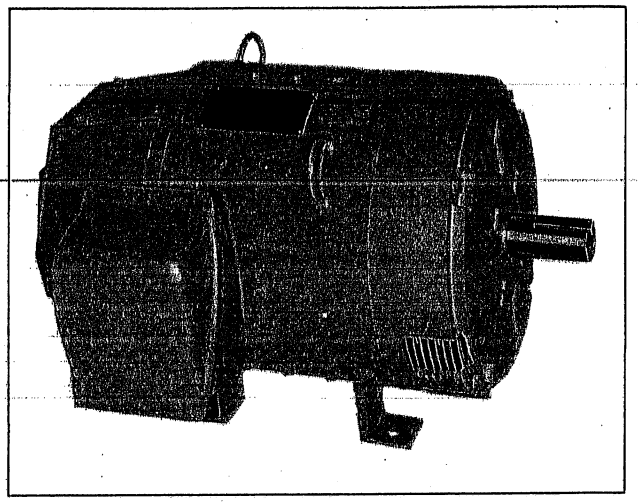
Instructions for LIFE-LINE® S DC Motors Frames 180A-500AT

I.L. 3500-S1



DESCRIPTION

LIFE-LINE S Motors in NEMA Frames 180A through 500AT are direct current machines designed for rapid response for both variable and constant voltage applications.

The motors are designed for use on rectified power supplies as follows:

180 Volts; NEMA Type K
240 or 500 Volts; NEMA Type C or D

LIFE-LINE S Motors are insulated with C1 F insulation as standard. Greaseable anti-friction bearings are standard.

LIFE-LINE S Motors are available as either dripproof guarded or as dripproof force ventilated (by either motor mounted blower or air forced from some external source). Guard screens are standard over ventilating openings in the brackets.

Tachometer kits and blower kits are available on motors built on Frame 216A and larger for mounting in the field when desired. If tachometer is required on motor built on Frame 187A, it must be mounted at the factory.

STANDARD WARRANTY

Westinghouse warrants that the equipment delivered by it will be of the kind and quality described in the order or contract, and will be free of defects in workmanship or material. Should any failure to conform to this warranty appear within one year after date of initial operation, not to exceed eighteen months after date of shipment, Westinghouse shall, on prompt notification from the purchaser, and provided that;

(1) the equipment has been stored, installed, operated and maintained in accordance with generally acceptable industry practices and Westinghouse instructions, and

(2) that the equipment has not been subject to alteration, misapplication or misuse, correct such non-conformity by repair or replacement F.O.B. point of shipment, of the non-conforming part or parts.

Westinghouse shall not be responsible for providing working access to the defects. Correction of non-conformities, in the manner and for the period of time provided above, shall constitute fulfillment of liabilities of Westinghouse with respect to the quality of the equipment.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES OF QUALITY, WHETHER WRITTEN, ORAL, OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

Any defects that may develop, should be referred to the nearest Westinghouse Sales Office for complete servicing information.

UNAUTHORIZED REPAIRS

In the event that the customer sends his motor to an unauthorized repair shop, the coverage of this warranty policy is automatically terminated.

Effective July, 1976 supersedes I.L. 3500-5-SK-IF dated April, 1972

Warning: **An electric motor, connected to a high voltage source and containing a rotating element, is a hazardous piece of equipment. Only qualified personnel should be allowed to install, operate and maintain it. It is recommended that NEMA "Safety Standard for Construction and Guide for Selection, Installation and Use of Fractional and Integral-Horsepower Motors and Generators" be consulted in addition to National Electric Code and other local regulations.**

RECEIVING

Unpack the machine and make certain that it was not damaged during shipment. Turn the shaft by hand to see that it turns freely.

Report any damage immediately to the carrier and the nearest Westinghouse office.

Check to see that the nameplate data agrees with the voltage of the power supply provided for the machine.

The shaft extension is coated with a slushing compound to prevent rusting during shipment and storage. This slushing compound may be removed by wiping with any petroleum solvent, such as benzine, gasoline, turpentine, Stoddard solvent, etc. Wear neoprene gloves to prevent skin irritation when using petroleum solvents. Petroleum solvents are flammable and comparatively non-toxic.

The slushing compound should be left on until the motor is about to be connected to the machine it is to drive.

STORAGE

Prior to the motor being installed, and particularly if it is going into storage for any length of time it must be protected from dirt, moisture and extremes of temperature. The last two can be particularly bad for motors especially if conditions exist which lead to condensation in the motor. Moisture cannot only cause corrosion of the metal surfaces, but it will cause deterioration of the electrical insulation.

If the motor is to be stored for any length of time, the brushes should be lifted out of the holders. Brushes in contact with the commutator while at standstill will in time create flat spots on the commutator.

It is advisable if the motor is stored in a cool and/or damp location to keep it slightly above ambient temperature by means of a heater. A relatively small heater in the order of .05 to .10 watt/lb. of motor is all that is required. Caution should be observed in the type of heater used; one having a concentrated heat might cause local damage to insulation if allowed to touch it.

Motors are shipped with the bearing cavity packed with the proper amount of lithium base grease which contains a rust inhibitor. While in storage the motor shaft should be rotated several revolutions by hand at two month intervals to distribute the grease over the bearing surfaces to prevent corrosion. After a motor has been stored for extended periods (approximately 2 years or more) the grease in the bearing and bearing cavity should be inspected. If it shows signs of caking or other deterioration the bearings should be replaced, old grease flushed out of cavities and fresh grease applied. See Page 12 for type of grease to be applied.

Motors in storage should also have the insulation resistance checked periodically with a megger. A record should be kept of all readings. Readings below 1 megohm should be regarded with suspicion and the motor should be inspected for evidence of condensation or dirt. Before the motor is placed into service the cause of the low megger reading should be found and corrected. In most cases a drying out will bring the reading up to a satisfactory level.

HANDLING

Motors have eyebolts or lifting lugs which are designed to carry the weight of the motor only. When the motor has two lifting devices a dual chain must be used. Do not use the shaft as a means of lifting the motor.

Warning: **If the motor is assembled or attached to another piece of equipment the motor eyebolts or lugs must not be used for lifting. Consult the equipment builder for proper lifting procedure.**

INSTALLATION

Location

The motor must be located in an environment that satisfies local codes and National Board of Fire Underwriters' Regulations. In addition, locate the machine in a

place that is clean, dry and well-ventilated. If protecting shields or guards are used, they must not obstruct the free flow of air around the machine. The ambient air temperature should not exceed 40°C or 104°F. This temperature limitation also applies to the cooling air when the motor is force ventilated from a separate source.

Foundation

The foundation or base must provide a permanent, rigid, fixed relationship between the motor and the driven load.

A rigid foundation is essential. If the foundation is poured concrete, it must be large enough to provide a fixed relationship between the motor and the driven load. If the motor is mounted on a structural steel foundation or bedplate, all beams or girders must be adequately braced to eliminate any flexing or resonance of the base. The machine must rest evenly on all mounting pads.

Mounting

To maintain the dripproof feature when mounting a motor horizontally to a wall or ceiling, the rear bracket should be rotated 90° (horizontal wall mount) or 180° (ceiling mount), and the covers on the commutator end bracket relocated to preserve the dripproof guarded enclosure. To rotate the rear end bracket proceed as follows:

1. Loosen inner bearing cap by unscrewing bolts or screws at end of bracket near the shaft. Do not remove completely unless necessary. Tap lightly on the screws while loose to push inner bearing cap back from its rabbet fit in the bracket.

2. Remove the bolts holding the bracket to the frame. Tap on the bracket's ears to loosen it from the frame fit.

3. When the bracket is free from its fit on the frame rotate it to its desired location.

4. Reassemble bracket onto the frame rabbet fit and tighten the bolts. Replace the inner bearing cap and tighten its screws or bolts.

Note: **The foregoing applies only to motors with four main poles such as the 256A, 280AT and larger. The 180A and 210A, being two-pole motors require for ceiling mounting, that the commutator end bracket be rotated 180° in order to preserve the dripproof enclosure. For a side wall mounting of two-pole motors, leave the commutator end bracket in its original position and remove the screen cover on what is now the top side of the bracket and replace it with a solid cover.**

To rotate the commutator end bracket 180° for ceiling mounting proceed as follows:

1. Remove covers.

2. Disconnect the leads from the rods on the rocker ring.

3. Remove brushes from holders without disconnecting terminals. Protect commutator from being scratched by the brushholders as the bracket is rotated.

4. Loosen the inner bearing cap bolts.

5. Remove the bolts holding bracket to the frame. Tap on bracket ears to loosen it from the frame fit.

6. Rotate the bracket 180°. Note that the rocker ring is not touched as it rotates with the bracket. The proper rocker ring location is determined at the factory and under no condition should it be moved relative to the bracket.

7. Reassemble bracket to frame rabbet fit and tighten bolts. Tighten inner bearing cap bolts. Reconnect rocker ring, replace brushes and covers. Note that the leads are now connected to the rod which was on the opposite side in the original location.

Motors vertically wall mounted require special louvered covers. Refer to factory specifying if shaft is up or down.

As stated in the preceding heading under "Foundation", the foundation must be sufficiently rigid to minimize vibration and to maintain alignment between the motor and the driven machine. Motors are dynamically balanced at the factory to NEMA standard vibration limits or better. However, vibration of the motor and driven units in service is determined not only by balance, but may be greatly affected by the base on which they are mounted. To minimize vibration, a rigid base must be provided for the motor and driven unit. When foundation caps and soleplates are used, they are designed to act as spacers between the motor and the true foundation and must be evenly supported on the foundation. Mounting plates should extend over the entire distance (front to rear) of the mounting feet and shims under the entire foot.

1) V-BELT DRIVE

Mount the machine on the slide base, which allows for adjusting the belt tension.

Mount the sheave on the machine close to the bearing housing. Sheaves should be carefully aligned.

The smallest sheave should not be less in diameter than that recommended by the belt manufacturer for the belt used. The minimum pitch diameter of the sheave is a function of the torque to be transmitted and the location of the center of the sheave face. The following formula can be used to calculate the minimum pitch diameter:

$$d = \frac{Hp}{rpm} (A - Bx)$$

where

d = minimum pitch diameter of V-belt sheave in inches.

Hp = maximum horsepower to be transmitted (this may exceed motor rating to take care of momentary overloads).

rpm = lowest operating speed at which maximum horsepower occurs.

x = axial distance of sheave face centerline from end of motor shaft toward the motor in inches. Situations where the centerline falls beyond the end of the shaft should be referred to the factory.

A & B = constants are shown on Table I.

To avoid excessive bearing loads and shaft stresses, belts should not be tightened more than necessary to transmit the torque for which the calculation is made.

The value of 'd' calculated in the foregoing formula may indicate a minimum sheave diameter which is smaller than is practicable to assemble on the motor shaft extension. For increased bearing life use the largest diameter sheave possible. Shaft stresses and bearing and belt loads will be reduced if sheave diameters larger than the calculated minimum are used.

The Table I values are based on a maximum belt pull factor of 1.5 for load transmission.

2) FLAT BELT DRIVE

Flat belts require more tension than V-Belts to transmit the necessary torque. As flat belts are not too common for these size motors it is recommended that these drives be referred to the factory.

Table I
V-Belt Formula Constants

Frame Diameter	A	B
180A	1700	330
210A	1200	110
250A	600	70
280AT	445	15
320AT	330	15
360AT	225	10
400AT	225	5.6
440AT	180	3.5
500AT	150	3.2

3) CHAIN DRIVE

Mount the machine on the slide base, which allows for adjusting the chain tension.

Mount the sprocket on the machine close to the bearing housing and align the sprockets accurately. Refer to factory for minimum pitch diameter.

4) GEAR DRIVE

Mount the machine and driven unit so as to maintain accurate alignment. The gears must mesh accurately to prevent vibration. Mount the gear on the machine close to the bearing housing to minimize the overhang. Dowel the machine to the base. Refer to factory for minimum pitch diameter.

5) DIRECT COUPLING ALIGNMENT

Direct coupled motors may be coupled to the driven unit through flexible couplings. Accurate mechanical lineup is essential for successful operation.

Position the motor on its foundation with the correct spacing between the motor shaft and the driven shaft. This distance is specified by the coupling manufacturer – usually 1/8 to 3/8 inch.

It is important to recognize that the commutator end bearings on LIFE-LINE S Motors are locked. This means that the drive end of the shaft can only move away from the motor as an increase in temperature causes the shaft to expand. The maximum amount that a given shaft might be expected to move is given in the following table:

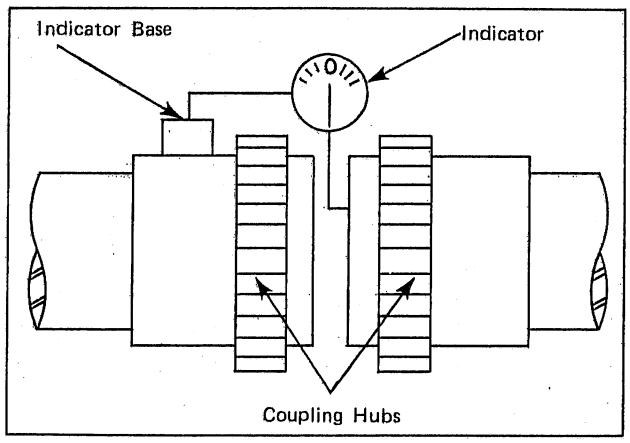
Frame Diameter – Inclusive	Maximum Movement – Inches
180 to 320	.065
360 to 440	.074
500	.095

Adjust the position of the motor by shimming until the angular and parallel alignment between the two shafts are within the following limits, as measured with a dial indicator with the motor bolted down.

Below 2000 RPM	.002 inch T.I.R.
2000 RPM and above	.001 inch T.I.R.

When adjusting the position of the motor, be sure that each foot of the motor is shimmed, before the motor is bolted down, so that no more than a .002" feeler gage can be inserted in the shim pack.

Angular misalignment is the amount by which the faces of the two coupling halves are out of parallel. It can be determined by mounting a dial indicator on one coupling half with the indicator probe on the face of the other half, then rotating both shafts together through 360 degrees to determine the T.I.R.

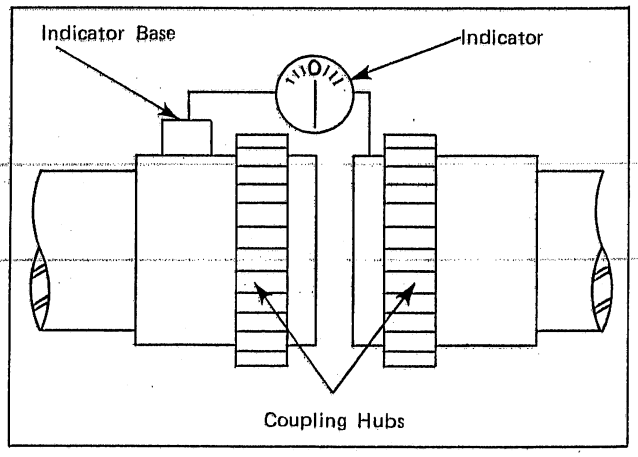


Measuring Angular Misalignment

It is important during this check to keep the driven load with endplay against its thrust shoulder. This prevents false readings due to shaft movements in the axial direction.

Parallel misalignment or shaft runout is the offset between the centerlines of the two shafts. It is determined by mounting a dial indicator on one coupling half with the indicator probe bearing radially on the other coupling half, then rotating both shafts together through 360 degrees.

It is critical that the motor and load be correctly aligned under actual operating temperatures and conditions. Machines which are correctly aligned at room temperature may become badly misaligned, due to deformation or different thermal growth, as they increase in temperature. The alignment must be checked and corrected, if necessary, after the motor and driven machine have reached their maximum temperature under load.



Measuring Shaft Runout

Use "floating shaft couplings" or "spacer couplings" on motors where the coupling alignment cannot be accurately checked or maintained. Misalignments of several thousandths of an inch will result when there are relatively small changes in the temperature differences in larger motors and the driven equipment.

After the alignment is completed, the equipment should be given a test run to verify that the lineup gives satisfactory performance. With the performance verified, the machines should be dowelled to their bedplate. Recommended dowelling is two dowels per machine, one in each of the diagonally opposite feet, with the size of the dowels approximately 1/2 the diameter of the holddown bolts.

Machines which are correctly aligned when they are first installed may subsequently become misaligned due to wear, vibration, shifting of the base, settling of the foundations, thermal expansion and contraction or corrosion. Recheck the alignment periodically to correct for any changes.

Note: **Pulleys, pinions, or couplings halves should have an interference fit on the shaft extension and must be securely locked to avoid hammering out in operation. Couplings and pinions should be heated and shrunk on the shaft. However, if it is necessary to drive the part into position, it is important, on ball bearing machines, that the end of the shaft opposite the extension be backed up so that the force of the blow is not taken in the bearing.**

Caution: **Any hammering can easily result in a bent shaft. Use a pinion puller for removing tight pulleys.**

Table II
Thrust Rating – Lbs.

Frame	Armature Wt. Lbs. – "A"	Horizontal RPM				Vertical RPM			
		2500	1750	1150	850	2500	1750	1150	850
187A	23	155	180	215	245	160 ± A	185 ± A	220 ± A	250 ± A
216,218A	35,42	165	190	225	255	170 ± A	205 ± A	240 ± A	270 ± A
256A	58	225	265	320	360	235 ± A	275 ± A	335 ± A	375 ± A
283,284,286AT	80,90,100	370	435	525	600	395 ± A	460 ± A	540 ± A	615 ± A
324,326,327AT	145,160,180	380	445	545	615	420 ± A	490 ± A	590 ± A	660 ± A
364,366,367AT	200,240,265	450	530	650	735	515 ± A	590 ± A	720 ± A	800 ± A
406,408AT	305,380	570	690	850	950	660 ± A	770 ± A	930 ± A	1050 ± A
447,448AT	465,510	600	700	900	1000	720 ± A	850 ± A	1020 ± A	1150 ± A
506,507,508AT	630,690,780	600	700	900	1000	750 ± A	900 ± A	1050 ± A	1200 ± A

Bearing Loads

The motor bearings, in addition to carrying the weight of the armature, may be called upon to carry additional loading imposed by the driven machine. These loads can be in the axial direction (thrust), the radial direction (overhung), or a combination of the two. If these are excessive they will materially reduce the life of the bearings.

Thrust Load

The maximum amount of thrust load that a given motor can tolerate is given in Table II. In the case of a vertical mounting the weight of the armature may add or subtract from the allowable load, depending on the direction of thrust. In the table the vertical loads are followed by a correction value "A" which is subtractive if thrust is downward, additive with thrust upward.

Overhung Load

Any radial load acting on the shaft is considered an overhung load. The most common overhung loads are V-belt, gear and chain drives. It is always advisable to keep the load as close to the motor bracket as possible to reduce the bending moment on the shaft extension. Refer overhung loads to the factory.

Caution: **The centerline of the overhung load should never extend beyond the end of the shaft extension.**

Refer to Diagram No. 1 and the diagrams furnished with the starter or control equipment when connecting the motor. Make certain that the voltage and type power supply agrees with the motor nameplate. The control should be so arranged that in the case of a shunt, stabilized shunt or compound wound motor, the shunt field is energized before voltage is applied to armature circuit.

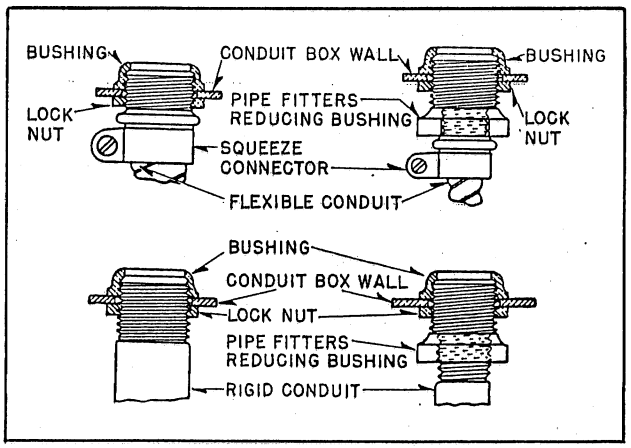


Fig. 1 *Method of Connecting Conduit*

The conduit box on the side of the machine is designed with conduit knock-outs to suit various conduit sizes. Where it is desired to extend conduit from above or one side, remove the four mounting screws, and turn the conduit box 90 degrees or 180 degrees so that the knock-out will be in the desired position. The recommended method of connecting the conduit is shown in Figure 1.

When the machine is mounted on a slide base for belt adjustment, flexible metallic conduit should be used to protect the leads to the machine. In making this connection, a squeeze connector should be used for attaching the flexible conduit to the conduit box. Squeeze connectors may be straight, 45 degrees or 90 degrees.

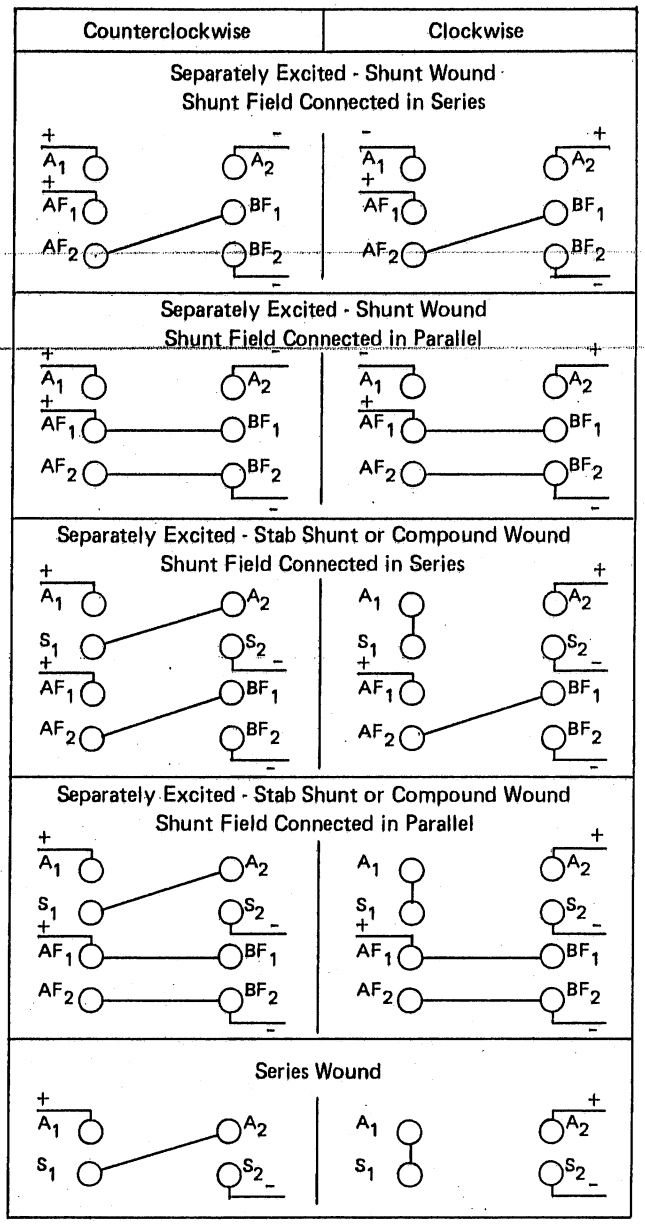


Diagram No. 1

Field Leads

The standard shunt, stabilized shunt or compound wound motor will have four shunt field leads for dual voltage connections. Check the field supply voltage and the motor nameplate and connect the leads in the correct series or parallel combination to suit.

THERMOGUARD®

Where a THERMOGUARD is supplied the standard will have normally-closed contacts, and the leads will be identified as P1P2 (normally open will be P3P4). THERMOGUARD contact ratings in alternating current circuits are as follows:

Volts AC	Amperes AC
110	6.0
220	3.0
440	1.5
550	1.2

They generally should not be used with DC except possibly in low voltage, noninductive circuits. Consult Westinghouse if any such use is contemplated.

It should be noted that while the THERMOGUARD is attached to the commutating coil and is in a sense monitoring temperature of components of the armature circuit it cannot be a reliable indicator of the temperature of both the armature and the commutating coils at all times. There are various factors such as degree of ripple, speed of motor, short-time overload that can effect this relationship, and therefore cannot provide complete protection against overheating for all conditions. It is however especially effective in providing protection against loss of ventilating air, high ambient temperature, and prolonged overloads.

F-2 Conversion

The standard motor comes with conduit box in the F1 position – on the right hand side facing the commutator end. It can be converted to F2 – conduit box on left facing commutator end. The procedure is as follows:

1. Remove conduit box and adapter from F1 side and lead hole cover plate from F2 side. Remove covers from commutator end bracket.

2. By pushing from the outside and pulling from the inside, working through the bracket openings, maneuver the leads from one side to the other. It may be necessary to cut ties inside where the leads have been looped. Cut only those ties that are absolutely necessary. After the conversion apply new ties to hold leads securely.

Note: **On some machines where the cable is very stiff and hard to manipulate it may be necessary to remove the commutator end bracket. Proceed as follows:**

a) Disconnect leads from rocker ring. Do not loosen rocker ring in the bracket.

b) Loosen inner bearing cap by removing screws or bolts at end of bracket near shaft. As screws are loosened tap on them lightly to push inner bearing cap away from its rabbet fit in bracket.

c) Raise brushes off commutator. Protect commutator surface by wrapping heavy paper around it.

d) Remove bolts holding bracket to frame. Tap on bracket ears next to frame to loosen it from rabbet fit and slide it off bearing. Support bracket so as not to drop it or allow the brushholders to dig into the commutator.

3. After the leads have been switched reassemble all parts, including lead hole cover plate. As a precaution check resistance to ground to make certain that leads have not become damaged or pinched during reassembly.

Power Supply

Most DC motors today are powered from some form of rectified AC, generally a thyristor power supply, in place of a DC generator. Because of the ripple in the output of the power supply the motor armature current contains components of AC as well as DC. The magnitude and frequency of these components depends on the exact type of power supply and how it is operated.

The existence of these AC components presents problems not encountered in a straight DC motor application. While they do nothing to produce useful torque they not only make the motor run hotter, but also make it more difficult to obtain spark-free commutation at the brushes. The LIFE-LINE S Motor was designed with such power supplies in mind and normally should experience no difficulty; however, in some extreme cases it may become necessary to connect an inductor in series with the armature circuit in order to reduce the amount of ripple.

The various types of power supplies have been given letter classifications which indicate increasing levels of difficulty in applying DC motors. These categories are based on a 60 Hz line frequency and no series inductor requirement.

Following is a tabulation of the types:

Type	Description
A	DC generator or battery.
C	*Full converter* type with 6 controlled Thyristors, 3 phase, 60 Hz, full wave with 240 volts DC output from 230 $^{+5}_{-0}$ volts AC power supply input or 500 or 550 volts DC output from 460 $^{+10}_{-0}$ volts AC power supply input.
D	*Semi-converter* type with 3 controlled Thyristor and 3 diodes, with a free wheeling diode, 3 phase, 60 Hz, full wave with 240 volts DC output from 230 $^{+5}_{-0}$ volts AC power supply input or 500 or 550 volts DC output from 460 $^{+10}_{-0}$ volts AC power supply input.
E	*Three phase, half wave* type with 3 controlled Thyristors, 3 phase, 60 Hz, half wave with 240 volts DC output from 460 $^{+10}_{-0}$ volts AC power supply input or 120 volts DC output from 230 $^{+5}_{-0}$ volts AC power supply input.
K	*Single phase full wave,* type with 2 controlled Thyristors and 2 diodes with a free wheeling diode, 1 phase, 60 Hz, full wave with 180 volts DC output from 230 $^{+5}_{-0}$ volts AC power supply input.

Power supplies (except type 'A') operated from a line frequency less than 60 Hz will present greater problems for the DC motor – the magnitude of difficulty increasing as the frequency decreases. These power supplies will have a more complex designation which defines not only the frequency but the types which require series inductors.

They will be identified as:

M/N F–V–H–L

where

M = a digit indicating total pulses per cycle.

N = a digit indicating controlled pulses per cycle.

F = free wheeling (this letter appears only if free wheeling is used).

V = three digits indicating nominal line-to-line alternating-current voltage to the rectifier.

H = two digits indicating input frequency in hertz.

L = one, two or three digits indicating the series inductance in millihenries (may be zero) to be added externally to the motor armature circuit.

Example: **"6/3 F–380–50–12" defines a power supply having six total pulses per cycle, three controlled pulses per cycle, with free wheeling, with 380 volts alternating-current input at 50 hertz input, and 12 millihenries of externally added series inductance to the motor armature circuit inductance.**

When connecting the motor check the nameplate to see what type power supply is specified against the supply it is being connected to. A motor can always be used with a power supply better than the one specified. For instance, if Type D is on the nameplate the motor can be used on Type C or A with no difficulty. But if it is desired to go the other way – D to E for instance – it may be necessary to use a series inductor; these situations should be referred to Westinghouse.

Accessory Mounting

The standard motor comes equipped with all the necessary rabbet fits and tapped holes so that two types of accessories can be added by the customer. Kits are available which contain all the parts necessary to complete the installation. The two types of kits are:

1. *Motor Mounted Blower,* with or without filter.

2. *Tachometer Generators* with or without the tachometer as follows:

a) Sigmation
b) Servotek
c) 5 PY, AC
d) 5 PY, DC
e) BC42
f) BC46

Each kit will contain assembly instructions.

Note: **Tachometer kits are not available on Frame 187A. Tachometers must be installed at the factory on motors built on Frame 187A.**

The standard blower motor is rated 230/460 Volts, 3 Phase, 60 Hz. A motor mounted blower is advised if prolonged operation below base speed is contemplated.

OPERATION

Caution: **Before energizing motor make certain that all safety devices such as coupling guards, belt guards, etc., are in place and all overload devices are functioning.**

Examine motor carefully to make certain there are no foreign objects such as tools, hardware, etc., which may have been introduced during installation. Rotate shaft by hand and listen for scraping or rubbing which might indicate presence of foreign objects or internal damage. Make sure all bolts – foot, bracket, pole, etc. – are tight. Pole bolts should be checked according to the following table of torques (dry):

Frame Diameter	Main Pole (Steel) Bolt Size	Main Pole Lb. Ft. Torque	Commutating Pole *(Silicon Bronze) Bolt Size	Commutating Pole Lb. Ft. Torque
180A	.313–18	20	.313–18	15
210A	.375–16	35	.375–16	25
256A	.375–16	35	.313–18	15
280AT	.375–16	35	.313–18	15
320AT	.5 –13	90	.375–16	25
360AT	.5 –13	90	.375–16	25
400AT	.625–11	180	.5 –13	50
440AT	.625–11	180	.5 –13	50
500AT	.75 –10	320	.625–11	100

*If commutating pole bolts are steel, use torques specified for main pole bolts.

Consult instructions accompanying the starter or power supply before starting. Operate the motor first

without load to check connections and direction of rotation. (A series motor should, of course, not be operated without load as it may attain speeds that could be destructive).

Inspection After Starting

Check for unusual noise or vibration. This could be due to misalignment, loose mounting bolts, insufficient shims under feet, etc. Noise could also be caused by power supply ripple.

Check temperature of bearing housing. It should not exceed 80°C. If bearing is running hot, check for excessive loading such as belts too tight, coupling misalignment, high thrust, etc. Also check lubrication. But *DO NOT OVER GREASE!*

Note for future reference appearance of commutator and degree of sparking if any at the brushes.

Inspection After Short Time in Service

This inspection is made to determine if any changes have occurred since installation. Check for noise, vibration, bearing temperature, commutator condition, etc. Any deterioration in these could be due to settling of foundation, bolts that have loosened, etc.

Check condition of air filters if any are present. The amount of dirt that has collected on them will give an indication of how often they should be cleaned or replaced.

If sparking at the brushes has increased it may be due to vibration, excessive loading or malfunction of the power supply.

MAINTENANCE

Warning: **Before touching internal parts of the motor make certain all sources of electrical power have been disconnected. With static power supplies, even though the motor is not turning, voltage may still be present at the motor terminals. Replace all covers and protective devices before placing back into operation.**

Suggestion: **For greater detail on maintenance of not only DC motors but all types of electrical equipment the book "Westinghouse Electrical Maintenance Hints" publication HB-6001 may be purchased. Refer to the nearest Westinghouse Sales Office.**

Although LIFE-LINE S machines require a minimum of attention in service, they should be inspected at regular intervals to guard against excessive (1) dirt, (2) moisture, (3) friction and (4) vibration, which account for 90% of all machine failures.

1. GUARD AGAINST DIRT

The insulation and mechanical parts of the machine should be kept clean. Dust that is free from oil or grease may be removed by wiping with a clean, dry cloth, or preferably, by suction. Dust may be blown from inaccessible parts with clean, dry air, using not more than 30 to 50 pounds pressure. Use care to prevent personal injury from the air hose; use goggles to avoid eye injury from flying particles. When grease or oil is present, wipe with a cloth moistened (but not dripping) with a petroleum solvent of a "safety type", such as Stoddard solvent, or similar material. Wear suitable gloves to prevent skin irritation. Such solvents are flammable, but relatively non-toxic. Dry by baking in a properly ventilated oven. Check the insulation resistance before returning to service.

2. GUARD AGAINST MOISTURE

Machines should always be guarded against the accidental intrusion of water from splatter or splashing. Stand-by units should be run at least once a week to guard against moisture condensation.

Before windings are blown out with air, make sure that water has not condensed in the air line.

3. GUARD AGAINST FRICTION

Excessive friction or overheating of bearings is usually traced to one of the following causes:

a) Excessive belt tension.

b) Poor alignment causing excessive vibration or binding.

c) Bent shaft.

d) Excessive end or side thrust due to gearing, flexible coupling, etc.

4. GUARD AGAINST VIBRATION

To avoid failures due to vibration, a few simple checks should be made regularly.

Check for misalignment such as may be caused by foundation settling or heavy floor loading. These may be causing vibration through misalignment. Check to see if vibration from the driven machine is being transmitted to the motor.

Check for excessive belt or chain tension or the push-apart effect inherent in spur gears.

Check mounting bolts and bracket bolts to be sure they are tight.

Coils

Revarnishing the windings when machines are overhauled will increase their life. Suitable varnish may be obtained from the nearest Westinghouse Sales Office.

Brushes

Warning: **High voltage and rotating machinery can cause serious or fatal injury! Make certain motor is shut down and all power disconnected before touching brushes!**

The correct brush position is the same for both directions of rotation. The neutral position of the brushes is indicated by a chiseled or painted mark in the front bracket. This mark registers with a notch molded in the rocker ring. The brushes should not require further adjustment.

The brush shunt comes with a wear marker on it. When the marker reaches the top of the box the brush is at its minimum length and should be replaced. Any further wear may damage the commutator. Note that the marker should be at the top of the box and not at the top of the ears which project above the box. The latter would result in needless changing of brushes.

Use only the brushes recommended by Westinghouse. These brushes are recommended on the basis of extensive tests which have proved their reliability for this service. Brushes should have only sufficient clearance in the box to slide easily.

Caution: **DC motors operated at light load for extended periods or in contaminated atmosphere may develop abnormal commutator and brush wear. This can result in excessive maintenance. Quite often, if there is no way to avoid the situation, the problem can be mitigated by a change in brush grade or some other action. Consult with Westinghouse.**

Brushholders

These machines are fitted with "CONPRES" brushholder. The "CONPRES" brushholder maintains constant pressure during the life of the brush. It requires no adjustment to compensate for brush wear (See Figure 2).

Where severe operating conditions, such as excessive vibration, high surges of load, line-starting, etc. are encountered brushholders are available with stronger springs. Refer such problems to Westinghouse.

If, for whatever reason, brushholders are removed, exercise care when replacing them. Make sure the serrations on the brushholder box engage the serrations on the rod and the brushholder is not cocked. The brushholder must not touch the face of the commutator, but it should be spaced no further off the commutator than .094 inches. If the brushholder is further than this off the commutator the brush may not ride properly.

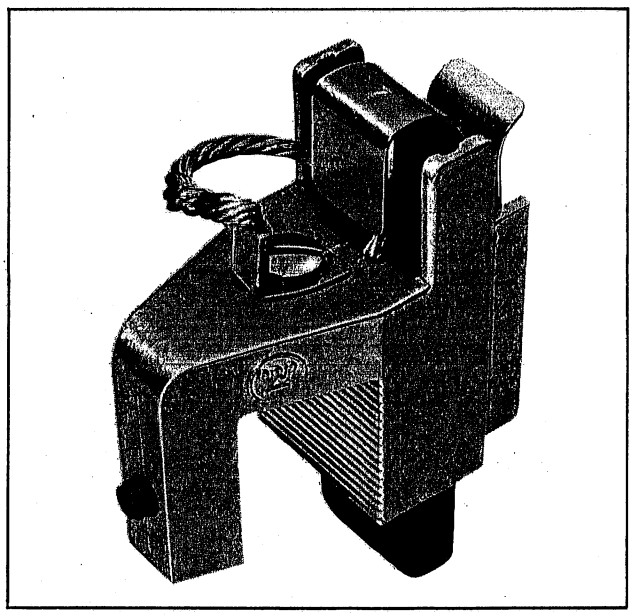


Fig. 2 *"CONPRESS" Brushholder*

Care of the Commutator and Brushes

Keep the commutator clean, wiping it at frequent intervals with a clean canvas cloth free from all lint. The brushes should fit the commutator, making contact over the entire surface.

A commutator that is taking on a polish and shows no sign of wear requires no other attention; but a raw, copper-colored or smutted commutator should be cleaned with a piece of sandpaper or sandstone ground to fit and then polished with No. 00 sandpaper. Always lift brushes when polishing commutator and do not replace them until all grit has been removed. Never use emery cloth or emery paper on the commutator.

If the commutator develops grooving eccentricity, high bar or mica, the armature should be removed and placed in a lathe, ground, polished, undercut, and beveled. The commutator should be concentric within .0005" "run-out" or total dial indicator reading at slow roll or .001" at rated speed after grinding. The mica should be undercut 1/16" deep. ± 1/64 using a small circular high-speed saw about .003" thicker than that of the mica. Care should be taken that slivers of mica are not left along the commutator bars. The bevel of the bars is done with a special beveling tool and should be about 1/32" chamfer at 45° for medium thickness of bars.

Installing New Brushes

The ends of all brushes should be fitted to the commutator so that they make good contact over their entire bearing face. This can be easily accomplished after the brushholders have been adjusted and the brushes inserted. Fit the brushes in each brushholder separately by drawing a sheet of sandpaper under the brushes in the direction of rotation while pressing them firmly against the commutator. Be careful to keep the ends of the sandpaper as close to the commutator surface as possible to avoid rounding the edges of the brushes. The sandpaper should cut the brushes only in the direction of normal rotation – lift the brushes as the sandpaper is drawn back. Never use emery cloth or emery paper to seat brushes. The abrasive material of which emery is made, becomes imbedded in the brushes and causes commutator wear and failure.

Bearings

Type

The standard ball bearings have either a shield or a seal on the inboard side to prevent grease leakage into the motor. The bearings should have a Class C3 internal clearance. It is recommended that replacement bearings be obtained from Westinghouse to insure correct operation.

Lubrication

Bearings are packed at the factory with a proper amount of lubricant and will require no additional grease for a long period of operation. Greasing and drain ports are provided on all machines for use if service lubrication is desired. When regreasing stop motor, remove drain plug, add Westinghouse grease (Westinghouse Spec. M-55272-BA, Shell Alvania No. 2) with hand operated gun only. Add amount of grease specified in Table III.

Caution: **Do not over grease.**

Table III
Volume of Grease for Lubrication

Shaft Diameter	Amount of Grease to Add
Up to 1"	1/2 cu.in. or .4 oz.
Above 1" to 2"	3/4 cu.in. or .6 oz.
Above 2" to 3"	1-1/2 cu.in. or 1.2 oz.
Above 3" to 4"	2-1/2 cu.in. or 2 oz.

After adding grease check to be sure that the grease did not enter inside of the motor. Run the motor 10 minutes before replacing the drain plug.

The standard grease has a temperature range of -30°C to +90°C. For operation in temperatures beyond this range refer to Westinghouse.

Frequency of Relubrication

For normal duty in a relatively clean atmosphere it is recommended that the bearings be lubricated every 12 to 18 months with the volume of grease listed in Table II. For severe duty, dusty locations and speeds over 2000 RPM the time interval between lubricating should be reduced to 6 to 9 months.

Failure

Warning: **Occasionally, due to extreme overload, flash-over or some other electrical fault, high temperatures are created inside the motor, which in turn cause the insulation to emit dangerous fumes. All power should be removed from the machine. Before any attempt is made to examine the motor the atmosphere around it should be allowed to clear itself and the motor itself cooled off.**

In the event of flames, use a type of fire extinguisher approved for use on electrical fires. UNDER NO CONDITION, USE WATER TO EXTINGUISH SUCH FLAMES.

Before operating motor after such failures, inspect it carefully to assess extent of damage. Check insulation resistance to determine if a ground is present. Check all windings for open or short circuit. Check shunt field resistance against value on nameplate. Repair or replace damaged parts.