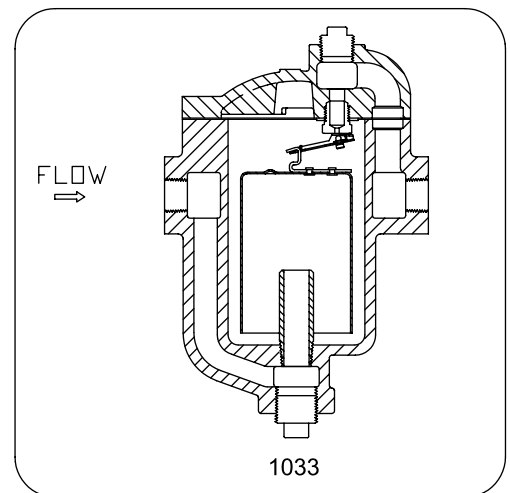
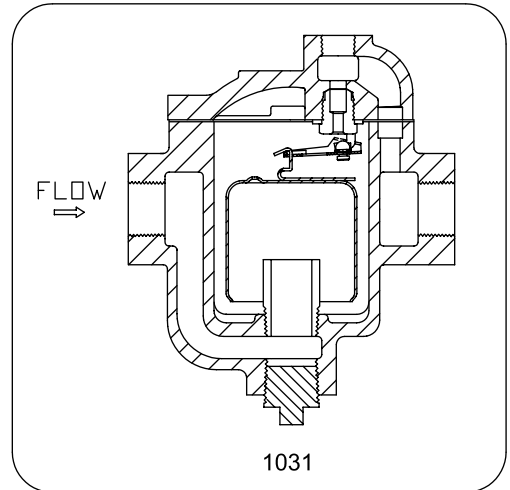
If the discharge piping is to be elevated, be sure that the differential pressure is adequate to overcome this lift. Install a check valve (optional) in the discharge piping near trap to prevent backflow when the system is not operational.

NOTE: Trap must be primed (filled with water) before start up. Without priming trap will not operate. This style trap is not recommended for superheated steam service, as the prime may be lost to the excessive heat.



RECOMMENDED INSTALLATION

	MAX. OPER. PRESSURE	MAX. ALLOW PRESSURE
1031 . . .	See Stamping on Trap Cover . . .	250 psig at 450°F
1032 . . .	See Stamping on Trap Cover . . .	250 psig at 450°F
1041 . . .	See Stamping on Trap Cover . . .	250 psig at 450°F
1042 . . .	See Stamping on Trap Cover . . .	250 psig at 450°F
1033 . . .	See Stamping on Trap Cover . . .	250 psig at 450°F
1034 . . .	See Stamping on Trap Cover . . .	250 psig at 450°F
1044 . . .	See Stamping on Trap Cover . . .	250 psig at 450°F
1038S . . .	See Stamping on Trap Cover . . .	250 psig at 450°F



Each Watson McDaniel Company Product is warranted against defects in material and workmanship for one year from date of shipment. This warranty extends to the first retail purchaser only. All defective material must be returned to the person from whom you purchased the Product, transportation prepaid, free of any liens or encumbrances, and if found to be defective will be repaired free of charge or replaced, at the warrantor's or seller's option. If the material is replaced, any replacement will be invoiced in the usual manner and after inspection of alleged defective material an adjustment will be made for depreciation caused by purchaser's use. In no event will Watson McDaniel Company be liable to do more than refund the original contract price. Incidental and consequential damages are excluded, whether under this warranty or otherwise. All implied warranties, including warranties of merchantability and fitness for a particular purpose, are disclaimed and excluded.

HOW IT WORKS

Having only two moving parts, the valve lever assembly and bucket, these traps will not stick, bind, or clog, since they do not have fixed pivots or complicated linkages. They operate on the difference in density between steam and water.

During start-up, the trap is open, air and gases vent slowly out the top of the bucket through the vent hole. Condensate entering through the feed tube forms a water seal on the bottom of the bucket, turning it into a float. When all the condensate has been discharged, the steam enters to fill the bucket, which then snaps up closing the trap. The bucket would normally stay in this position, however when the steam condenses, more condensate enters the trap pushing the gases out through the vent hole causing the bucket to be completely submerged in condensate. Loosing its buoyancy, the bucket (its weight being greater than the weight of the water) falls, opening the trap.

MAINTENANCE

Isolate trap from both supply and return lines.

Wait until trap can be comfortably touched by hand before removing cover.

Remove cover and discard gasket.

Unhook bucket from lever.

Inspect lever and seat assembly for dirt and wear. If worn install a new repair kit. If dirty, clean using method compatible with system.

Reinstall cover and bucket assembly using a new gasket.

Torque cover bolts and reactivate supply and return lines.

ORDERING SPARE PARTS

Specify the description of the part. Indicate the trap Series number and differential pressure which is stamped on the cover. Also indicate adjacent Part No.

Typical Specification: Series 1031 lever and seat assembly for 20 psig differential pressure. Part No. 5-9.

MATERIALS:

Body & Cover Cast Iron, ASTM A-278 Class 30
 Nuts & Bolts High-tensile Steel
 Gasket Non-Asbestos Fiber
 Bucket Stainless Steel
 Lever & Seat Ass'y Stainless Steel
 Valve & Seat Heat Treated Stainless Steel
 Strainer Stainless Steel*

* 1041, 1042, 1044 only

REPAIR KITS

1031/1041 REPAIR PARTS CONSIST OF:

SCREEN Part No. 9-1

GASKET Part No. 3-7

BUCKET and CLIP Part No. 4-6

** LEVER and SEAT ASSEMBLY Part No. 5-9

1032/1042 REPAIR PARTS CONSIST OF:

SCREEN Part No. 9-2

GASKET Part No. 3-7

BUCKET and CLIP Part No. 4-7

** LEVER and SEAT ASSEMBLY Part No. 5-10

1034/1044 REPAIR PARTS CONSIST OF:

SCREEN Part No. 9-3

GASKET Part No. 3-8

BUCKET and CLIP Part No. 4-8

** LEVER and SEAT ASSEMBLY Part No. 5-11

1033 REPAIR PARTS CONSIST OF:

GASKET Part No. 3-12

BUCKET and CLIP Part No. 4-14

** LEVER and SEAT ASSEMBLY Part No. 5-15

1038S REPAIR PARTS CONSIST OF:

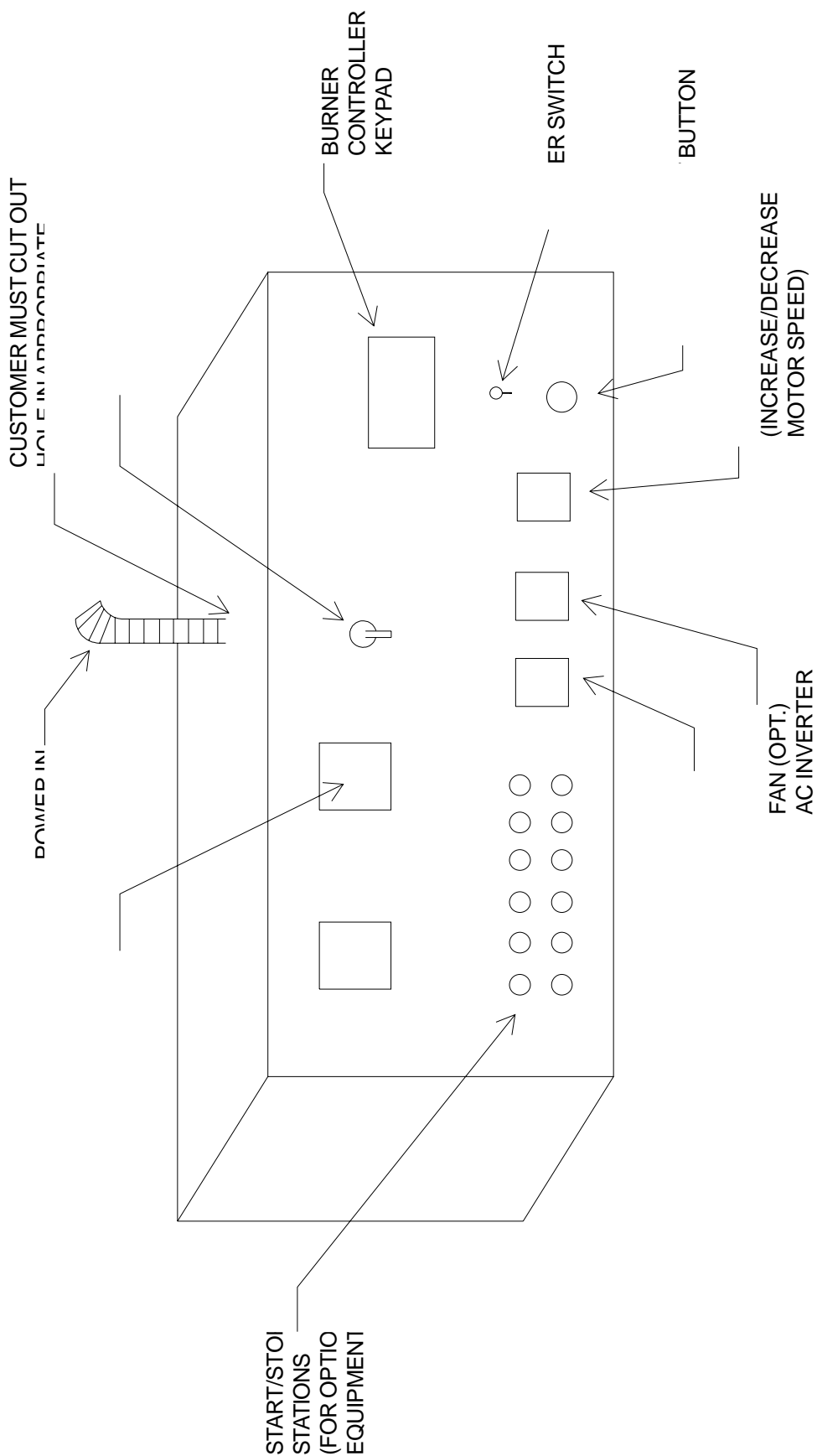
GASKET Part No. 3-9

BUCKET and CLIP Part No. 4-9

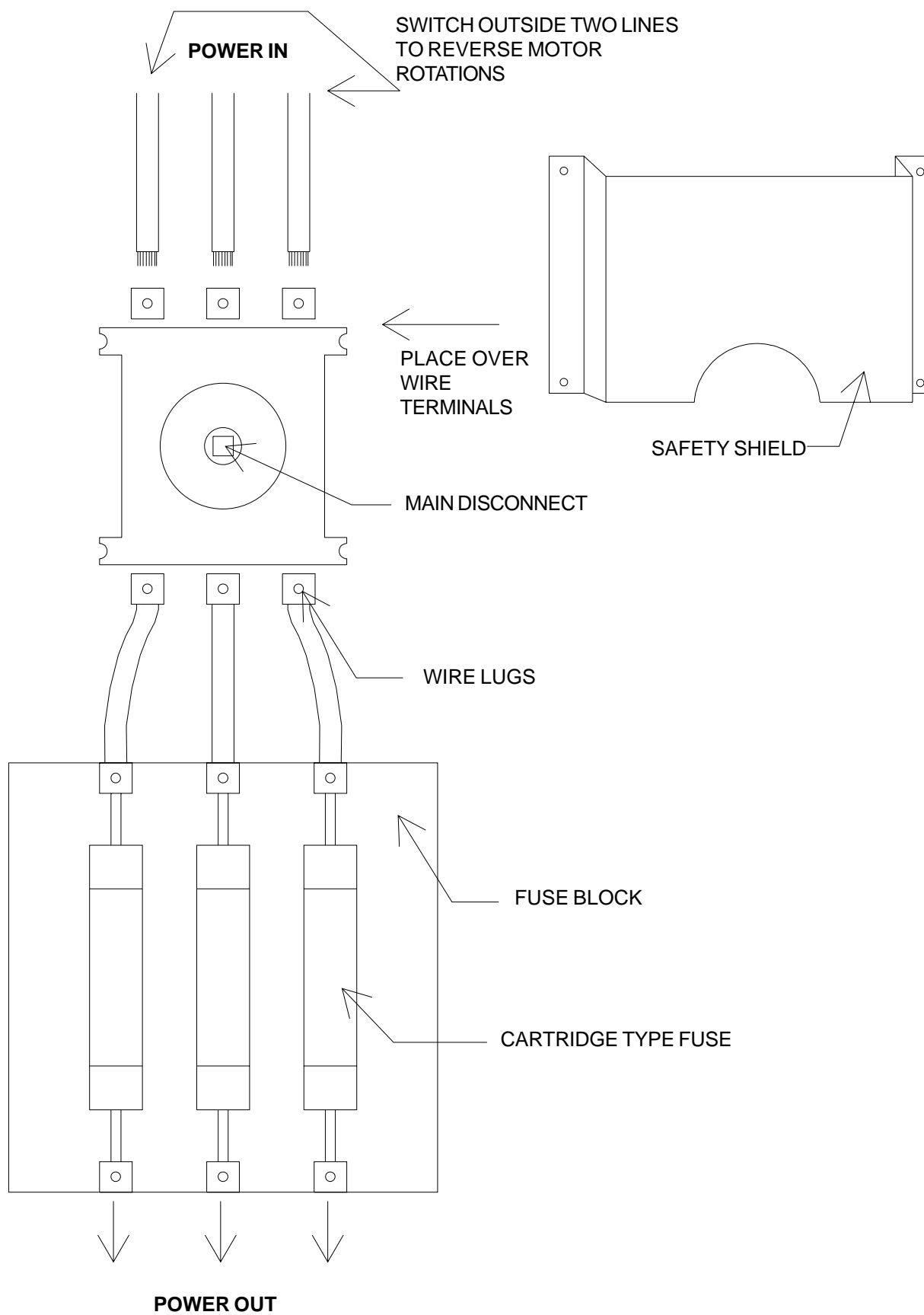
** LEVER and SEAT ASSEMBLY Part No. 5-12

** SPECIFY MAXIMUM OPERATING INLET PRESSURE WHEN ORDERING.

Electrical Control Box



Power Hook Up



for Non-Fusible Disconnect Switches

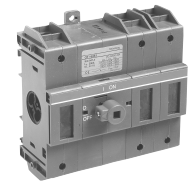
CDNF16 – CDFN160



CDNF16 CDFN25 CDFN32



CDNF30 CDFN60 CDFN100



CDNF160

Catalog number	3 pole	CDNF16	CDNF25	CDNF32	CDNF45	CDNF63	CDNF30	CDNF60	CDNF100	CDNF160
General purpose amp rating	A	16	25	40	60	80	30	60	100	125
Approvals ^①										
	2 pole	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UL98
	3 pole	UL508	UL508	UL508	UL508	UL508	UL98	UL98	UL98	UL98
	4 pole	UL508	UL508	UL508	UL508	UL508	UL98	UL98	UL98	UL98
Technical ratings										
UL, CSA^②										
Max operating voltage	V	600	600	600	600	600	600	600	600	600
Max horsepower rating										
Three phase										
200 – 208V	HP	3	7.5	10	15	20	10	20	25	—
240V	HP	5	7.5	10	15	20	10	20	25	30
480V	HP	10	15	20	30	40	20	40	50	60
600V	HP	10	20	25	20	40	30	40	40	75
Single phase										
120V	HP	1/2	3/4	1	2	2	2	3	5	7.5
240V	HP	1.5	2	3	5	5	5	7.5	15	20
Technical ratings										
IEC^③										
Rated insulation and operational voltage. AC20 and DC20 ^④	V	750	750	750	750	750	750	750	750	750
Rated thermal current, I _{th}										
AC 20/DC 20 open	A	25	32	40	63	80	40	63	115	200
AC 20/DC 20 enclosed	A	25	32	40	63	80	40	63	115	160
AC 21A 500V	A	16	25	32	63	80	40	63	100	160
AC 21A 690V	A	16	25	32	63	80	40	63	100	160
Rated operational power AC23										
400/415V	kW	7.5	9	11	22	37	15	18.5	37	75
690V	kW	7.5	9	11	15	18.5	15	15	37	75
Physical characteristics										
Weight ^④	3 pole lb	0.24	0.24	0.24	0.59	0.59	0.79	0.79	0.79	2.42
Dimension	3 pole H in	2.68	2.68	2.68	3.60	3.60	3.94	3.94	3.94	5.00
	W in	1.38	1.38	1.38	2.07	2.07	2.76	2.76	2.76	4.96
	D in	2.20	2.20	2.20	2.85	2.85	2.95	2.95	2.95	2.93
Accessories										
Terminal lug kit		Integral	Integral	Integral	Integral	Integral	Integral	Integral	Integral	integral
Terminal shroud		•	•	•	•	•	•	•	•	•
Auxiliary contact		•	•	•	•	•	•	•	•	•
Handle UL/NEMA type										
Type 1, 3R, 12		•	•	•	•	•	•	•	•	•
Type 1, 3R, 4, 4X, 12		•	•	•	•	•	•	•	•	•
Handle type										
Selector		•	•	•	•	•	—	—	—	—
Pistol		•	•	•	•	•	•	•	•	•
Conversion kits										
6 pole		•	•	•	•	•	•	•	•	•
Transfer		•	•	•	•	•	•	•	•	•
Bypass		•	•	•	•	•	•	•	•	•
Mechanical interlock		•	•	•	•	•	•	•	—	•
Electrical interlock		—	—	—	—	—	—	—	—	—

• = Available
 — = Not available

UL listed, CSA approved, IEC rated, CE marked

- ① UL listed switches are also CSA approved.
- ② For complete technical information please see page 58 & 59.
- ③ 1000V, IEC 408.
- ④ Switch only

Fusible

Non-Fused

Enclosed Fused

Enclosed Non-Fused

for Non-Fusible Disconnect Switches

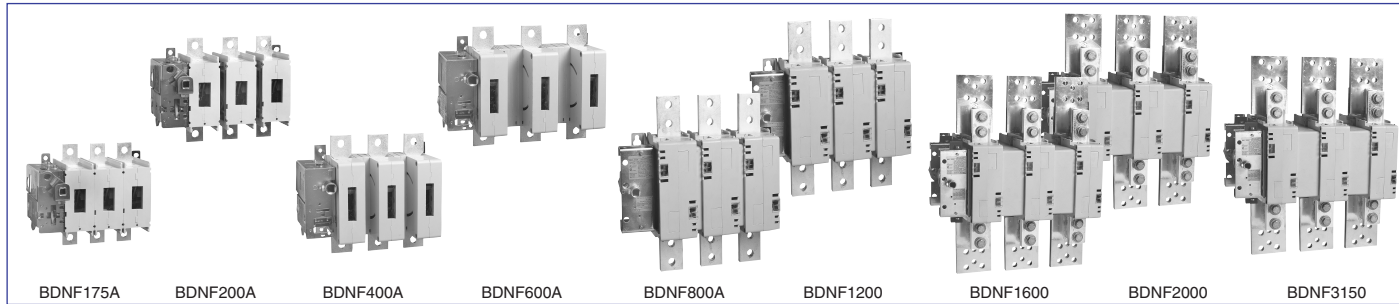
BDNF200A – BDNF3150

Fusible

Non-Fused

Enclosed Fused

Enclosed Non-Fused



Catalog number	3 pole	BDNF175A	BDNF200A	BDNF400A	BDNF600A	BDNF800A	BDNF1200	BDNF1600	BDNF2000	BDNF3150
General purpose amp rating	A	175	200	400	600	800	1200	1600	2000	3150
Approvals^①										
	2 pole	UL508 & IEC	UL98 & IEC	UL98 & IEC	UL98 & IEC	UL98 & IEC	UL98 & IEC	UL98 & IEC	UL98 & IEC	IEC
	3 pole	UL508 & IEC	UL98 & IEC	UL98 & IEC	UL98 & IEC	UL98 & IEC	UL98 & IEC	UL98 & IEC	UL98 & IEC	IEC
	4 pole	IEC	IEC	UL98 & IEC	UL98 & IEC	IEC	IEC	IEC	IEC	IEC
Technical ratings										
UL, CSA^②										
Max operating voltage	V	600	600	600	600	600	600	600	600	600
Max horsepower rating										
Three phase										
200 – 208V	HP	30	60	100	150	200	—	—	—	—
240V	HP	40	75	125	200	250	—	—	—	—
480V	HP	75	150	250	400	500	—	—	—	—
600V	HP	100	200	350	500	600	—	—	—	—
Single phase										
120V	HP	—	—	—	—	—	—	—	—	—
240V	HP	—	—	—	—	—	—	—	—	—
Technical ratings										
IEC^②										
Rated insulation and operational voltage, AC20 and DC20 ^③	V	1000	1000	1000	1000	1000	1000	1000	1000	1000
Rated thermal current, I _m										
AC 20/DC 20 open	A	200	315	630	800	1250	1600	2500	2500	3150
AC 20/DC 20 enclosed	A	200	270	630	720	1250	1600	2300	2300	2600
AC 21A 500V	A	200	250	630	800	1250	1600	2500	2500	3150
AC 21A 690V	A	200	250	630	800	1250	1600	2500	2500	3150
Rated operational power AC23										
400/415V	kW	90	132	315	355	400	400	400	400	400
690V	kW	170	200	355	355	—	—	—	—	—
Physical characteristics										
Weight ^④	3 pole	lb	6.61	6.61	13.66	13.66	35.9	38.55	127.7	127.7
Dimension	3 pole									
	H	in	8.35	8.35	11.81	11.77	19.09	19.09	25.04	25.04
	W	in	7.83	8.62	10.24	11.93	14.29	14.29	18.43	18.43
	D	in	4.55	4.55	5.12	5.12	4.92	4.92	10.67	10.67
Accessories										
Terminal lug kit		BDTL25	BDTL25	BDTL26	BDTL27	BDTL30	BDTL28	BDTL28	BDTL28/2	BDTL28/2
Terminal shroud		•	•	•	•	•	•	—	—	—
Auxiliary contact		•	•	•	•	•	•	•	•	•
Handle UL/NEMA type										
Type 1, 3R, 12		•	•	•	•	•	•	•	•	•
Type 1, 3R, 4, 4X, 12		•	•	•	•	•	•	•	•	•
Handle type										
Selector		—	—	—	—	—	—	—	—	—
Pistol		•	•	•	•	•	•	•	•	•
Conversion kits										
6 pole		•	•	•	•	•	•	—	—	—
Transfer		•	•	•	•	•	•	—	—	—
Bypass		•	•	•	•	•	•	—	—	—
Mechanical interlock		•	•	•	•	•	•	•	•	•
Electrical interlock		•	•	•	•	•	•	•	•	•

S = Standard feature
 • = Available
 — = Not available

UL listed, CSA approved, IEC rated, CE marked

① UL listed switches are also CSA approved.
 ② For complete technical information please see page 58 & 59.
 ③ 1000V, IEC 408.
 ④ Switch only

for Non-Fusible Disconnect Switches
Base & DIN Rail Mounted

For a complete assembly,
 please select one of each:

- 1 switch
- 1 handle
- 1 shaft



CDNF63



CDS85S



CDH3S

16 – 100 Amp switches, 600V, 3 pole^①

UL general purpose amp rating	IEC AC21 amp rating	Maximum horsepower rating						Terminal lugs		Catalog number
		Single phase		Three phase				Wire size	Wire type	
		120V	240V	200V	240V	480V	600V			
16	16	1/2	1.5	3	5	10	10	#18 – 8	Cu	CDNF16
25	25	3/4	2	7.5	7.5	15	20	#18 – 8	Cu	CDNF25
40	40	1	3	10	10	20	25	#18 – 8	Cu	CDNF32
60	63	2	5	15	15	30	20	#14 – 4	Cu	CDNF45
80	80	2	5	20	20	40	40	#14 – 1	Cu	CDNF63
30	40	2	5	10	10	20	30	#14 – 4	Cu	CDNF30
60	63	3	7.5	20	20	40	40	#14 – 4	Cu	CDNF60
100	115	5	15	25	25	50	40	#8 – 1/0	Cu	CDNF100



CDNF16
 CDNF25
 CDNF32



CDNF30
 CDNF60
 CDNF100



CDH1S



CDH15S



CDH6S



CDS_S

Selector handles — for use with shafts \square .20 x .20" (\square 5x5mm)

NEMA type	IEC type	Color	Defeatable	Padlockable	Weight (lbs)	Catalog number
All marked both O/I & Off/On						
1	IP54	Black	—	—	0.09	CDH1S ^②
1	IP54	Red/Yel	—	—	0.09	CDH2S ^②
1	IP54	Black	—	Yes	0.12	CDH15S ^②
1	IP54	Red/Yel	—	Yes	0.12	CDH16S ^②
1,3R,12	IP65	Black	—	Yes	0.16	CDH3S
1,3R,12	IP65	Red/Yel	—	Yes	0.16	CDH4S
1,3R,12	IP65	Black	Yes	Yes	0.16	CDH5S
1,3R,12	IP65	Red/Yel	Yes	Yes	0.16	CDH6S

Shafts — for use with CDH selector handles \square .20 x .20" (\square 5x5mm)

Shaft length inches/mm	Mounting depth ^③ in inches						Weight (lbs)	Catalog number
	CDNF16 CDNF25 CDNF32		CDNF45 CDNF63		CDNF30 CDNF60 CDNF100			
	CDH1S, CDH2S CDH15S, CDH16S	CDH3S, CDH4S CDH5S, CDH6S	CDH1S, CDH2S CDH15S, CDH16S	CDH3S, CDH4S CDH5S, CDH6S	CDH3S, CDH4S CDH5S, CDH6S	CDH3S, CDH4S CDH5S, CDH6S		
3.3/85	4.2 – 5.0	3.6 – 4.3	4.9 – 5.6	4.4 – 5.0	3.9 – 4.9	0.04	CDS85S	
4.1/105	5.0 – 5.8	4.4 – 5.1	5.7 – 6.4	5.1 – 5.8	4.7 – 5.7	0.04	CDS105S	
4.7/120	5.6 – 6.4	5.0 – 5.8	6.3 – 7.0	5.7 – 6.4	5.3 – 6.3	0.05	CDS120S	
5.1/130	6.0 – 6.7	5.4 – 6.1	6.7 – 7.4	6.1 – 6.8	5.6 – 6.7	0.05	CDS130S	
7.1/180	7.1 – 8.7	7.4 – 8.1	8.6 – 9.4	8.1 – 8.7	7.6 – 8.6	0.08	CDS180S	
9.8/250	10.7 – 11.5	10.1 – 10.8	11.4 – 12.1	10.9 – 11.5	10.4 – 11.4	0.10	CDS250S	
13/330	13.8 – 14.6	13.3 – 14.0	14.6 – 15.3	14.0 – 14.7	13.5 – 14.5	0.14	CDS330S	

① A snap on fourth pole may be added

② Not suitable for use with CDNF30, 60, 100.

③ Mounting depth is the distance from the outside of door to the disconnect switch mounting plate. Shaft can be cut to desired length.

for 16A – 100A Non-Fusible Disconnect Switches Base & DIN Rail Mounted

Fusible

Non-Fused

Enclosed Fused

Enclosed Non-Fused



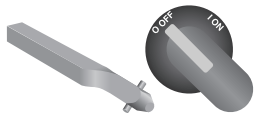
BDH104, 6



BDH105



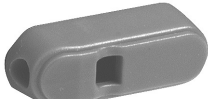
CDS_P



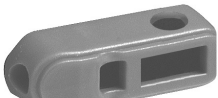
CDS_T



OPMRH



CDBY68306



CDBY68419/1




CDMC1

Pistol handles — for use with shafts \square .20 x .20" (\square 5 x 5 mm)


NEMA type	IEC type	Color	Marking	Length inches/mm	Defeatable	Padlockable	Weight (lbs.)	Catalog number
1,3R,12	IP65	Black	O/I & Off/On	1.8/45	Yes	Yes	0.28	BDH104
1,3R,12	IP65	Red/Yel	O/I & Off/On	1.8/45	Yes	Yes	0.28	BDH105
1,3R,12	IP65	Black	O/I & Off/On	2.6/65	Yes	Yes	0.29	BDH106
1,3R,12	IP65	Red/Yel	O/I & Off/On	2.6/65	Yes	Yes	0.29	BDH107
1,3R,12,4,4X	IP66	Black	O/I & Off/On	2.6/65	Yes	Yes	0.29	CDHXB65
1,3R,12,4,4X	IP66	Red/Yel	O/I & Off/On	2.6/65	Yes	Yes	0.29	CDHXY65

Shafts — for use with pistol handles \square .20 x .20" (\square 5 x 5 mm)



Shaft length (inches/mm)	Mounting depth ^① in inches			Weight (lbs.)	Catalog number
	CDNF16 CDNF25 CDNF32	CDNF45 CDNF63	CDNF30 CDNF60 CDNF100		
5.9/150	6.2 – 6.7	6.9 – 7.4	6.4 – 7.4	0.07	CDS48P
6.7/170	7.0 – 7.5	7.7 – 8.1	7.2 – 8.1	0.08	CDS67P
10.4/265	10.7 – 11.3	11.4 – 11.9	10.9 – 11.9	0.12	CDS49P
15.8/400	16.0 – 16.6	16.8 – 17.2	16.2 – 17.2	0.18	CDS50P
19.7/500	20.0 – 20.5	20.7 – 21.1	20.1 – 21.1	0.23	CDS99P

Twisted shafts — Rotates handle 45° \square .20 x .20" (\square 5 x 5 mm)



Shaft length (inches/mm)	Mounting depth ^① in inches			Weight (lbs.)	Catalog number
	CDNF16 CDNF25 CDNF32	CDNF45 CDNF63	CDNF30 CDNF60 CDNF100		
5.9/150	6.2 – 6.7	6.9 – 7.4	6.4 – 7.4	0.07	CDS48T
6.7/170	7.0 – 7.5	7.7 – 8.1	7.2 – 8.1	0.08	CDS67T
10.4/265	10.7 – 11.3	11.4 – 11.9	10.9 – 11.9	0.12	CDS49T
15.8/400	16.0 – 16.6	16.8 – 17.2	16.2 – 17.2	0.18	CDS50T

Replacement knob — mounts directly to switch; no shaft necessary

NEMA Type	Color	For use on:	Length (inches)	Padlockable	Catalog number
1	Red	CDNF16, 25, 32	1.0	—	OPMRH
1	Red	CDNF30, 45, 60, 63, 100	1.4	—	CDBY68306 ^③
1	Red	CDNF30, 45, 60, 63, 100	1.6	Yes ^②	CDBY68419/1 ^③
Metal collar		CDNF16 – CDNF100	—	—	CDMC1
Set screw		CDNF16, 25, 30, 32, 45, 60, 63, 100	—	—	CDSWM5X8

① Mounting depth is the distance from the outside of door to the disconnect switch mounting plate. Shaft can be cut to desired length.

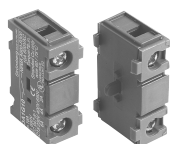
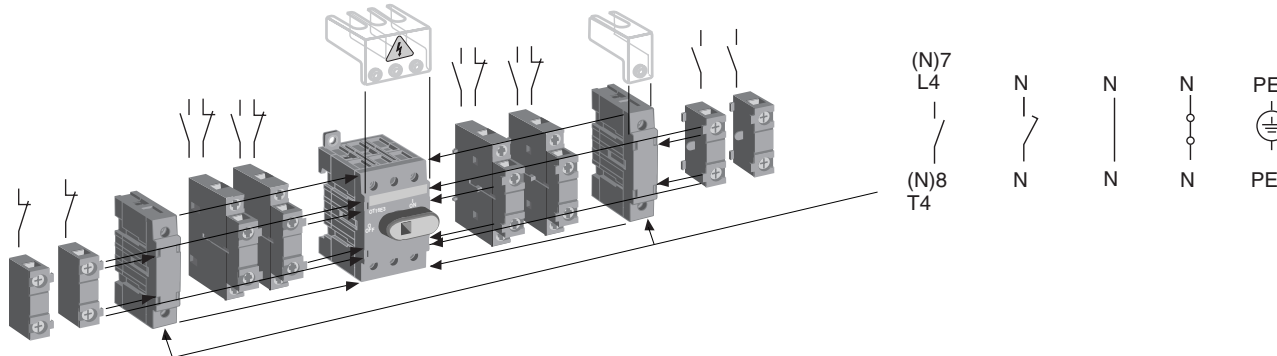
② .1875" (3/16") diameter shackle required.

③ Set screw CDSWM5X8 needed with replacement knobs CDBY__.

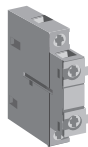
for 16A – 100A Non-Fusible Disconnect Switches

Base & DIN Rail Mounted

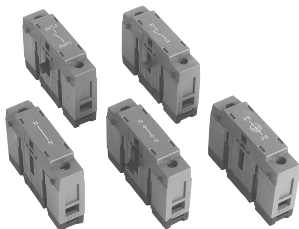
Base and DIN rail mounted switches



CDAUX_



CDAUX11



CD_32P



CD_63P



CD_125P

Auxiliary contacts^① — snap-on mounting

Description	For use on:	Weight (lbs.)	AC thermal amp rating	AC rated voltage	Catalog number
1 N.O. mounts on right hand side of switch only	CDNF16 – CDNF100	0.07	10	600	CDAUX10
1 N.C. mounts on left hand side of switch only	CDNF16 – CDNF100	0.07	10	600	CDAUX01
1 N.O. + 1 N.C. mounts on left or right hand side of switch	CDNF16 – CDNF100	0.07	10	600	CDAUX11

Max. two contacts on each side of switch

Power poles

- Only one power pole per switch
- Mounts on left or right side of switch

Description	For use on:	Weight (lbs.)	AC thermal amp rating	AC rated voltage	Catalog number
Fourth pole ^②	CDNF16 – CDNF100	0.07 0.13 0.31	40 80 100	600 600 600	CDS32P CDS63P CDS125P
Late-break/early-make ^②	CDNF16 – CDNF100	0.07 0.13 0.31	40 80 100	600 600 600	CDL32P CDL63P CDL125P

Terminal poles

- Switch accepts one terminal pole per side
- Mounts on left or right side of switch

Description	For use on:	Weight (lbs.)	AC thermal amp rating	AC rated voltage	Catalog number
Solid neutral ^②	CDNF16 – CDNF100	0.07 0.13 0.31	40 80 100	600 600 600	CDN32P CDN63P CDN125P
Detachable neutral ^②	CDNF16 – CDNF100	0.07 0.13 0.31	40 80 100	600 600 600	CDD32P CDD63P CDD125P
Ground terminal ^②	CDNF16 – CDNF100	0.07 0.13 0.31	40 80 100	600 600 600	CDE32P CDE63P CDE125P

① UL File # E83510

② Switch accepts one power pole or one terminal pole per side. Only one power pole per switch.

Fusible

Non-Fused

Enclosed Fused

Enclosed Non-Fused

for 16A – 100A Non-Fusible Disconnect Switches

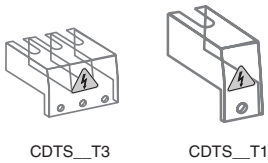
Base & DIN Rail Mounted

Fusible

Non-Fused

Enclosed Fused

Enclosed Non-Fused



CDTs_T3

CDTs_T1

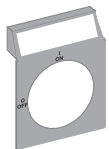


CDSA1

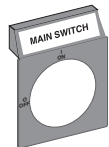
CDSA2



CDTL-ST

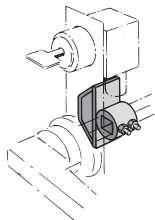


CDT-E



CDP_2

CDP_2EN1



CDETL-ZW16

NDNA100
NDNA200

Terminal shrouds* — snap on mounting for line or load side

Description	For use on:	Weight (lbs.)	Catalog number
3 pole includes one shroud for line or load side	CDNF16, CDNF25, CDNF32, CDNF45, CDNF63, CDNF30, CDNF60, CDNF100	0.02 0.02	CDTS32T3 CDTS63T3 CDTS125T3
4th pole includes one shroud for line or load side	CD_32P CD_63P CD_125P	0.02 0.02 0.02	CDTS32T1 CDTS63T1 CDTS125T1

* All disconnects are IP20 touch safe as standard. Terminal shrouds provide an additional level of protection.

Padlocking adapter

Description	For use on:	Weight (lbs.)	Catalog number
Adapter for one padlock with a max. 0.137" shackle	CDNF30, CDNF45 CDNF60, CDNF63 CDNF100	0.02	CDSA1
Padlock for DS-SA1		0.22	CDSA2
Adapter and padlock		0.24	CDSA3

Labelling accessories

Description	For use on:	Package quantity	Catalog number
1 Pkg. of label carriers	CDNF30, CDNF45 CDNF60, CDNF63 CDNF100	100 pieces	CDTL-ST
1 Pkg of blank description labels		315 pieces	CDT-E

Legend plates for selector handles

Description	For use on:	Catalog number
Blank plate Black Yellow Black Yellow	CDH15, 25, 75, 85, 115, 125 155, 165, 175, 185, 195, 205	CDPB1 CDPY1 CDPB2 CDPY2
	CDH35, 45, 55, 65, 95, 105, 135, 145	
Plate marked with: MAIN SWITCH Black Yellow Black Yellow	CDH15, 25, 75, 85, 115, 125 155, 165, 175, 185, 195, 205	CDPB1EN1 CDPY1EN1 CDPB2EN1 CDPY2EN1
	CDH35, 45, 55, 65, 95, 105, 135, 145	

Locking accessories

Description	For use on:	Weight (lbs.)	Catalog number
Cam attachment for Kirk Key, Castell, Lowe & Fletcher and Ronis interlock. For adapting to the interlock system. The interlock is not included.	5, 6 & 8mm shafts	0.29	CDETL-ZW16

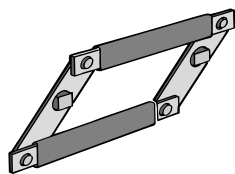
DIN rail

Description	For use on:	Weight (lbs.)	Length inches/mm	Catalog number
35mm DIN Rail	CDNF16 – CDNF100	.38	39.4/1000	NDNA100
35mm Aluminum DIN Rail	CDNF16 – CDNF100	.75	78.8/1000	NDNA200

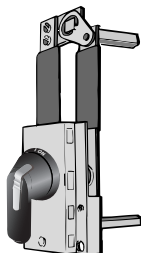
Shaft support

Description	For use on:	Weight (lbs.)	Catalog number
Shaft support	CDNF16 – CDNF100	0.30	CDTL-ZX58

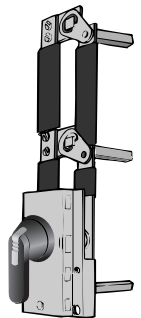
for 16A – 100A Non-Fusible Disconnect Switches Base & DIN Rail Mounted



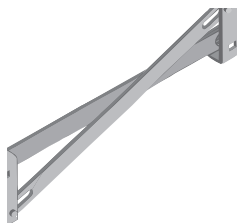
CDZW8



CDZW6



CDZW17



CDZW24

Conversion mechanisms

- For use with Base and DIN rail mounted switches only
- Switches are not included

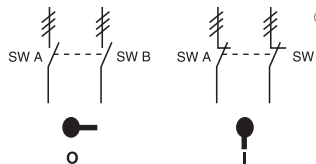
Description	For use on:	Weight (lbs.)	Catalog number
6 or 8 pole	CDNF16 – CDNF100	0.33	CDZW8
Transfer		1.87	CDZW6
Bypass		1.54	CDZW17

6 or 8 pole — CDZW8

6 (8) pole mechanism allows two switches controlled by one handle to open or close simultaneously.

Equipment required for a complete installation:

- One conversion mechanism
- Two disconnect switches
- One handle^①
- One 5mm shaft



	POS. O	POS. I
SW. A	O	X
SW. B	O	X

X = Closed
O = Open

Transfer — CDZW6

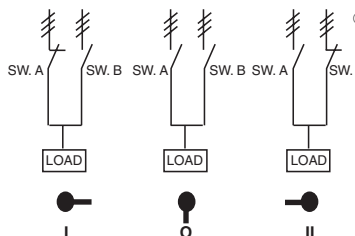
Transfer mechanism manually transfers between two power sources using two switches and a center OFF position.

A 3-position handle is included:

(UL Type 1, 3R & 12) or
(UL Type 1, 3R, 4, 4X, 12)

Shafts included. Equipment required for a complete installation:

- One conversion mechanism
- Two disconnect switches



	POS. I	POS. O	POS. II
SW. A	X	O	O
SW. B	O	O	X

X = Closed
O = Open

Bypass — CDZW17

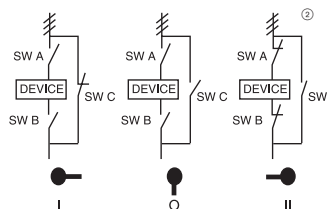
Bypass mechanism operates three switches: Two switches in series and one changeover switch to allow power bypass.

A 3-position handle is included:

(UL Type 1, 3R & 12) or
(UL Type 1, 3R, 4, 4X, 12) Shafts

included. Equipment required for a complete installation:

- One conversion mechanism
- Three disconnect switches



	POS. I	POS. O	POS. II
SW. A	O	O	X
SW. B	O	O	X
SW. C	X	O	O

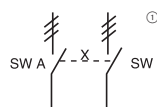
X = Closed
O = Open

Mechanical interlock — CDZW24

Mechanical interlock mechanism prevents both switches from being in the ON position at the same time.

Equipment required for a complete installation:

- One conversion mechanism
- Two disconnect switches
- Two handles
- Two shafts



	SW. A POS. I	SW. B POS. I
SW. A	X	O
SW. B	O	X

X = Closed
O = Open

① CDNF16 – CDNF32 can use a selector or pistol handle. All other sizes must use a pistol handle.

② = Three poles

Fusible

Non-Fused

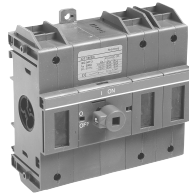
Enclosed Fused

Enclosed Non-Fused

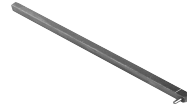
Non-Fusible Disconnect Switches

For a complete assembly, please select one of each:

- 1 switch
- 1 handle
- 1 shaft



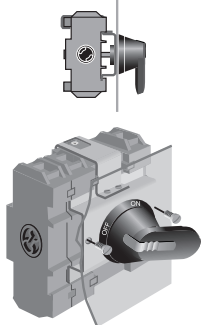
CDNF160



BDS210



BDH60



CDNF160D



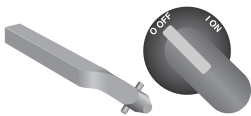
BDH60



BDH61



BDS_



BDST_

125 Amp Base & DIN rail mounted switches^①, 600V

UL general purpose amp rating	IEC AC21 amp rating	Maximum horsepower rating					Terminal lugs		Catalog number
		Three phase					Wire size	Wire type	
		200V	208V	240V	480V	600V			
2 pole 125	160	—	—	—	—	—	#8 – 1/0	Cu	CDNF160-2
3 pole 125	160	30	30	30	60	75	#8 – 1/0	Cu	CDNF160

125 Amp Door mounted switch^①, 600V, 3 pole

UL general purpose amp rating	IEC AC21 amp rating	Maximum horsepower rating					Terminal lugs		Catalog number
		Three phase					Wire size	Wire type	
		200V	208V	240V	480V	600V			
125	160	30	30	30	60	75	#8 – 1/0	Cu	CDNF160D

Pistol handles — for use with $\square .24 \times .24$ " ($\square 6 \times 6$ mm)

NEMA type	IEC type	Color	Length in/mm	Marking	Defeat-able	Padlock-able	Weight (lbs)	Catalog number
1, 3R, 12	IP65	Black	2.6/65	O/I & Off/On	Yes	Yes	0.29	BDH58
1, 3R, 12	IP65	Red/Yel	2.6/65	O/I & Off/On	Yes	Yes	0.29	BDH59
1, 3R, 12	IP65	Black	3.1/80	O/I & Off/On	Yes	Yes	0.30	BDH60
1, 3R, 12	IP65	Red/Yel	3.1/80	O/I & Off/On	Yes	Yes	0.30	BDH61
1, 3R, 4, 4X, 12	IP66	Black	3.1/80	O/I & Off/On	Yes	Yes	0.30	CDHXB86
1, 3R, 4, 4X, 12	IP66	Red/Yel	3.1/80	O/I & Off/On	Yes	Yes	0.30	CDHXY86

Shafts — for use with pistol handles $\square .24 \times .24$ " ($\square 6 \times 6$ mm)

Shaft length inches/mm		Mounting depth ^② in inches	Weight (lbs)	Catalog number
5.2/130		4.3 – 6.0	0.08	BDS130
5.9/150		5.0 – 6.7	0.09	BDS150
8.3/210		7.4 – 9.1	0.13	BDS210
11.4/290		10.5 – 12.2	0.18	BDS290
14.2/360		13.3 – 15.0	0.23	BDS360
16.9/430		16.0 – 17.8	0.27	BDS430

Twisted shafts — Rotates handle 45° $\square .24 \times .24$ " ($\square 6 \times 6$ mm)

Shaft length inches/mm		Mounting depth ^② in inches	Weight (lbs)	Catalog number
5.2/130		4.3 – 6.0	0.08	BDST4
8.3/210		7.4 – 9.1	0.13	BDST25
11.4/290		10.5 – 12.2	0.18	BDST29
14.2/360		13.3 – 15.0	0.23	BDST30

① A snap on fourth pole may be added

② Mounting depth is the distance from the outside of the door to the disconnect switch mounting plate. Shaft can be cut to desired length.

Fusible

Non-Fused

Enclosed Fused

Enclosed Non-Fused

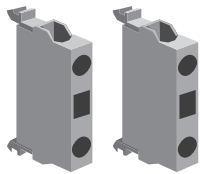
for 125A Non-Fusible Disconnect Switches

Fusible

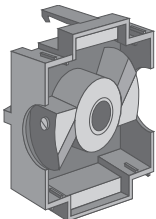
Non-Fused

Enclosed Fused

Enclosed Non-Fused



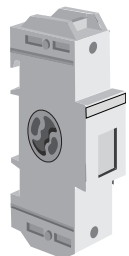
CDAUXCA10 CDAUXCA01



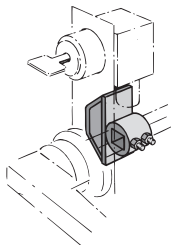
CDAUXB160



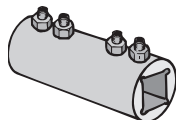
CDAUX16011 CDMB160



CD_160P



CDETL-ZW16



BDZX167
BDZX95

Auxiliary contacts, top mounted

- Accepts four contacts maximum, mounting base always required

Description	For use on:	Weight (lbs)	AC thermal amp rating	AC rated voltage	Catalog number
1 N.O. 1 N.C.	CDNF160	0.07	10 10	600 600	CDAUXCA10 CDAUXCA01
1 N.O. gold plated ^① 1 N.C. gold plated ^①	CDNF160	0.07	10 10	600 600	CDEA-10AU CDEA-01AU
Mounting base – required for CDAUX_	CDAUX_	0.06	—	—	CDAUXB160

Auxiliary contacts, side mounted

- Accepts four contacts maximum

Description	For use on:	Weight (lbs)	AC thermal amp rating	AC rated voltage	Catalog number
1 N.O. & 1 N.C.	CDNF160	0.07	10	600	CDAUX16011
Mounting base, required for CDAUX16011	CDNF160	0.06	—	—	CDMB160

Max. two contacts on each side of switch. One mounting base required for each side of switch

Numbering stickers^②

Description	For use on:	Package qty.	Catalog number
1 Pkg. of blank labels for OBEA-10, 1 N.O.	CDNF160	10	CDEA-ZX10
1 Pkg. of blank labels for OBEA-01, 1 N.C.	CDNF160	10	CDEA-ZX01

Power pole — for use with base or door mounted switch

- Only one power pole per switch
- Mounts on left or right side of switch

Description	For use on:	Weight (lbs)	AC thermal amp rating	AC rated voltage	Catalog number
Fourth pole	CDNF160	0.66	125	600	CDS160P

Terminal poles — for use with base or door mounted switch

- Switch accepts one terminal pole per side
- Mounts on left or right side of switch

Description	For use on:	Weight (lbs)	AC thermal amp rating	AC rated voltage	Catalog number
Detachable neutral mounts on side of switch or DIN rail	CDNF160	0.66	125	600	CDN160P
Ground terminal	CDNF160	0.66	125	600	CDE160P

Locking accessories

Description	For use on:	Weight (lbs)	Catalog number
Cam attachment for Kirk Key, Castell, Lowe & Fletcher and Ronis interlock. For adapting to the interlock system. The interlock is not included.	5, 6 & 8mm shafts	0.29	CDETL-ZW16

Handle support bracket

Description	For use on:	Weight (lbs)	Catalog number
Allows pistol handle to be directly mounted to switch behind the door	CDNF160	0.33	CDZX5

Shaft extension couplers

Description	For use on:	Weight (lbs)	Catalog number
Joins two shafts together for applications where extended length is required	for 6mm shafts	0.26	BDZX167 BDZX95
	for 12mm shafts	0.26	

① Type _AU for low energy applications. The contacts are gold-plated. AC & DC ratings — Maximum: A600 & P600. Minimum: 12V, 1mA; 5V, 2mA

② Required if several contact blocks are used in the same installation.

for 125A Non-Fusible Disconnect Switches



Conversion mechanisms

- For use with Base and Din rail mounted switches only
- Switches are not included

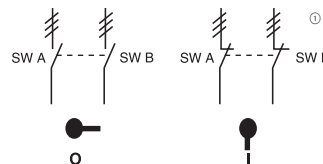
Description	For use on:	Weight (lbs.)	Catalog number
6 or 8 pole	CDNF160	1.52	BDZW2
Transfer (1, 3R, 12)		2.20	BDZW1
Transfer (4X)		2.20	BDZW1X
Mechanical interlock		0.55	CDZW10

6 or 8 pole — BDZW2

6 (8) pole mechanism allows two switches controlled by one handle, to open or close simultaneously. Shafts included.

Equipment required for a complete installation:

- One conversion mechanism
- Two disconnect switches
- One handle



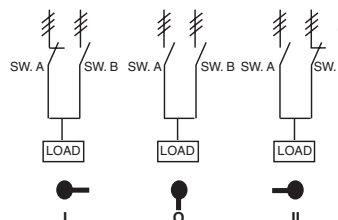
	POS. O	POS. I
SW. A	O	X
SW. B	O	X

X = Closed
O = Open

Transfer — BDZW1

Transfer mechanism manually transfers between two power sources using two switches and a center OFF position. A 3 position handle is included. (UL Type 1, 3R & 12) or (UL Type 1, 3R, 4, 4X, 12) Shafts included. Equipment required for a complete installation:

- One conversion mechanism
- Two disconnect switches



	POS. I	POS. O	POS. II
SW. A	X	O	O
SW. B	O	O	X

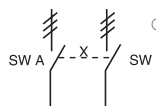
X = Closed
O = Open

Mechanical interlock — CDZW10

Mechanical interlock mechanism prevents both switches from being in the ON position at the same time.

Equipment required for a complete installation:

- One conversion mechanism
- Two disconnect switches
- Two handles
- Two shafts



	SW. A POS. I	SW. B POS. I
SW. A	X	O
SW. B	O	X

X = Closed
O = Open

Shaft adapter

Description	For use on:	Weight (lbs)	Catalog number
Adapts one end of a 5 or 6mm shaft to 12mm Use with shaft extension coupler	5 & 6mm shafts	0.20	CDZK19

Power pole interlock (replacement part)

Description	For use on:	Weight (lbs)	Catalog number
Interlocks a power pole with an adjacent power pole	CDNF160	0.05	CDBY68005

Replacement collar (optional replacement for knob)

Description	For use on:	Weight (lbs)	Catalog number
Red knob (like original) for locking shaft in place ** re-use original set screw **	CDNF160	0.05	CXBY68100
Replaces original red knob for locking shaft in place ** re-use original set screw **	CDNF160	0.05	CDMC2

① = Three poles

for Non-Fusible Disconnect Switches
CDNF16 – CDFN160

UL & CSA

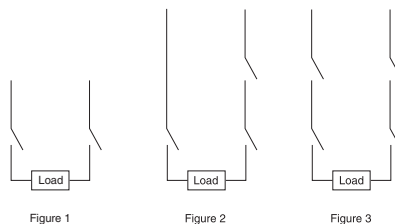
Catalog number	3 pole	CDNF16	CDNF25	CDNF32	CDNF45	CDNF63	CDNF30	CDNF60	CDNF100	CDNF160			
Approvals ^①	2 pole 3 pole 4 pole	N/A UL508 & IEC UL508 & IEC	N/A UL508 & IEC UL508 & IEC	N/A UL508 & IEC UL508 & IEC	N/A UL508 & IEC UL508 & IEC	N/A UL508 & IEC UL508 & IEC	N/A UL98 & IEC UL98 & IEC	N/A UL98 & IEC UL98 & IEC	N/A UL98 & IEC UL98 & IEC	UL98 & IEC UL98 & IEC UL98 & IEC			
General purpose amp rating pf = 0.7 – 0.8	-40° to 40°C A	16	25	40	60	80	30	60	100	125			
Max. operating voltage	V	600	600	600	600	600	600	600	600	600			
Max. horsepower rating/motor FLA current, pf = 0.4 – 0.5													
Three phase	200V – 208V	HP/A	3/10.6	7.5/24.2	10/30.8	15/46.2	20/60.0	10/30.8	20/60.0	25/75.0	30/88.0		
	240V	HP/A	5/15.2	7.5/22.0	10/28.0	15/42.0	20/54.0	10/28.0	20/54.0	25/68.0	30/80.0		
	480V	HP/A	10/14.0	15/21.0	20/27.0	30/40.0	40/52.0	20/27.0	40/52.0	50/65.0	60/77.0		
	600V	HP/A	10/11.0	20/22.0	25/27.0	20/22.0	40/41.0	30/32.0	40/41.0	40/41.0	75/77.0		
Single phase	120V	HP/A	0.5/9.8	0.75/13.8	1/16.0	2/24.0	2/24.0	2/24.0	3/34.0	5/56.0	7.5/80		
	240V	HP/A	1.5/10.0	2/12.0	3/17.0	5/28.0	5/28.0	5/28.0	7.5/40.0	15/68.0	20/88.0		
Short circuit rating with fuse													
Fuse type	CC	kA	10	—	10	—	10	—	—	—	—		
Fuse type	J	kA	10	10	10	10	100	—	100	—	100		
Fuse type	T	kA	10	10	10	10	100	—	50	—	50		
Fuse type	RK1	kA	10	—	10	—	—	—	—	—	—		
Fuse type	RK5	kA	5	5	5	5	—	5	10	5	—		
Fuse type	L	kA	—	—	—	—	—	—	—	—	—		
Fuse type	H	kA	—	—	—	—	5	—	—	—	—		
Fuse size	A	A	30	60	30	60	100	150	100	150	60	100	200
Short circuit rating with MCCB	kA	—	—	—	—	—	—	—	—	—	—	25	
Endurances													
Min. Electrical endurance, pf = 0.75 – 0.80	operation cycles	6000	6000	6000	6000	6000	6000	6000	6000	6000			
Min. Electrical endurance, pf = 0.40 – 0.50	operation cycles	1000	1000	1000	1000	1000	1000	⊙	⊙	⊙			
Mechanical endurance	operations	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	16,000			
Physical characteristics													
Weight, switches	3 pole	lb	0.24	0.24	0.24	0.59	0.59	0.79	0.79	0.79	2.42		
	4 pole	lb	0.33	0.33	0.33	0.77	0.77	1.10	1.10	1.10	2.86		
Dimension, switches	3 pole	H in	2.68	2.68	2.68	3.60	3.60	3.94	3.94	3.94	5.00		
		W in	1.38	1.38	1.38	2.07	2.07	2.76	2.76	2.76	4.96		
		D in	2.20	2.20	2.20	2.85	2.85	2.95	2.95	2.95	2.93		
Shaft size — square □		in	.20 x .20	.20 x .20	.20 x .20	.20 x .20	.20 x .20	.20 x .20	.20 x .20	.20 x .20	.24 x .24		
		mm	5 x 5	5 x 5	5 x 5	5 x 5	5 x 5	5 x 5	5 x 5	5 x 5	6 x 6		
Switch operating torque for rotary 3 pole switches		lb. in.	8.8	8.8	8.8	10.5	10.5	17.5	17.5	17.5	52.5		
Terminal lug kits			Not required	Not required	Not required	Not required	Not required	Not required	Not required	Not required			
Wire range	AWG	#18 – 8	#18 – 8	#18 – 8	#14 – 4	#14 – 1	#14 – 4	#14 – 4	#8 – 1/0	#8 – 1/0			
Torque:													
Wire tightening	lb. in.	7	7	7	18	18	55	55	55	70			
Lug mounting	lb. in.	Integral	Integral	Integral	Integral	Integral	Integral	Integral	Integral	Integral			
Auxiliary contacts		CDAUX_ _	CDAUX_ _	CDAUX_ _	CDAUX_ _	CDAUX_ _	CDAUX_ _	CDAUX_ _	CDAUX_ _	CDAUX_ _			
NEMA ratings, AC		A600	A600	A600	A600	A600	A600	A600	A600	A600			
AC rated voltage	VAC	600	600	600	600	600	600	600	600	600			
AC thermal rated current	A	10	10	10	10	10	10	10	10	10			
AC maximum volt-ampere making	VA	7200	7200	7200	7200	7200	7200	7200	7200	7200			
AC maximum volt-ampere breaking	VA	720	720	720	720	720	720	720	720	720			
NEMA ratings, DC		R300	R300	R300	R300	R300	R300	R300	R300	P600			
DC rated voltage	VDC	300	300	300	300	300	300	300	300	600			
DC thermal rated current	A	1	1	1	1	1	1	1	1	5			
DC maximum make-break	VA	28	28	28	28	28	28	28	28	138			
Torque:													
Wire tightening	lb. in.	7	7	7	7	7	7	7	7	7			
Wire range	AWG	#18 – 14	#18 – 14	#18 – 14	#18 – 14	#18 – 14	#18 – 14	#18 – 14	#18 – 14	#22 – 14			

① UL Listed switches are also CSA Approved.
② UL98 overload test, 50 operations, pf 0.40 – 0.50 at 2x FLA.

for Non-Fusible Disconnect Switches
CDNF16 – CDNF160

IEC

Catalog number	3 pole	CDNF16	CDNF25	CDNF32	CDNF45	CDNF63	CDNF30	CDNF60	CDNF100	CDNF160	
Rated insulation and operation voltage, AC20 and DC20 ^①	40°C V	750	750	750	750	750	750	750	750	750	
Rated impulse withstand voltage	kV	8	8	8	8	8	8	8	8	12	
Rated thermal current, I _m											
AC 20/DC 20	open ^②	A	25	32	40	63	80	40	63	115	200
	40°C enclosed	A	25	32	40	63	80	40	63	115	160
	60°C enclosed	A	25	32	40	63	80	40	63	115	160
Rated operational currents											
AC 21A	≤500V	A	16	25	32	63	80	40	63	100	160^③
	≤690V	A	16	25	32	63	80	40	63	100	160 ^③
	≤1000V ^①	A	—	—	—	—	—	—	—	—	—
AC 22A	≤500V	A	16	25	32	63	80	40	63	100	160 ^③
	≤690V	A	16	25	32	63	80	40	63	100	160 ^③
	≤1000V ^①	A	—	—	—	—	—	—	—	—	—
AC 23A	≤415V	A	16	20	23	45	75	40	63	80	135
	≤500V	A	16	20	23	45	58	40	63	60	125
	≤690V	A	10	11	12	20	20	40	40	40	80
	≤1000V ^①	A	—	—	—	—	—	—	—	—	—
Rated operational currents/poles in series											
DC21A	48V	A	16/1	25/1	32/1	⊕	⊕	40/1	63/1	100/1	160/1
	110V	A	16/2	25/2	32/2	45/2	63/2	40/2	63/2	100/2	160/1
	220V	A	16/3	25/3	32/3	⊕	⊕	40/4	63/4	100/4	160/2
	440V	A	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	160/3
	750V	A	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	160/4
DC22A	48V	A	16/1	25/1	32/1	⊕	⊕	40/1	63/1	100/1	160/1
	110V	A	16/2	25/2	32/2	45/2	63/2	40/2	63/2	100/2	160/1
	220V	A	16/3	25/3	32/4	⊕	⊕	40/4	63/4	63/4	160/2
	440V	A	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	160/3
	750V	A	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕
DC23A	48V	A	16/1	25/1	32/1	⊕	⊕	40/1	63/1	100/1	160/1
	110V	A	16/2	25/2	32/2	45/2	63/2	40/2	63/2	100/2	160/1
	220V	A	16/4	25/4	32/4	⊕	⊕	40/4	63/4	63/4	160/2
	440V	A	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	160/3
	750V	A	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕
Rated operational power											
AC23A	230V	kW	3	4	5.5	11	22	7.5	11	22	45
	400/415V	kW	7.5	9	11	22	37	15	18.5	37	75
	500V	kW	7.5	9	11	22	37	15	18.5	37	75
	690V	kW	7.5	9	11	15	18.5	15	15	37	75
Short-circuit current	kA	50	50	50	50	50	50	50	50	50	
with back-up fuses of size ^①	A	25	32	40	63	80	100	100	100	200	

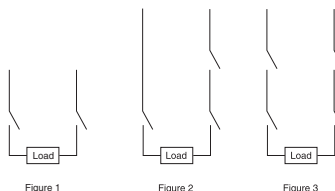


① 1000V, IEC 408.
 ② The ambient air temperature does not exceed +40°C and its average over a period of 24 hours does not exceed +35°C according to IEC 947.
 ③ IEC 947-3, utilization category B, infrequent operation.
 ④ Not available at time of printing, please consult factory.

for Non-Fusible Disconnect Switches
CDNF16 – CDNF160

IEC

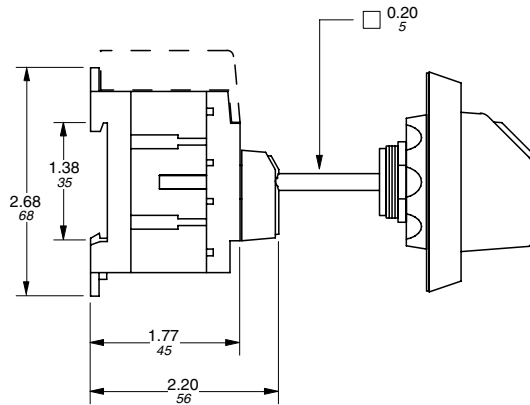
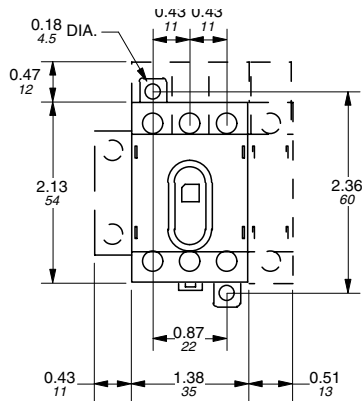
Catalog number	3 pole	CDNF16	CDNF25	CDNF32	CDNF45	CDNF63	CDNF30	CDNF60	CDNF100	CDNF160
Rated voltage, U ^e	V/V	415	415	415	415	415	415	415	415	415/690
Rated conditional short-circuit current	kA	50	50	50	50	50	50	50	50	80/50
Max. allowed fuse size, type OFAA	A	16	32	40	63	80	100	100	100	160/250
Max. allowed cut-off current, peak value	kA	4	4.3	4.6	8.3	11	9.2	9.2	9.2	21.0/21.6
Rated short-circuit making capacity, prospective peak value, I ^{cm}	kA	0.7	0.7	1.4	1.4	3.6	3.6	3.6	12	
Rated short time withstand current, RMS I ^{cw}	0.2s kA	—	—	—	—	—	—	—	—	7
	1.0s kA	0.5	0.5	0.5	1	1	2.5	2.5	2.5	4
AC breaking capacity										
pf = 0.35										
≤415V	A	128	160	184	240	304	320	504	640	1080
≤500V	A	128	160	184	240	256	320	504	504	1000
≤690V	A	80	88	96	160	160	320	320	320	640
≤1000V ^①	A	—	—	—	—	—	—	—	—	—
DC breaking capacity/poles in series										
L/R = 15ms, 3 pole in series										
≤48V	A	64/1	100/1	128/1	180/1	252/1	160/1	252/1	400/1	640/1
≤110V	A	64/2	100/2	128/2	180/2	180/2	160/2	252/2	400/2	640/1
≤220V	A	64/3	100/4	128/4	180/4	180/4	160/4	252/4	252/4	640/2
≤440V	A	②	②	②	②	②	②	②	—	640/3
≤750V	A	②	②	②	②	②	②	②	—	—
Capacitor ratings	≤400/415V kVar	②	②	②	②	②	②	②	②	②
Rated capacitor duty	kA	②	②	②	②	②	②	②	②	②
Physical characteristics										
Electrical endurance at rated operational current, pf = 0.65	operation cycles	3000	3000	3000	3000	3000	3000	3000	3000	1000
Mechanical endurance	operations	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	16,000
Weight	3 pole kg	0.11	0.11	0.11	0.27	0.27	0.36	0.36	0.36	1.1
	4 pole kg	0.15	0.15	0.15	0.35	0.35	0.5	0.5	0.5	1.3
Dimension 3 pole	H mm	68	68	91.5	91.5	100	100	100	127	
	W mm	35	35	35	52.5	52.5	70	70	70	126
	D mm	56	56	56	72.5	72.5	75	75	75	74.5
Power loss per pole	W	0.3	0.6	1	1.4	2.8	1	1.6	4	6.5
Shaft size — square	mm	5 X 5	5 x 5	5 x 5	5 x 5	5 x 5	5 x 5	5 x 5	5 x 5	6 x 6
Switch operating torque for rotary 3 pole switches	Nm	1	1	1	1.2	1.2	2	2	2	6
Suitable conductor cross section Cu	mm ²	0.75 – 10	0.75 – 10	0.75 – 10	1.5 – 35	1.5 – 35	1.5 – 25	1.5 – 25	1.5 – 25	10 – 70
Bolt size		—	—	—	—	—	—	—	—	—
Auxiliary contacts		CDAUX_ _	CDAUX_ _	CDAUX_ _	CDAUX_ _	CDAUX_ _	CDAUX_ _	CDAUX_ _	CDAUX_ _	CDAUX_ _
Ratings according to IEC 9-47-5-1										
Rated voltage, U _i	VAC	690	690	690	690	690	690	690	690	690
Thermal current, I _m	A	16	16	16	16	16	16	16	16	10
AC12/DC12 I _e , A U _e =										
120V	A	—	—	—	—	—	—	—	—	8/—
125V	A	—	—	—	—	—	—	—	—	—/1.1
240V	A	6 ^③	6 ^③	6 ^③	6 ^③	6 ^③	6 ^③	6 ^③	6 ^③	6/—
250V	A	—	—	—	—	—	—	—	—	—/0.55
400V	A	4 ^③	4 ^③	4 ^③	4 ^③	4 ^③	4 ^③	4 ^③	4 ^③	4/—
415V	A	—	—	—	—	—	—	—	—	4/—
440V	A	—	—	—	—	—	—	—	—	—/0.31
480V	A	—	—	—	—	—	—	—	—	3/—
500V	A	—	—	—	—	—	—	—	—	3/0.27
600V	A	—	—	—	—	—	—	—	—	—/0.2
690V	A	2 ^③	2 ^③	2 ^③	2 ^③	2 ^③	2 ^③	2 ^③	2 ^③	2/—



① 1000V, IEC 408.
② Not available at time of printing, please consult factory.
③ AC15, according to IEC947-5-1.

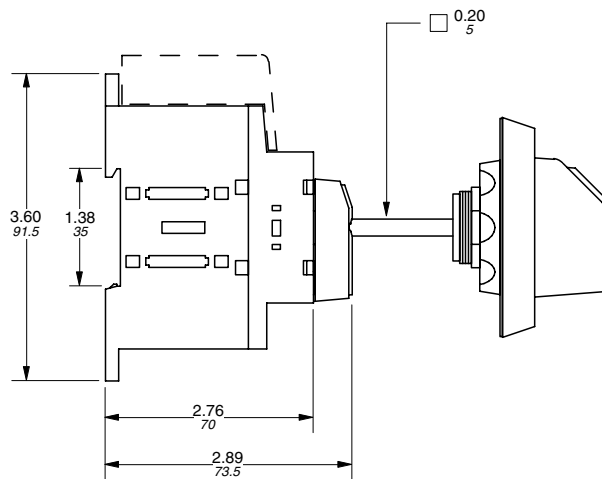
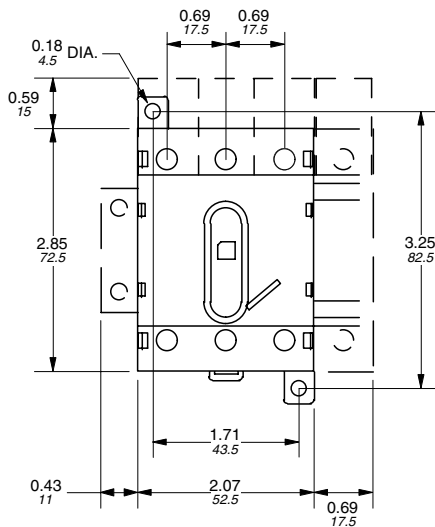
for Non-Fusible Disconnect Switches
CDNF16 — CDNF100

CDNF16, CDNF25, CDNF32 — base & DIN rail mounted switch



Fusible

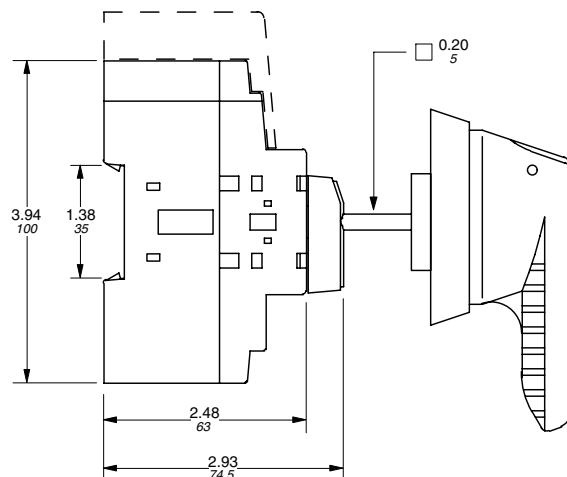
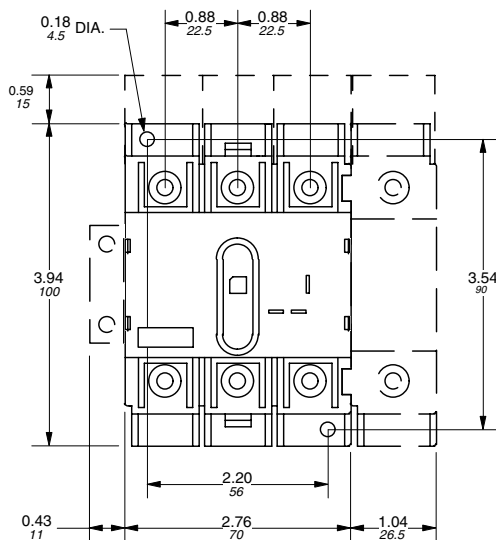
CDNF45, CDNF63 — base & DIN rail mounted switch



Non-Fused

Enclosed Fused

CDNF30, CDNF60, CDNF100 — base & DIN rail mounted switch



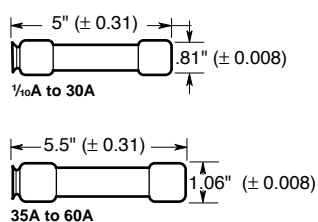
Enclosed Non-Fused

Fusetron® Dual-Element, Time-Delay Fuses Class RK5 – 600 Volt

FRS-R 1/10-60A



Dimensional Data



Catalog Symbol: FRS-R
Dual-Element, Time-Delay – 10 second (minimum) at 500% rated current
Current-Limiting
Ampere Rating: 1/10 to 60A
Voltage Rating: 600Vac (or less)
Interrupting Rating: 200,000A RMS Sym. dc Ratings (20,000AIC @ 250Vdc)
Agency Information:
UL Listed, Std. 248-12, Class RK5, Guide JDDZ, File E4273
CSA Certified, C22.2 No. 248.12, Class 1422-02, File 53787

Catalog Numbers

FRS-R-1/10	FRS-R-1 9/10	FRS-R-8
FRS-R-1/8	FRS-R-2	FRS-R-9
FRS-R-15/100	FRS-R-2 1/4	FRS-R-10
FRS-R-2/10	FRS-R-2 1/2	FRS-R-12
FRS-R-1/4	FRS-R-2 9/10	FRS-R-15
FRS-R-3/10	FRS-R-3	FRS-R-17 1/2
FRS-R-4/10	FRS-R-3 3/10	FRS-R-20
FRS-R-1/2	FRS-R-3 1/2	FRS-R-25
FRS-R-9/10	FRS-R-4	FRS-R-30
FRS-R-9/10	FRS-R-4 1/2	FRS-R-35
FRS-R-1	FRS-R-5	FRS-R-40
FRS-R-1 1/8	FRS-R-5 9/10	FRS-R-45
FRS-R-1 1/4	FRS-R-6	FRS-R-50
FRS-R-1 1/10	FRS-R-6 1/4	FRS-R-60
FRS-R-1 1/2	FRS-R-7	—
FRS-R-1 9/10	FRS-R-7 1/2	—

Carton Quantity and Weight

Ampere Ratings	Carton Qty.	Weight*	
		Lbs.	Kg.
1/10-15	10	0.40	0.181
17.5-30	10	0.50	0.277
35-60	10	3.10	1.406

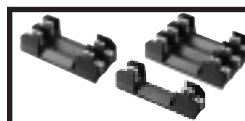
*Weight per carton.

General Information:

- Provides motor overload, ground fault and short-circuit protection. When used in circuits subject to surge currents such as those caused by motors, transformers and other inductive components, these fuses can be sized close to full-load amperes to give maximum overcurrent protection.
- Permits the use of smaller and less costly switches. The time-delay feature makes it possible to use fuse ampere ratings which are much smaller than those of non-time-delay fuses. Considerable cost saving occurs by permitting the use of smaller size switches, panels and fuses themselves.
- Provides a higher degree of short-circuit protection (greater current-limitation) in circuits in which surge currents or temporary overloads occur.
- Helps protect motors against burnout from overloads.
- Gives motor running back-up protection to motors without extra costs.
- Helps protect motors against burnout from single phasing on three phase systems.
- Simplifies and improves blackout prevention (selective coordination).
- Dual-element fuses can be applied in circuits subject to temporary motor overloads and surge currents to provide both high-performance, short-circuit and overload protection.
- The overload element provides protection against low level overcurrent of overloads and will hold an overload which is five times greater than the ampere rating of the fuse for a minimum of ten seconds.

Fuse Reducers For Class R Fuses

Equipment Fuse Clips	Desired Fuse (Case) Size	Catalog Number (Pairs) 600V
60A	30A	No. 663-R
100A	30A	No. 216-R
	60A	No. 616-R
200A	60A	No. 626-R



Recommended fuseblocks for Class R 600V fuses
See Data Sheet: 1111

CE CE logo denotes compliance with European Union Low Voltage Directive (50-1000Vac, 75-1500Vdc). Refer to Data Sheet: 8002 or contact Bussmann Application Engineering at 314-527-1270 for more information.

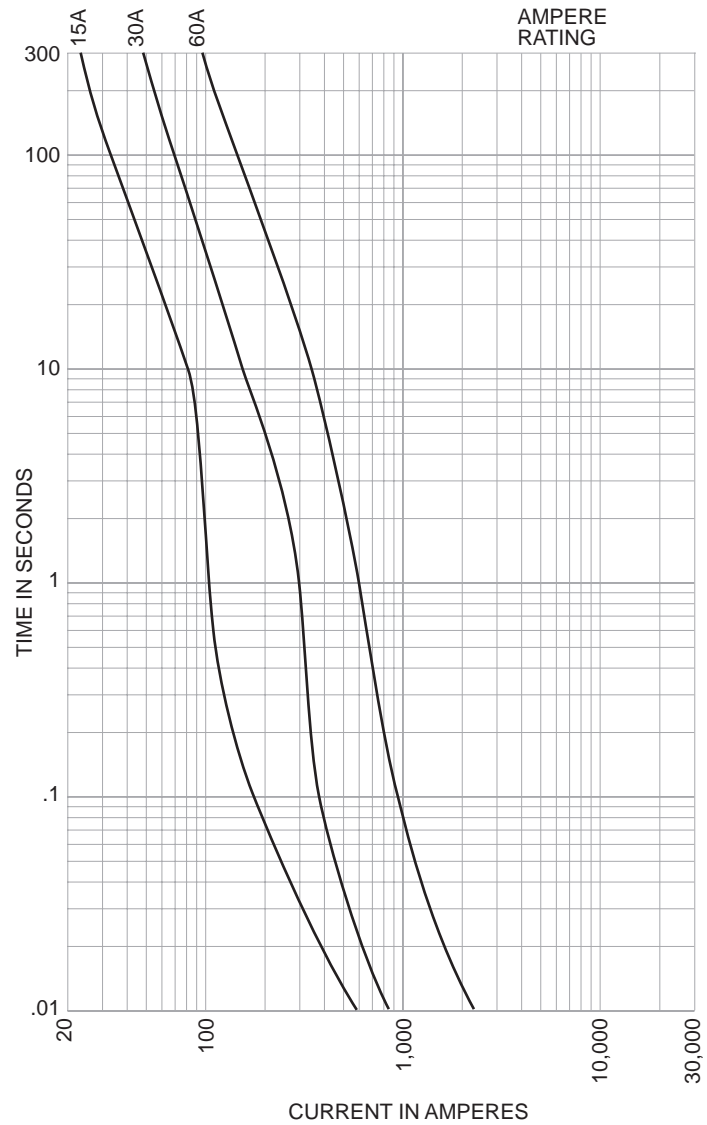
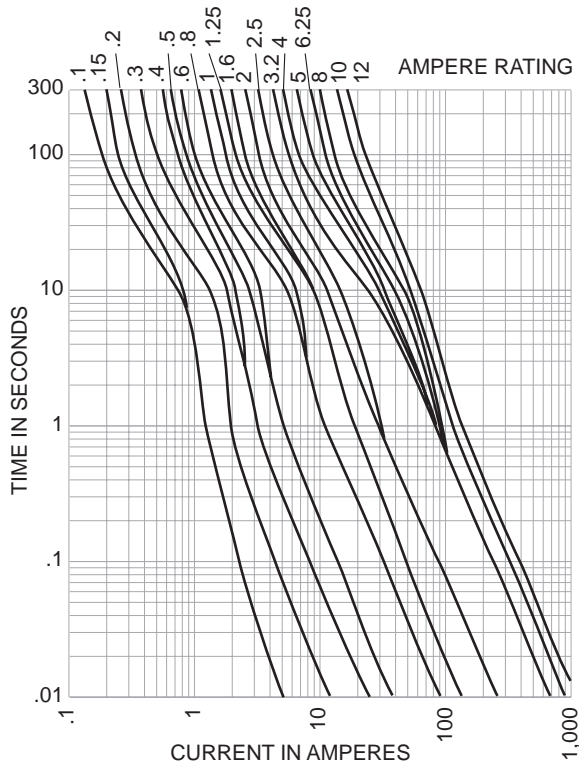
Fusetron®

Dual-Element, Time-Delay Fuses

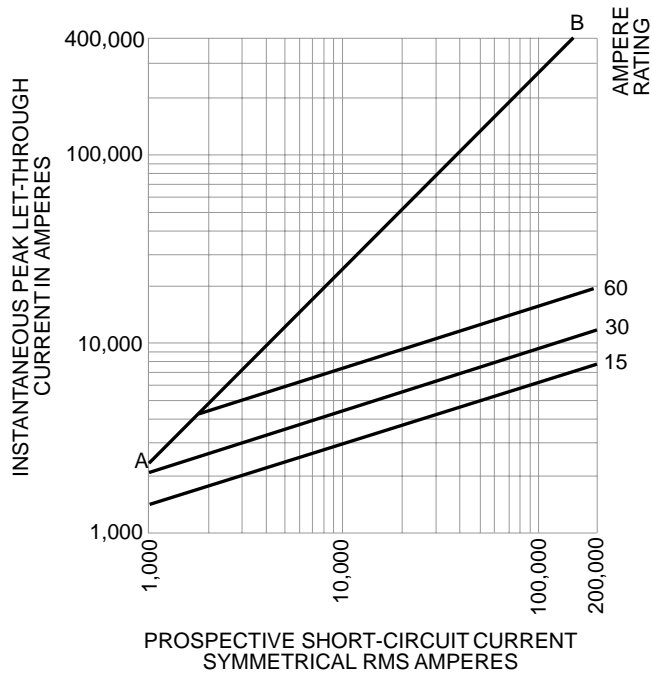
Class RK5 – 600 Volt

FRS-R
1/10-60A

Time-Current Characteristic Curves—Average Melt



Current-Limitation Curves



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Fusetron®

Dual-Element, Time-Delay Fuses

Class RK5 — 600 Volt

FRS-R
65-600A



Catalog Symbol: FRS-R

Dual-Element, Time-Delay – 10 seconds (minimum) at 500% rated current

Current-Limiting

Ampere Rating: 65 to 600A †

Voltage Rating: 600Vac (or less)

Interrupting Rating: 200,000A RMS Sym.

dc Ratings (20,000AIC @ 300Vdc)

Agency Information:

UL Listed, Std. 248-12, Class RK5, Guide JDDZ, File E4273

CSA Certified, C22.2 No. 248.12, Class 1422-01, File 53787

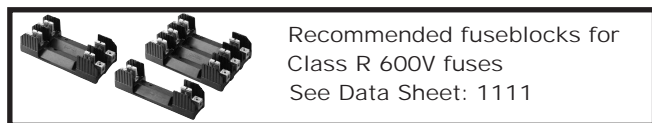
Catalog Numbers

FRS-R-65	FRS-R-135	FRS-R-325
FRS-R-70	FRS-R-150	FRS-R-350
FRS-R-75	FRS-R-175	FRS-R-400
FRS-R-80	FRS-R-200	FRS-R-450
FRS-R-90	FRS-R-225	FRS-R-500
FRS-R-100	FRS-R-250	FRS-R-600
FRS-R-110	FRS-R-275	—
FRS-R-125	FRS-R-300	—

Carton Quantity and Weight

Ampere Ratings	Carton Qty.	Weight*	
		Lbs.	Kg.
65-100	1	0.54	0.245
101-200	1	1.22	0.544
201-400	1	3.00	1.359
401-600	1	5.00	2.268

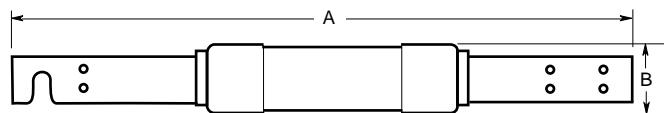
*Weight per carton.



Recommended fuseblocks for Class R 600V fuses
See Data Sheet: 1111

† To obtain information for 0-60A, access Data Sheet: 1017

Dimensional Data



Dimensions (inches)

Ampere Ratings	A	B
65-100	7.88 (± 0.062)	1.11 (± 0.020)
110-200	9.63 (± 0.062)	1.61 (± 0.020)
225-400	11.63 (± 0.094)	2.34 (± 0.020)
450-600	13.38 (± 0.094)	2.88 (± 0.020)

General Information:

- Provides motor overload, ground fault and short-circuit protection. When used in circuits subject to surge currents such as those caused by motors, transformers and other inductive components, these fuses can be sized close to full-load amperes to give maximum overcurrent protection.
- The time-delay feature makes it possible to use fuse ampere ratings which are much smaller than those of non-time-delay fuses. Considerable cost saving occurs by permitting the use of smaller size switches, panels and fuses themselves.
- Provides a good degree of short-circuit protection (greater current-limitation) to help protect downstream components from high fault currents.
- Gives motor running back-up protection to motors without extra costs.
- Helps protect motors against burnout from overloads and single phasing when sized properly.
- Simplifies and improves blackout prevention (selective coordination ratios).
- Dual-element fuses can be applied in circuits subject to temporary motor overloads and surge currents to provide both high-performance, short-circuit and overload protection.

Fuse Reducers For Class R Fuses

Equipment Fuse Clips	Desired Fuse (Case) Size	Catalog Number (Pairs) 600V
200A	100A	No. 2621-R
	100A	No. 2641-R
400A	200A	No. 642-R
	100A	No. 2661-R
600A	200A	No. 2662-R
	400A	No. 2664-R*

*Single reducer only (pair not required).

For additional information, see Data Sheet: 1118.

CE CE logo denotes compliance with European Union Low Voltage Directive (50-1000Vac, 75-1500Vdc). Refer to Data Sheet: 8002 or contact Bussmann Application Engineering at 636-527-1270 for more information.

Fusetron®

Dual-Element, Time-Delay Fuses

Class RK5 -- 600 Volt

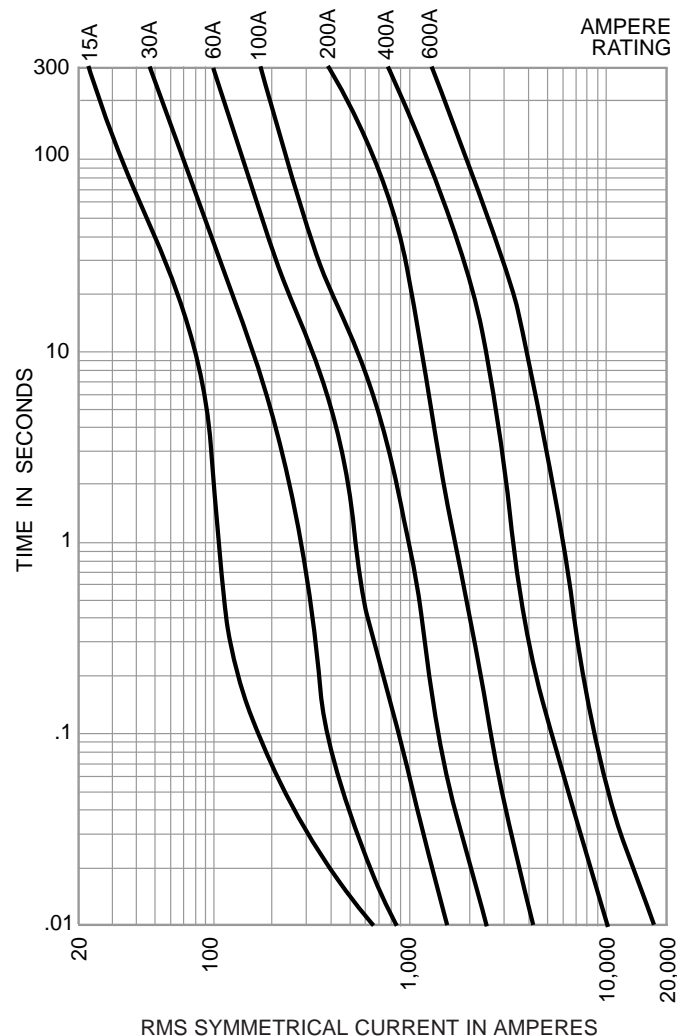
FRS-R
65-600A

Current-Limiting Effects

FRS-R Apparent RMS Symmetrical Let-Through Current						
Prospective SCC	30A	60A	100A	200A	400A	600A
5,000	1,400	2,000	2,900	3,950	5,000	5,000
10,000	1,850	2,650	3,600	5,100	8,550	10,000
15,000	2,200	3,200	4,100	5,950	9,750	13,700
20,000	2,450	3,550	4,500	6,600	10,700	15,000
25,000	2,700	3,900	4,850	7,150	11,500	16,100
30,000	2,900	4,280	5,150	7,650	12,200	17,050
35,000	3,100	4,400	5,400	8,100	12,800	17,900
40,000	3,300	4,760	5,600	8,500	13,400	18,700
50,000	3,550	5,150	6,050	9,250	14,400	20,050
60,000	3,800	5,500	6,400	9,850	15,250	21,250
80,000	4,300	6,100	7,000	10,950	16,750	23,300
100,000	4,500	6,600	7,550	11,900	18,000	25,000
150,000	5,200	8,000	8,600	13,800	20,550	28,450
200,000	5,800	8,500	9,400	15,350	22,550	31,200

For information on previous design FRS-R, 70-600, see Data Sheet: 1153.

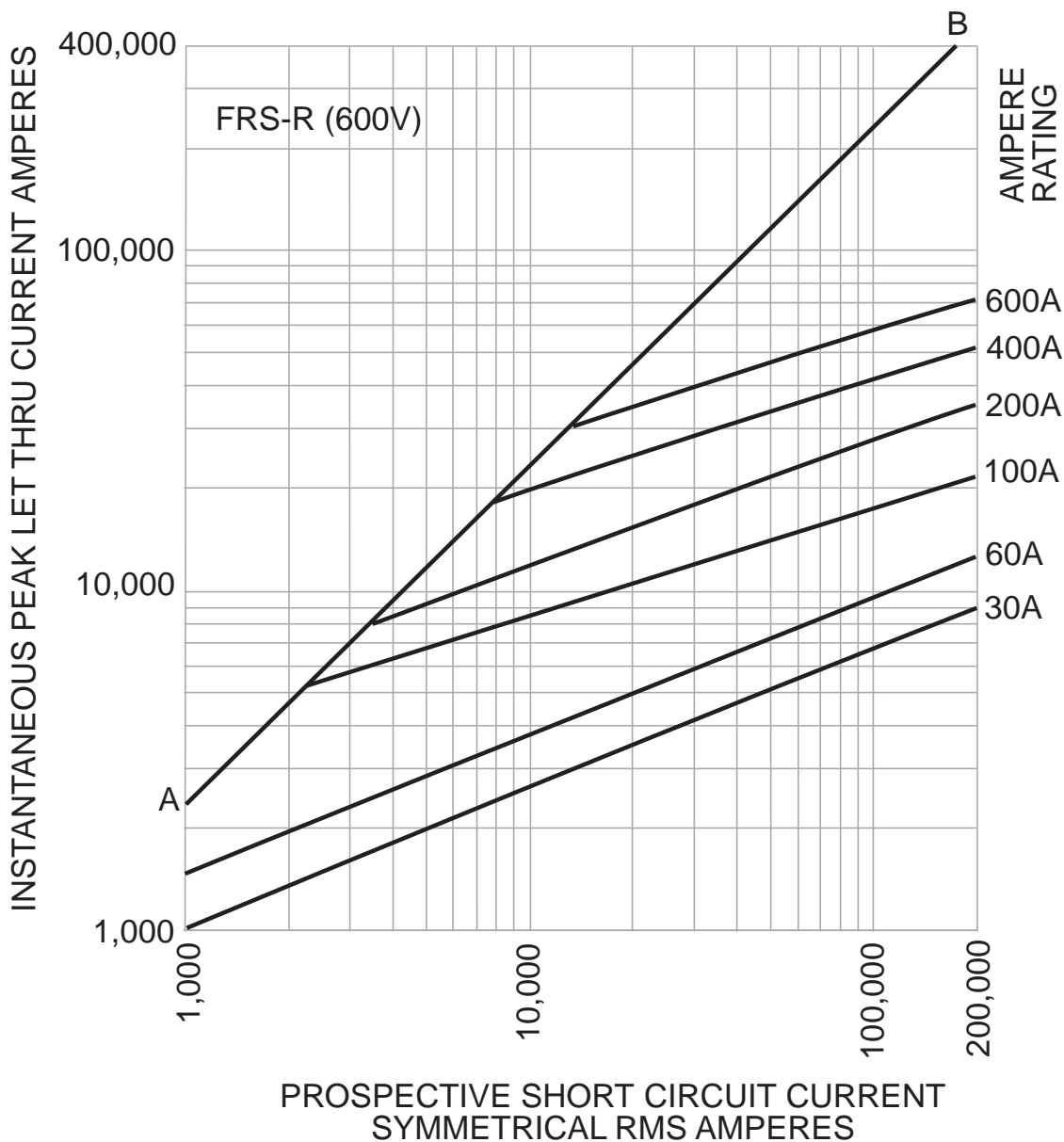
Time-Current Characteristic Curves-Average Melt



Fusetron®
 Dual-Element, Time-Delay Fuses
 Class RK5 — 600 Volt

FRS-R
 65-600A

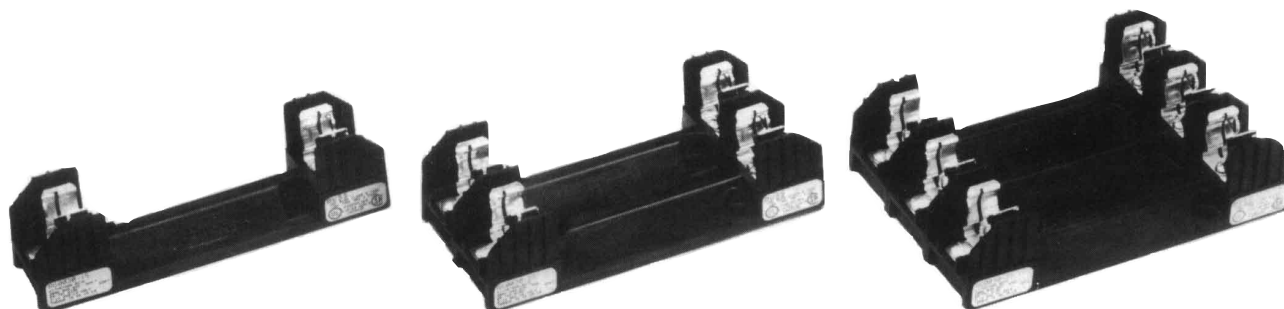
Current-Limitation Curves



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Class R Fuseblocks 600 Volts

R600 Series



Catalog Symbol: R600 Series

Ampere Rating: 1/10 to 600A

Voltage Rating: 600V

Agency Information:

UL Listed, UL 512, Guide IZLT, File E14853

CSA Certified, C22.2 No. 39, Class 6225-01, File 47235

Withstand Rating: 200,000A RMS Sym.

For use with Class R fuses (LPS-RK and FRS-R)

UL Flammability: 94VO

Materials: Thermoplastic

Class R Fuseblocks (600V) Catalog Data (for LRS-RK, FRS-R, DLS-R and KTS-R Fuses)

Amps	Poles	Basic Catalog Number	Terminal Type (Suffix No.)					Fig. No.	Dimensions (Inches)											Wire Range										
			Screw w/		Box Lug w/		0.25" Quick-Connect		A	B	C	D	E	F	G	H	J Dia. x C' Bore	K												
			—	Pres. Plate	—	Clip Cu Only																								
1/10 to 30	1	R60030-1	SR	PR	CR	COR	—	6.25	1.73	1.54	1.56	0.25	0.62	3.13	1.56	0.28 x 0.5	.26	COR #6-14 CU ONLY CR #2-14 CU, #2-12 AL PR, SR #10-18 CU ONLY												
	2	R60030-2	SR	PR	CR	COR	—			2.90																				
	3	R60030-3	SR	PR	CR	COR	—			4.25																				
31 to 60	1	R60060-1	—	—	CR	COR	—	(See Figures)											COR #2-14 CU ONLY CR #2-14 CU, #2-8 AL											
	2	R60060-2	—	—	CR	COR	—	(See Figures)																						
	3	R60060-3	—	—	CR	COR	—	(See Figures)																						
61 to 100	1	R60100-1	—	—	CR	COR	—	9.5	2.38	2.22	2.63	0.67	0.88	4.25	1.81	0.28 x 0.5	0.34	COR 1/0 -8 CU ONLY CR, CRO 1/0-8 CU/AL												
	2	R60100-2	—	—	CR	COR	—			4.03																				
	3	R60100-3	—	—	CR	COR	CRO†			5.84																				
101 to 200	1	R60200-1	—	—	CR	—	CRO†	10	9.63	3.09	3.0	3.31	0.5	2.0	3.0	0.75	—	0.31	CR, CRO 250kcmil-6 CU/AL											
	3	R60200-3	—	—	CR	—	—													(See Figures)										
	(See Figures)																													
201 to 400	1	R60400-1	—	—	CR‡	COR‡	—	10	12.0	4.0	3.0	4.5	0.63	1.75	3.0	1.0	—	0.56	COR 500kcmil-4/0 CU ONLY CR 500kcmil-4 CU/AL											
	3	R60400-3	—	—	CR†	—	—													(See Figures)										
	(See Figures)																													
401 to 600	1	R60600-1	—	—	CR	—	—	10	14.0	4.97	3.0	5.5	1.125	1.75	4.0	1.0	—	0.56	CR (2) 500kcmil-4/0 CU/AL											
	3	R60600-3	—	—	CR†	—	—													(See Figures)										
	(See Figures)																													

†No UL, No CSA Certification.

‡UL Recognized, CSA Certification

Dimensional Data: See pages 2 and 3.

CE CE logo denotes compliance with European Union Low Voltage Directive (50-1000Vac, 75-1500Vdc). Refer to Data Sheet: 8002 or contact Bussmann Application Engineering at 314-527-1270 for more information.

Class R Fuseblocks

600 Volts

R600 Series

Dimensional Data

600V, 1/10 to 30A

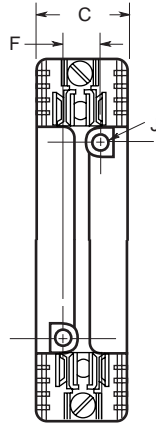
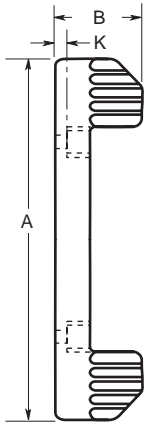


FIGURE 1.

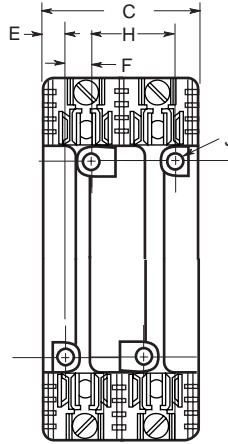


FIGURE 2.

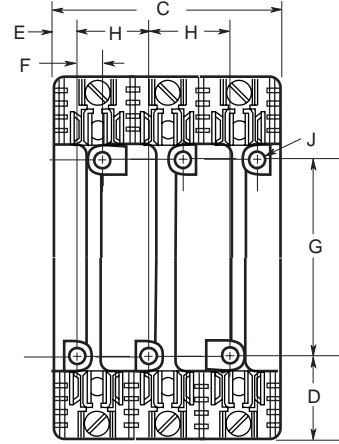


FIGURE 3.

600V, 31 to 60A

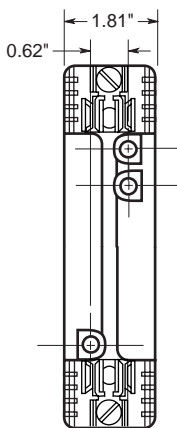
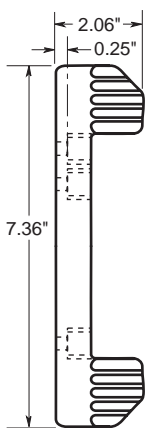


FIGURE 4.

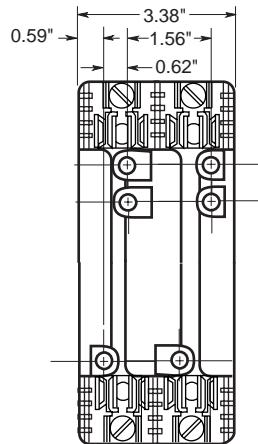


FIGURE 5.

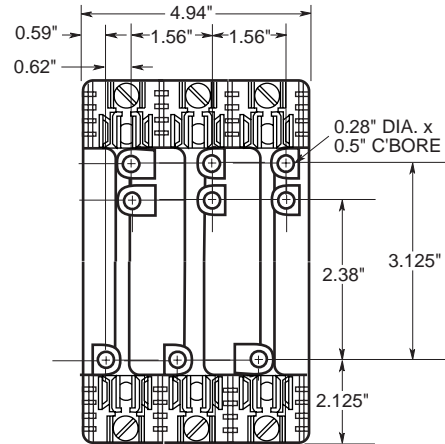


FIGURE 6.

600V, 61 to 100A

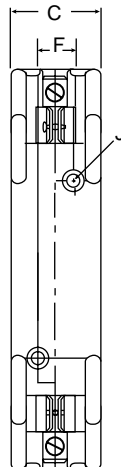
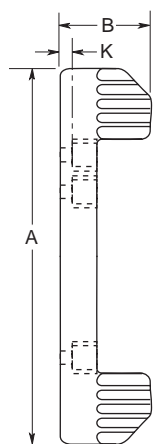


FIGURE 7.

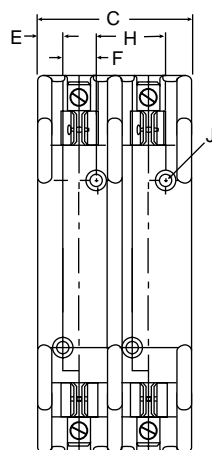


FIGURE 8.

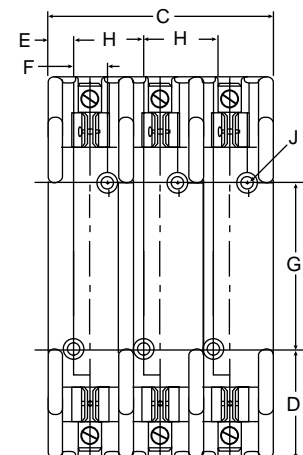


FIGURE 9.

Class R Fuseblocks

600 Volts

R600 Series

600V, 101 to 600A

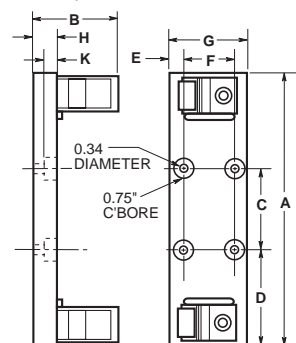


FIGURE 10.

600V, 101 to 200A

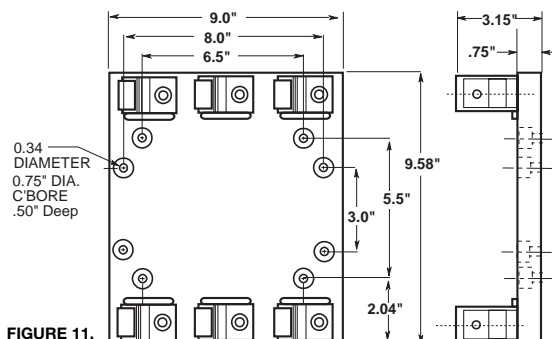


FIGURE 11.

600V, 201 to 400A

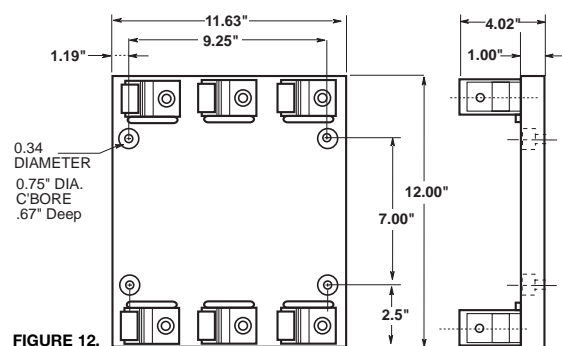


FIGURE 12.

600V, 401 to 600A

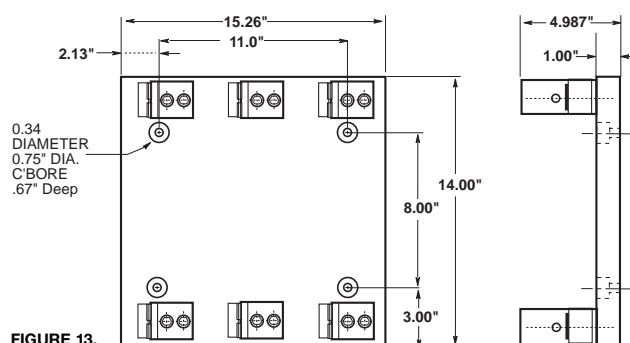


FIGURE 13.

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Series 50 Industrial Control Transformers

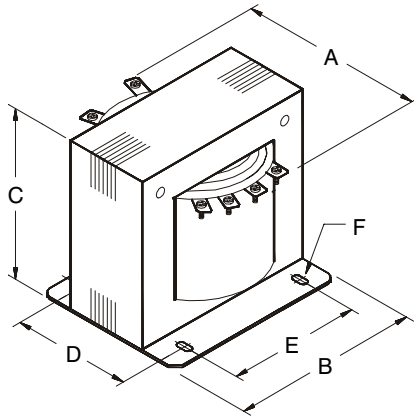
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Series 50 Industrial Control Transformers are designed to the highest NEMA and industrial standards. Series 50 offer compact designs for ease of installation in hundreds of control panel and automation applications.

All Series 50 transformers are UL approved and CSA certified.

Series 50 are available in both domestic and export voltage combinations. Other voltage, frequency and size requirements are readily manufactured by consulting the factory or your Dongan representative.

CE Marked, TÜV Licensed Industrial Control Transformers are featured on pgs. 82-83 in this section.



Domestic Series:

Features

- **UL Listed, File E3210.**
- **CSA Certified, File LR 560.**
- **All copper windings.**
- **All designs are rated 50 / 60 Hertz.**
- **Rugged coil mounted screw terminals.**
- **Primary fuse blocks and secondary fuse holders are available and are easily installed.**
- **Regulation characteristics equal or exceed the highest industry standards.**
- **Transformers .750 kVA and below employ a UL Class 105°C insulation system with 55°C temperature rise at a maximum ambient of 40°C.**
- **Transformers 1.0 kVA and above are designed with a UL Class 180°C insulation system with 115°C temperature rise at a maximum ambient of 40°C.**
- **Nonstandard designs are available by consulting the factory or your Dongan Representative.**

Voltage Combinations:

Suffix	Primary	Secondary
-052	120 x 240	24
-053	240 x 480	120
-054	208	120
-056	600	120
-134	240 x 480	120 / 240

SUFFIX -052, 50 / 60 HZ

Primary Volts 120 X 240, Secondary Volts 24

General Information			Dimensions (inches)						Primary		Secondary		
kVA Cap.	Catalog Number	Wgt. Lbs	Height A	Width B	Depth C	Mounting			Pri. Max. Amps 120V / 240V	Pri. Fuse Kit	Sec. Max. Amps	Sec. Fuse Kit	Sec. Fuse Size
						D	E	F					
.050	50-0050-052	3	3.00	3.00	2.50	2.00	2.50	.203 x .375	.42 / .21	BR-734-1	2.08	GLF 1¼	2.25
.075	50-0075-052	3	3.38	3.00	2.50	2.50	2.50	.203 x .375	.63 / .31	BR-734-1	3.13	GLF 1¼	3.2
.100	50-0100-052	4	3.38	3.38	2.81	2.38	2.81	.203 x .375	.83 / .42	BR-734-2	4.17	GLF 1¼	4.5
.150	50-0150-052	6	3.90	3.75	3.13	2.63	3.13	.203 x .375	1.25 / .63	BR-734-3	6.25	GLF 1¼	6.25
.200	50-0200-052	8	4.12	4.50	3.75	2.50	3.75	.203 x .375	1.67 / .83	BR-734-4	8.33	GLF 1¼	9
.250	50-0250-052	9	4.25	4.50	3.75	2.75	3.75	.203 x .375	2.08 / 1.04	BR-734-4	10.42	GLF 1¼	10
.300	50-0300-052	11	4.75	4.50	3.75	3.13	3.75	.203 x .375	2.50 / 1.25	BR-734-4	12.50	GLF 1¼	15
.375	50-0375-052	12	5.25	4.50	3.75	3.63	3.75	.203 x .375	3.13 / 1.56	BR-734-4	16.63	GLF 1¼	20
.500	50-0500-052	17	5.88	5.25	4.38	3.63	4.38	.281 x .562	4.17 / 2.08	BR-734-6	20.83	265 B	25
.750	50-0750-052	25	7.50	5.25	4.38	5.25	4.38	.281 x .562	6.25 / 3.13	BR-734-6	31.25	265 B	30
1.0	50-1000-052	26	7.50	5.25	4.38	5.25	4.38	.281 x .562	8.33 / 4.17	BR-734-6	41.67	--	--

Series 50 Industrial Control Transformers

Export Series:

Features

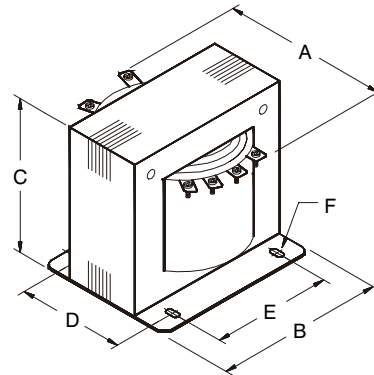
- **UL Listed, File E3210.**
- **CSA Certified, File LR 560.**
- All copper windings.
- All designs are rated 50 / 60 Hertz.
- Rugged coil mounted screw terminals.
- Primary fuse blocks and secondary fuse holders are available and are easily installed.
- Regulation characteristics equal or exceed the highest industry standards.
- Transformers .750 kVA and below employ a UL Class 105°C insulation system with 55°C temperature rise at a maximum ambient of 40°C.
- Transformers 1.0 kVA and above are designed with a UL Class 180°C insulation system with 115°C temperature rise at a maximum ambient of 40°C.
- Nonstandard designs are available by consulting the factory or your Dongan Representative.



Connection Diagrams may be found on Pg. 74

Note: Dimension C increases approximately 1 3/8" when Primary Fuse Kit BR-734-X is installed. Drawing is for dimensional purposes only. Actual terminal arrangements may vary.

Dimensions & weights may change. Consult factory for certified drawings.



Voltage Combinations:

Suffix	Primary	Secondary
-058	220/380/415	95/115
-059	208 or 500	85/100/110
	220/380/440/550	91/110/120
	230/400/460/575	95/115/125
	240/416/480/600	99/120/130

SUFFIX -053, 50 / 60 HZ

Primary Volts 240 X 480, 230 X 460, 220 X 440, Secondary Volts 120/115/110

General Information			Dimensions (inches)						Primary		Secondary		
kVA Cap.	Catalog Number	Wgt. Lbs	Height A	Width B	Depth C	Mounting			Pri. Max. Amps 240V / 480V	Pri. Fuse Kit	Sec. Max. Amps	Sec. Fuse Kit	120 V Fuse Size
						D	E	F					
.050	50-0050-053	3	3.00	3.00	2.50	2.00	2.50	.203 x .375	.21 / .10	BR-734-1	.42	GLF 1¼	.5
.075	50-0075-053	3	3.38	3.00	2.50	2.50	2.50	.203 x .375	.31 / .16	BR-734-1	.63	GLF 1¼	.6
.100	50-0100-053	4	3.38	3.38	2.81	2.38	2.81	.203 x .375	.42 / .21	BR-734-2	.83	GLF 1¼	1
.150	50-0150-053	6	3.90	3.75	3.13	2.63	3.13	.203 x .375	.63 / .31	BR-734-3	1.25	GLF 1¼	1.25
.200	50-0200-053	8	4.12	4.50	3.75	2.50	3.75	.203 x .375	.83 / .42	BR-734-4	1.67	GLF 1¼	2
.250	50-0250-053	9	4.25	4.50	3.75	2.75	3.75	.203 x .375	1.04 / .52	BR-734-4	2.08	GLF 1¼	2.25
.300	50-0300-053	11	4.75	4.50	3.75	3.13	3.75	.203 x .375	1.25 / .63	BR-734-4	2.50	GLF 1¼	2.5
.375	50-0375-053	12	5.25	4.50	3.75	3.63	3.75	.203 x .375	1.56 / .78	BR-734-4	3.13	GLF 1¼	3.2
.500	50-0500-053	17	5.88	5.25	4.38	3.63	4.38	.281 x .562	2.08 / 1.04	BR-734-6	4.17	265 B	4.5
.750	50-0750-053	25	7.50	5.25	4.38	5.25	4.38	.281 x .562	3.13 / 1.56	BR-734-6	6.25	265 B	6.25
1.0	50-1000-053	26	7.50	5.25	4.38	5.25	4.38	.281 x .562	4.17 / 2.08	BR-734-6	8.33	265 B	9
1.5	50-1500-053	32	7.00	6.38	5.62	4.50	5.31	.312 x .625	6.25 / 3.13	BR-734-7	12.50	265 B	15
2.0	50-2000-053	38	7.62	6.38	5.62	5.00	5.31	.312 x .625	6.25 / 3.13	BR-734-7	16.67	265 B	20
3.0	50-3000-053	50	7.75	7.50	6.62	4.75	6.75	.312 x .625	12.50 / 6.25	BR-734-8	25.00	265 B	25
5.0	50-5000-053	70	10.25	7.50	6.62	6.88	6.75	.312 x .625	20.83 / 10.42	BR-734-8	41.67	--	--

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SUFFIX -054, 50 / 60 HZ

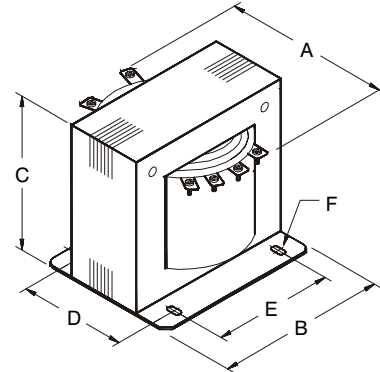
Primary Volts 208, Secondary Volts 120

General Information			Dimensions (inches)						Primary		Secondary		
kVA Cap.	Catalog Number	Wgt. Lbs	Height A	Width B	Depth C	Mounting			Pri. Max. Amps 208V	Pri. Fuse Kit	Sec. Max. Amps	Sec. Fuse Kit	Sec. Fuse Size
						D	E	F					
.050	50-0050-054	3	3.00	3.00	2.50	2.00	2.50	.203 x .375	.24	BR-734-1	.42	GLF 1¼	.4
.075	50-0075-054	3	3.38	3.00	2.50	2.50	2.50	.203 x .375	.36	BR-734-1	.63	GLF 1¼	.6
.100	50-0100-054	4	3.38	3.38	2.81	2.38	2.81	.203 x .375	.48	BR-734-2	.83	GLF 1¼	1
.150	50-0150-054	6	3.90	3.75	3.13	2.63	3.13	.203 x .375	.72	BR-734-3	1.25	GLF 1¼	1.25
.200	50-0200-054	8	4.12	4.50	3.75	2.50	3.75	.203 x .375	.96	BR-734-4	1.67	GLF 1¼	2
.250	50-0250-054	9	4.25	4.50	3.75	2.75	3.75	.203 x .375	1.20	BR-734-4	2.08	GLF 1¼	2.25
.300	50-0300-054	11	4.75	4.50	3.75	3.13	3.75	.203 x .375	1.44	BR-734-4	2.50	GLF 1¼	2.5
.375	50-0375-054	12	5.25	4.50	3.75	3.63	3.75	.203 x .375	1.80	BR-734-4	3.13	GLF 1¼	3.2
.500	50-0500-054	17	5.88	5.25	4.38	3.63	4.38	.281 x .562	2.40	BR-734-6	4.17	265 B	4.5
.750	50-0750-054	25	7.50	5.25	4.38	5.25	4.38	.281 x .562	3.61	BR-734-6	6.25	265 B	6.25
1.0	50-1000-054	26	7.50	5.25	4.38	5.25	4.38	.281 x .562	4.81	BR-734-6	8.33	265 B	9
1.5	50-1500-054	32	7.00	6.38	5.62	4.50	5.31	.312 x .625	7.21	BR-734-7	12.50	265 B	15
2.0	50-2000-054	38	7.62	6.38	5.62	5.00	5.31	.312 x .625	9.62	BR-734-7	16.67	265 B	20
3.0	50-3000-054	50	7.75	7.50	6.62	4.75	6.75	.312 x .625	14.42	BR-734-8	25.00	265 B	25

Connection Diagrams may be found on Pg. 74

Note: Dimension C increases approximately 1 3/8" when Primary Fuse Kit BR-734-X is installed. Drawing is for dimensional purposes only. Actual terminal arrangements may vary.

Dimensions & weights may change. Consult factory for certified drawings.



SUFFIX -056, 50 / 60 HZ

Primary Volts 600/575/550, Secondary Volts 120/115/110

General Information			Dimensions (inches)						Primary		Secondary		
kVA Cap.	Catalog Number	Wgt. Lbs	Height A	Width B	Depth C	Mounting			Pri. Max. Amps 600V	Pri. Fuse Kit	Sec. Max. Amps	Sec. Fuse Kit	120 V Fuse Size
						D	E	F					
.050	50-0050-056	3	3.00	3.00	2.50	2.00	2.50	.203 x .375	.08	BR-734-1	.42	GLF 1¼	.4
.075	50-0075-056	3	3.38	3.00	2.50	2.50	2.50	.203 x .375	.13	BR-734-1	.63	GLF 1¼	.6
.100	50-0100-056	4	3.38	3.38	2.81	2.38	2.81	.203 x .375	.17	BR-734-2	.83	GLF 1¼	1
.150	50-0150-056	6	3.90	3.75	3.13	2.63	3.13	.203 x .375	.25	BR-734-3	1.25	GLF 1¼	1.25
.200	50-0200-056	8	4.12	4.50	3.75	2.50	3.75	.203 x .375	.33	BR-734-4	1.67	GLF 1¼	2
.250	50-0250-056	9	4.25	4.50	3.75	2.75	3.75	.203 x .375	.42	BR-734-4	2.08	GLF 1¼	2.25
.300	50-0300-056	11	4.75	4.50	3.75	3.13	3.75	.203 x .375	.50	BR-734-4	2.50	GLF 1¼	2.5
.375	50-0375-056	12	5.25	4.50	3.75	3.63	3.75	.203 x .375	.63	BR-734-4	3.13	GLF 1¼	3.2
.500	50-0500-056	17	5.88	5.25	4.38	3.63	4.38	.281 x .562	.83	BR-734-6	4.17	265 B	4.5
.750	50-0750-056	25	7.50	5.25	4.38	5.25	4.38	.281 x .562	1.25	BR-734-6	6.25	265 B	6.25
1.0	50-1000-056	26	7.50	5.25	4.38	5.25	4.38	.281 x .562	1.67	BR-734-6	8.33	265 B	9
1.5	50-1500-056	32	7.00	6.38	5.62	4.50	5.31	.312 x .625	2.50	BR-734-7	12.50	265 B	15
2.0	50-2000-056	38	7.62	6.38	5.62	5.00	5.31	.312 x .625	3.33	BR-734-7	16.67	265 B	20
3.0	50-3000-056	50	7.75	7.50	6.62	4.75	6.75	.312 x .625	5.00	BR-734-8	25.00	265 B	25



Series 50 Industrial Control Transformers

SUFFIX -058, 50 / 60 HZ

Primary Volts 220 / 380 / 415, Secondary Volts 95 / 115

General Information			Dimensions (inches)						Primary		Secondary		
kVA Cap.	Catalog Number	Wgt. Lbs	Height A	Width B	Depth C	Mounting			Pri. Max. Amps 220V / 380V / 415	Pri. Fuse Kit	Sec. Max. Amps	Sec. Fuse Kit	115 V Fuse Size
						D	E	F					
.250	50-0250-058	11	4.81	4.50	3.75	3.38	3.75	.203 x .375	1.14 / .66 / .60	BR-734-4	2.17	GLF 1¼	2.25
.500	50-0500-058	22	6.63	5.25	4.38	4.60	4.38	.281 x .406	2.27 / 1.32 / 1.20	BR-734-6	4.35	265 B	4.5
.750	50-0750-058	23	7.38	5.75	4.25	4.38	4.94	.281 x .406	3.41 / 1.97 / 1.81	BR-734-5	6.52	265 B	7
1.0	50-1000-058	32	6.75	6.38	5.31	4.50	5.31	.312 x .625	4.55 / 2.63 / 2.41	BR-734-7	8.70	265 B	9
1.5	50-1500-058	41	6.25	7.50	6.25	4.00	6.75	.312 x .625	6.82 / 3.95 / 3.61	BR-734-8	13.04	265 B	15
2.0	50-2000-058	49	7.80	7.50	6.25	4.75	6.75	.312 x .625	9.09 / 5.26 / 4.82	BR-734-8	17.39	265 B	20
3.0	50-3000-058	75	9.88	7.50	6.25	4.62	6.75	.312 x .625	13.64 / 7.89 / 7.23	BR-734-8	26.09	265 B	30
5.0	50-5000-058	113	9.12	9.00	7.50	6.93	7.50	.437 x .750	22.73 / 13.16 / 12.05	BR-734-9	43.48	--	--

SUFFIX -059, 50 / 60 HZ

Primary Volts 208/500
220/380/440/550
230/400/460/575
240/416/480/600

Secondary Volts 85/100/110
91/110/120
95/115/125
99/120/130

General Information			Dimensions (inches)						Primary	Secondary		
kVA Cap.	Catalog Number	Wgt. Lbs	Height A	Width B	Depth C	Mounting			Pri. Fuse Kit	Sec. Max. Amps	Sec. Fuse Kit	120 V Fuse Size
						D	E	F				
.150	50-0150-059	11	4.57	5.25	4.38	2.63	4.38	.281 x .406	BR-734-6	1.25	265 B	1.25
.250	50-0250-059	15	5.25	5.25	4.38	3.38	4.38	.281 x .406	BR-734-6	2.08	265 B	2.25
.375	50-0375-059	18	6.25	5.75	4.25	3.44	4.94	.281 x .406	BR-734-5	3.13	265 B	3.2
.500	50-0500-059	22	6.68	5.75	4.25	4.38	4.94	.281 x .406	BR-734-5	4.17	265 B	4.5
.750	50-0750-059	32	6.75	6.38	5.31	4.63	5.31	.312 x .625	BR-734-7	6.25	265 B	6.25
1.0	50-1000-059	35	7.25	6.38	5.31	5.10	5.31	.312 x .625	BR-734-7	8.33	265 B	9
1.5	50-1500-059	53	8.63	7.50	6.25	5.38	6.75	.312 x .625	BR-734-8	12.5	265 B	15
2.0	50-2000-059	60	8.75	7.50	6.25	5.80	6.75	.312 x .625	BR-734-8	16.67	265 B	20
3.0	50-3000-059	74	10.25	7.50	6.25	6.88	6.75	.312 x .625	BR-734-8	25.00	265 B	25

SUFFIX -134, 50 / 60 HZ

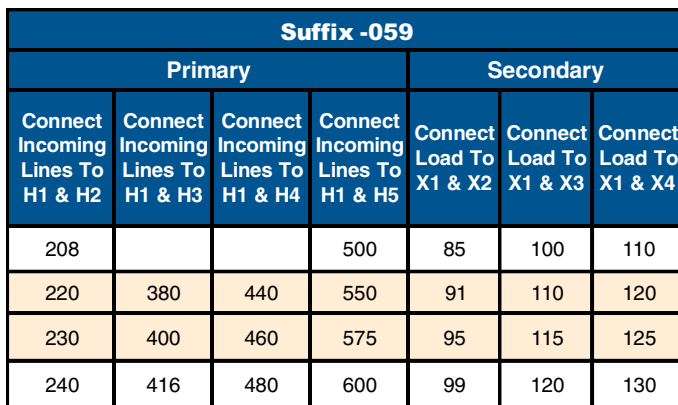
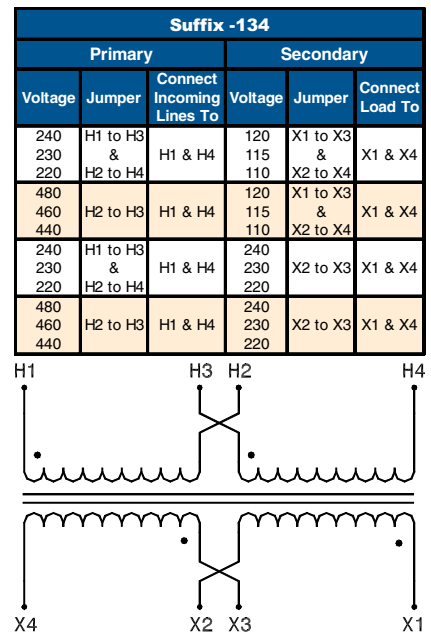
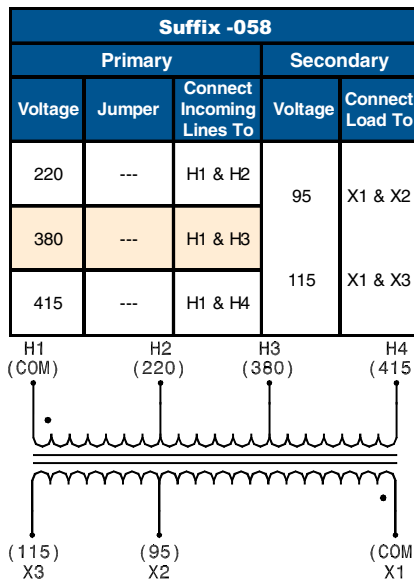
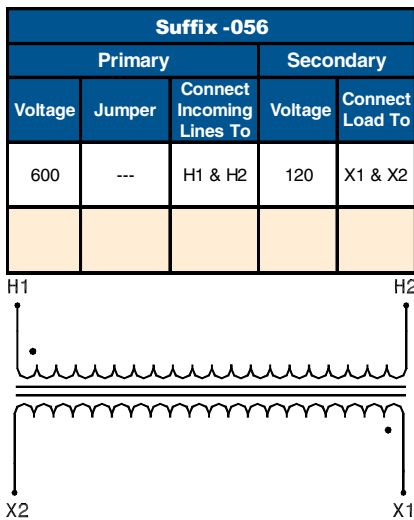
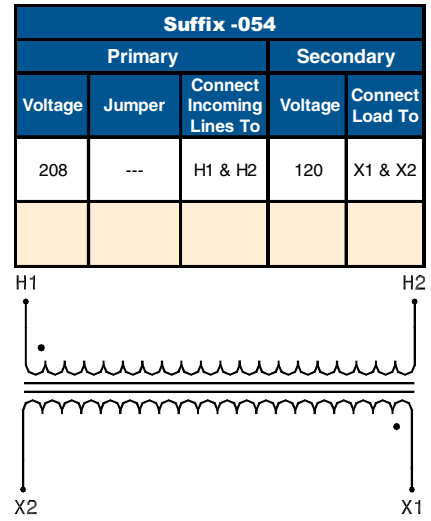
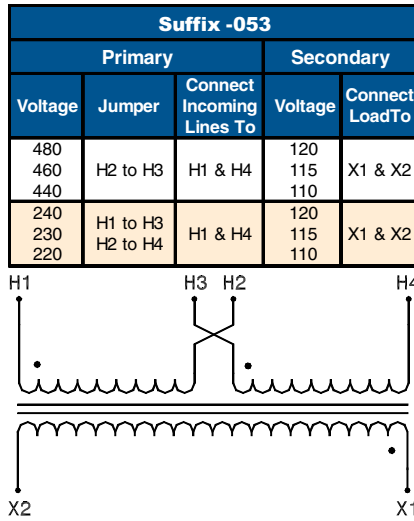
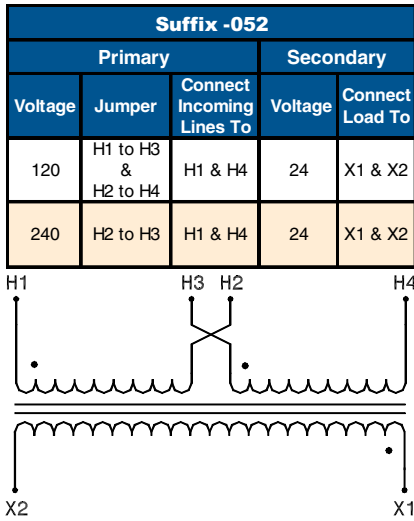
Primary Volts 240 X 480, 230 X 460, 220 X 440,
Secondary Volts 120/240,115/230,110/220

General Information			Dimensions (inches)						Primary		Secondary		
kVA Cap.	Catalog Number	Wgt. Lbs	Height A	Width B	Depth C	Mounting			Pri. Max. Amps 240V / 480V	Pri. Fuse Kit	Sec. Max. Amps 120V / 240V	Sec. Fuse Kit	120 V Fuse Size
						D	E	F					
.050	50-0050-134	3	3.00	3.00	2.50	2.00	2.50	.203 x .375	.21 / .10	BR-734-1	.42 / .21	GLF 1¼	.5
.075	50-0075-134	3	3.38	3.00	2.50	2.50	2.50	.203 x .375	.31 / .16	BR-734-1	.63 / .31	GLF 1¼	.6
.100	50-0100-134	4	3.38	3.38	2.81	2.38	2.81	.203 x .375	.42 / .21	BR-734-2	.83 / .42	GLF 1¼	1
.150	50-0150-134	6	3.90	3.75	3.13	2.63	3.13	.203 x .375	.63 / .31	BR-734-3	1.25 / .63	GLF 1¼	1.25
.200	50-0200-134	8	4.12	4.50	3.75	2.50	3.75	.203 x .375	.83 / .42	BR-734-4	1.67 / .83	GLF 1¼	2
.250	50-0250-134	9	4.25	4.50	3.75	2.75	3.75	.203 x .375	1.04 / .52	BR-734-4	2.08 / 1.04	GLF 1¼	2.25
.300	50-0300-134	11	4.75	4.50	3.75	3.13	3.75	.203 x .375	1.25 / .63	BR-734-4	2.50 / 1.25	GLF 1¼	2.5
.375	50-0375-134	12	5.25	4.50	3.75	3.63	3.75	.203 x .375	1.56 / .78	BR-734-4	3.13 / 1.56	GLF 1¼	3.2
.500	50-0500-134	17	5.88	5.25	4.38	3.63	4.38	.281 x .562	2.08 / 1.04	BR-734-6	4.17 / 2.08	265 B	4.5
.750	50-0750-134	25	7.50	5.25	4.38	5.25	4.38	.281 x .562	3.13 / 1.56	BR-734-6	6.25 / 3.13	265 B	6.25
1.0	50-1000-134	26	7.50	5.25	4.38	5.25	4.38	.281 x .562	4.17 / 2.08	BR-734-6	8.33 / 4.17	265 B	9
1.5	50-1500-134	32	7.00	6.38	5.62	4.50	5.31	.312 x .625	6.25 / 3.13	BR-734-7	12.50 / 6.25	265 B	15
2.0	50-2000-134	38	7.62	6.38	5.62	5.00	5.31	.312 x .625	6.25 / 3.13	BR-734-7	16.67 / 8.33	265 B	20
3.0	50-3000-134	50	7.75	7.50	6.62	4.75	6.75	.312 x .625	12.50 / 6.25	BR-734-8	25.00 / 12.50	265 B	25

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Series 50 Industrial Control Transformers Connection Diagrams

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Series 50 Industrial Control Transformers

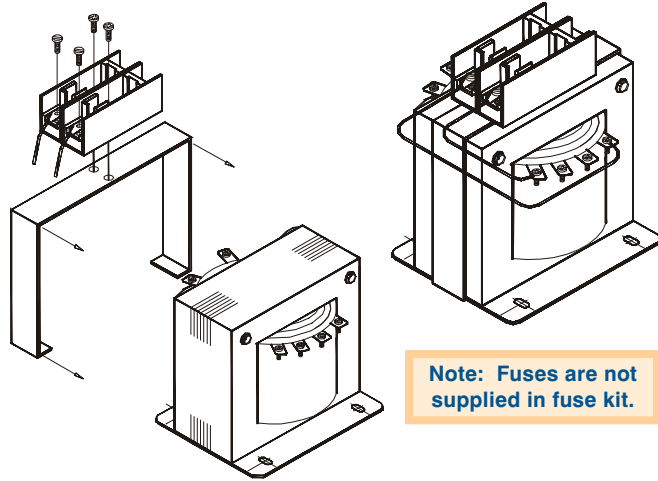
SERIES 50 PRIMARY FUSE KIT

Fuse Kit BR-734

- Meets UL 508
- Meets NEC Article 450
- Uses Class CC Fuses

Installation Procedure

- Loosen bolts holding transformer to the panel backplate.
- Slide the BR-734 bracket over the transformer.
- Retighten mounting bolts.
- Connect the fuse holder leads to the transformer terminals with the jumper leads furnished.



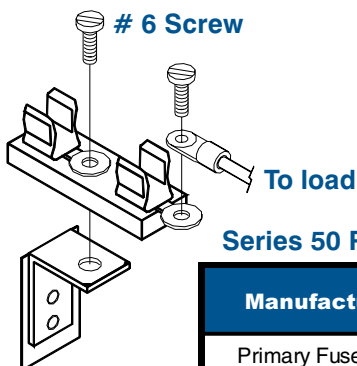
SERIES 50 SECONDARY FUSE KITS

Fuse Kit GLF 1¼

- Meets UL 508
- Meets NEC Article 450
- Uses ¼" x 1¼" Fuses

Installation Procedure

- Remove #6 screw in the transformer terminal to be fused.
- Fasten GLF 1¼ fuse holder to transformer terminal with the longer #6 screw provided, as shown in the diagram.
- Connect the load lead to the terminal provided on the GLF 1¼ fuse holder.

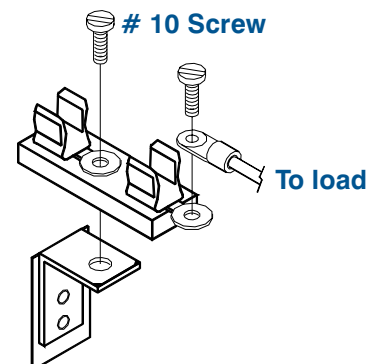


Fuse Kit 265B

- Meets UL 508
- Meets NEC Article 450
- Uses 13/32" x 1½" Fuses

Installation Procedure

- Remove #10 screw in the transformer terminal to be fused.
- Fasten 265B fuse holder to transformer terminal with the longer #10 screw provided, as shown in the diagram.
- Connect the load lead to the terminal provided on the 265B fuse holder.

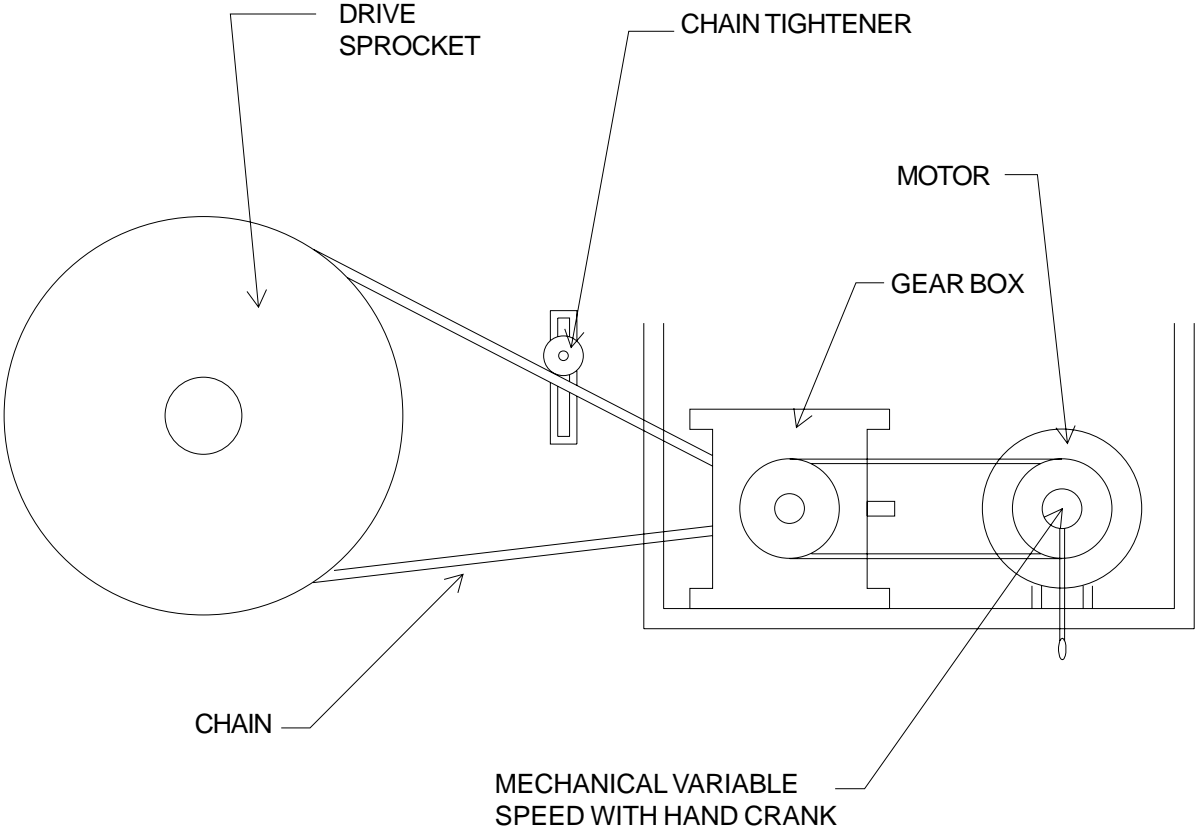


Series 50 Recommended Fuse Type By Manufacturer

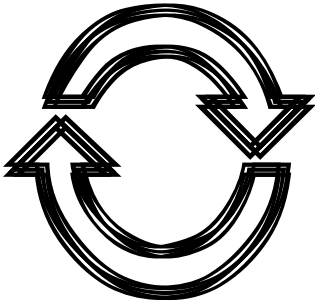
Manufacturer	Bussman	Gould	Littlefuse
Primary Fuse Type	FNQ-R	ATQR / ATDR	KLDR / CCRM
Secondary Fuse Type Fuse Holder 265-B	FNM / FNQ (250V) (500V)	TRM / ATQ (250V) (500V)	FLM / FLQ (250V) (500V)
Secondary Fuse Type Fuse Holder GLF-1¼	MDQ (250V)	GDL (250V)	3AB (250V)

Drive Plate & Chain Tightener

Frame 431 lower and Explosion proof drives



Adjust chain tightener to keep tension on chain



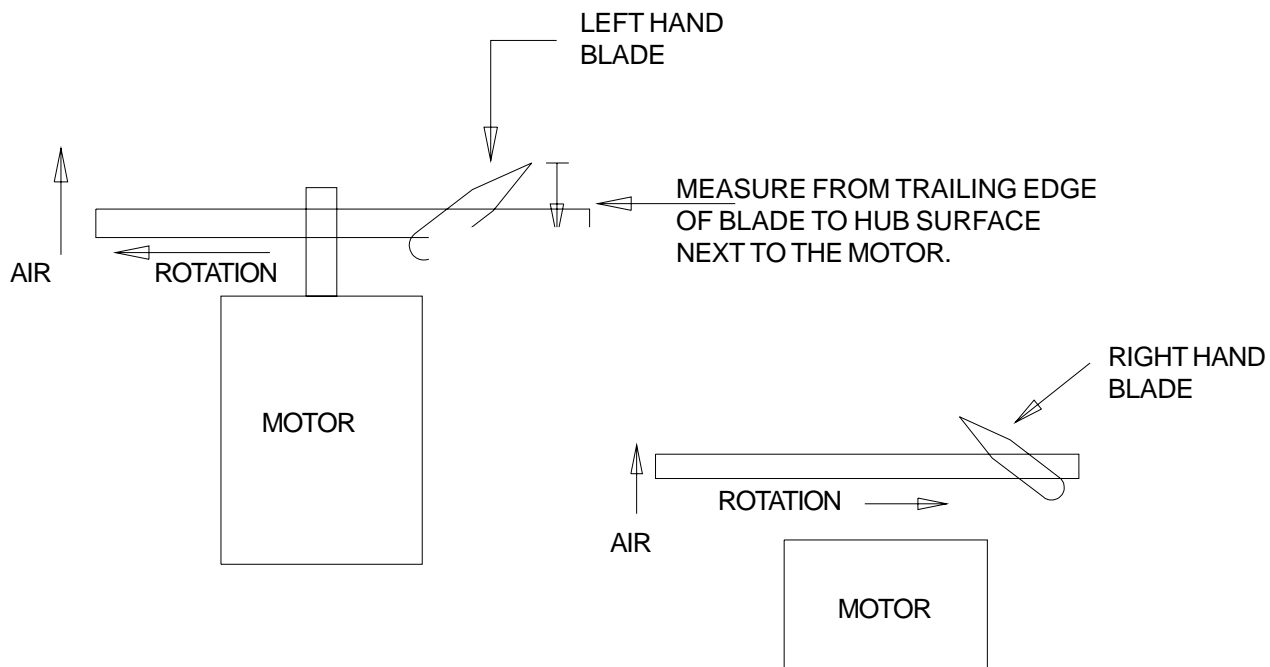
Rotation of hand crank (more speed)

Setting the Fan Blade Pitch

38" Fan Blade Setting with Steel Hub (Add 3/16" for Aluminum Hub)

30HP	3"
25HP	2-7/8"
20HP	2-3/4"
15HP	2-5/8"
10HP	2-1/2"

CAUTION: Settings can vary under different conditions. Always check motor amp. draw.



1. Get correct blade next to air straightener CCR looking from motor.
2. Set blades before installing in housing. Set a bolt or something as a caliper.
3. Always check amp draw on motors after changing the blades.

Installation of and Use of Special Fan Blade Washers

(Note: Torque 3/4" Fan Bolts to 135 FT/LBS)

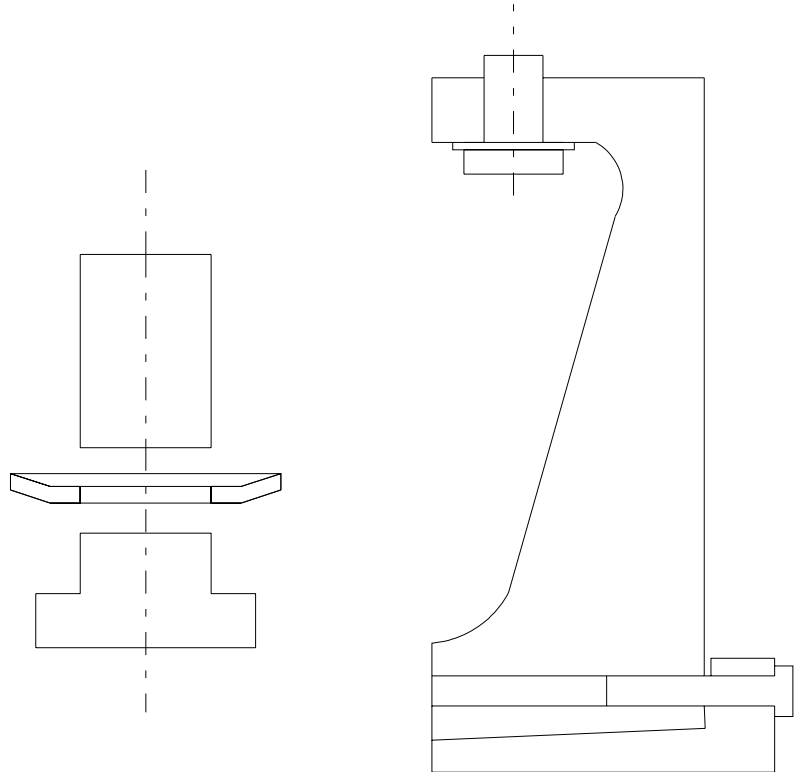
Bolts are to be lubricated with SAE 30 non-detergent motor oil.

THIS INFORMATION APPLIES
TO: 12" & 16" DIAM HUBS

Typical special washer, slightly deformed not tumbled.

Place on bolt with outside burr/deflection away from the head of bolt.

Thus providing extra cushion, tension and locking action.

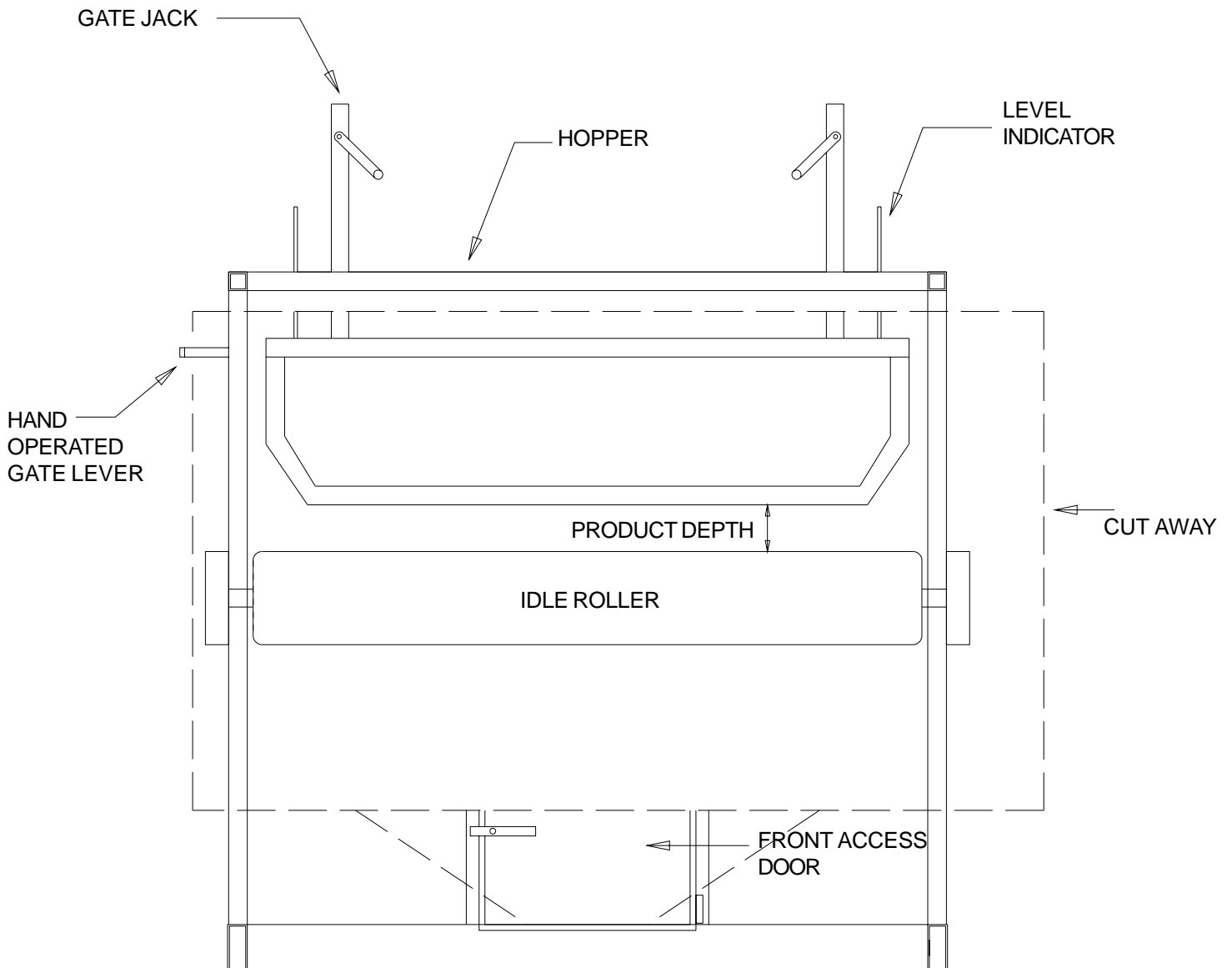


When installing the fan use 30 motor oil on the outside of the browning bushing and on the inside of the fan hub.

Lubricate the bolts, draw up the bolts evenly; after reasonable tension use hammer to tap on bushing and then redraw the bolts thus assuring a good set on the shaft.

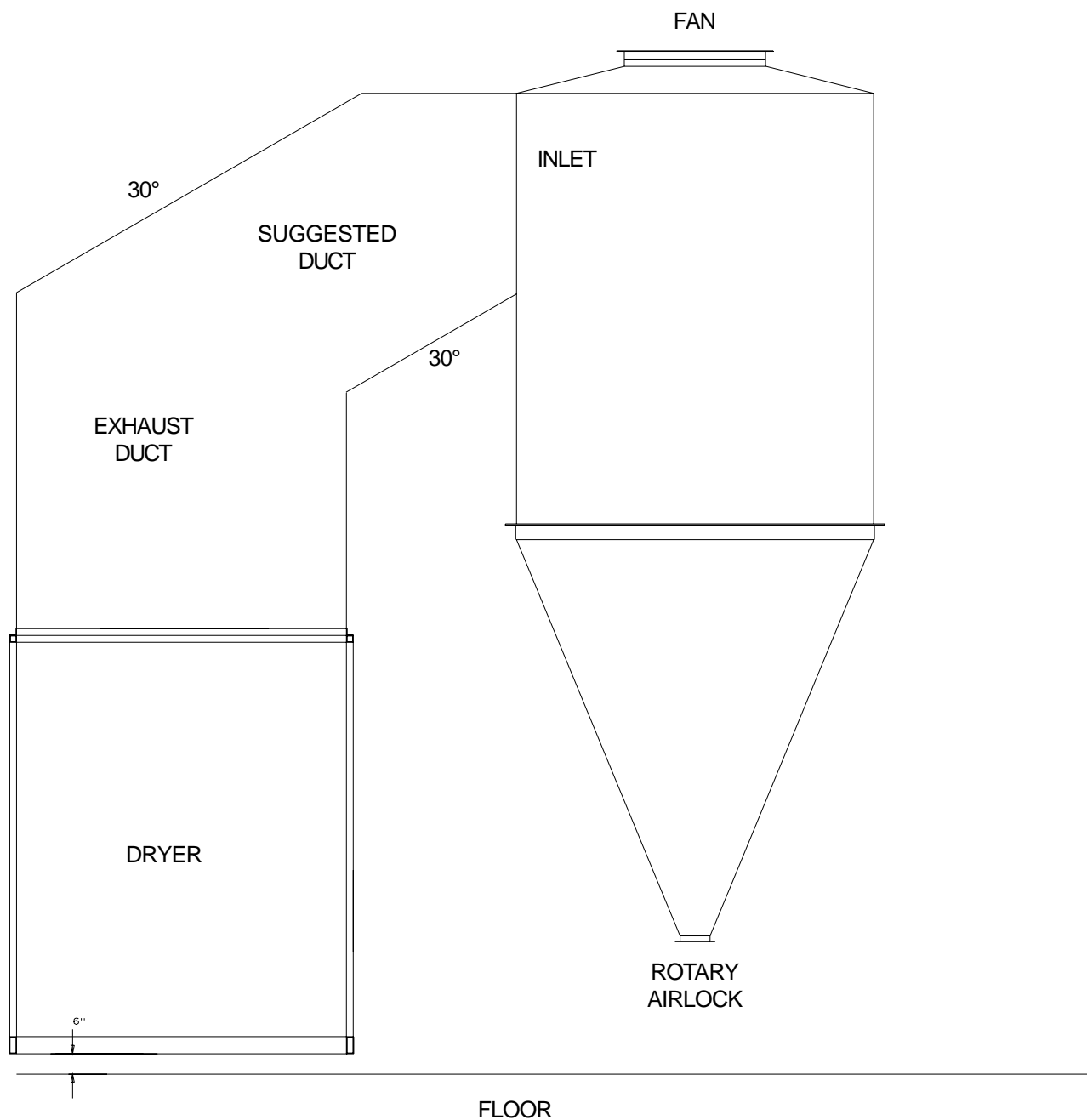
In disassembly after putting tension on bolts in removal position again use hammer and tap to loosen taper bushing from shaft.

Leveling Gate Adjustment for Product Depth



Dotted line indicates a cut away section.
Either the top jacks or the hand operated lever are used.
The hand operated level is used in smaller units.

Air Duct to Cyclone Transition Drawing



Drawing shows the suggested transition from dryer or cooler to cyclone. The dimension will be different with different size cyclones. The two fans that sit on top are counter rotating. Looking from the motor side the top one is L.H. (counter clockwise) and the bottom one next to the cyclone is R.H.. (clockwise) See pages J-1 and J-2a in the manual about blade adjustment. Always check rotation of fans and amp draw of the motors. An overloaded motor will burn up.

FOOT PER MINUTE WEB TRAVEL CHART

OVERALL REDUCTION RATIO

	250	500	600	750	1000	1250	1500	1800	2000	2250	2500	3000	3200	3750	4000	5000	6250
60HZ	20.60	10.30	8.40	6.88	5.16	4.12	3.44	2.86	2.58	2.29	2.06	1.72	1.61	1.37	1.29	1.04	0.82
57HZ	19.57	9.79	7.98	6.54	4.90	3.91	3.27	2.72	2.45	2.18	1.96	1.63	1.53	1.30	1.23	0.99	0.78
54HZ	18.54	9.27	7.56	6.19	4.64	3.71	3.10	2.57	2.32	2.06	1.85	1.55	1.45	1.23	1.16	0.94	0.74
51HZ	17.51	8.76	7.14	5.85	4.39	3.50	2.92	2.43	2.19	1.95	1.75	1.46	1.37	1.16	1.10	0.88	0.70
48HZ	16.48	8.24	6.72	5.50	4.13	3.30	2.75	2.29	2.06	1.83	1.65	1.38	1.29	1.10	1.03	0.83	0.66
45HZ	15.45	7.73	6.30	5.16	3.87	3.09	2.58	2.15	1.94	1.72	1.55	1.29	1.21	1.03	0.97	0.78	0.62
42HZ	14.42	7.21	5.88	4.82	3.61	2.88	2.41	2.00	1.81	1.60	1.44	1.20	1.13	0.96	0.90	0.73	0.57
39HZ	13.39	6.70	5.46	4.47	3.35	2.68	2.24	1.86	1.68	1.49	1.34	1.12	1.05	0.89	0.84	0.68	0.53
36HZ	12.36	6.18	5.04	4.13	3.10	2.47	2.06	1.72	1.55	1.37	1.24	1.03	0.97	0.82	0.77	0.62	0.49
33HZ	11.33	5.67	4.62	3.78	2.84	2.27	1.89	1.57	1.42	1.26	1.13	0.95	0.89	0.75	0.71	0.57	0.45
30HZ	10.30	5.15	4.20	3.44	2.58	2.06	1.72	1.43	1.29	1.15	1.03	0.86	0.81	0.69	0.65	0.52	0.41
27HZ	9.27	4.64	3.78	3.10	2.32	1.85	1.55	1.29	1.16	1.03	0.93	0.77	0.72	0.62	0.58	0.47	0.37
24HZ	8.24	4.12	3.36	2.75	2.06	1.65	1.38	1.14	1.03	0.92	0.82	0.69	0.64	0.55	0.52	0.42	0.33
21HZ	7.21	3.61	2.94	2.41	1.81	1.44	1.20	1.00	0.90	0.80	0.72	0.60	0.56	0.48	0.45	0.36	0.29
18HZ	6.18	3.09	2.52	2.06	1.55	1.24	1.03	0.86	0.77	0.69	0.62	0.52	0.48	0.41	0.39	0.31	0.25
15HZ	5.15	2.58	2.10	1.72	1.29	1.03	0.86	0.72	0.65	0.57	0.52	0.43	0.40	0.34	0.32	0.26	0.21
12HZ	4.12	2.06	1.68	1.38	1.03	0.82	0.69	0.57	0.52	0.46	0.41	0.34	0.32	0.27	0.26	0.21	0.16
9HZ	3.09	1.55	1.26	1.03	0.77	0.62	0.52	0.43	0.39	0.34	0.31	0.26	0.24	0.21	0.19	0.16	0.12
6HZ	2.06	1.03	0.84	0.69	0.52	0.41	0.34	0.29	0.26	0.23	0.21	0.17	0.16	0.14	0.13	0.10	0.08

MOTOR SELECTION

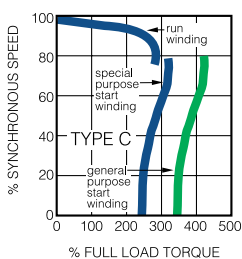
Electric motors are the workhorses of industry. Many applications exist where more than one motor can be used and/or the exact replacement is not available. LEESON makes every effort to maximize interchangeability, mechanically and electrically, where compromise does not interfere with reliability and safety standards. If you are not certain of a replacement condition, contact any LEESON Authorized Distributor or the LEESON District Sales Office.

SELECTION

Identifying a motor for replacement purposes or specifying a motor for new applications can be done easily if the following information is known:

1. Nameplate Data
2. Motor Type
3. Electrical and Performance Characteristics
4. Mechanical Construction

TYPICAL SPEED TORQUE CURVES



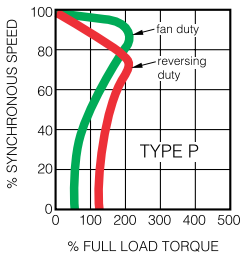
Capacitor Start/Induction Run

A single phase general purpose design, with an electrolytic capacitor in series with the start winding, offering maximum starting torque per ampere.

A centrifugal switch removes the auxiliary winding and capacitor when the motor approaches full load speed. The design is a heavy-duty unit which has approximately 300% (of full load) starting torque. Common applications include compressors, pumps, conveyors and other "hard-to-start" applications.

Capacitor Start/Capacitor Run

This design has two capacitors of different values. A centrifugal switch is used to remove the electrolytic capacitor when the motor approaches full load speed. A second run capacitor remains in series with the auxiliary winding during full load operation. This type of design has lower full-load amps as a result of the run capacitor and is consequently used on most higher horsepower single phase motors.



Permanent Split Capacitor (PSC)

This design has an auxiliary winding with a "run" capacitor, but unlike the capacitor start/induction run motor, the capacitor and auxiliary winding remain in the circuit under running conditions. (There is no centrifugal switch on this type motor.) A permanent split capacitor design has low starting torque and low starting current. They are generally used on direct-drive fans and blowers. They can also be designed for higher starting torque and intermittent applications, where rapid reversing is desired.

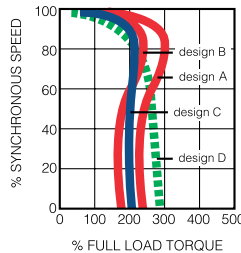
NAMEPLATE DATA

Nameplate data is the most important first step in determining motor replacement. Much of the information needed can generally be obtained from the nameplate of the motor to be replaced. Take time to record all the nameplate information because it can save time, avoid confusion and MISAPPLICATION.

MOTOR TYPE

Alternating current (AC) induction motors are divided into two electrical categories, based on power source—single phase and polyphase (three phase). Direct current (DC) motors are used in applications where precise speed control is required or when battery or generated direct current is the available power source.

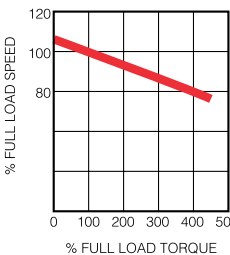
Three Phase or Polyphase



General purpose three phase motors have different electrical design classifications as defined by NEMA. NEMA Design A and B motors are of normal starting torque with normal starting current. NEMA Design C motors have higher starting torque with normal starting current. All three types have slip of less than 5%. ("Slip" being a term which expresses, as a percentage, the difference between synchronous motor speed and full load motor speed, for example, 1800 rpm synchronous versus a full load speed of 1740 rpm.

NEMA's Design B and C standards are minimum performance standards. In practice, some manufacturers (including LEESON) build small integral HP Design B motors with locked rotor and breakdown torque levels equalling NEMA Design C standards.

NEMA T frame motors 1 through 200 HP covered by EPACT (identified with a "G" catalog prefix) are labeled Design B, exceed NEMA Design B performance levels, and have efficiencies equal to EPACT mandated levels. EPACT exempt three phase, base-mounted motors are labeled Design C and have performance characteristics meeting NEMA's Design C standards, with standard motor efficiencies. Motors 250 HP and larger are exempt from EPACT legislation.



Permanent Magnet DC

This design has linear speed/torque characteristics over the entire speed range. SCR rated motor features include high starting torque for heavy load applications and dynamic braking, variable speed and reversing capabilities. Designs are also available for use on generated low voltage DC power or remote applications requiring battery power.

ELECTRICAL AND PERFORMANCE CHARACTERISTICS

One of the best ways to guarantee economical performance and long motor life is to make sure your motors operate at nameplate voltage. Applying too high a voltage may reduce the motor's efficiency and increase operating temperatures. The net result is shorter motor life.

Under-voltage can also shorten motor life. Operating on too low a voltage reduces the motor's effective horsepower. The motor will attempt to drive the load it was intended to drive, become overloaded, draw more current than normal, and overheat. Again, the result will be premature failure.

ENCLOSURES AND ENVIRONMENT

DRIP-PROOF: Venting in end frame and/or main frame located to prevent drops of liquid from falling into motor within a 15° angle from vertical. Designed for use in areas that are reasonably dry, clean, and well ventilated (usually indoors). If installed outdoors, it is recommended that the motor be protected with a cover that does not restrict the flow of air to the motor.

TOTALLY ENCLOSED AIR OVER (TEAO): Dust-tight fan and blower duty motors designed for shaft mounted fans or belt driven fans. The motor must be mounted within the airflow of the fan.

TOTALLY ENCLOSED NON-VENTILATED (TENV): No vent openings, tightly enclosed to prevent the free exchange of air, but not airtight. Has no external cooling fan and relies on convection for cooling. Suitable for use where exposed to dirt or dampness, but not for hazardous (explosive) locations.

TOTALLY ENCLOSED FAN COOLED (TEFC): Same as the TENV except has external fan as an integral part of the motor, to provide cooling by blowing air around the outside frame of the motor.

TOTALLY ENCLOSED, HOSTILE AND SEVERE ENVIRONMENT MOTORS: Designed for use in extremely moist or chemical environments, but not for hazardous locations.

TOTALLY ENCLOSED BLOWER COOLED MOTORS (TEBC): Used to extend the safe speed range of inverter-fed motors. Similar to TEFC except a small, constant-speed fan provides uniform airflow regardless of the drive motor's operating speed.

EXPLOSION-PROOF MOTORS: These motors meet Underwriters Laboratories and Canadian Standards Association standards for use in hazardous (explosive) locations, as indicated by the UL label affixed to the motor. Locations are considered hazardous because the atmosphere does or may contain gas, vapor, or dust in explosive quantities.



NEMA SERVICE FACTORS

HP	ENCLOSURE	RPM		
		3600	1800	1200
1/4-1/3	Open	1.35	1.35	1.35
1/2-3/4	Open	1.25	1.25	1.25
1 & Larger	Open	1.15	1.15	1.15
All	Totally Enclosed	1.00	1.00	1.00

Most LEESON Totally Enclosed Motors have 1.15 Service Factor. Refer to the Service Factor information on each page to identify specific totally enclosed motors with NEMA 1.00 Service Factor or LEESON 1.15 Service Factor. All drip-proof motors have NEMA Service Factors of 1.15 or higher. All three phase totally enclosed motors have NEMA Service Factors of 1.15 except when noted (♣).

SCR PM DC MOTORS ON PWM POWER SUPPLIES

Pulse width modulated DC controls have a voltage output similar to pure direct current which has a form factor of 1.00. SCR thyristor drives, such as the SPEEDMASTER® controls listed on page 83, have a form factor of 1.4.

LEESON stock SCR rated motors can also be used with PWM controls. In fact, the motor's HP rating can be increased because of less heating in the motor. In addition, the motor will operate quieter and the brush life will be extended.

Rated HP 1.40 FF	Rated RPM	Rated Volts	Catalog Number	Rated HP 1.05 FF
1/4	1750	90	098002	0.40
	1750	180	098003	0.50
1/3	1750	90	098004	0.50
	1750	90	108424	0.56
	1750	180	098005	0.50
1/2	2500	90	098006	0.75
	2500	180	098007	0.70
	1750	90	098000	0.70
	1750	90	108014	0.75
	1750	90	108226	0.75
	1750	180	098008	0.56
	1750	180	108015	0.70
3/4	2500	90	098009	1.00
	2500	90	108016	1.00
	2500	180	098010	1.00
	2500	180	108017	0.86
	1750	90	098032	1.00
	1750	90	108018	1.00
	1750	90	108228	1.25
	1750	180	098069	1.00
	1750	180	108019	1.00
	1750	180	108229	1.25
1	2500	90	108020	1.50
	2500	180	108021	1.50
	1750	90	108022	1.25
	1750	90	108230	1.25
	1750	180	108023	1.25
1 1/2	1750	180	108231	1.25
	2500	180	108265	2.00
	1750	180	108092	1.75
	1750	180	108262	1.75
	1750	180	108232	1.75
	1750	180	128000	--
2	2500	180	108266	3.00
	1750	180	128001	--
	1750	180	128010	--
3	2500	180	128008	--
	1750	180	108502	--

METRIC (IEC) DESIGNATIONS

The International Electrotechnical Commission (IEC) is a European-based organization that publishes and promotes worldwide mechanical and electrical standards for motors, among other things. In simple terms, it can be said that IEC is the international counterpart to the National Electrical Manufacturers Association (NEMA), which publishes the motor standards used in the United States.

IEC standards are expressed in metric units.

IEC ENCLOSURE PROTECTION INDEXES

Like NEMA, IEC has designations indicating the protection provided by a motor's enclosure. However, where NEMA designations are word descriptive, such as Open Drip-Proof or Totally Enclosed Fan Cooled. IEC uses a two-digit Index of Protection (IP) designation. The first digit indicates how well-protected the motor is against the entry of solid objects, the second digit refers to water entry.

By way of general comparison, an IP22 motor relates to Open Drip-Proof, IP54 to totally enclosed.

Protection Against Solid Objects		Protection Against Liquids	
Number	Definition	Number	Definition
0	No protection	0	No protection
1	Protected against solid objects of over 50 mm (e.g. accidental hand contact)	1	Protected against water vertically dripping (condensation)
2	Protected against solid objects of over 12 mm (e.g. finger)	2	Protected against water dripping up to 15° from the vertical
3	Protected against solid objects of over 2.5 mm (e.g. tools, wire)	3	Protected against rain falling at up to 60° from the vertical
4	Protected against solid objects of over 1 mm (e.g. thin wire)	4	Protected against water splashes from all directions
5	Protected against dust	5	Protected against jets of water from all directions
6	Totally protected against dust. Does not involve rotating machines	6	Protected against jets of water comparable to heavy seas
		7	Protected against the effects of immersion to depths of between 0.15 and 1m
		8	Protected against the effects of prolonged immersion at depth

IEC DESIGN TYPES

The electrical performance characteristics of IEC Design N motors in general mirror those of NEMA Design B—the most common type of motor for industrial applications. By the same token, the characteristics of IEC Design H are nearly identical to those of NEMA Design C. There is no specific IEC equivalent to NEMA Design D.

MOTOR EFFICIENCY TEST METHODS

Performance data of single phase motors is determined by using I.E.E. Std. 114 (Method B), three phase motors by I.E.E. Std. 112 (Method B). Motor efficiency is calculated using CSA C390. These testing methods meet the requirements of EPACT of 1992 and most utility companies.

For complete performance data on all LEESON motors, please review the Find-A-Product section on www.leeson.com.

U.L., CSA, ISO AND OTHER STANDARDS & APPROVALS – MOTORS

UNDERWRITERS LABORATORIES INC.

- All motor models listed with prefix “C” have U.L. component recognition (without thermal overload). File Number E57948, Guide Number PRGY2.
- All units have U.L. recognized Class B, F or H insulation systems unless otherwise noted. File Number E55555, Guide Number OBJY2.
- Single phase motors with a model number prefix of “A” or “M” (automatic or manual protectors) have U.L. recognized protector winding combinations and component recognition. File Number E57955, Guide Number XEWR2.
- Three phase motors with a model number prefix of “A” or “M” (automatic or manual protectors) have U.L. recognized protector winding combinations plus have capability of providing U.L. recognized primary single phasing which is included in our U.L. file E57955, Guide Number XEWR2.
- Explosion-Proof, single and three phase for 56, 143T and 145T frames: File Number E75276, Guide Number PTDR.
Explosion-Proof motors 182T and larger: File Number E12044, Guide Number PTDR.
Explosion-Proof motors DC motors 48 frame: File Number E75276, Guide Number PTDR..
- Permanent Magnet DC motors except PZ and P300 gearmotors are recognized components under File Number E57948, Guide Number PRGY2.
- PZ and P300 Permanent Magnet DC gearmotors: File number E49849 or E49747, Guide Number PRGY2.
- Speedmaster SCR Drives, Component Recognition, File E132235, Guide Number NMMS2, except catalog numbers 174902 and 174903.
- Speedmaster SCR Drives, catalog numbers 174902 and 174903. File Number E154901, Guide Number NMFT2.
- Speedmaster AC Adjustable Speed Drives, File Number E161242. Canadian UL covered by File Number E161242 also, Guide Number NMMS.

CANADIAN STANDARDS ASSOCIATION

- Motor construction for all single and three phase NEMA 42 through S254T frame, IEC/metric 63 through 90L frame, and all sub-fractional horsepower motors: Report Number LR33543, Guide Number 260-0-0..
- Motor construction for all steel or cast iron three phase NEMA 182T through 447T frame and IEC/metric 100L through 250M frame motors: Report Number LR62104.
- Thermally protected single phase motors through 7½ HP, Report Number LR33543.
- All Farm Duty motors 1/3 HP through 7½ HP, Report Number LR33543
- Explosion proof single and three phase for 56, 143T and 145T frames: File Number LR47667.
Explosion-Proof motors 182T and larger: File Number LR21839 and LR47504.
Explosion-Proof DC motors 48 frame: File Number LR701080.
- Permanent Magnet DC motors are listed under File Number LR33543.
- Multi-Speed Motors, steel or cast iron, 182T through 447T frames are listed under file number LR33543.
- Speedmaster SCR Drives, catalog numbers 174902 and 174903. File Number LR75790.

MOTOR EFFICIENCY VERIFICATION

Energy Efficiency Verification - Full load efficiency ratings of three phase, single speed, NEMA/EEMAC Design A or B squirrel cage induction motors, 1 through 200 HP, 230, 460 or 575 volts, 60 Hz, in totally enclosed and open, drip-proof enclosures for non-hazardous applications, CSA Report Number EEV 78720-1. Tested to CSA 390 (IEEE 112B) Standards. The Grafton testing facility is qualified for CSA energy efficiency performance testing of polyphase induction motors. The Grafton Testing Facility is NVLAB recognized for energy efficiency testing of electric motors to EPACT requirements of the Department of Energy.

ISO QUALITY CERTIFICATION

Grafton and Saukville, Wisconsin administrative, design and manufacturing facility, ISO 9001, Certificate Number RvC #93-102. EN29001, BS5750: Part 1 and ANSI/ASQC Q91-19.

Black River Falls, Wisconsin manufacturing facility, ISO 9002, Certificate Number RvC #93-090.

Mississauga (Toronto), Ontario, administrative, distribution facility, ISO 9002, Certificate Number QMI #003027.

Hanover, Ontario, manufacturing facility, ISO 9002, Certificate Number QMI #003028.

BAKING INDUSTRY SANITATION STANDARDS COMMITTEE

WASHGUARD® II, stainless steel washdown duty motors, NEMA frames 56, 143T, 145T, 182T and 184T are certified to Standard No. 29 for Electric Motors and Accessory Equipment, authorization number 769. The WBMQ Series of gear reducers are BISSC certified to Standard No. 29 for Electric Motors and Accessory Equipment, authorization number 941.

SAUDI ARABIAN STANDARDS ORGANIZATION

SCCP Ref. No.: R-100157

The CE Mark

CE is an acronym for the French phrase “*Conformite Europeene*” and is similar to the UL or CSA marks of North America. However, unlike UL or CSA which require independent laboratory testing, the CE mark can be applied by the motor manufacturer through “self certifying” that its products are designed to the appropriate standards. The European Union has issued 24 directives related to the **CE** mark. Three Directives apply to electric motors.

Low Voltage Directive (73/23/EEC) This directive applies to electrical equipment operating in the voltage range of 50-1000 volts AC or 75-1500 volts DC. Virtually all LEESON motors (except low voltage DC) are included in this directive.

Based on our testing to the applicable electrical and mechanical standards EN60034 and IEC 34, LEESON certifies conformity to this directive. All three phase 50 Hz stock motors comply with the nameplate designations, lead markings and connection diagrams required. A “Declaration of Conformity” accompanies these motors and a CE label is applied.

Machinery Directive (89/3392/EEC) This directive applies to machinery that may contain certain motors. This is an issue with equipment manufacturers and requires the use of a motor meeting the Low Voltage Directive and requires a “Declaration of Incorporation” document which means that only the motor complies with the requirements of the Low Voltage Directive. A CE label is applied to the motor but it remains the responsibility of the equipment manufacturer to obtain certification for the finished product.

Electromagnetic Compatibility (EMC) Directive (89/336/EEC) This directive addresses the final product and is again a concern for the equipment manufacturer. Since this Directive addresses electromagnetic interference (EMI) concerns, it does not affect three phase AC motors because they do not produce EMI. DC motors, however, do produce EMI. How much of the “noise” is emitted outside the machine depends on a host of factors. LEESON’s Engineering Department can assist OEM’s in applying DC motors in machinery destined for Europe and requiring certification to the EMC Directive.





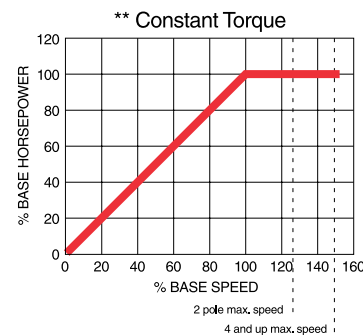
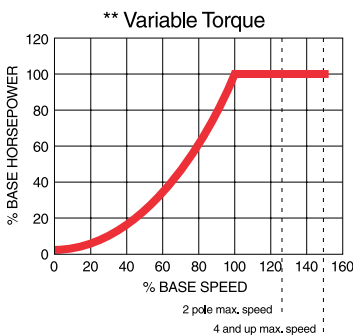
INVERTER CAPABILITIES OF LEESON MOTORS

STEEL FRAME MOTORS	NEMA Frame	Variable Torque**	Constant Torque**	Notes
Standard General Purpose				
TEFC	56-210 frame	10-90* Hz	20-90* Hz	
ODP	56-210 frame	10-90* Hz	20-90* Hz	
WATTSAVER® Premium Efficiency				
TEFC	56-210 frame	6-90* Hz	20-90* Hz	CT: 10-90 Hz on some ratings
ODP	56-210 frame	6-90* Hz	20-90* Hz	CT: 10-90 Hz on some ratings
Special Purpose Motors				
WASHGUARD® motors				
TENV	56-140 frame	10-90* Hz	10-90* Hz	
TEFC	56-210 frame	10-90* Hz	20-90* Hz	
CAST IRON MOTORS				
Standard General Purpose				
TEFC	180-440 frame	10-90* Hz	20-90* Hz	CT: 15-90 Hz on some ratings
ODP	180-440 frame	10-90* Hz	20-90* Hz	CT: 15-90 Hz on some ratings
TEFC with blower kit	180-320 frame	5-90* Hz	5-90* Hz	full torque at low speed with vector drive
WATTSAVER® Premium Efficiency				
TEFC	180-280 frame	6-90* Hz	6-90* Hz	
	320-440 frame	10-90* Hz	15-90* Hz	CT: 6-90 Hz on some ratings
ODP	180-280 frame	6-90* Hz	6-90* Hz	
	320-440 frame	10-90* Hz	15-90* Hz	CT: 6-90 Hz on some ratings
TEFC with blower kit	180-320 frame	0-90* Hz	0-90* Hz	full torque at zero speed with vector drive
SPEEDMASTER® Extreme-Duty Inverter Motors				
TENV	143TC-256TC	0-120 Hz	0-120 Hz	
TEBC	284T-449T	0-90 Hz	0-90 Hz	

NOTES:

- All motors are class F insulated, 40°C ambient, 3300 ft. and 1.0 service factor when used with an inverter.
- Optimized voltage boost is required for continuous operation throughout the frequency range specified. (See operating curves.)
- Motors with blower kits have continuous cooling and are capable of full rated torque at 0 speed with properly tuned vector drive.
- Maximum recommended cable length for IGBT inverters is 250 ft. (longer cable lengths may require noise or voltage suppression).
- All LEESON three phase stock motors (1 HP and larger) have the IRIS™ insulation system, which is designed to meet the NEMA requirements for peak voltages up to 1600 volts, and pulse rise time greater than or equal to 0.1 microseconds.
- Operating curves are available for WATTSAVER® motors. Refer to curves for more details about frequency ranges.
- Refer to Bulletin 1051 for performance data of WATTSAVER® motors fed by inverters.

* The maximum recommended frequency (speed) for 2 pole (3600 rpm) motor is Hz=75, rather than 90 Hz.
 ** Operation for variable or constant torque is up to a base frequency of 60 Hz only. Operation above 60 Hz to the maximum frequency listed is constant horsepower (horsepower equal to motor rated horsepower).



LEESON MOTOR MODEL NUMBER NOMENCLATURE

All LEESON motors, both stock and custom, have a catalog number and a model number. The model number appears on the motor's nameplate and describes pertinent electrical and mechanical features of the motor. An example follows along with a listing of the various letters and positions used.

POSITION 1: U.L. PREFIX

- A = Auto protector. U.L. recognized for locked rotor plus run, also recognized construction (U.L. 1004)*.
- M = Manual protector. U.L. recognized for locked rotor plus run, also recognized construction (U.L. 1004)*.
- L = Locked rotor protector (automatic). U.L. recognized for locked rotor only, also recognized construction (U.L. 1004)*.
- C = Component recognition. (U.L. 1004) No protector.
- U = Auto protector. Not U.L. recognized.
- P = Manual protector. Not U.L. recognized.
- T = Thermostat, not U.L. recognized.
- N = No overload protection.

*This applies only to 48, S56, and 56 frame designs through 1 HP, Open & TENV.

POSITION 2: (OPTIONAL)

- This position is not always used.
- M = Sub-Fractional HP Motors.
- Z = BISSC Approved.
- Other = Customer Code

POSITION 3: FRAME

4 = 48 Frame	23 = 23 Frame	40 = 40 Frame
6 = 56 Frame	30 = 30 Frame	43 = 43 Frame
42 = 42 Frame	34 = 34 Frame	44 = 44 Frame
143 = 143T Frame	36 = 36 Frame	53 = 53 Frame
145 = 145T Frame	38 = 38 Frame	65 = 65 Frame
182 = 182T Frame	39 = 39 Frame	
184 = 184T Frame		
213 = 213T Frame		
215 = 215T Frame		

POSITION 4: MOTOR TYPE

- C = Cap. Start/Ind. Run
- D = Direct Current
- K = Cap. Start/Cap. Run
- P = Permanent Split
- S = Split Phase
- T = Three Phase
- B = Brushless DC
- H = Hysteresis Sync.
- R = Reluctance Sync.

POSITION 5: RPM

RPM-Single Speed	RPM-Multi-Speed
34 = 3450 RPM 60 Hz 2 Pole	24 = 2 and 4 Poles
28 = 2850 RPM 50 Hz 2 Pole	26 = 2 and 6 Poles
17 = 1725 RPM 60 Hz 4 Pole	82 = 2 and 8 Poles
14 = 1425 RPM 50 Hz 4 Pole	212 = 2 and 12 Poles
11 = 1140 RPM 60 Hz 6 Pole	46 = 4 and 6 Poles
9 = 950 RPM 50 Hz 6 Pole	48 = 4 and 8 Poles
8 = 960 RPM 60 Hz 8 Pole	410 = 4 and 10 Poles
7 = 720 RPM 50 Hz 8 Pole	412 = 4 and 12 Poles
7 = 795 RPM 60 Hz 10 Pole	68 = 6 and 8 Poles
6 = 580 RPM 50 Hz 10 Pole	
6 = 580 RPM 60 Hz 12 Pole	

Odd frequencies other than 50 Hz show synchronous speed code.

DC and special motors may have one, two, or three digits indicating motor speed rounded to the nearest hundred RPM.

EXAMPLE:

Position No.	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
Sample Model No.	A	B	4	C	17	D	B	1	A	(A-Z)

POSITION 6: ENCLOSURE

- D = Drip-Proof
- E = Explosion-Proof TENV
- F = Fan Cooled
- N = TENV
- O = Open
- S = Splashproof
- W = Weatherproof, Severe Duty, Chemical Duty, WASHGUARD™ - TEFC
- X = Explosion-Proof TEFC
- V = Weatherproof, Severe Duty, Chemical Duty, WASHGUARD™ - TENV

POSITION 7: MOUNTING

- B = Rigid base standard
- C = "C" face - no base - NEMA
- D = "D" flange - no base - NEMA
- H = 48 frame - 56 frame mounting/shaft rigid
- J = 48 frame - 56 frame mounting/shaft resilient
- K = Rigid mount with "C" flange
- L = Rigid mount with "D" flange
- M = Motor parts - rotor and stator
- R = Resilient base
- S = Shell motor
- T = Round body
- Z = Special mounting

POSITION 8: SEQUENCE NUMBER

Number assigned as required when new designs with new characteristics are needed.

POSITION 9: MODIFICATION LETTER

Major modification letter. Used when revisions made in existing model *will* affect service parts.

POSITION 10: (OPTIONAL)

A date code consisting of either A-Z, and two digits 00-99.

Letter when shown on nameplate indicates model has U.L. primary single phasing recognition. (Applies to 3 phase motors only.)

Code letters indicate manufacturing location:

- A = Grafton, WI
- B = Black River Falls, WI
- C = Saukville, WI
- E = Neillsville, WI
- G = Lincoln, MO
- P = West Plains, MO

Lubrication Instructions For Ball Bearing Motors

Lubrication

This motor is supplied with pre-lubrication ball bearings. No lubrication required before start up.

Relubrication Intervals

The following intervals are suggested as a guide:

SUGGESTED RELUBRICATION INTERVALS		
HOURS OF SERVICE PER YEAR	H.P. RANGE	RELUBE INTERVAL
5,000	Sub Fractional to 7 1/2 10 to 40 50-200	5 Years 3 Years 1 Year
Continuous Normal Applications	Sub Fractional to 7 1/2 10 to 40 50 to 200	2 Years 1 Year 9 Months
Season Service Motor Idle 6 Months or More	All	1 Year (Beginning of Season)
Continuous High Ambients Dirty or Moist Locations High Vibrations Where Shaft End is Hot (Pumps-Fans)	Sub Fractional to 40 50 to 200	6 Months 3 Months

Lubrication

Use high quality ball bearing lubricant. Use consistency of lubricant suitable for class of insulation stamped on nameplate as follows:

LUBRICATION CONSISTENCY				
INSULATION CLASS	CONSISTENCY	TYPE	TYPICAL LUBRICATION	FRAME TYPE
B & F F & H	Medium	Polyurea	Shell Dolium R and/or Chevron SR1 2	Sub Fractional to 447T All

Procedure

If motor is equipped with Alemite fitting, clean tip of fitting and apply grease gun. Use 1 to 2 full strokes on motors in NEMA 215T frame and smaller. Use 2 to 3 strokes on NEMA 254T thru NEMA 365 T frame. Use 3 to 4 strokes on NEMA 404T frames and larger. On motors having drain plugs, remove drain plug and operate motor for 20 minutes before replacing drain plug.

On motors equipped with slotted head grease screw, remove screw and apply grease tube to hole. Insert 2 to 3 inch length of grease string into each hole on motors in NEMA 215T frame and smaller. Insert 3 to 5 inch length on larger motors. For motors having drain plug and operate motor for 20 minutes before replacing drain plug.

CAUTION: Keep lubricant clean. Lubricate motors at standstill. remove and replace drain plugs at standstill. Do not mix petroleum lubricant and silicone lubricant in motor bearings.



ELECTRIC MOTORS, GEARMOTORS AND DRIVES

LEESON ELECTRIC

GRAFTON, WISCONSIN 53024-0241 U.S.A.
TEL (262)377-8810 FAX (262)377-9025 www.leeson.com

A Subsidiary of Regal-Beloit Corporation

Installation Maintenance Instructions

AC Induction Motors

Installation

After unpacking, check for damage. Be sure that shaft rotates freely. Before making electrical power connections, check for proper grounding of motor and application. All electrical contacts and connections must be properly insulated and enclosed. Couplings, belts, chains or other mounted devices must be in proper alignment, balance and secure to insure safe motor operation.

Electrical Wiring

Prior to connecting to the power line, check nameplate for proper voltage and rotation connection. This motor should be installed in compliance with the National Electrical Code and any other applicable codes. Voltage at motor not to exceed + or -10% of nameplate. Authorized person should make all electrical connections.

Mounting

This motor should be securely mounted to the application. Sufficient ventilation area should be provided to insure proper operation.

RECOMMENDED COPPER WIRE & TRANSFORMER SIZE

SINGLE PHASE MOTORS - 230 VOLTS						
H.P.	TRANSFORMER KVA	DISTANCE - MOTOR TO TRANSF. IN FT.				
		100	150	200	300	500
1 1/2	3	10	8	8	6	4
2	3	10	8	8	6	4
3	5	8	8	6	4	2
5	7 1/2	6	4	4	2	0
7 1/2	10	6	4	3	1	0

THREE PHASE MOTORS - 230 & 460 VOLTS							
H.P.	VOLTS	TRANSFORMER KVA	DISTANCE - MOTOR TO TRANSF. IN FT.				
			100	150	200	300	500
1 1/2	230	3	12	12	12	12	10
1 1/2	460	3	12	12	12	12	12
2	230	3	12	12	12	10	8
2	460	3	12	12	12	12	12
3	230	5	12	10	10	8	6
3	460	5	12	12	12	12	10
5	230	7	10	8	8	6	4
5	460	1/2	12	12	12	10	8
7 1/2	230	7 1/2	8	6	6	4	2
7 1/2	460	10	12	12	12	10	8
10	230	10	6	4	4	4	1
10	460	15	12	12	12	10	8
15	230	15	4	4	4	2	0
15	460	20	12	10	10	8	6
20	230	20	4	2	2	1	000
20	460		10	8	8	6	4
25	230		2	2	2	0	000
25	460	Consult	8	8	6	6	4
30	230	Local	2	1	1	00	0000
30	460	Power	8	6	6	4	2
40	230	Company	1	0	00	0000	300
40	460		6	6	4	2	0
50	230		1	0	00	0000	300
50	460		4	4	2	2	0
60	230		1	00	000	250	500
60	460		4	2	2	0	00
75	230		0	000	0000	300	500
75	460		4	2	0	00	000



MC3000 FAULT MESSAGES

FAULT	DESCRIPTION
OUTPUT	Output Transistor fault. Output current exceeded 200%. May be ground fault or short circuit.
LO VOLTS	Low DC Bus Voltage fault. DC bus voltage dropped below 60%. May be low line voltage.
HI VOLTS	High DC Bus Voltage fault. DC Bus voltage exceeded 120%. May be overhauling load .
HI TEMP	High Temperature fault. Heatsink or ambient temperature too high.
OVERLOAD	Current Overload fault. Output current exceeded 100% for too long. VFD may be undersized.
PWR TRAN	Power Transient fault.
PWR SAG	Power Sag fault: New control board installed. Perform factory reset using Parameter 65.
LANGUAGE	Language EEPROM fault.
EXTERNAL	External fault: TB-130 activated (Parameter 50).
DB ERROR	Dynamic Brake fault. DB Resistors overloaded.
CONTROL	Control Board fault. New software installed. Perform factory reset using Parameter 65.
INTERNAL	Internal fault
INTERN (#)	Internal fault.

MICRO SERIES FAULT HISTORY

Parameter 70 — FAULT HISTORY stores the last eight faults that tripped the drive. The FAULT HISTORY indicates the number of the fault (number 1 is the most recent fault), the fault message, and the status of the drive at the time of the fault. An example is shown below:

FAULT NUMBER	FAULT MESSAGE	DRIVE STATUS
2	OUTPUT	ACCEL

In the example above, the second fault is being viewed, which is an OUTPUT fault that occurred while the drive was accelerating.

MICRO SERIES PARAMETERS

NO.	PARAMETER NAME	FACTORY DEFAULT	NO.	PARAMETER NAME	FACTORY DFAULT
0	LINE VOLTS	AUTO	29	MANUAL	KEYPAD
1	SPEED #1	20.00 Hz	30	CONTROL	LOCAL
2	SPEED #2	20.00 Hz	31	UNITS	HERTZ
3	SPEED #3	20.00 Hz	32	HZ MULT	1
4	SPEED #4	20.00 Hz	33	UNITS DP	XXXX
5	SKIP #1	.00 Hz	34	LOAD MLT	100%
6	SKIP #2	.00 Hz	35	CONTRAST	HIGH
7	BAND WID	1.00 Hz	39	TB5 MIN	.00 Hz
8	ACCEL	30.0 SEC	40	TB5 MAX	60.00 Hz
9	DECEL	30.0 SEC	42	TB10A OUT	NONE
10	MIN FRQ	.50 Hz	43	@TB10A	60.00 Hz
11	MAX FRQ	60.00 Hz	44	TB10B OUT	NONE
12	DC BRAKE	.0 VDC	45	@TB10B	125%
13	DC TIME	.0 SEC	47	TB13A	NONE
14	DYN BRAKE	OFF	48	TB13B	NONE
16	CURRENT	180%	49	TB13C	NONE
17	MOTOR OL	100%	50	TB13D	FAULT
18	BASE	60.00 Hz	52	TB14 OUT	NONE
19	FX BOOST	(NOTE 1)	53	TB15 OUT	NONE
20	AC BOOST	.0%	54	RELAY	NONE
21	SLIP COMP	.0%	58	ADDRESS	30
22	TORQUE	CONSTANT	61	PASSWORD	0019
23	CARRIER	2.5 kHz	63	SOFTWARE	(NOTE 2)
25	START	NORMAL	64	MONITOR	ON
26	STOP	COAST	65	PROGRAM	RESET 60
27	ROTATION	FORWARD	66	HISTORY	MAINTAIN
28	AUTO/MAN	BOTH	70	FAULT HIST.	(NOTE 2)

NOTE 1: REFER TO THE MICRO SERIES MANUAL.

NOTE 2: THESE PARAMETERS ARE VIEW-ONLY.

Exhibit O-8

LEESON

Variable Speed AC Motor Drives

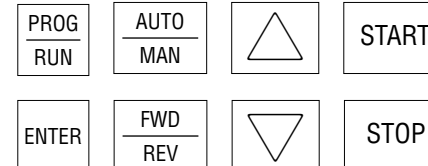
LEESON SPEEDMASTER

Digital

RUN 60.00 HZ

Micro Series

Intelligent Drive

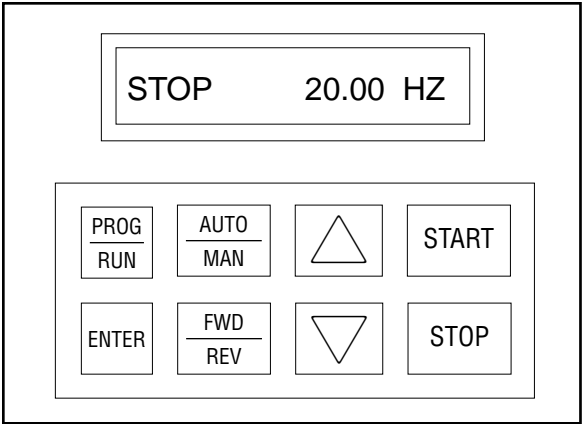


Adjustable Speed AC Motor Control

Micro Series Quick Reference Guide

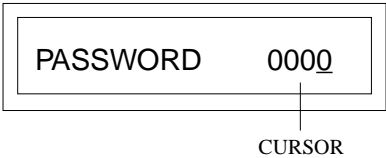
NOTE: Before installing and operating the MICRO SERIES drive, please read and become familiar with the MICRO SERIES Installation and Operation Manual.

MICRO SERIES KEYPAD



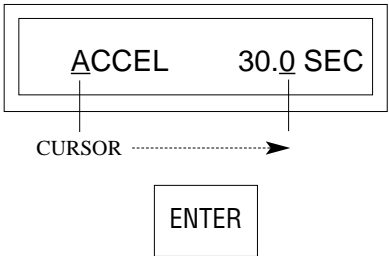
PROGRAMMING THE MICRO SERIES

1. Press the PROG/RUN key. This will cause the PASSWORD prompt to appear (unless the password protection has been disabled), as shown below:



2. Use the ARROW keys to scroll to the correct password value (the factory default password is 0019) and press ENTER. The PROGRAM mode will be entered at the start of the parameter menu. A cursor will highlight the parameter name.

3. Use the ARROW keys to scroll to the desired parameter and press ENTER. The cursor will shift from the parameter name to the parameter value, as the example below illustrates:



4. Use the ARROW keys to scroll to the desired parameter value, and press ENTER to store the new value.

5. Press PROG/RUN to exit the PROGRAM mode.

MICRO SERIES KEYPAD FUNCTIONS

START
Press the START key to start the drive. The START key is only active in LOCAL mode.

STOP
Press the STOP key to stop the drive.
NOTE: The STOP key is active in both LOCAL and REMOTE mode.

The STOP key is also used to reset faults. If the fault condition has passed, pressing the STOP key will clear the fault and return the drive to a STOP condition.

UP and DOWN ARROWS — Used to change the speed setpoint in MANUAL mode, scroll through the parameter menu, and change parameter values.

AUTO/MAN
Toggles between AUTOMATIC (terminal strip) and MANUAL (keypad) speed control.
NOTE: Parameter 28 — AUTO/MAN must be set to BOTH for this key to be active.

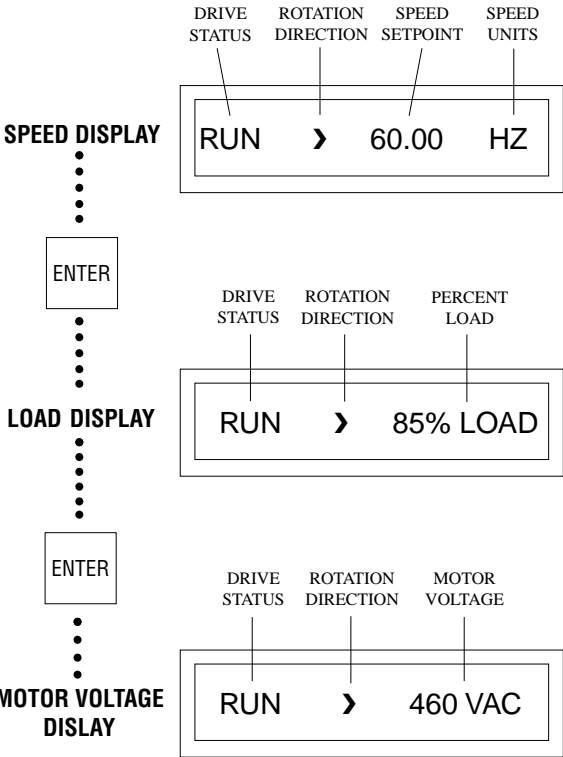
FWD/REV
Toggles between forward and reverse directions. ENTER key must be pressed.

PROG/RUN
Used to enter and exit the PROGRAM mode to set the parameters.

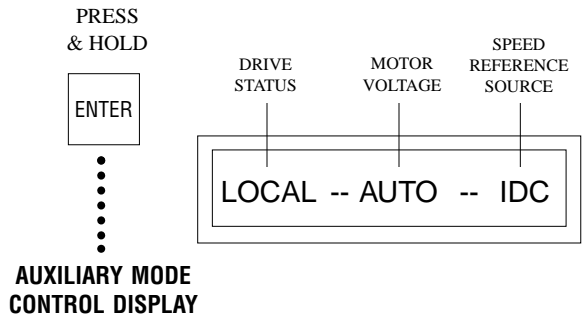
ENTER
Used for: toggling the display between SPEED, LOAD, and MOTOR VOLTAGE; confirming new parameter values; confirming AUTO and MANUAL speed control selections.

MICRO SERIES DISPLAYS

Shown below are examples of MICRO SERIES displays. To scroll through the SPEED, LOAD, and MOTOR VOLTAGE displays, press and release the ENTER key.



Press and hold the ENTER key to activate the AUXILIARY MODE, which will toggle to a CONTROL DISPLAY. An example is shown below:





TECHNICAL INFORMATION



CONDENSED GLOSSARY OF MOTOR AND GEARING TERMS

Axial Movement - Often called “endplay.” The endwise movement of motor or gear shafts. Usually expressed in thousandths of an inch.

Back Driving - Driving the output shaft of a reducer — using it to increase speed rather than reduce speed. Worm gear reducers are not suitable for service as speed increasers.

Backlash - Rotational movement of the output shaft clockwise and counter clockwise, while holding the input shaft stationary. Usually expressed in thousandths of an inch and measure at a specific radius at the output shaft.

Center Distance - A basic measurement or size reference for worm gear reducers, measured from the centerline of the worm to the centerline of the worm wheel.

Drip-Proof - Venting in end frame and/or main frame located to prevent drops of liquid from falling into motor within 15 angle from vertical. Designed for use in areas that are reasonably dry, clean, and well ventilated (usually indoors). If installed outdoors, it is recommended that the motor be protected with a cover that does not restrict the flow of air to the motor.

Efficiency - A ratio of the input power compared to the output, usually expressed as a percentage.

Explosion-Proof Motors - These motors meet Underwriters Laboratories and Canadian Standards Association standards for use in hazardous (explosive) locations, as indicated by the UL label affixed to the motor. Locations are considered hazardous because the atmosphere does or may contain gas, vapor, or dust in explosive quantities.

Flanged Reducer - Usually used to refer to a reducer having provisions for close coupling of a motor either via a hollow (quill) shaft or flexible coupling. Most often a NEMA C face motor is used.

Gear+Motor™ - LEESON’s registered trademark for a separable gear and NEMA C face motor as opposed to an integral gearmotor. Integral gearmotors suffer from lack of application and availability constraints as well as having inherent service issues when one or the other component needs replacement.

Input Horsepower - The power applied to the input shaft of a reducer. The input horsepower rating of a reducer is the maximum horsepower the reducer can safely handle.

Mechanical Rating - The maximum power or torque a reducer can transmit. LEESON reducers typically have a safety margin equal to 200% or more of its mechanical rating allowing momentary overloads during start-up or other transient overload conditions.

Motor Selection - See the technical section of LEESON’s Stock Motor Catalog 1050, request LEESON’s book, Practical Motor Basics or contact LEESON’s District Office for expert assistance.

Mounting Position - The relationship of the input and output shafts of a reducer relative to horizontal.

Output Horsepower - The amount of horsepower available at the output shaft of the reducer. Output horsepower is always less than the input horsepower due to the efficiency of the reducer.

Overhung Load - A force applied at right angles to a shaft beyond the shaft’s outermost bearing. This shaft-bending load must be supported by the bearing. Overhung load ratings are listed for each reducer size and should not be exceeded.

Prime Mover - In industry, the prime mover is most often an electric motor. Occasionally engines, hydraulic or air motors are used. Special application considerations are called for when other than an electric motor is the prime mover.

Self-Locking - The inability of a reducer to be driven backwards by its load. As a matter of safety, no LEESON reducer should be considered self-locking.

Service Factor for Gearing - A method of adjusting a reducer’s load carrying characteristics to reflect the application’s load characteristics. AGMA (American Gear Manufacturer’s Association) has established standardized service factor information.

Service Factor for Motors - Refers to a motor’s ability to handle a load greater than the motor’s rated HP on a continuous basis. Most LEESON motors have a continuous duty service factor of 1.15 or higher. This ability of the motor is intended to handle momentary or transient overloads or unusual service conditions and should not be utilized when sizing motors for continuous service. For assistance in motor selection please contact your LEESON’s District Office.

Thermal Rating - The power or torque a reducer can transmit continuously. This rating is based upon the reducer’s ability to dissipate the heat caused by friction.

Thrust Load - Force imposed on a shaft parallel to a shaft’s axis. Thrust loads are often induced by the driven machine. Take care to be sure the thrust load rating of the reducer is sufficient that it’s shafts and bearings can absorb the load without premature failure.

Totally Enclosed Non-Ventilated (TENV) - No vent openings, tightly enclosed to prevent the free exchange of air, but not airtight. Has no external cooling fan and relies on convection for cooling. Suitable for use where exposed to dirt or dampness, but not for hazardous (explosive) locations.

Totally Enclosed Fan Cooled (TEFC) - Same as the TENV except has external fan as an integral part of the motor, to provide cooling by blowing air around the outside frame of the motor.

WORM GEAR REDUCER SERVICE FACTORS

Proper determination of an application’s service factor characteristics is critical for maximum reducer life and trouble free service. See the definition of service factor in the glossary.

All worm reducers and LEESON Gear+Motor motorized reducers are sized for applications having an AGMA defined service of 1.0, unless otherwise stated. (Alternately, 1.0 service factor is sometimes expressed as “Class I Service”.) Reducers in such applications operate on a continuous duty basis, for 10 hours per day or less, and are free of recurrent shock loads. When operating characteristics are different than noted, the input horsepower and torque ratings listed must be divided by the service factor selected from the table below. This table applies to reducers with an electric or hydraulic motor input.

SPECIAL APPLICATION CONSIDERATIONS

CAUTION: Please contact LEESON for assistance in applications not listed or for applications with unusual characteristics. Including the following:

- Input speeds not listed in catalog
- Frequent starting or repetitive shock applications
- Selection of reducers for man lifts or people moving equipment
- High energy loads, including stalling
- Starting or momentary overloads exceeding 200% of gear reducer mechanical capacity (100% overload)

SERVICE FACTOR TABLE

Duration of Service (Hours per day)	Uniform Load	Moderate Shock	Heavy Shock	Extreme Shock
Occasional 1/2 Hour	—*	—*	1.00	1.25
Less than 3 Hours	1.00	1.00	1.25	1.50
3 - 10 Hours	1.00	1.25	1.50	1.75
Over 10 Hours	1.25	1.50	1.75	2.00

* Unspecified service factors should be 1.00 or as agreed upon by the user and manufacturer.

When a single or multi-cylinder engine is the input power, the service factor selected from the table above should be increased by multiplying the value by the factor selected from the table below.

Service Factor Conversion Table for Engine Driven Applications.

Hydraulic or Electric Motor	Single Cylinder Engines	Multi-Cylinder Engines
1.00	1.50	1.25
1.25	1.75	1.50
1.50	2.00	1.75
1.75	2.25	2.00
2.00	2.50	2.25

On the next page, AGMA standardized service factor data is listed for a wide variety of applications operating 3 to 10 hours per day and for 10 hours or more per day.



TECHNICAL INFORMATION



OHIO GEAR™

A.G.M.A. SERVICE FACTORS

Application	Service Factor	
	3-10 Hours	Over 10 Hours
AGITATORS		
Pure Liquids	1.00	1.25
Liquids & Solids	1.25	1.50
Liquids-Variable Density	1.25	1.50
APRON CONVEYORS		
Uniformly Loaded or Fed	1.00	1.25
Heavy Duty	1.25	1.50
APRON FEEDERS	1.25	1.50
ASSEMBLY CONVEYORS		
Uniformly Loaded or Fed	1.00	1.25
Heavy Duty	1.25	1.50
BARGE HAUL PULLERS	1.50	1.75
BARKING		
Drums (Coupling Connected)		1.75
Mechanical		1.75
BAR SCREENS (Sewage)	1.00	1.25
BELT CONVEYORS		
Uniformly Loaded or Fed	1.00	1.25
Heavy Duty	1.25	1.50
BELT FEEDERS	1.25	1.50
BLOWERS		
Centrifugal	1.00	1.25
Lobe	1.25	1.50
Vane	1.00	1.25
BOLTING MACHINERY	1.00	1.25
BREWING & DISTILLING		
Bottling Machinery	1.00	1.25
Brew Kettles, Cont. Duty	1.00	1.25
Can Filling Machines	1.00	1.25
Cookers-Cont. Duty	1.00	1.25
Mash Tubs-Cont. Duty	1.00	1.25
Scale Hoppers-Frequent Starts	1.25	1.50
BUCKET		
Conveyors Uniform	1.00	1.25
Conveyors Heavy Duty	1.25	1.50
Elevators Cont.	1.00	1.25
Elevators Uniform	1.00	1.25
Elevators Heavy Duty	1.25	1.50
CALENDARS		
Rubber		1.50
Textile	1.25	1.50
CANE KNIVES		1.50
CAN FILLING MACHINES	1.00	1.25
CAR DUMPERS	1.50	1.75
CAR PULLERS	1.25	1.50
CENTRIFUGAL		
Blowers, Compressors, Discharge Elevator, Fans or Pumps	1.00	1.25
CHAIN CONVEYORS		
Uniformly Loaded or Fed	1.00	1.25
Heavy Duty	1.25	1.50
CLARIFIERS	1.00	1.25
CLASSIFIERS	1.25	1.50
CLAY WORKING INDUSTRY		
Brick Press	1.75	2.00
Briquette Machines	1.75	2.00
Clay Working Machinery	1.25	1.50
Plug Mills	1.25	1.50
COMPRESSORS		
Centrifugal	1.00	1.25
Lobe	1.25	1.50
Reciprocating:		
Multi-Cylinder	1.25	1.50
Single Cylinder	1.50	1.75
CONCRETE MIXERS		
Continuous	1.25	1.50
Intermittent	1.25	1.50
CONVEYORS-Uniformly Loaded or Fed		
Apron, Assembly, Belt, Bucket, Chain, Flight, Oven, Screw	1.00	1.25
CONVEYORS-Severe Duty		
Live Roll		Contact Factory
Reciprocating, Shaker	1.50	1.75
COOLING TOWER FANS		Contact Factory
CRANES		
Dry Dock Cranes		Contact Factory
Main Hoist	1.00	1.25
Bridge and Trolley Travel		Contact Factory
CRUSHERS		
Ore or Stone	1.50	1.75
Sugar		1.50
DISC FEEDERS	1.00	1.25

DOUBLE ACTING PUMPS		
2 or more Cylinders	1.25	1.50
Single Cylinder		Contact Factory
DRAW BENCH (Metal Mills)		
Carriage & Main Drive	1.25	1.50
DREDGES		
Cable Reels, Conveyors	1.25	1.50
Cutter Head & Jig Drives	1.75	2.00
Maneuvering Winches, Pumps	1.25	1.50
Screen Drives	1.50	1.75
Stackers, Utility Winches	1.25	1.50
ELEVATORS		
Bucket-Uniform Load	1.00	1.25
Bucket-Heavy Duty	1.25	1.50
Bucket-Continuous	1.00	1.25
Centrifugal Discharge Escalators	1.00	1.25
Freight		Not Approved
Gravity Discharge	1.00	Not Approved
Man Lifts, Passenger		Not Approved
EXTRUDERS (Plastic)		
Film Sheet, Coating, Rods, Pipe Tubing	1.25	1.25
Blow Molders, Pre-plasticizers		1.50
FANS		
Centrifugal	1.00	1.25
COOLING TOWERS		Contact Factory
Forced Draft		1.25
Induced Draft	1.25	1.50
Large (Mine, etc.)	1.25	1.50
Large Industrial	1.25	1.50
Light (Small Diameter)	1.00	1.25
FEEDERS		
Apron, Belt	1.25	1.50
Disc	1.00	1.25
Reciprocating	1.75	2.00
Screw	1.25	1.50
FLIGHT		
Conveyors, Uniform	1.00	1.25
Conveyors, Heavy	1.25	1.50
FOOD INDUSTRY		
Beet Slicers	1.25	1.50
Bottling, Can Filling Mach.	1.00	1.25
Cereal Cookers	1.00	1.25
Dough Mixers, Meat Grinders	1.25	1.50
HAMMER MILLS	1.50	1.75
HOISTS		
Heavy Duty	1.75	2.00
Medium Duty	1.25	1.50
Skip Hoist	1.25	1.50
INDUCED DRAFT FANS	1.25	1.50
LAUNDRY WASHERS AND TUMBLERS	1.25	1.50
LINE SHAFTS		
Driving Processing Equipment	1.25	1.50
Other Line Shafts, Light	1.00	1.25
LUMBER INDUSTRY		
Barkers-Spindle Feed	1.25	1.50
Barkers-Main Drive	1.75	1.75
Carriage Drive		Contact Factory
CONVEYORS		
Burner	1.25	1.50
Main or Heavy Duty	1.50	1.50
Main Log	1.75	2.00
Re-saw Merry-Go-Round	1.25	1.50
Slab	1.75	2.00
Transfer	1.25	1.50
Chains-Floor	1.50	1.50
Chains-Green	1.50	1.75
Cut-Off Saws-Chain & Drag	1.50	1.75
Debarking Drums	1.75	2.00
Feeds-Edger	1.25	1.50
Feeds-Gang	1.50	1.50
Feeds-Trimmer	1.25	1.50
Log Deck	1.50	1.50
Log Hauls-Incline Well Type	1.50	1.50
Log Turning Devices	1.50	1.50
Planer Feed	1.25	1.50
Planer Tilling Hoist	1.50	1.50
Rolls-Live-Off Bearing-Roll Cases	1.50	1.50
Sorting Table, Tipple Hoist	1.25	1.50
Transfers-Chain & Craneway	1.50	1.75
Tray Drives	1.25	1.50
Veneer Lathe Drives		Contact Factory
MACHINE TOOLS		
Auxiliary Drives	1.00	1.25
Bending Rolls	1.25	1.50
Main Drives	1.25	1.50
Notching Press (Belted)		Contact Factory
Plate Planers	1.50	1.75
Punch Press (Geared)	1.50	1.75
Tapping Machines	1.50	1.75

METAL MILLS		
Draw Bench Carriages & Main Drives	1.25	1.50
Pinch, Dryer and Scrubber		Contact Factory
Rolls Reversing		Contact Factory
Slitters	1.25	1.50
Table Conveyors Non-Reversing		
Group Drives	1.25	1.50
Individual Drives	1.50	1.75
Reversing Wire Drawing & Flattening Machines	1.25	1.50
Wire Winding Machines	1.25	1.50
MILLS, ROTARY		
Ball and Rod Mills with Spur Ring Gear		1.75
with Helical Ring Gear		1.50
Direct Connect		1.50
Cement Kilns, Dryers, Coolers, Pebble, Plain & Wedge Bar Mills	1.50	1.50
Tumbling Barrels		1.75
MIXERS (Also see Agitators)		
Concrete, Cont. & Int.	1.25	1.50
Constant Density	1.00	1.25
Variable Density	1.25	1.50
OIL INDUSTRY		
Chillers	1.25	1.50
Oil Well Pumping		Contact Factory
Paraffin Filter Press	1.25	1.50
Rotary Kilns	1.25	1.50
PAPER MILLS		Contact Factory
PASSENGER ELEVATORS		Contact Factory
PLATE PLANERS	1.50	1.75
PRINTING PRESSES		Contact Factory
PUMPS		
Centrifugal	1.00	1.25
Proportioning	1.25	1.50
Reciprocating		
Single Act, 3 or more Cyl.	1.25	1.50
Double Act, 2 or more Cyl.	1.25	1.50
Single Act, 1 or 2 Cyl		Contact Factory
Double Act, 1 Cyl.		Contact Factory
Rotary: Gear, Lobe, Vane	1.00	1.25
PUNCH PRESSES (Gear Driven)	1.50	1.75
RUBBER & PLASTIC INDUSTRIES		
Calendars		1.50
Crackers		1.75
Laboratory Equipment	1.25	1.50
Mills (2 on line)	1.50	1.50
Mills (3 on line)	1.25	1.50
Mixing Mills	1.50	1.50
Refiners		1.50
Sheeters		1.50
Tire Building & Machines		Contact Factory
Tire & Tube Press Openers		Contact Factory
Tubers & Strainers		1.50
Warming Mills		1.50
SCREENS		
Air Washing	1.00	1.25
Rotary-Sand or Gravel	1.25	1.50
Traveling Water Intake	1.00	1.25
SEWAGE DISPOSAL		
Bar Screens	1.00	1.25
Chemical Feeders	1.00	1.25
Collectors	1.00	1.25
Dewatering Screens	1.25	1.50
Scum Breakers	1.25	1.50
Slow or Rapid Mixers	1.25	1.50
Thickeners	1.25	1.50
Vacuum Filters	1.25	1.50
SKI TOWS & LIFTS		Not Approved
STOKERS	1.00	1.25
STONE CRUSHERS	1.50	1.75
SUGAR INDUSTRY		
Cane Knives, Crushers, Mills		1.50
TABLE CONVEYORS (Non-Reversing)		
Group Drives	1.25	1.50
Individual Drives	1.50	1.75
Reversing		Contact Factory
TEXTILE INDUSTRY		
Batchers, Calendars	1.25	1.50
Card Machines	1.25	1.50
Dry Cans, Dryers	1.25	1.50
Dyeing Machinery	1.25	1.50
Knitting Machinery		Contact Factory
Looms, Mangles, Nappers, Pads	1.25	1.50
Range Drives		Contact Factory
Slashers, Soapers, Spinners	1.25	1.50
Tenter Frames, Washers, Winders	1.25	1.50
TUMBLING BARRELS	1.50	1.75
VANE BLOWERS	1.00	1.25
WINDLASS		Contact Factory
WIRE		
Drawing Machines	1.25	1.50
Winding Machines	1.25	1.50



OHIO GEAR™

ELECTRIC MOTORS, GEARMOTORS AND DRIVES

Speed Reducers Installation, Lubrication and Maintenance Instructions

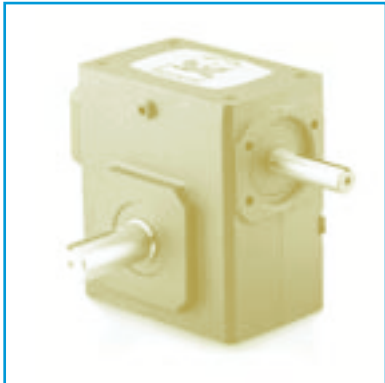


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Instruction Manual

Exhibit P-4



Selection Information

Read ALL instructions prior to operating reducer. Injury to personnel or reducer failure may be caused by improper installation, maintenance or operation.

Written authorization from LEESON ELECTRIC is required to operate or use reducers in man lift or people moving devices.

Check to make certain application does not exceed the allowable load capacities published in the current catalog.

Buyer shall be solely responsible for determining the adequacy of the product for any and all uses to which Buyer shall apply the product. The application by Buyer shall not be subject to any implied warranty of fitness for a particular purpose.

Safety Alert

WARNING

- For safety, Buyer or User should provide protective guards over all shaft extensions and any moving apparatus mounted thereon. The User is responsible for checking all applicable safety codes in his area and providing suitable guards. Failure to do so may result in bodily injury and/or damage to equipment.
- Hot oil and reducers can cause severe burns. Use extreme care when removing lubrication plugs and vents.
- Make certain that the power supply is disconnected before attempting to service or remove any components. Lock out the power supply and tag it to prevent unexpected application of power.
- Reducers are not to be considered fail safe or self-locking devices. If these features are required, a properly sized, independent holding device should be utilized. Reducers should not be used as a brake.
- Any brakes that are used in conjunction with a reducer must be sized or positioned in such a way so as to not subject the reducer to loads beyond the catalog rating.
- Lifting supports including eyebolts are to be used for vertically lifting the gearbox only and no other associated attachments or motors.
- Use of an oil with an EP additive on units with backstops may prevent proper operation of the backstop. Injury to personnel, damage to the reducer or other equipment may result.
- Overhung loads subject shaft bearings and shafts to stress which may cause premature bearing failure and/or shaft breakage from bending fatigue, if not sized properly.

CAUTION

- Test run unit to verify operation. If the unit tested is a prototype, that unit must be of current production.
- If the speed reducer cannot be located in a clear and dry area with access to adequate cooling air supply, then precautions must be taken to avoid the ingestion of contaminants such as water and the reduction in cooling ability due to exterior contaminants.
- Mounting bolts should be routinely checked to ensure that the unit is firmly anchored for proper operation.

Important Information

In the event of the resale of any of the goods, in whatever form, Resellers/Buyers will include the following language in a conspicuous place and in a conspicuous manner in a written agreement covering such sale:

The manufacturer makes no warranties or representations, express or implied, by operation of law or otherwise, as to the merchantability or fitness for a particular purpose of the goods sold hereunder. Buyer acknowledges that it alone has determined that the goods purchased hereunder will suitably meet the requirements of their intended use. In no event will the manufacturer be liable for consequential, incidental or other damages. Even if the repair or replacement remedy shall be deemed to have failed of its essential purpose under Section 2-719 of the Uniform Commercial Code, the manufacturer shall have no liability to Buyer for consequential damages.

Resellers/Buyers agree to also include this entire document including the warnings above in a conspicuous place and in a conspicuous manner in writing to instruct users on the safe usage of the product.

This instructions manual should be read together with all other printed information such as catalogs, supplied by LEESON ELECTRIC.



Instruction Manual



General Operation

1. Run the motor which drives the reducer and check the direction of reducer output rotation. Consult motor nameplate for instructions to reverse the direction of rotation.
2. Attaching the load: On direct coupled installations, check shaft and coupling alignment between speed reducer and loading mechanism. On chain/sprocket and belt/pulley installation, locate the sprocket or pulley as close to the oil seal as possible to minimize overhung load. Check to verify that the overhung load does not exceed specifications published in the catalog.
3. High momentum loads: If coasting to a stop is undesirable, a braking mechanism should be provided to the speed reducer output or the driven mechanism.



The system of connected rotating parts must be free from critical speed, torsional or other type vibration, no matter how induced. The responsibility for this system analysis lies with the purchaser of the speed reducer.

Installation

1. Mount the unit to a rigid flat surface using grade 5 or higher fasteners. The mounting fasteners should be the largest standard size that will fit in the base mounting hole. Shim as required under flange or base feet which do not lie flat against the mounting surface.
2. For shipment, pipe plugs are installed in the unit and a vent plug is packed separately. After mounting the unit in position, remove the appropriate pipe plug and install the vent plug in the location shown on page 5. On double reduction units both the primary and the secondary must be vented. Failure to vent the unit can cause premature seal wear or loss of seal and oil. These conditions are not covered by warranty. Check for correct oil level. Contact the factory for level and vent recommendations on non-standard mounting positions. **WASHGUARD® (BISSC)** units with Enviro-Seal do not use vents. See (Enviro-Seal) under **Lubrication** for further information.
3. **WASHGUARD® (BISSC)** units include synthetic oil and an Enviro-Seal pre-installed at the factory. It is not necessary to vent these units, and they can be used as supplied from the factory. Do not loosen the nut holding the stem of the Enviro-Seal, and do not block the hole in the stem. Do not blow pressurized air into the hole, and avoid spraying washdown chemicals directly into the hole.
4. Connect motor to speed reducer.



Depending upon gear geometry and operating conditions worm gear reducers may or may not backdrive. Special consideration should be given to high inertia loads connected to the output shaft. Consult the factory for further details.



DO NOT CHANGE MOUNTING POSITIONS WITHOUT CONTACTING FACTORY.
Altering the mounting position may require special lubrication provisions which must be factory installed.



Do not operate the reducer without making sure it contains the correct amount of oil. Do not overfill or underfill with oil, or injury to personnel, reducer or other equipment may result. **WASHGUARD®** units are lubed and sealed for life, so in most applications it will not be necessary to drain or re-fill the unit.



A unit cannot be used as an integral part of a machine superstructure which would impose additional loads on the unit other than those imposed by the torque being transmitted either through a shaft-mounted arrangement, and any shaft mounted power transmitting device. (e.g., sprockets, pulleys, couplings)



For safe operation and to maintain the unit warranty, when changing a factory installed fastener for any reason, it becomes the responsibility of the person making the change to properly account for fastener grade, thread engagement, load, tightening torque and the means of torque retention.

Lubrication - Standard Units

All standard reducers ordered from the factory are filled with synthetic lubricant to operate within a -10° to 105° F ambient temperature range. Double reduction units have separate oil sumps and must be filled/checked independently. Prior to startup, verify that the oil is at the level shown on the drawings on page 5.

Enviro-Seal: WASHGUARD® (BISSC) and stainless steel reducers come standard with an Enviro-Seal and synthetic oil pre-installed at the factory. It is not necessary to vent these reducers, and they can be used as supplied from the factory.



In the Food and Drug Industry (including animal food), consult the lubrication supplier for recommendation of lubricants which are acceptable to the Food and Drug Administration and/or other authoritative bodies having jurisdiction.



Do not mix different oils in the reducer. Oils should be compatible with Viton® seal material.



Instruction Manual



Lubrication

The reducer is properly filled at the factory with sufficient lubricant per customer specified mounting position. If position is not specified by customer, reducer will be filled to level in mounting position 1 (worm over) Reducer ordered with a "MOD" will be filled based on the factory assumed mounting position, mounting position should be specified with order to assure proper lubrication.

Factory Assumed Mounting Orientation	Applicable Unit Styles*	
Worm Over	B, T, F, H, FH, C D, DT, DF, DH, DFH DX, DXT, DXH, DXFH	Single Reduction Double Reduction Worm-Worm Double Reduction Helical-Worm
Worm Under	U DU	Single Reduction Double Reduction Worm-Worm
Vertical Output	VL, VH DVL, DVH DXVL, DXVH	Single Reduction Double Reduction Worm-Worm Double Reduction Helical-Worm
Vertical Input	J DJ DXJ	Single Reduction Double Reduction Worm-Worm Double Reduction Helical-Worm

* INCLUDES MOTORIZED COUPLING AND QUILL INPUT VERSIONS OF ALL STYLES LISTED

All standard IRONMAN BY OHIO GEAR™ Worm Reducers are factory filled with MOBIL SHC-634 lubricant, a synthesized hydrocarbon formulated for long life and wide operating temperature range (-25°F to +220°F). Change oil only when performing maintenance that requires gearbox disassembly.

If oil must be replaced, use only MOBIL SHC-634

Do not confuse MOBIL SHC-634 with MOBILGEAR 634. MOBILGEAR 634 is an EP type gear oil NOT suitable for use in the IRONMAN™ BY OHIO worm gear reducers.

SPECIAL LUBRICATION REQUIREMENTS - Size 830 & Larger

Please specify mounting position *with order* if any of the following applies:

- 1- Reducer is mounted with input or output shafts vertical
- 2- Input speed is less than 900 RPM
- 3- Reducer is mounted in inclined position

NOTE: The reducer may require modifications to assure proper lubrication in these applications.

For lubrication requirements of helical reducers (primaries of helical/worm reducers and ratio multipliers), contact factory.

Oil Capacities (ounces) - Standard Units

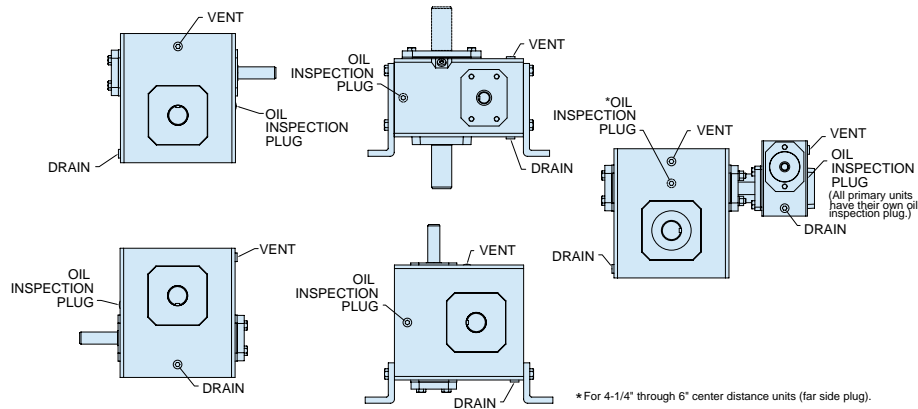
Mounting Position	UNIT SIZE										
	813	815	818	821	824	826	830	832	842	852	860
1-Worm Over	4	12	12	20	24	40	56	72	112	188	312
2-Worm Under	8	16	20	28	40	60	84	108	152	304	328
3-Vertical Output	4	16	16	28	32	48	68	88	128	248	320
4-Vertical Input	4	16	16	24	32	48	72	92	128	248	325
5-Worm Over on Secondary Unit of Double Reduction	—	—	—	N/A	N/A	N/A	N/A	192	308	320	485

16 OZ.	=	1 PINT
2 PINTS	=	1 QUART
4 QUARTS	=	1 GALLON
1 GALLON	=	128 OZ.



Always check for proper oil level after filling. Capacities vary somewhat with model and mounting position. Oil should rise to bottom edge of level hole. Do not overfill.

Standard Speed Reducer Mounting Positions & Vent Plug, Level and Drain Locations



Maintenance - Standard Units

Your IRONMAN BY OHIO GEAR™ reducer has been tested and adjusted at the factory. Dismantling or replacement of components must be done by LEESON to maintain the warranty.

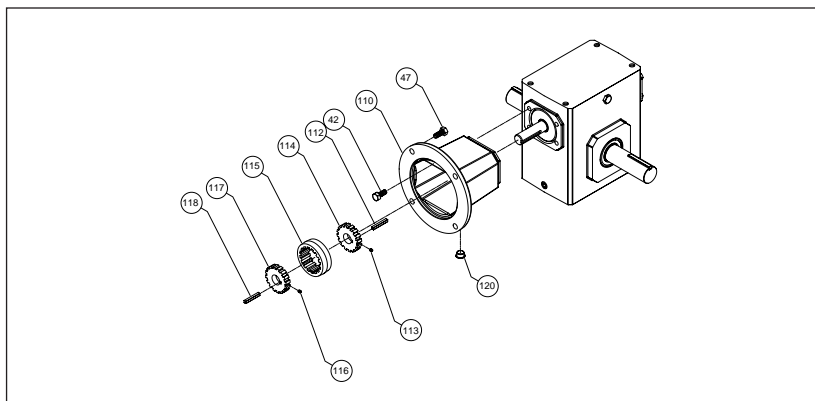
Inspect vent plug often to insure it is clean and operating.

CAUTION Mounting bolts should be routinely checked to ensure that the unit is firmly anchored for proper operation.

Seals: The IRONMAN BY OHIO GEAR™ line of speed reducers utilize premium quality seals which are the state-of-the-art in sealing technology. Seals are, however, a wear item and eventually need to be replaced. Replacement can be easily accomplished by following the steps below:

1. Remove the worn seal without damaging the shaft surface or the seal bore. This can be done by drilling a .062" diameter hole in the seal casing (being careful not to drill into the bearing behind the seal). Screw a #10 sheet metal screw into the hole and pry out the seal.
2. Clean the seal bore of sealant.
3. Before installing the new seal, use electrical tape to cover any keyways on the shaft to prevent seal lip damage.
4. Grease the seal lips with bearing grease and apply a sealant to the seal bore.
5. Slide the seal into the shaft being careful not to fold the inner lip over on any shaft steps.
6. Press the seal into its bore with a sleeve that presses on the seal casing, being careful to keep the seal square in its bore.

Installation Extended "C" Flange Adapter Kits With Flexible Couplings (BM Style)



These instructions must be followed for proper installation of "C" Flange Adapter and Motor onto IRONMAN BY OHIO GEAR™ Worm Reducers. These reducers have input ball bearings mounted directly in the housing, and no bearing cap on the input shaft side.

1. Make sure reducer pilot and face, and frame pilot and face are clean.
2. Install "C" Flange Adapter (ref. 110) onto reducer, being careful not to damage seal.
3. Install capscrews (ref. 42) and tighten to torque specified in tightening torque chart on page 6.
4. Install key (ref. 112) in the input shaft, key should be flush with shaft end. Install coupling hub (ref. 114) flush with end of reducer shaft.


OHIO GEAR™

Instruction Manual



5. Rotate input shaft of reducer to position the set screw (ref. 113) in line with access hole provided in the "C" flange adapter, tighten set screw (make sure key is properly in place under set screw).
6. Slide plastic sleeve (ref. 115) over reducer hub until it comes to a stop.
7. **Discard motor key** and install key supplied in kit (ref. 118) flush with motor shaft end. Install coupling hub (ref. 117) flush with end of motor shaft and tighten set screw (ref. 116), make sure key is under set screw.
8. Install motor by sliding hub into sleeve until it comes to a stop. Install capscrews (ref. 47) and tighten to torque specified on tightening torque chart.
9. **Install plastic plug (ref. 120) into the "C" Flange Adapter access hole.**

Items Included in "C" Flange Adapter Kit

- | | |
|--|--|
| 1. One "C" Flange Adapter (ref. 110) | 7. One coupling sleeve (ref. 115) |
| 2. Four capscrews (ref. 42) adapter to reducer | 8. One motor coupling hub (ref. 117) |
| 3. One reducer coupling hub (ref. 114) | 9. One motor shaft key (ref. 118) |
| 4. One reducer input key (ref. 112) | 10. One motor hub set screw (ref. 116) |
| 5. One reducer hub set screw (ref. 113) | 11. One access hole plug (ref. 120) |
| 6. Four capscrews (ref. 47), motor to adapter | |

Capscrew Tightening Torque Grade 5 Capscrews (dry, without lubricant)

Capscrew Size	Tightening Torque (lb.-in.)
1/4 UNC	75
5/16 UNC	155
3/8 UNC	275
1/2 UNC	780

Maintenance

Your **IRONMAN BY OHIO GEAR™** reducer has been tested and adjusted at the factory. Dismantling or replacement of components must be done by LEESON to maintain the warranty.

Inspect the stem of the Enviro-Seal often to ensure it is clean and operating properly.

CAUTION Mounting bolts should be routinely checked to ensure that the unit is firmly anchored for proper operation.

Seals: The **IRONMAN BY OHIO GEAR™** line of speed reducers utilize premium quality seals which are state-of-the-art in sealing technology. Seals are, however, a wear item and eventually need to be replaced. Replacement can easily be accomplished by following the procedure on page 5.

If seal leakage has resulted in the loss of a significant amount of oil, it may be necessary to add more lubricant. For normal ambient temperature conditions, LEESON recommends Mobil SHC 634 synthetic gear oil for worm drives, and Mobil SHC 150 for helical drives.

CAUTION Always check for proper oil level after filling. Do not overfill or underfill with oil, or injury to personnel, reducer, or other equipment may result.

CAUTION Do not mix different oils in the reducer.

Class of Service

All capacity ratings are based on proper application of American Gear Manufacturers Association (AGMA) service factors as given on page 174 of the **IRONMAN BY OHIO GEAR™** 8050 Catalog. Load conditions must be within cataloged ratings published in the current LEESON Catalog (available upon request).

Warranty From LEESON Electric - See 8050 catalog pages 185-187 for warranty terms and conditions.


LEESON ELECTRIC

 GRAFTON, WISCONSIN 53024-0241 U.S.A.
 TEL (262)377-8810 FAX (262)377-9025 www.leeson.com

A Subsidiary of REGAL-BELOIT CORPORATION


Mobil SHC 600 Series

Supreme Performance Gear and Bearing Oils

Product Description

Mobil SHC 600 Series lubricants are supreme performance gear and bearing oils designed to provide outstanding service in terms of equipment protection, oil life and problem-free operation. They are formulated from synthesised, wax-free hydrocarbon base fluids. The combination of a naturally high viscosity index and a unique, proprietary, additive system enables these products to provide outstanding performance in extreme service applications at high and low temperatures, well beyond the capabilities of mineral oils. These products are resistant to mechanical shear, even in heavily loaded gear and high shear bearing applications, so that there is virtually no loss of viscosity.

The Mobil SHC 600 Series products have low traction coefficients, which derive from the molecular structure of the base stocks used. This results in low fluid friction in the load zone of non-conforming surfaces such as gears and rolling contact bearings. Low fluid friction produces lower operating temperatures and improved gear efficiency, which translates into reduced power consumption. It also results in extended parts life and allows for more economical equipment design. The base oils used in the Mobil SHC 600 Series have outstanding response to antioxidant additives resulting in superior resistance to oxidation and sludging, especially at high temperatures. The additive combination used in these oils also provides exceptional resistance to rusting and corrosion, very good antiwear, demulsibility, foam control and air release properties, as well as multimetal compatibility. The Mobil SHC 600 Series oils are also compatible with the same seal and other construction materials used in equipment normally lubricated with mineral oils.

The leading edge technology on which Mobil SHC 600 Series lubricants have always been based has made these the products of choice for operators of a wide range of equipment, worldwide. While initially recognised as a high temperature problem solver, these products are now used in many industrial applications because of the range of benefits they offer.

Features & Benefits

The Mobil SHC brand of lubricants are recognised and appreciated around the world for their innovation and outstanding performance. These molecular designed synthetic products, pioneered by our research scientists, symbolise the continuing commitment to using advanced technology to provide outstanding lubricant products. A key factor in the development of Mobil SHC 600 Series were the close contacts between our scientists and application specialists with key OEMs to ensure that our product offerings will provide exceptional performance in the continually evolving industrial equipment designs.

Our work with equipment builders has helped confirm the results from our own laboratory tests showing the exceptional performance of the Mobil SHC 600 Series lubricants. Not least among the benefits, shown in work with OEMs, is the potential for significant efficiency improvements in changing from mineral oil. These benefits are particularly evident in equipment which, by design, cannot avoid low overall efficiency, such as high ratio wormgears.

To combat high thermal exposure of the oil, our product formulation scientists chose proprietary base oils for Mobil SHC 600 Series oils because of their exceptional thermal/oxidative resistance potential. Our formulators chose specific additives which would maximize the

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benefits of the base oils to provide exceptional oil life and deposit control and resistance to thermal/oxidative and chemical degradation, as well as the balance of the performance features. The wax-free nature of the base oil also provides low temperature fluidity characteristics unmatched by mineral products and is a key benefit for remote, low ambient temperature applications. The Mobil SHC 600 Series oils offer the following features and potential benefits:

Features	Advantages and Potential Benefits
Superb high temperature thermal/oxidation resistance	Extends equipment high temperature operating capability Long oil life, reduced need and costs for oil change outs Minimises sludges and deposits for trouble-free operation and long filter life
High Viscosity Index and absence of wax	Maintains viscosity and film thickness at high temperatures Exceptional low temperature performance, including start-up
Low traction coefficient	Reduces overall friction and can increase efficiency in sliding mechanisms such as gearing, with potential for reduced power consumption and lower steady-state operating temperatures. Minimises effects of micro slip in rolling contact bearings for longer rolling-element life potential
High load carrying capability	Protects equipment and extends life; minimises unexpected downtime and extends service periods
Balanced additive combination	Provides excellent performance in terms of rust & corrosion prevention, water separability, foam control, air release performance ensuring problem-free operation in a wide range of industrial applications and reduced operating costs

Applications

While Mobil SHC 600 Series are compatible with mineral oil based products, admixture may detract from their performance. Consequently it is recommended that before changing a system to one of the Mobil SHC 600 Series, it should be thoroughly cleaned out and flushed to achieve the maximum performance benefits. The Mobil SHC 600 Series oils are compatible with the following seal materials: fluorocarbon, polyacrylate, polyurethane ether, some silicone, ethylene/acrylic, chlorinated polyethylene, polysulfide, and some nitrile rubbers. There is the potential for substantial variations in the elastomers being used today. For best results, consult your equipment supplier, seal manufacturer, or your local Mobil representative to verify compatibility.

Mobil SHC 600 Series lubricants are recommended for use in a wide variety of gear and bearing applications where high or low temperatures are encountered or where operating temperatures or bulk oil temperatures are such that conventional lubricants give unsatisfactory life, or where improved efficiency is needed. They are particularly effective in applications where the maintenance costs of component replacement, system cleaning and lubricant changes are high. Specific applications include:

- Filled for life gearboxes, especially high ratio/ low-efficiency worm gears
- Remotely located gearboxes, where oil change-out is difficult
- Low temperature applications, such as ski lifts where seasonal oil changes can be avoided
- Mixer roll bearings and roll neck bearings where high temperatures are encountered
- Plastic calendars
- Severe centrifuge applications, including marine centrifuges
- Railroad A/C Traction Drives
- Mobil SHC 625, 627, 629 and 630 are suitable for Oil Flooded Rotary Screw Compressors compressing natural gas, field gas gathering, CO₂ and other process gasses used in the natural gas industry



Specifications & Approvals

Mobil SHC 600 Series has the following builder approvals	624	625	626	629	630	632	634	636	639
Cone Drive (US)							X		
Boston Gear (US)							X		

Typical Properties

Mobil SHC 600 Series	624	625	626	627	629	630	632	634	636	639
ISO Viscosity Grade	32	46	68	100	150	220	320	460	680	1000
Viscosity, ASTM D 445										
cSt @ 40° C	32.4	48.0	69.9	99.1	143	216	326	430	664	933
cSt @ 100° C	6.3	7.9	10.9	13.9	18.3	25.2	38.6	48.5	62.8	79.5
Viscosity Index, ASTM D 2270	148	135	146	143	144	152	169	173	165	164
Pour Point, °C, ASTM D 97	-54	-48	-48	-42	-45	-42	-39	-42	-42	-15
Flash Point, °C, ASTM D 92	240	252	236	248	228	235	250	262	236	270
Specific Gravity, ASTM D 4052, 15° C/15° C	0.85	.85	0.86	0.86	0.86	0.87	0.87	0.87	0.87	0.87
Appearance, visual	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange
TOST, ASTM D 943, Hours to 2 NN	10,000 +	10,000 +	10,000 +	10,000 +	10,000 +	10,000 +	10,000 +	10,000 +	10,000 +	10,000 +
RBOT, ASTM D 2272, min.	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Rust protection, ASTM D665, Sea Water	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Water Seperability, ASTM D 1401, Min. to 3 ml emulsion @ 54° C	10	10	10	-	-	-	-	-	-	-
Water Seperability, ASTM D 1401, Min. to 3 ml emulsion @ 82° C	-	-	-	15	15	15	25	25	30	40
Copper Corrosion, ASTM D130, 24 hrs @ 121° C	1B	1B	1B	1B	1B	1B	1B	1B	1B	1B
Foam Test, ASTM D 892, Seq I,II,III Tendency / Stability, ml/ml										
Seq I	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
Seq II	20/0	0/0	0/0	0/0	0/0	0/0	0/0	20/0	0/0	0/0
Seq III	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
FZG scuffing test, DIN 51534 (mod), A/16.6/90, Failure Stage	10	11	11	13	13	13+	13+	13+	13+	13+

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Health & Safety

Based on available information, this product is not expected to produce adverse effects on health when used for the intended application and the recommendations provided in the Material Safety Data Sheet (MSDS) are followed. MSDS's are available upon request through your sales contract office, or via the Internet. This product should not be used for purposes other than its intended use. If disposing of used product, take care to protect the environment.

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602912-00 MOBIL SHC 634
MATERIAL SAFETY DATA BULLETIN

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: MOBIL SHC 634
SUPPLIER: EXXONMOBIL OIL CORPORATION
3225 GALLOWS RD.
FAIRFAX, VA 22037

24 - Hour Health and Safety Emergency (call collect): 609-737-4411

24 - Hour Transportation Emergency:
CHEMTREC: 800-424-9300 202-483-7616
LUBES AND FUELS: 281-834-3296

Product and Technical Information:
Lubricants and Specialties: 800-662-4525 800-443-9966
Fuels Products: 800-947-9147
MSDS Fax on Demand: 613-228-1467
MSDS Internet Website: <http://emmsds.ihssolutions.com/>

2. COMPOSITION/INFORMATION ON INGREDIENTS

CHEMICAL NAMES AND SYNONYMS: SYN. HYDROCARBONS AND ADDITIVES

GLOBALLY REPORTABLE MSDS INGREDIENTS:

None.

See Section 8 for exposure limits (if applicable).

3. HAZARDS IDENTIFICATION

Under normal conditions of use, this product is not considered hazardous according to regulatory guidelines (See section 15).

EMERGENCY OVERVIEW: Orange Liquid. DOT ERG No. : NA

POTENTIAL HEALTH EFFECTS: Under normal conditions of intended use, this product does not pose a risk to health. Excessive exposure may result in eye, skin or respiratory irritation.

For further health effects/toxicological data, see Section 11.

4. FIRST AID MEASURES

EYE CONTACT: Flush thoroughly with water. If irritation occurs, call a physician.

SKIN CONTACT: Wash contact areas with soap and water. Remove and clean oil soaked clothing daily and wash affected area. (See Section 16 - Injection Injury)

INHALATION: Not expected to be a problem. However, if respiratory irritation, dizziness, nausea, or unconsciousness occurs due to excessive vapor or mist exposure, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or mouth-to-mouth resuscitation.

INGESTION: Not expected to be a problem. Seek medical attention if discomfort occurs. Do not induce vomiting.

5. FIRE-FIGHTING MEASURES

EXTINGUISHING MEDIA: Carbon dioxide, foam, dry chemical and water fog.

SPECIAL FIRE FIGHTING PROCEDURES: Water or foam may cause frothing.

Use water to keep fire exposed containers cool. Water spray may be used to flush spills away from exposure. Prevent runoff from fire control or dilution from entering streams, sewers, or drinking water supply.

SPECIAL PROTECTIVE EQUIPMENT: For fires in enclosed areas, fire fighters must use self-contained breathing apparatus.

UNUSUAL FIRE AND EXPLOSION HAZARDS: None.

COMBUSTION PRODUCTS: Fumes, smoke, carbon monoxide, sulfur oxides, aldehydes and other decomposition products, in the case of incomplete combustion.

Flash Point C(F): > 93(200) (ASTM D-93).

Flammable Limits (approx.% vol.in air) - LEL: 0.9%, UEL: 7.0%

NFPA HAZARD ID: Health: 0, Flammability: 1, Reactivity: 0

6. ACCIDENTAL RELEASE MEASURES

NOTIFICATION PROCEDURES: Report spills/releases as required to appropriate authorities. U.S. Coast Guard and EPA regulations require immediate reporting of spills/releases that could reach any waterway including intermittent dry creeks. Report spill/release to Coast Guard National Response Center toll free number (800)424-8802. In case of accident or road spill notify CHEMTREC (800) 424-9300.

PROCEDURES IF MATERIAL IS RELEASED OR SPILLED:

LAND SPILL: Shut off source taking normal safety precautions. Take measures to minimize the effects on ground water. Recover by pumping or contain spilled material with sand or other suitable absorbent and remove mechanically into containers. If necessary, dispose of adsorbed residues as directed in Section 13.

WATER SPILL: Confine the spill immediately with booms. Warn other ships in the vicinity. Notify port and other relevant authorities. Remove from the surface by skimming or with suitable absorbents. If

permitted by regulatory authorities the use of suitable dispersants should be considered where recommended in local oil spill procedures.

ENVIRONMENTAL PRECAUTIONS: Prevent material from entering sewers, water sources or low lying areas; advise the relevant authorities if it has, or if it contaminates soil/vegetation.

PERSONAL PRECAUTIONS: See Section 8

7. HANDLING AND STORAGE

HANDLING: No special precautions are necessary beyond normal good hygiene practices. See Section 8 for additional personal protection advice when handling this product.

STORAGE: Keep containers closed when not in use. Do not store in open or unlabelled containers. Store away from strong oxidizing agents and combustible materials. Do not store near heat, sparks, flame or strong oxidants.

SPECIAL PRECAUTIONS: Prevent small spills and leakages to avoid slip hazard.

EMPTY CONTAINER WARNING: Empty containers retain residue (liquid and/or vapor) and can be dangerous. DO NOT PRESSURIZE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION; THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. Do not attempt to refill or clean container since residue is difficult to remove. Empty drums should be completely drained, properly bunged and promptly returned to a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

OCCUPATIONAL EXPOSURE LIMITS:

When mists/aerosols can occur, the following are recommended: 5 mg/m³ (as oil mist)- ACGIH Threshold Limit Value (TLV), 10 mg/m³ (as oil mist) - ACGIH Short Term Exposure Limit (STEL), 5 mg/m³ (as oil mist) - OSHA Permissible Exposure Limit (PEL)

VENTILATION: If mists are generated, use adequate ventilation, local exhaust or enclosures to control below exposure limits.

RESPIRATORY PROTECTION: If mists are generated, and/or when ventilation is not adequate, wear approved respirator.

EYE PROTECTION: If eye contact is likely, safety glasses with side shields or chemical type goggles should be worn.

SKIN PROTECTION: Not normally required. When splashing or liquid contact can occur frequently, wear oil resistant gloves and/or other protective clothing. Good personal hygiene practices should always be followed.

9. PHYSICAL AND CHEMICAL PROPERTIES

Typical physical properties are given below. Consult Product Data Sheet

for specific details.

APPEARANCE: Liquid
COLOR: Orange
ODOR: Mild
ODOR THRESHOLD-ppm: NE
pH: NA
BOILING POINT C(F): > 316(600)
MELTING POINT C(F): NA
FLASH POINT C(F): > 93(200) (ASTM D-93)
FLAMMABILITY (solids): NE
AUTO FLAMMABILITY C(F): NA
EXPLOSIVE PROPERTIES: NA
OXIDIZING PROPERTIES: NA
VAPOR PRESSURE-mmHg 20 C: < 0.1
VAPOR DENSITY: > 2.0
EVAPORATION RATE: NE
RELATIVE DENSITY, 15/4 C: 0.86-1
SOLUBILITY IN WATER: Negligible
PARTITION COEFFICIENT: > 3.5
VISCOSITY AT 40 C, cSt: > 20.0
VISCOSITY AT 100 C, cSt: NE
POUR POINT C(F): < -30(-22)
FREEZING POINT C(F): NE
VOLATILE ORGANIC COMPOUND: NE
DMSO EXTRACT, IP-346 (WT.%): <3, for mineral oil only
NA=NOT APPLICABLE NE=NOT ESTABLISHED D=DECOMPOSES

FOR FURTHER TECHNICAL INFORMATION, CONTACT YOUR MARKETING REPRESENTATIVE

10. STABILITY AND REACTIVITY

STABILITY (THERMAL, LIGHT, ETC.): Stable.
CONDITIONS TO AVOID: Extreme heat and high energy sources of ignition.
INCOMPATIBILITY (MATERIALS TO AVOID): Strong oxidizers.
HAZARDOUS DECOMPOSITION PRODUCTS: Product does not decompose at ambient temperatures.
HAZARDOUS POLYMERIZATION: Will not occur.

11. TOXICOLOGICAL DATA

---ACUTE TOXICOLOGY---

ORAL TOXICITY (RATS): Practically non-toxic (LD50: greater than 2000 mg/kg). ---Based on testing of similar products and/or the components.
DERMAL TOXICITY (RABBITS): Practically non-toxic (LD50: greater than 2000 mg/kg). ---Based on testing of similar products and/or the components.
INHALATION TOXICITY (RATS): Practically non-toxic (LC50: greater than 5 mg/l). ---Based on testing of similar products and/or the components.
EYE IRRITATION (RABBITS): Practically non-irritating. (Draize score: greater than 6 but 15 or less). ---Based on testing of similar products and/or the components.
SKIN IRRITATION (RABBITS): Practically non-irritating. (Primary

Irritation Index: greater than 0.5 but less than 3). ---Based on testing of similar products and/or the components.
OTHER ACUTE TOXICITY DATA: Although an acute inhalation study was not performed with this product, a variety of mineral and synthetic oils, such as those in this product, have been tested. These samples had virtually no effect other than a nonspecific inflammatory response in the lung to the aerosolized mineral oil. The presence of additives in other tested formulations (in approximately the same amounts as in the present formulation) did not alter the observed effects.

---SUBCHRONIC TOXICOLOGY (SUMMARY)---

No significant adverse effects were found in studies using repeated dermal applications of similar formulations to the skin of laboratory animals for 13 weeks at doses significantly higher than those expected during normal industrial exposure. The animals were evaluated extensively for effects of exposure (hematology, serum chemistry, urinalysis, organ weights, microscopic examination of tissues etc.).

---REPRODUCTIVE TOXICOLOGY (SUMMARY)---

No teratogenic effects would be expected from dermal exposure, based on laboratory developmental toxicity studies of major components in this formulation and/or materials of similar composition.

---CHRONIC TOXICOLOGY (SUMMARY)---

Repeated and/or prolonged exposure may cause irritation to the skin, eyes or respiratory tract. Overexposure to oil mist may result in oil droplet deposition and/or granuloma formation. For mineral base oils: Base oils in this product are severely solvent refined and/or severely hydrotreated. Chronic mouse skin painting studies of severely treated oils showed no evidence of carcinogenic effects. These results are confirmed on a continuing basis using various screening methods such as Modified Ames Test, IP-346, and/or other analytical methods. For synthetic base oils: The base oils in this product have been tested in the Ames assay and other tests of mutagenicity with negative results. These base oils are not expected to be carcinogenic with chronic dermal exposures.

---SENSITIZATION (SUMMARY)---

Not expected to be sensitizing based on tests of this product, components, or similar products.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL FATE AND EFFECTS:

In the absence of specific environmental data for this product, this assessment is based on information for representative products.

ECOTOXICITY: Available ectotoxicity data (LL50 >1000 mg/L) indicates that adverse effects to aquatic organisms are not expected from this product.

MOBILITY: When released into the environment, adsorption to sediment and soil will be the predominant behavior.

PERSISTENCE AND DEGRADABILITY: This product is expected to be inherently biodegradable.

BIOACCUMULATIVE POTENTIAL: Bioaccumulation is unlikely due to the very low water solubility of this product, therefore bioavailability to aquatic organisms is minimal.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL: Product is suitable for burning in an enclosed, controlled burner for fuel value. Such burning may be limited pursuant to the Resource Conservation and Recovery Act. In addition, the product is suitable for processing by an approved recycling facility or can be disposed of at an appropriate government waste disposal facility. Use of these methods is subject to user compliance with applicable laws and regulations and consideration of product characteristics at time of disposal.

RCRA INFORMATION: The unused product, in our opinion, is not specifically listed by the EPA as a hazardous waste (40 CFR, Part 261D), nor is it formulated to contain materials which are listed hazardous wastes. It does not exhibit the hazardous characteristics of ignitability, corrosivity, or reactivity. The unused product is not formulated with substances covered by the Toxicity Characteristic Leaching Procedure (TCLP). However, used product may be regulated.

14. TRANSPORT INFORMATION

USA DOT: NOT REGULATED BY USA DOT.

RID/ADR: NOT REGULATED BY RID/ADR.

IMO: NOT REGULATED BY IMO.

IATA: NOT REGULATED BY IATA.

STATIC ACCUMULATOR (50 picosiemens or less): YES

15. REGULATORY INFORMATION

US OSHA HAZARD COMMUNICATION STANDARD: When used for its intended purposes, this product is not classified as hazardous in accordance with OSHA 29 CFR 1910.1200.

EU Labeling: Product is not dangerous as defined by the European Union Dangerous Substances/Preparations Directives. EU labeling not required.

Governmental Inventory Status: All components comply with TSCA, EINECS/ELINCS, and DSL.

U.S. Superfund Amendments and Reauthorization Act (SARA) Title III: This product contains no "EXTREMELY HAZARDOUS SUBSTANCES".

SARA (311/312) REPORTABLE HAZARD CATEGORIES: None.

This product contains no chemicals subject to the supplier notification requirements of SARA (313) toxic release program.

THIS PRODUCT HAS BEEN AUTHORIZED BY USDA FOR USE UNDER THE FOLLOWING CATEGORY: This product is acceptable as a lubricant where there is no possibility of food contact (complies with earlier USDA guidelines for H-2 lubricant use).

The following product ingredients are cited on the lists below:

CHEMICAL NAME	CAS NUMBER	LIST CITATIONS *
NAPHTHALENE (COMPONENT ANALYSIS) (<0.01%)	91-20-3	16, 22

--- REGULATORY LISTS SEARCHED ---

1=ACGIH ALL	6=IARC 1	11=TSCA 4	16=CA P65 CARC	21=LA RTK
2=ACGIH A1	7=IARC 2A	12=TSCA 5a2	17=CA P65 REPRO	22=MI 293
3=ACGIH A2	8=IARC 2B	13=TSCA 5e	18=CA RTK	23=MN RTK
4=NTP CARC	9=OSHA CARC	14=TSCA 6	19=FL RTK	24=NJ RTK
5=NTP SUS	10=OSHA Z	15=TSCA 12b	20=IL RTK	25=PA RTK
				26=RI RTK

* EPA recently added new chemical substances to its TSCA Section 4 test rules. Please contact the supplier to confirm whether the ingredients in this product currently appear on a TSCA 4 or TSCA 12b list.

Code key: CARC=Carcinogen; SUS=Suspected Carcinogen; REPRO=Reproductive

16. OTHER INFORMATION

USE: LUBRICANT

NOTE: PRODUCTS OF EXXON MOBIL CORPORATION AND ITS AFFILIATED COMPANIES ARE NOT FORMULATED TO CONTAIN PCBS.

Health studies have shown that many hydrocarbons pose potential human health risks which may vary from person to person. Information provided on this MSDS reflects intended use. This product should not be used for other applications. In any case, the following advice should be considered:

INJECTION INJURY WARNING: If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

INDUSTRIAL LABEL

Under normal conditions of intended use, this product does not pose a risk to health. Excessive exposure may result in eye, skin or respiratory irritation. Always observe good hygiene measures. First Aid: Wash skin with soap and water. Flush eyes with water. If overcome by fumes or vapor, remove to fresh air. If ingested do not induce vomiting. If symptoms persist seek medical assistance. Read and understand the MSDS before using this product.

For Internal Use Only: MHC: 1* 1* 1* 1* 1*, MPPEC: A, TRN: 602912-00,
ELIS: 400007, CMCS97: 970321, REQ: US - MARKETING, SAFE USE: L
EHS Approval Date: 04APR2002

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Prepared by: ExxonMobil Oil Corporation
Environmental Health and Safety Department, Clinton, USA



3F05-1



3L05-1



F6-1798 (1 per pack)

ADJUSTABLE SNAP DISC FAN & LIMIT CONTROLS

Adjustable Snap Disc Thermostat Allows You to Set the Temperature Set Point to Match Your Specific Needs Which Simplifies Inventory

FEATURES

- ¼" quick connect terminals are standard.
- Reduces inventory while providing coverage for a wide range of temperature applications.
- Replaces the majority of fixed disc thermostats now on heating equipment and various appliances.
- 2 adjustable fan control models replace 7 fixed snap disc models.
- 4 adjustable limit control models replace 10 fixed snap disc models.

SPECIFICATIONS

ELECTRICAL RATINGS

VAC	Resistive (Non-Inductive)	Motor Rating (Inductive)		Pilot Duty
		Full Load	Locked Rotor	
120	25.0A	14.0A	72.0A	125 VA
240	25.0A	10.0A	60.0A	125 VA

PARTS AND ACCESSORIES

- F6-1798 Adapter plates (Order separately) — 1 per pack

Model Number	Temperature Range	Differential	Switch Action	Function	Accessories	Therm-O-Disc Part Number
3F05-1	90 to 130°F	20°F	SPST	Fan Controls (Close on Rise)	Includes thermostat and tab-to-screw terminals.	74T12-310708
3F05-2	140 to 180°F	20°F	SPST			74T12-310709
3L05-1	135 to 175°F	40°F	SPST	Limit Controls (Open on Rise)		74T11-310710
3L05-2	175 to 215°F	40°F	SPST			74T11-310711
3L05-3	210 to 250°F	40°F	SPST	74T11-310712		
3L05-10	135 to 175°F	20°F	SPST	74T11-310724		
3L05-13	250 to 290°F	40°F	SPST	74T11-310730		
3F05-3	90 to 130°F	20°F	SPST	Fan Controls (Close on Rise)	Includes thermostat, tab-to-screw terminals, adapter bracket and mounting screws.	74T12-310708
3F05-4	140 to 180°F	20°F	SPST			74T12-310709
3L05-4	135 to 175°F	40°F	SPST	Limit Controls (Open on Rise)		74T11-310710
3L05-5	175 to 215°F	40°F	SPST			74T11-310711
3L05-6	210 to 250°F	40°F	SPST	74T11-310712		

APPLIANCE



757-1



775-1

FLUSH MOUNT FAN OR LIMIT CONTROLS/ ATTIC FAN CONTROL

Ideal for Replacement of Similar Type Controls

FEATURES

- For use where space is limited.
- Small bimetal sensing element.
- Snap-Action switch.
- Fan control has adjustable range with direct reading temperature dial.
- **758** has adjustable limit setting.

SPECIFICATIONS

Dimensions for 757 & 758 1" H x 3" W x 1 1/4" D
Dimensions for 775 2.8" H x 3.59" W x 2.02" D

Model Number	Description	Range	Differential	Switch Action	Motor Rating – Full Load		Pilot Duty
					120 VAC	240 VAC	
757-1	Fan	70 to 160°F ① (21 to 71°C)	Fixed 25°F (14°C)	Close on Rise	8.0 A	4.0 A	125 VA
758-1	Limit	110 to 200°F ② (43 to 93°C)	Fixed 25°F (14°C)	Open on Rise	8.0 A	4.0 A	125 VA
NEW! 775-1	Attic Fan Control with Thermal Limiter	60 to 120°F ③ (15 to 49°C)	Fixed 10°F (6°C)	Close on Rise	9.0 A	—	—

- ① Cut-in setting (cut-out is cut-in setting minus the differential)
② Cut-out setting (cut-in is cut-out setting minus the differential)
③ Thermal limiter opens at 183°F (84°C)



416-4

SINGLE FAN OR LIMIT CONTROL

Starts and Stops Fan Operation and the 416-4 Provides Positive Reliable High Limit Protection on Warm Air Furnaces

FEATURES

- Specially designed hydraulic action element can be bent to any position.
- Temperature dial calibrated in °F and °C and can be adjusted through cover.
- Easy to set cut-in and cut-out indicators on adjustable differential.
- Dustproof steel case has top and bottom knockouts.
- SPDT for use as fan or limit, also as fan “selector” on 2-speed blower application

SPECIFICATIONS

Dimensions 5 3/8" H x 2 5/16" W x 1 7/8" D
Finish Grey
Agency U.L. listed and C.S.A. certified

Model Number	Range	Differential	Length	Switch Action	Full Electrical Rating	Motor Rating (Full Load)		Valves & Relays
						12 VAC	240 VAC	
416-4 ① ②	100 to 350°F (38 to 177°C)	Fixed 20°F (11°C)	9"	SPDT	HH See page 219	7.4A	3.7A	2.9A

- ① Includes a standoff bracket for high temperature mounting.
② U.L. approved adjustable dial stop, factory set at 250°F maximum.

Power Drive:	Mfg. Number	BNW Ind. Number
1 15/16" Insert Bearing	210-31	BSC-01PEB1.94
1 15/16" Pillow Block Bearing	P210-31	BSC-01PEPBB156
1 15/16" Slot Take-Up Bearing	T210-31	BSC-01PEBM.69
1" Pillow Block Bearing	P205-16	BSC-01PEBPB1
1" Slot Take-Up Bearing	T205-16	BSC-01PESTU1
Gearbox Multiplier 5:1	TXQ1-5-56C-56C	GBM-01ALGB-HPF-5M
Gearbox Multiplier 4:1	TXQ1-4-56C-56C	GBM-01ALGB-HPF-4M
Gearbox Multiplier 3:1	TXQ1-3-56C-56C	GBM-01ALGB-HPF-3M
Gearbox Multiplier 2:1	TXQ1-2-56C-56C	GBM-01ALGB-HPF-2M
Conveyor Gearbox 30HWYF	30HWYF -2-1.9375-56C-(Ratio)	GBM-01ALGB30-(Ratio)
Conveyor Gearbox 32HWYF	32HWYF -2-1.9375-56C-(Ratio)	GBM-01ALGB32-(Ratio)
Conveyor Gearbox 42HWYF	42HWYF -2-1.9375-56C-(Ratio)	GBM-01ALGB42-(Ratio)
Auto Fines Clean Out Gearbox	26DYF-1-1.00-56C-400	GBM-01ALGB26-400
Stirrer Gearbox	30YF-2-1.9375-56C-(Ratio)	GBM-01ALGB30-YF(Ratio)
Conveyor Drive Motor	3/4 HP 56C INVERTER DUTY	GBM-01LEM.75-ID
Fan Motor	HP?	VARIOUS
Aux. Motor	HP?	VARIOUS
Conveyor Belting - Coarse-SS	B-60-48-16 SS	RWL-01PEN16WSS
Conveyor Belting - Coarse-Galv.	B-60-48-16 Galv.	RWL-01PEN16WG
Conveyor Belting - Compound-SS	CB2-120-96-18 SS	RWL-01IWCB218SS
Conveyor Belting - Compound-Galv.'	CB2-120-96-18 Galv.	RWL-01IWCB218G
Conveyor Belting - S Trays	Solid Tray	RWL-01BNWSIT
Lagging 6' ___ 8' ___		RWL-01BNHBL
Lagging Vulcanized 6' ___ 8' ___		RWL-01BNVL
Fan 24" Alum. Or Steel-Blades # ___		FAR-01JLF24L
Fan 28" Alum. Or Steel-Blades # ___		FAR-01JLF28L
Fan 34" Alum. Or Steel-Blades # ___		FAR-01JLF34L
Fan 38" Alum. Or Steel-Blades # ___		FAR-01JLF38L

Electrical:	Mfg. Number	BNW Ind. Number
Fuses	Type? Amp?	VARIOUS
Push Button NC/NO	ABW111 NC/NO	ELE-01VMPB
Hi Limit Snapdisc (250 F Max.)	3L05-3	GVL-01VMLCSD
Hi Limit Snapdisc (290 F Max.)	3L05-13	GVL-01VMLCSD-H
Hi Limit NC/NO contactor	416-4	GVL-01VMLCO
Hi Limit Bi-Metal (500 F Max.)	M-51-74	GVL-01VMLC-BM
Ignition Transformer	A06-SA6	ELE-01WEIT
Machine Tool Transformer	50-0150-053	ELE-01VMT
Fuse Block for Machine Tool	265B	ELE-01VMTFB
AC Relay		ELE-01DARAC
Panel Light-Amber	SL53416-6	ELE-01SSPLA
Panel Light-Red	SL53415-6	ELE-01SSPLR
Disconnect Pistol Handle	BDH47	ELE-01STDH
Disconnect Selector Handle	BDSL105	ELE-01STDSh

Parts Order Form

From: _____

Date: _____

Address: _____

Serial No. _____

Model No. _____

1 Part Description: _____

BNW Number: _____ Amount: _____

2 Part Description: _____

BNW Number: _____ Amount: _____

3 Part Description: _____

BNW Number: _____ Amount: _____

4 Part Description: _____

BNW Number: _____ Amount: _____

Date Needed _____

All parts shipped FOB Factory Tippecanoe, IN 46570

Fax: 219-353-8152
Phone: 219-353-7855
Email: sales@belt-o-matic.com

Mail: BNW Industries
7930 N 700 E
Tippecanoe, IN 46570