



# **Integral Horsepower DC Motor**

**Installation & Operating Manual**

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# Section 1

## General Information

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

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

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

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

### Limited Warranty

1. Baldor Electric motors are warranted for a period of one (1) year, from date of shipment from the factory or factory warehouse against defects in material and workmanship. To allow for stocking and/or fabrication period and to provide one year of actual service, the warranty period is extended for an additional period of six (6) months for a total of eighteen (18) months from the original date of shipment from the factory or factory warehouse stock. In no case will the warranty period be extended for a longer period. Baldor extends this limited warranty to each buyer of the electric motor for the purpose of resale and to the original purchaser for use.
2. Baldor will, at its option repair or replace a motor which fails due to defects in material or workmanship during the warranty period if:
  - a. the purchaser presents the defective motor at or ships it prepaid to, the Baldor plant in Fort Smith, Arkansas or one of the Baldor Authorized Service Centers and
  - b. the purchaser gives written notification concerning the motor and the claimed defect including the date purchased, the task performed by the Baldor motor and the problem encountered.
3. Baldor will not pay the cost of removal of any electric motor from any equipment, the cost of delivery to Fort Smith, Arkansas or a Baldor Authorized Service Center, or the cost of any incidental or consequential damages resulting from the claimed defects. (Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply to you.) Any implied warranty given by laws shall be limited to the duration of the warranty period hereunder. (Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.)
4. Baldor Authorized Service Centers, when convinced to their satisfaction that a Baldor motor developed defects in material or workmanship within the warranty period, are authorized to proceed with the required repairs to fulfill Baldor's warranty when the cost of such repairs to be paid by Baldor does not exceed Baldor's warranty repair allowance. Baldor will not pay overtime premium repair charges without prior written authorization.
5. The cost of warranty repairs made by centers other than Baldor Authorized Service Centers **WILL NOT** be paid unless first authorized in writing by Baldor.
6. Claims by a purchaser that a motor is defective even when a failure results within one hour after being placed into service are not always justified. Therefore, Baldor Authorized Service Centers must determine from the condition of the motor as delivered to the center whether or not the motor is defective. If in the opinion of a Baldor Authorized Service Center, a motor did not fail as a result of defects in material or workmanship, the center is to proceed with repairs only if the purchaser agrees to pay for such repairs. If the decision is in dispute, the purchaser should still pay for the repairs and submit the paid invoice and the Authorized Service Center's signed service report to Baldor for further consideration.
7. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

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**Safety Notice:**

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

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

- WARNING:** Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.
- WARNING:** Be sure the system is properly grounded before applying power. Do not apply power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury. National Electrical Code and Local codes must be carefully followed.
- WARNING:** Avoid extended exposure to machinery with high noise levels. Be sure to wear ear protective devices to reduce harmful effects to your hearing.
- WARNING:** This equipment may be connected to other machinery that has rotating parts or parts that are driven by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt to install operate or maintain this equipment.
- WARNING:** Do not by-pass or disable protective devices or safety guards. Safety features are designed to prevent damage to personnel or equipment. These devices can only provide protection if they remain operative.
- WARNING:** Avoid the use of automatic reset devices if the automatic restarting of equipment can be hazardous to personnel or equipment.
- WARNING:** Be sure the load is properly coupled to the motor shaft before applying power. The shaft key must be fully captive by the load device. Improper coupling can cause harm to personnel or equipment if the load decouples from the shaft during operation.
- WARNING:** Use proper care and procedures that are safe during handling, lifting, installing, operating and maintaining operations. Improper methods may cause muscle strain or other harm.
- WARNING:** Before performing any motor maintenance procedure, be sure that the equipment connected to the motor shaft cannot cause shaft rotation. If the load can cause shaft rotation, disconnect the load from the motor shaft before maintenance is performed. Unexpected mechanical rotation of the motor parts can cause injury or motor damage.
- WARNING:** Disconnect all electrical power from the motor windings and accessory devices before disassembly of the motor. Electrical shock can cause serious or fatal injury.
- WARNING:** Do not use these motors in the presence of flammable or combustible vapors or dust. These motors are not designed for atmospheric conditions that require explosion proof construction.

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**Safety Notice** Continued

- WARNING:** UL listed motors must only be serviced by authorized Baldor Service Centers if these motors are to be returned to a flammable and/or explosive atmosphere.
- WARNING:** Thermostat contacts automatically reset when the motor has slightly cooled down. To prevent injury or damage, the control circuit should be designed so that automatic starting of the motor is not possible when the thermostat resets.
- Caution:** To prevent premature equipment failure or damage, only qualified maintenance personnel should perform maintenance.
- Caution:** Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load from the motor shaft before moving the motor.
- Caution:** If eye bolts are used for lifting a motor, be sure they are securely tightened. The lifting direction should not exceed a 20° angle from the shank of the eye bolt or lifting lug. Excessive lifting angles can cause damage.
- Caution:** To prevent equipment damage, be sure that the electrical service is not capable of delivering more than the maximum motor rated amps listed on the rating plate.
- Caution:** If a HI POT test (High Potential Insulation test) must be performed, follow the precautions and procedure in NEMA MG 1 and MG 2 standards to avoid equipment damage.

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

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## **Receiving**

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

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

## **Storage**

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

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

## **Unpacking**

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

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

## **Handling**

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

1. Use the lugs or eye bolts provided to lift the motor. Never attempt to lift the motor and additional equipment connected to the motor by this method. The lugs or eye bolts provided are designed to lift only the motor. Never lift the motor by the motor shaft.
2. If the motor must be mounted to a plate with the driven equipment such as pump, compressor etc., it may not be possible to lift the motor alone. For this case, the assembly should be lifted by a sling around the mounting base. The entire assembly can be lifted for installation. Do not lift using the motor lugs or eye bolts provided.

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

## **Lifting Magnet Generators**

Treat Baldor lifting magnet generators like motors during installation or maintenance. Generally, they have standard compound self-excited fields. Standard magnetism is for counter-clockwise rotation (facing the drive end of the motor). To reverse (operate clockwise), refer to the connection diagrams in Section 4 of this manual.

## Section 2 Installation & Operation

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### Overview

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

### Location

The motor should be installed in an area that is protected from direct sunlight, corrosives, harmful gases or liquids, dust, metallic particles, and vibration. Exposure to these can reduce the operating life and degrade performance. Be sure to allow clearance for ventilation and access for cleaning, repair, service and inspections. Ventilation is extremely important. Be sure the area for ventilation is not obstructed. Obstructions will limit the free passage of air. Motors get warm and the heat must be dissipated to prevent damage.

These motors are not designed for atmospheric conditions that require explosion proof operation. They must **NOT** be used in the presence of flammable or combustible vapors or dust.

TEFC motors can be used for indoor or outdoor standard service. They cannot be used outdoors where they would be exposed to freezing rain. Standard TEFC motors are not designed for atmospheric conditions requiring explosion-proof operation, such as flammable or combustible vapors or dust.

### Mounting

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

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

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

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

### Alignment

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

#### 1. **Direct Coupling**

For direct drive, use flexible couplings if possible. Consult the drive or equipment manufacturer for more information. Mechanical vibration and roughness during operation may indicate poor alignment. Use dial indicators to check alignment. The space between coupling hubs should be maintained as recommended by the coupling manufacturer.

#### 2. **End-Play Adjustment**

The axial position of the motor frame with respect to its load is also extremely important. The motor bearings are not designed for excessive external axial thrust loads. Improper adjustment will cause failure.

#### 3. **Pulley Ratio**

The pulley ratio should not exceed 8:1. Consult your Baldor distributor or authorized Baldor Service Center for further information.

#### 4. **Belt Drive**

Refer to NEMA MG 1 section 14.07 or Baldor application section for the application of pulleys, sheaves, sprockets, and gears. Align sheaves carefully to minimize belt wear and axial bearing loads (see End-Play Adjustment). Belt tension should be sufficient to prevent belt slippage at rated speed and load. However, belt slippage may occur during starting. Do not over-tension belts.



## **Doweling & Bolting**

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

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

## **Power Connection**

Motor and control wiring, overload protection, disconnects, accessories and grounding should conform to the National Electrical Code and local codes and practices. Ground the motor by attaching a strap from an established ground point to the grounding bolt provided inside the conduit box.

### **Conduit Box**

For ease of making connections, an oversize conduit box is provided. The box can be rotated 360° in 90° increments.

### **Power**

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

1. DC power is within  $\pm 5\%$  of rated voltage (not to exceed 600VDC). (See motor name plate for ratings).

### **OR**

2. DC field power is within  $\pm 1\%$  of rated voltage.

### **Motor Connections**

Terminal connections should be made as specified. See the connection diagrams located in Section 4 of this manual. Tables 2-1 and 2-2 show the NEMA standard lead markings and the Accessory Markings.

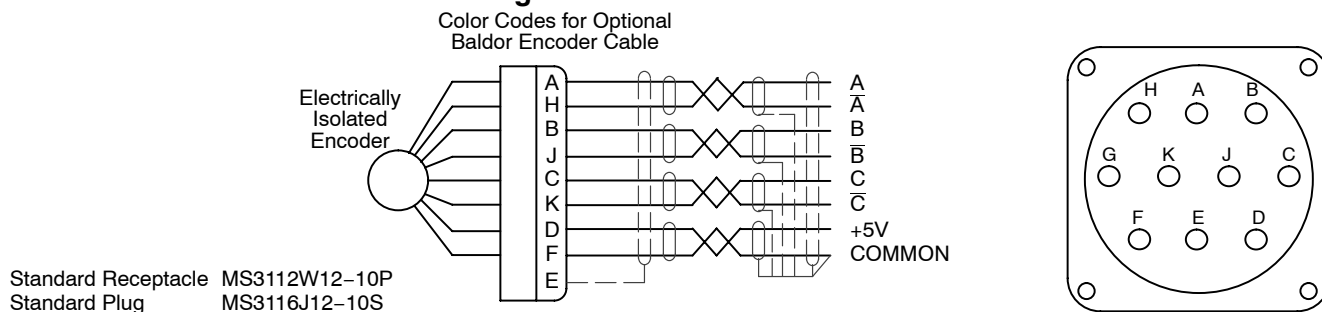
**Table 2-1 NEMA Standard Lead Markings**

<b>Lead Markings</b>	<b>Motor</b>
Armature	A1, A2
Field (shunt)	F1, F2, F3, F4, etc.
Field (series)	S1, S2
Thermostat	P1, P2, etc.
Space Heater	H1, H2, H3, H4, etc.
Resistance Temperature Detector (RTD)	R1, R2, R3, R4, etc.
Optional Brush Monitor System	A1Probe, A2Probe

**Table 2-2 Accessory Markings**

<b>DC Tachometers</b>	<b>+</b>	<b>—</b>	
XPY	1	2	G
XC	Red (1)	Black (2)	G
NCS Pancake	Red	Black	
<b>AC Tachometers 45/90V Output</b>			
45V	Red	White	
90V	Red	Black	
<b>Brake Coil Leads</b>	B1, B2, B3, etc.		
<b>Space Heater (Brake)</b>	H1, H2, H3, H4, etc.		
<b>Brake Interlock Switch</b>	BS1, BS2, BS3, etc.		

**Figure 2-1 Encoder Connections**



**Thermostats**

The thermostat is a pilot circuit device used in a protective relay circuit. The thermostat ratings are given in Table 2-3.

**Table 2-3 Thermostat Ratings**

Maximum Current Ratings for Thermostats (Normally Open or Closed Contacts)				
Voltage	125VAC	250VAC	24VDC	Continuous Current All Voltages
Amperage	12A	8A	2A	2A

**Initial Start-Up**

If driven equipment can be damaged by rotating in the wrong direction, uncouple the motor from the load before checking for rotation.

If the direction of rotation needs to be corrected, disconnect the input power supply and interchange the appropriate leads. Refer to the motor connection diagrams in Section 4 of this manual.

1. The first start-up and running of the motor should be with the motor uncoupled from the load.
2. Check the direction of rotation by momentarily applying power to the motor.
3. With the motor running, make sure it's running smoothly without too much noise or vibration. If either are present, shut down the motor immediately and find the cause of the problem.

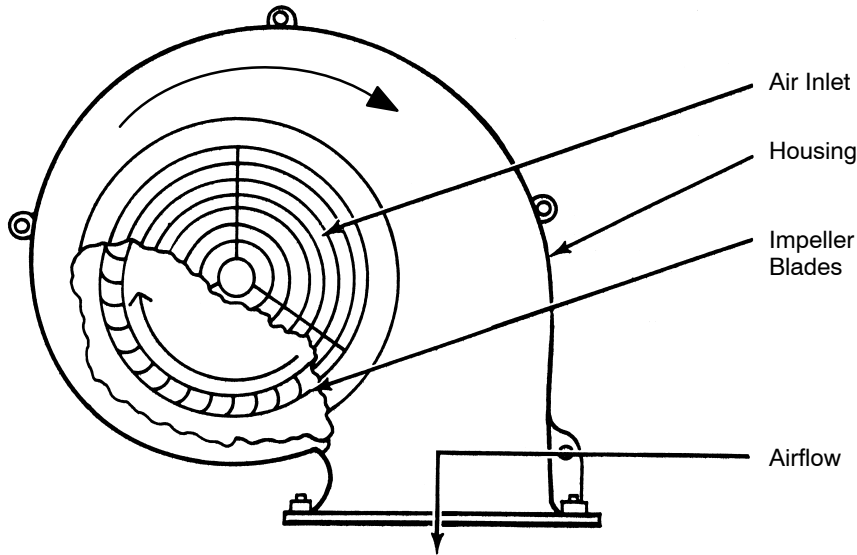
**Blower Ventilation System**

Before loading a force-ventilated motor, be sure that the blowers, cooling fans, or central air supply systems are operating properly to supply cooling air to the motor. Air filters should also be in place. If you energize the main fields with the motor at standstill, the blowers or external cooling systems must be left on. This will prevent excessive heat buildup that will decrease the life of the insulation.

When using field economy circuits to reduce the voltage to the main fields during standstill, blowers do not need to be left on.

Blower motors should be checked for correct rotation. Don't rely on feeling airflow from the drive end of the motor. Look at the outline drawing or rotation arrow shown on the blower housing. Refer to Figure 2-1.

**Figure 2-1 View from Air Inlet (Motor is on Opposite Side)**



**Table 2-4 Electrical Data - Forced Ventilation Blower Units**

Size	Motor Frame	HP	RPM	Volts	Phase	Hz	Amps
LM2	180	1/40	3000	230	1	60	0.4
LM3	180	1/8	3450	115/230	1	50/60	2.6/1.3
LM3	210-250	1/8	3450	208-230/460	3	50/60	0.66-0.60/0.30
LM4	280	1/3	3450	208-230/460	3	50/60	1.5-1.4/0.7
LM6	320-400	1	3450	208-230/460	3	50/60	3.1-3.0/1.5
LM8	504-506	3/4	1750	208-230/460	3	50/60	3.4-3.2/1.6
LM9	508-5012	3	3450	208-230/460	3	50/60	8.2-7.6/3.8

Note: Motor mounted blower units. Mount on commutator end (opposite drive end of motor). We supply blowers that are powered by totally enclosed motors (standard). Blowers have a cast aluminum fan housing with washable, wire mesh filters.

**Table 2-5 Minimum Blower CFM for DPBV Motors (Drip Proof Blower Ventilated)**

Blower Size	Motor Frame Size	Blower CFM	Blower Static Pressure (In H <sub>2</sub> O)
LM2	180	55	0.50
LM3	180	150	1.45
LM3	210	175	1.45
LM3	250	215	0.78
LM4	280	350	0.88
LM6	320	780	2.80
LM6	360	780	2.80
LM6	400	820	2.50
LM8	504-506	1120	1.58
LM9	508-5012	2000	5.00

Each motor nameplate is stamped with the above data for DPBV (less Blower), DPSV and TEPV enclosures.

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## **Coupled Start-Up**

1. After the first successful no load start-up, stop the motor and assemble the coupling.
2. Align the coupling and be sure it is not binding in any way.
3. The first coupled start-up should be without load. Check to see that the driven equipment is not transmitting any vibration back to the motor through the coupling or the base. Vibrations (if any) should be within acceptable levels.
4. Run about 1 hour with driven equipment unloaded.
5. After completing these steps, the motor can now be loaded.
6. Do not exceed the value of armature nameplate amperes under steady continuous loads.



## Section 3 Maintenance & Troubleshooting

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### General Inspection

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

1. Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Oily vapor, paper pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Use a “Megger” periodically to ensure that the integrity of the winding insulation has been maintained. Record the Megger readings. Immediately investigate any significant drop in insulation resistance.
3. Check all electrical connectors to be sure that they are tight.
4. Check for too much vibration or looseness. It may be caused by improper alignment, an unbalanced coupling sheave, damaged motor bearings, or loose mounting bolts. Excessive vibration will damage the motor bearings, brushes and commutator.
5. Listen for unusual noises, especially in the area of the bearings. Also, rubbing or rumbling noises could be signs of internal damage. Check for loose parts on the motor such as thru bolts, hold down bolts, bad alignment of hoods, etc. An unbalanced armature or load may also cause noise.

Note: Motors applied with rectified power supplies will often make a humming noise when operating normally. This is even more noticeable at lower operating speeds. If you can hear a growling or erratic hum, the power supply should be checked for proper operation and phase balance. Improper adjustment or functioning of the power supply can cause overheating of the motor and shorten its life.

6. At start-up, check the tightness of the main and commutating pole bolts (external on the frame) as listed in Table 3-1. Loose pole bolts could be a source of unpleasant noise when rectified power runs the motor.

**Table 3-1 Torque Specifications for Commutating and Main Pole Bolts**

Frame	Bolt Size	Torque (lb-ft)
180AT	3/8 - 16	24 - 30
210AT	3/8 - 16	24 - 30
250AT	3/8 - 16	24 - 30
280AT	1/2 - 13	60 - 75
320AT	1/2 - 13	60 - 75
360AT	3/8 - 16	24 - 30
400AT	3/8 - 16	24 - 30
500AT	1/2 - 13	60 - 75

## **Lubrication & Bearings**

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

### **Type of Grease**

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

Equivalent and compatible greases include:

Texaco Polystar, Rykon Premium #2, Pennzoil Pen 2 Lube and Chevron SRI-2.

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

### **Lubrication Intervals**

Recommended lubrication intervals are shown in Table 3-2. It is important to realize that the recommended intervals of Table 3-2 are based on average use.

**Refer to additional information contained in Tables 3-3 and 3-4.**

**Table 3-2 Lubrication Intervals \***

NEMA / (IEC) Frame Size	Base Speed - RPM			
	>2500	1750	1150	<800
Up to 210 incl. (132)	5500 Hrs.	12000 Hrs.	18000 Hrs.	22000 Hrs.
Over 210 to 280 incl. (180)	3600 Hrs.	9500 Hrs.	15000 Hrs.	18000 Hrs.
Over 280 to 360 incl. (225)	* 2200 Hrs.	7400 Hrs.	12000 Hrs.	15000 Hrs.
Over 360 to 500 incl. (300)	*2200 Hrs.	3500 Hrs.	7400 Hrs.	10500 Hrs.

\* Lubrication intervals are for ball bearings. For roller bearings, divide the listed lubrication interval by 2.

**Table 3-3 Service Conditions**

Severity of Service	Ambient Temperature Maximum	Atmospheric Contamination	Type of Bearing
Standard	40° C	Clean, Little Corrosion	Deep Groove Ball Bearing
Severe	50° C	Moderate dirt, Corrosion	Ball Thrust, Roller
Extreme	>50° C* or Class H Insulation	Severe dirt, Abrasive dust, Corrosion	All Bearings
Low Temperature	<-30° C **		All Bearings

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

\*\* Special low temperature grease is recommended (Aeroshell 7). Different brushes may also be required. Contact your local Baldor district office or an authorized Baldor service center for technical assistance.

**Table 3-4 Lubrication Interval Multiplier**

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

**Table 3-5 Bearings Sizes and Types**

Frame Size NEMA (IEC)	Bearing Description (These are the “Large” bearings (Shaft End) in each frame size)					
	Bearing	OD D mm	Width B mm	Weight of Grease to add * oz (Grams)	Volume of grease to be added	
					in <sup>3</sup>	tea- spoon
Up to 210 incl. (132)	6307	80	21	0.30 (8.4 )	0.6	2.0
Over 210 to 280 incl. (180)	6311	120	29	0.61 (17 )	1.2	3.9
Over 280 to 360 incl. (225)	6313	140	33	0.81 (23 )	1.5	5.2
Over 360 to 500 incl. (300)	NU319	200	45	2.12 (60)	4.1	13.4

\* Weight in grams = .005 DB

**Lubrication Procedure**

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

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

**With Grease Outlet Plug**

1. Clean all grease fittings.
2. Remove grease outlet plug.
3. If motor is stopped, add the recommended amount of grease.

If motor is to be greased while running, a slightly greater quantity of grease will have to be added. Add grease slowly until new grease appears at shaft hole in the endplate or purge outlet plug.

4. Re-install grease outlet plug.

**Without Grease Outlet Plug**

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

Note: Bearing is 1/3 full when only one side of bearing is completely full of grease.

3. Assemble motor.

**Sample Lubrication Determination**

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

1. Table 3-2 list 9500 hours for standard conditions.
2. Table 3-3 classifies severity of service as “Severe”.
3. Table 3-4 lists a multiplier value of 0.5 for Severe conditions.
4. Table 3-5 shows that 1.2 in<sup>3</sup> or 3.9 teaspoon of grease is to be added.

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



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## **Brush Replacement**

**Do not change brush grades or suppliers without first contacting Baldor for technical assistance.**

Brush life will vary greatly due to motor load conditions and the operating environment. The brush pigtail leads should be checked for secure connection to the brush support stud. Brushes should be replaced when their pigtails touch the top of the brush holder.

**When replacing brushes, proper seating is important!**

1. Wrap a strip of coarse grit (60#) sandpaper, rough side out, around the commutator and under the brush holder. (Do not use metal oxide based sandpaper or emery cloth that contains electrically conductive materials).
2. Slide the new brush into the holder and snap the spring clip in place.
3. Rotate the armature slowly in the direction of normal motor rotation.
4. Remove the brush and inspect the face. The brush should be seated over 90% of the face area and completely seated from leading to trailing edge.

Brushes should move freely in their holders. If brushes stick, it is usually due to built up dirt and oil. Brushes should be inspected on occasion to see that they are long enough to press firmly against the commutator. Brush springs should have equal tension. Only brushes of the same size, grade and shape as those originally supplied should be used.

All motors have their brushes set on neutral before leaving Baldor's factory. After replacing the brush holder, realign it to the factory neutral mark.

When replacing a turned-down commutator in the motor with a new commutator, the brush holder assembly must be adjusted. Keep 1/16" clearance between the bottom of the brush holder and commutator. The brush holder assembly is designed with a nut/bolt guide assembly for ease in positioning of the brush-box.

During periodic inspections, check that electrical connections are tight and properly insulated.

## **Brush Springs**

Brush springs should be inspected for proper tension during brush replacement. If the spring shows a loss in tension, it should be replaced. Routine replacement of brush springs is recommended with every third set of brushes.

## **Poor Brush Life**

Poor brush life may be caused by overloading, brushes operating at higher than their rated speed, or very light electrical loads. These can be corrected by using a brush with greater current-carrying capacity for overloads. Friction-reducing treatments reduce wear on high speed applications. Where light loading is the cause, the answer may be to remove some brushes from the motor (with multiple brushes per pole). Another is to install brushes with a higher content of graphite that can handle the lower current and still film properly. Poor brush life is generally not related to the "softness" or "hardness" of the brush.

Do not change brush grades or the number of brushes per pole. Doing so may void the warranty and make the motor unsafe to operate. Contact your local Baldor district office or an authorized Baldor service center for technical assistance.

## **Brush Chatter or Bounce**

Brush chatter or bouncing can be caused by vibration from an external source. This may be a bad gearbox coupling or condition, or insecure mounting of the motor. Stronger carbon grades are available that provide more capacity for the brush to resist vibration. It is always best to fix the cause of the problem.

## **Brush Sparking**

Excessive sparking of brushes may be due to electrical causes such as an overload or a very unstable DC power supply. Mechanical causes include a flat spot on the commutator or external vibration. Changing to a better brush grade, or a split-brush design may be required.

---

## **Carbon Brushes For Special Operating Conditions**

Sometimes, there are problems if motor operation requires a different design or grade of carbon brush than what was installed when the motor was built. These special operating conditions include long periods of operation with loads that are significantly greater or less than rated load capacity. Also, operation in the presence of certain chemicals, or extreme temperature and humidity can degrade brush performance.

Generally, poor brush life or commutator wear can occur if one or more of the above conditions exist. The brush used doesn't match the operating conditions.

Baldor offers optional brush grades for the above conditions and has replacement brushes available to retrofit motors. Contact your local Baldor District Office or an Authorized Baldor Service Center for technical assistance.

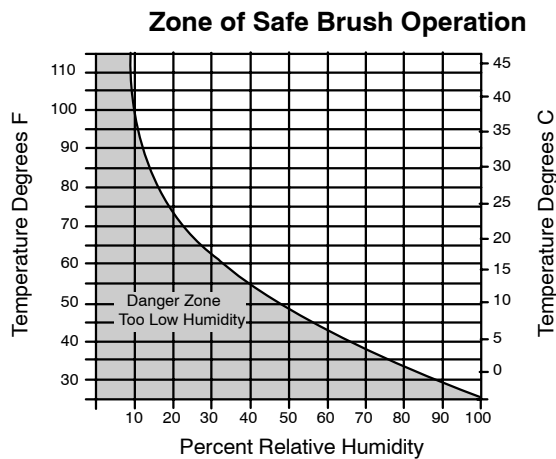
Do not change brush grades or the number of brushes per pole. Doing so may void the warranty and make the motor unsafe. Contact your local Baldor district office or an authorized Baldor service center for technical assistance.

### **Authorized Service**

Baldor catalog 505 (and the Baldor CD-ROM) lists service shops authorized to service Baldor DC motors. Contact your local Baldor District Office for more information.

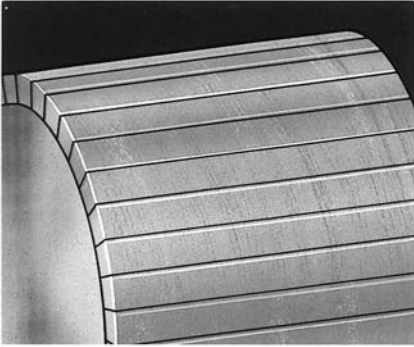
### **Humidity And Brush Wear**

This curve represents 2 grains of water per cubic foot of dry air or 4.6 grams per cubic meter of dry air.

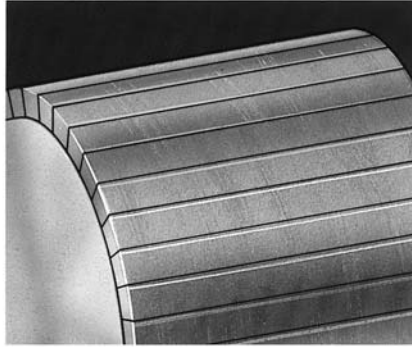


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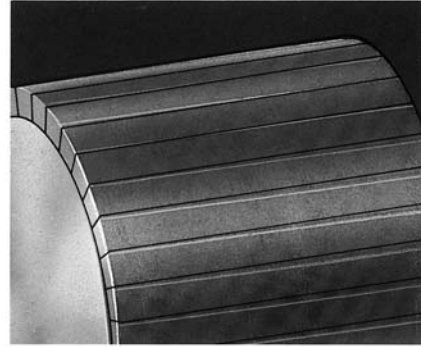
## Guide To Commutator Appearance



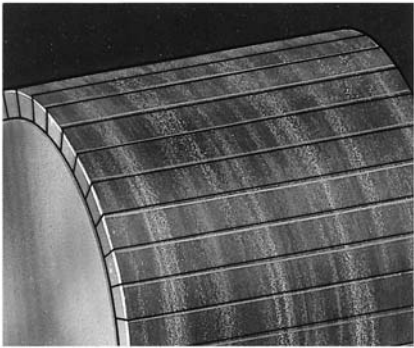
**Light Film:** Indicates good brush performance. Light load, low humidity, brush grades with low filming rates, or film reducing contamination can cause lighter color.



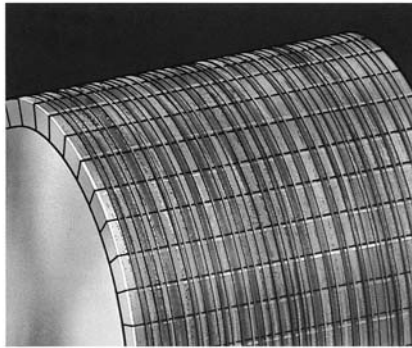
**Medium Film:** Is the ideal commutator condition for maximum brush and commutator life.



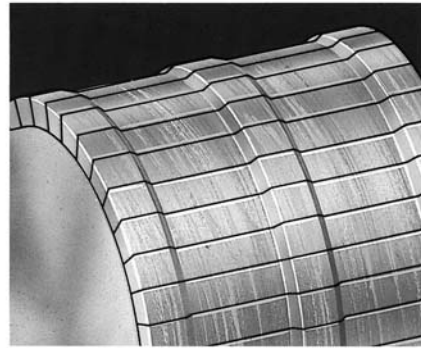
**Heavy Film:** Results from high load, high humidity or heavy filming rate grades. Colors not in the brown tones indicate contamination resulting in high friction and high resistance.



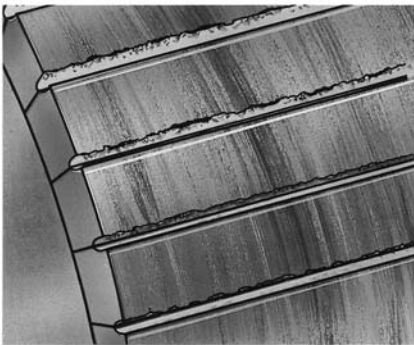
**Striking:** Results from metal transfer to the brush face. Light loads and/or light spring pressure are most common causes. Contamination can also be a contributing factor.



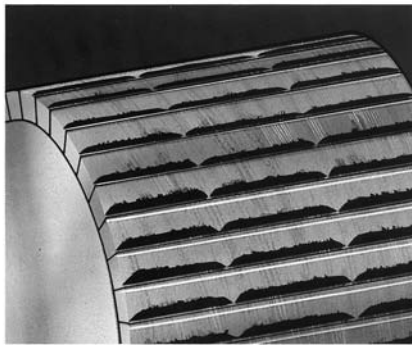
**Threading:** Is a further development of the striking condition as the metal transferred becomes work hardened and machines into the commutator surface. With increased loads and increased spring pressure this condition can be avoided.



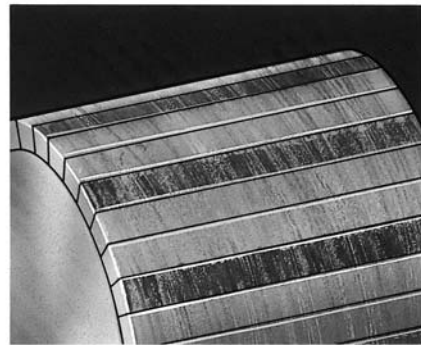
**Grooving:** May result from an overly abrasive brush grade. The more common cause is poor electrical contact resulting in arcing and the electrical machining of the commutator surface. Increased spring pressure reduces this electrical wear.



**Copper Drag:** Develops as the commutator surface becomes overheated and softened. Vibration or an abrasive grade causes the copper to be pulled across the slots. Increased spring pressure will reduce commutator temperature.



**Bar Edge Burning:** Results from poor commutation. Check that brush grade has adequate voltage drop, that the brushes are properly set on neutral and that the interpole strength is correct.



**Slot Bar Marking:** Results from a fault in the armature windings. The pattern relates to the number of conductors per slot.

**This chart courtesy of Helwig Carbon Products, Inc., Milwaukee, WI**

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## Commutator

After several hours of operation, the commutator surface under the brush should take on a darker bronze color. This is due to self-generated film caused by normal commutation. This coloration should be even, without blotches or black areas. A shiny copper color or black streaks in the brush tracks are signs of improper commutation or contamination by a foreign material. Contact Baldor for assistance in correcting these problems.

If the commutator becomes rough and burned, or becomes black, it should be cleaned of dirt and carbon particles. This can be done by wiping it with a dry, lint-free cloth. Also vacuuming or blowing out the motor with a dry air supply are suitable cleaning methods.

**Do not use solvents or cleaning solutions on the commutator.** To remove spots or contamination that will not wipe off, wrap a strip of coarse (60# grit) sandpaper around the commutator. Then rotate the armature back and forth by hand. **Do not use emery cloth as this contains electrically conductive materials.**

Another method of commutator resurfacing is to use a commercially available commutator dressing stone. This should only be done by trained and experienced people. This stone should be taped or attached to the end of a stick made of electrically insulated material. The motor should be run at about half speed and the stone applied lightly to the commutator surface. This operation must be done with no load on the motor.

The surface of the commutator should be smooth and round. This can be checked while the motor is running at low speed. Press lightly on one brush with an insulated stick. **Do not use a lead pencil as this contains electrically conductive graphite.** If you feel movement of the brush, it suggests a worn or uneven commutator. The armature must be removed from the motor and the commutator machined by a qualified repair shop.

## Rapid Commutator Wear

Light electrical loads and contamination are the usual causes of rapid commutator wear. Light loading may require the removal of some brushes on motors with multiple brushes per pole. Sometimes a low current density brush grade is used. There are also brushes that have a mild polishing action. These prevent certain chemicals, especially chlorine and silicone, from attacking the commutator. Brushes, are available for use in plastic extruder applications where PVC is present. Usually, you do not have to change the design or grade of the brushes on new motors unless special operating conditions exist.

Do not change brush grades or the number of brushes per pole. Doing so may void the warranty and make the motor unsafe. Contact your local Baldor district office or an authorized Baldor service center for technical assistance.

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## Turning The Commutator

After commutator turning, check its run-out with the bearings on V blocks. For all commutators, maximum run-out is .002". New and minimum commutator diameters are listed as follows.

Commutator Brush Track Diameters		
Frame	New Motor Commutator Diameter (inches)	Minimum Diameter after Refinishing (inches)
180	2.750	2.51
210	4.500	4.29
250	5.000	4.72
280	5.750	5.45
320	6.500	6.20
360	7.500	7.21
400	8.250	7.90
500	10.250	9.72

### Notes:

The above diameters are approximate.

They are for standard design and speed motors. high speed motors require larger minimum bar diameters. Contact Baldor for dimensions.

Commutator surface finish, after machining, should be between 40 and 65 micro-inch RMS.

## Commutator Undercutting

Check the commutator mica between bars for an under-cut depth of 1/64" minimum, 5/64" maximum. The grooves of the under-cut are to be free of mica and chips.

**⚠ Caution: Be very careful when repainting a drip proof motor. Do not get any paint on the commutator. Paint on the commutator will show up as black marks in brush tracks. Also, excessive brush sparking or erratic operation can be caused by paint or other material on the commutator.**

## Blowers & Filters

Do not use silicone RTV around DC motors as commutator surface damage can occur. Intake filters on blowers and louvers of drip proof motors should be cleaned to remove any dust or foreign matter. Canister type filters should be replaced when dirty. Failure to keep air intakes clear will cause overheating and premature failure of the insulating system.

## Troubleshooting

### **Armature Overheating**

Excessive overloads will cause a noticeable odor of overheated varnish or charred insulation. The commutator may eventually become blackened and pitted and the brushes burned. This overheating may be general and uniform. To cure, remove the overload and rewind or replace armature if damaged beyond use.

An open-circuited armature coil will cause flashing at the commutator. Two adjacent bars will show severe burning and a resulting overheated armature. Short-circuited coils or commutator bars may cause local heating that could destroy the insulation at that spot. This may result in the burning of the armature coils, banding or commutator bars.

Grounds in the armature circuit may be found by using a megger. Connect one lead to motor frame and the other lead to a commutator bar. If the armature is grounded, the megger will show less than 1 meg ohm.

These tests should be done by experienced and qualified personnel.

---

**Field Coil Overheating**

The blowers or external cooling systems should be left in operation if the main field windings remain fully energized with the motor at standstill. Failure to do so may cause too much heat build-up which could cause reduced insulation life.

When using field economy circuits to reduce voltage to the main fields during standstill, blowers do not need to be operating. The most common failure with overheated field coils is a short in one or more of the shunt coils.

Shorted coils show less than half the line voltage for two pole motors. This is with the fields connected for high voltage (in series). Shorted four pole motor coils will read less than 1/4 of the line voltage with the coils connected for high voltage (in series).

A grounded coil may cause overheating. This defect may be tested as shown by the ground test for an armature. With brushes lifted, place one test point of the megger on either field lead, the other on the motor frame. The megger will read less than 1 meg ohm, if a grounded coil is present.

An open field coil on a motor will cause the armature to have no torque. The motor may run at a very high speed at no load. The commutator may be flashing. To locate an open coil, apply line voltage to the shunt coils (brushes lifted). A voltmeter will show no reading across a good coil. It will show about the line voltage across the open coil.

These tests should be done by experienced and qualified personnel. If you find any of the above defects, don't run the motor. First contact your local Baldor District Office or an Authorized Baldor Service Center for repairs.

**Excessive Load**

Excessive load may be found by checking the DC armature ampere input and comparing it with the rating on the nameplate. An excessive load may prevent the motor from starting or accelerating to full load speed. It could finally result in premature failure of the motor or control. Be sure to use an averaging type ammeter if the motor's power is coming from a rectifier or SCR control.

**Jogging and Repeated Starts**

Repeated starts or jogs of motors may reduce the life of the brushes and winding insulation. The heat produced by excessive starting may be more than what can be dissipated by the motor under a constant full load conditions. If you must frequently start or jog a motor, you should check the application with the local Baldor District Office.

**Heating**

Duty cycle and maximum ambient temperature are shown on the nameplate of the motor. If there is any question about safe operation, contact the local Baldor District Office.

Motor overheating may be caused by improper ventilation, excessive ambient temperature, dirty conditions or an inoperable blower or dirty filter. Electrical causes may be due to excess current caused by an overload or over-voltage to the fields.

**Thermostat**

Most stock Baldor DC motors 180 frame and above have a standard temperature-sensing thermostat mounted to their interpole winding. This normally closed thermostat opens when the temperature limit is exceeded. Another option available is a normally open thermostat that closes with temperature.

On blower cooled or separately ventilated motors, the protection capabilities of the thermostats are greatly reduced at low speeds. This is because the interpoles have the same amount of heat transfer regardless of speed. Armature heat transfer is less at low speed. There is less internal air turbulence at low speeds causing higher temperatures at the armature.

The thermal time constant for interpoles can be as much as five times longer than the armature's time constant. Because of this, the thermostat cannot be relied upon to protect the armature during extreme overloads lasting a short time.

The ripple of the rectified power supply and manufacturing tolerances of mounting the device affect the thermostat's accuracy.

For thermostat contact ratings, refer to Thermostats in Section 2 of this manual.

**Table 3-6 Troubleshooting Chart**

<b>Symptom</b>	<b>Possible Causes</b>	<b>Possible Solutions</b>
Motor will not start	Usually caused by line trouble, such as, single phasing at the starter.	Check source of power. Check overloads, fuses, controls, etc.
Excessive humming	High Voltage.	Check input line connections.
	Loose pole pieces.	Torque the bolts as specified in Table 3-1.
Motor Over Heating	Overload. Compare actual amps (measured) with nameplate rating.	Locate and remove source of excessive friction in motor or load. Reduce load or replace with motor of greater capacity.
	Improper ventilation.	Check external cooling blower to be sure air is moving properly across cooling fins. Check blower for proper direction of rotation. Check motor brush covers to ensure they are solid on the commutator end and that they are not louvered. Check filter for dirt, clean or replace. Excessive dirt build-up on motor. Clean motor.
	Armature rubbing on stator.	Check air gap clearance and bearings.
		Tighten "Thru Bolts" that hold the endplates to frame. Torque the pole bolts as specified in Table 3-1.
	Field over voltage.	Check input voltage.
	Full voltage on field with motor stopped.	Reduce field voltage to 60% with field economy circuit in the control.
	Grounded winding.	Perform dielectric test and repair as required.
	Improper connections.	Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity. Refer to connection diagram.
Bearing Over Heating	Misalignment.	Check and align motor and driven equipment.
	Excessive belt tension.	Reduce belt tension to proper point for load.
	Excessive end thrust.	Reduce the end thrust from driven machine.
	Excessive grease in bearing.	Remove grease until cavity is approximately $\frac{3}{4}$ filled.
	Insufficient grease in bearing.	Add grease until cavity is approximately $\frac{3}{4}$ filled.
	Dirt in bearing.	Clean bearing cavity and bearing. Repack with correct grease until cavity is approximately $\frac{3}{4}$ filled.
Vibration	Misalignment.	Check and align motor and driven equipment.
	Rubbing between rotating parts and stationary parts.	Isolate and eliminate cause of rubbing.
	Armature out of balance.	Have armature balance checked and repaired at your Baldor Service Center.
	Resonance.	Tune system or contact your Baldor Service Center for assistance.
Noise	Foreign material in air gap or ventilation openings.	Remove armature and foreign material. Reinstall armature. Check insulation integrity. Clean ventilation openings.
Growling or whining	Bad bearing.	Replace bearing. Clean all grease from cavity and new bearing. Repack with correct grease until cavity is approximately $\frac{3}{4}$ filled.

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## Accessories

The following list shows some accessories available through Baldor's Mod Express or available on custom manufactured motors. Contact your Baldor supplier for information on each additional accessory or those listed below.

### **Bearing RTD**

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

### **Bearing Thermocouples**

Used to measure or monitor bearing temperatures.

### **Bearing Thermostat**

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

### **Blowers with Filters:**

Available to increase the constant torque speed range of DPGF motors. This increases the continuous operating torque range at low speeds.

### **Brush Wear Indicator:**

Provides a warning when the brushes have worn down to the level where they need to be replaced (before damage to the commutator).

### **Condensation Drains & Breathers:**

Stainless steel drains and separate breathers are available.

### **Conduit Boxes**

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

### **Cord & Plug Assembly**

Adds a line cord and plug for portable applications.

### **Drip Covers**

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

### **Fan Cover & Lint Screen**

To prevent build-up of debris on the cooling fan.

### **Nameplate**

Additional stainless steel nameplates are available.

### **Roller Bearings**

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

### **Rotation Arrow Labels**

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

### **Slide Bases:**

Allows easy belt adjustment while maintaining correct pulley and belt alignment.

### **Space Heater**

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

### **Stainless Hardware**

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



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**Tachometers:**

DC, AC and digital outputs are available. These can be mounted to our motors or shipped separately. Tachs help the SCR control achieve more precise speed regulation than by armature feedback alone.

**Transparent Brush Inspection:**

For easy brush inspection and commutation monitoring without disassembly of the motor.

**Winding RTD**

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

**Winding Thermocouples**

Used to measure or monitor winding temperatures.

**Winding Thermostat**

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

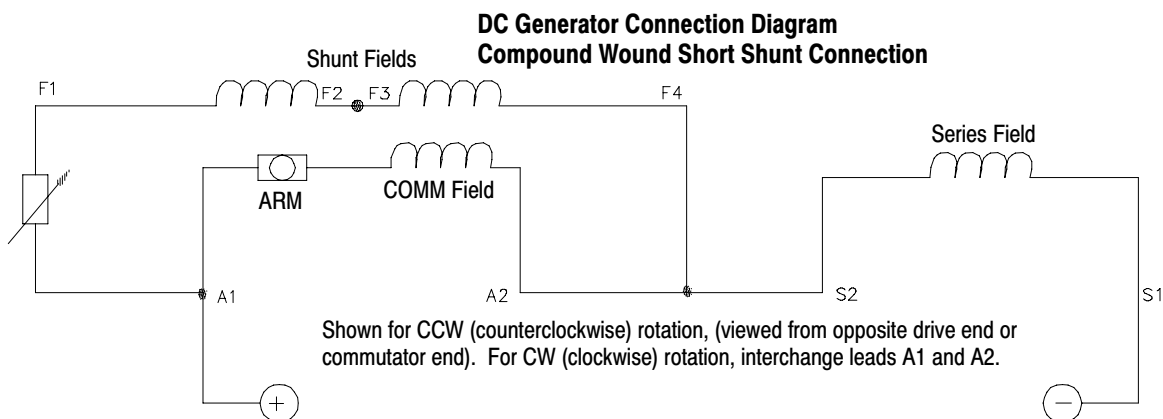
**Reflash Instructions**

Instructions to reflash the residual magnetism for **Lifting Magnet Generators only**.

These generators are self-exciting. If voltage will not build up, it is possible the residual magnetism is insufficient to initiate excitation. This procedure is to restore sufficient residual magnetism to self excite.

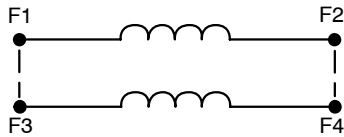
Note: Loss of residual magnetism can be caused by misconnection (reversing the connections) of F1 and F4.

1. Disconnect F1 and F4. All other leads may remain connected.
2. Connect 24 to 40VDC power source positive lead to F1 and negative to F4. DC source may be batteries, a DC welder (not AC) or rectified AC.
3. Drive generator at rated RPM.
4. Measure the voltage across A1 and A2. Voltage should be 150 to 200% of F1 to F4 voltage. When A1 to A2 voltage level reaches this level (approximately 30 seconds) carefully remove the source leads, an arc may be present during disconnect.
5. Stop the generator.
6. Reconnect F1 and F4 as shown in the DC Generator Connection Diagram. Rotation is viewed from opposite drive end (commutator end) A1 is positive for CCW rotation. A2 is positive for CW rotation. S1 is always negative.

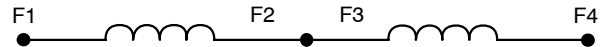


# Section 4 Connection Diagrams

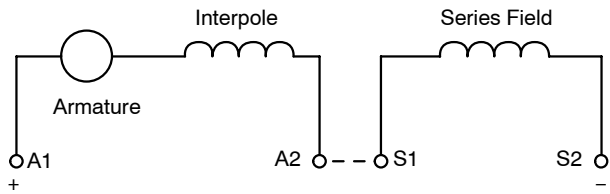
Low Voltage connection Shunt Field



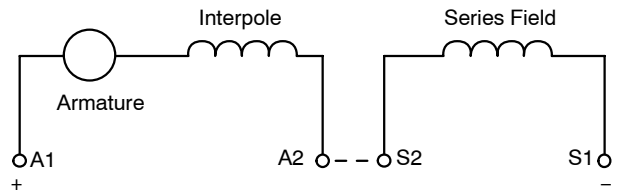
High Voltage connection Shunt Field



## Field Reversing Series Motor

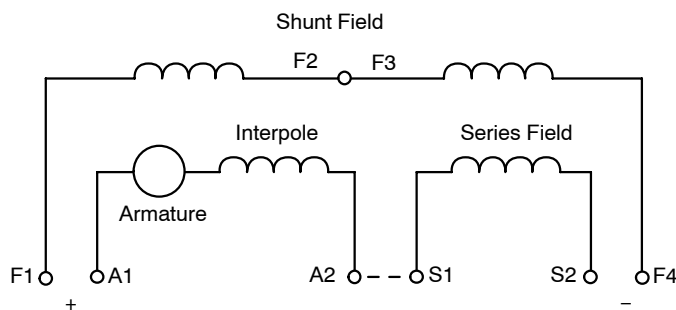


Series Motor CCW Rotation  
(Facing Commutator End)

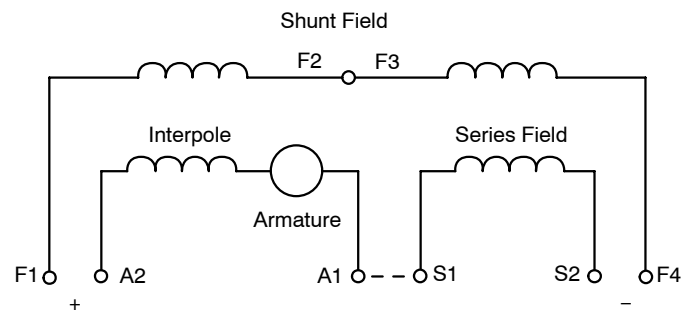


Series Motor CW Rotation  
(Facing Commutator End)

## Armature Reversing Compound and Stabilized Motors

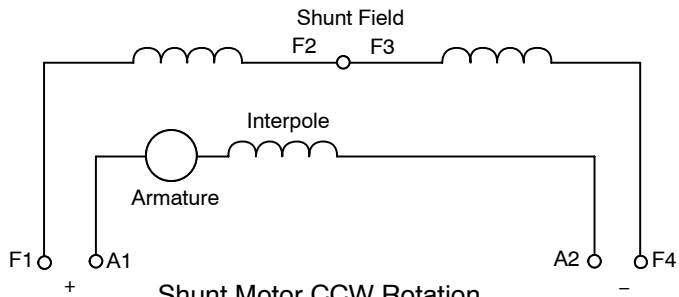


Compound or Stabilized Shunt Motor  
CCW Rotation (Facing Commutator End)  
High Voltage Field Connection



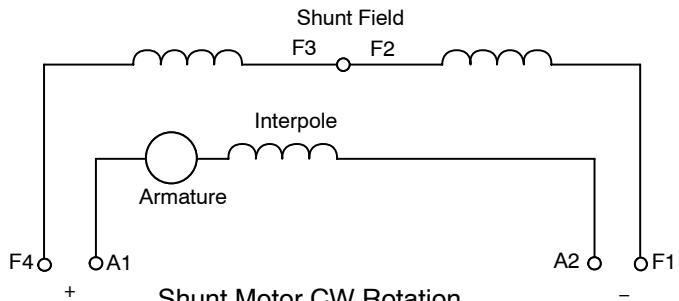
Compound or Stabilized Shunt Motor  
CW Rotation (Facing Commutator End)  
High Voltage Field Connection

### Field Reversing Shunt Motor



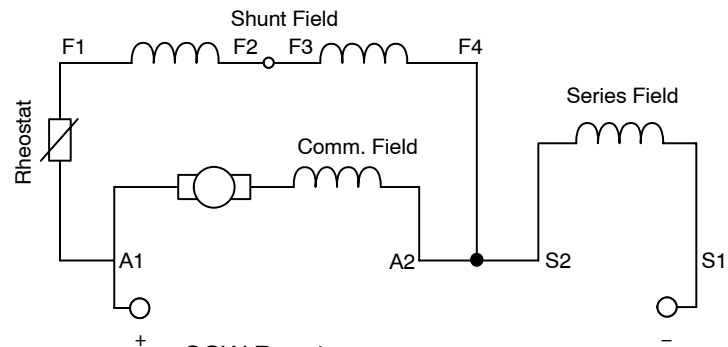
Shunt Motor CCW Rotation  
(Facing Commutator End)  
High Voltage Field Connection

### Field Reversing Shunt Motor



Shunt Motor CW Rotation  
(Facing Commutator End)  
High Voltage Field Connection

### DC Generator Connection Diagram Compound Wound Short Shunt Connection



CCW Rotation  
(Facing Commutator End)  
For CW Rotation, Interchange Leads A1 and A2.

## Baldor District Offices

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PHONE: 508-854-0708  
FAX: 508-854-0291

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33782 STERLING PONDS BLVD.  
STERLING HEIGHTS, MI 48312  
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FAX: 586-978-9969

#### MICHIGAN Continued

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GREENSBORO, NC 27406  
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GREENSBORO, NC 27416  
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FAX: 336-273-6628

#### OHIO

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WEST CHESTER, OH 45069  
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FAX: 513-772-2219

#### CLEVELAND

8929 FREEWAY DRIVE  
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MEMORIAL HIGHWAY  
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2230 SOUTH MAIN STREET  
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#### BALDOR CENTROAMERICA

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