



GE Industrial Systems

Instructions

Direct Current Motors & Generators

Type CD

Frames 2512AT, 2513AT

Frames 2812AT, 2813AT

These instructions do not purport to cover all of the details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

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Direct Current Motors and Generators Type CD Frames 2512AT, 2513AT, 2812AT, 2813AT

I. INTRODUCTION

This instruction book covers the CD2512AT-CD2813AT line of DC motors and generators.

 Warning	<p><i>High voltage and rotating parts can cause serious or fatal injury. The use of electric machinery, like all other utilization of concentrated power and rotating equipment, can be hazardous. Installation, operation and maintenance of electric machinery should be performed by qualified personnel. Familiarization with NEMA Safety Standard for Construction and Guide for Selection, Installation and</i></p> <p><i>Use of Integral HP Motors and Generators, National Electrical Code and sound local practices is recommended.</i></p>
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These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency or hazard to be met in connection with installation, operation and maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to GE Industrial Systems.

II. RECEIVING

The equipment should be placed under adequate cover immediately upon receipt, as packing coverings are NOT suitable for out-of-doors or unprotected storage.

Each shipment should be carefully examined upon arrival. Any damage should be reported promptly to the carrier and to the nearest office of GE Industrial Systems.

A. Storage

During installation or when in storage, the machine and its parts must be protected from the following:

1. Dirt of all kinds.
2. Wetness and temperature extremes.

Protection from dirt can be achieved by covering the machine with a tarpaulin or polyethylene sheet or keeping it in a clean area.


Protection from wetness and temperature extremes includes moisture from the surrounding atmosphere condensing onto cooler machine surfaces. This condensation on machine surfaces can result in rusting or corrosion and the electrical windings may suffer serious damage.

Where wetness and/or cold conditions are present, the machine and its parts must be protected by a safe reliable heating system which, at all times, will keep the machine temperature slightly above that of the surrounding atmosphere. If a space heater is included in the machine, it should be energized.

Smaller machines shipped in paper cartons are protected from condensing-type wetness by the insulating characteristics of the carton. To avoid sweating where these have been exposed to low temperature for an extended period, allow the machine and carton to attain room temperature before unpacking.

Brushes should not remain in contact with the commutator during prolonged storage because corrosion may occur and later result in flat spots on the commutator. Release the brush springs and lift the brushes when stored for a period of more than six months.


All exposed machined steel parts are slushed with a rust preventative before shipment. These surfaces should be examined carefully for signs of rust and moisture, and reslushed if necessary. Once started, rust will continue if the surface is reslushed without first removing all rust and moisture. Rust may be removed by careful use of fine abrasive paper. Slushing compound can be removed by use of a suitable solvent such as mineral spirits.

 Warning	<p><i>Mineral spirits are flammable and moderately toxic. The usual precautions for handling chemicals of this type must be observed. These include:</i></p> <ol style="list-style-type: none"> <i>1. Avoid excessive contact with skin.</i> <i>2. Use in well ventilated areas.</i> <i>3. Take necessary precautions to prevent fire or explosion hazards.</i>
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Extreme care must be exercised in removing rust on shaft extensions near shaft seals, since it is difficult, and sometimes impossible, to remove rust from these surfaces without damaging or deforming them.


Burrs or bumps on other machined surfaces should be carefully removed by using a fine file or scraper.

Machines in storage should be inspected, have the insulation resistance checked at frequent and regular intervals (**refer to Insulation Resistance** section), and a log kept of pertinent data.

 Caution	<p><i>When stored, it is suggested that the armature be rotated every three months to prevent loss of grease protection on the bearings and races. Loss of grease protection causes rust.</i></p>
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B. Handling

Complete motors or generators can be lifted by using hooks or slings in the lifting lugs of the unit. The lifting lugs are designed to safely carry the weight of the individual machine. **DO NOT** lift the machine with the shaft extensions.

 Warning	<p><i>Motor generator sets or units with heavy attachments such as gear boxes or pumps must not be lifted by using the lifting lugs of the individual machines.</i></p>
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Motor generator set bases have lifting holes, to be used with spreader bars or hooks. Care must be taken in handling to avoid twisting bases.

Table 1
Typical Weights**

	Motor (Less Accessories)	Armature
CD2512AT	500	120
CD2513AT	550	135
CD2812AT	650	160
CD2813AT	750	190

**Typical weights. For specific weight, see certified outline.

III. INSTALLATION

Installation should be in accordance with the National Electrical Code and consistent with all local codes. Coupling, belt and chain guards should be installed as needed to protect against accidental contact with moving parts. Machines accessible to the public should be further guarded by screening, guard rails, etc. to prevent personnel from coming in contact with the equipment. Fully guarded covers are supplied on motors and generators. Shaft guards are supplied on motor generator sets.

Totally enclosed and waterproof motors must have all covers securely in place with gaskets intact in order to exclude dirt, oil and water. It is generally preferred to remove plugs from drain holes at the bottom of the frame to ensure that no condensation will collect inside the motor. However, if the installation requires plugs to be installed, they must be removed periodically to make certain that all water is eliminated.


A. Location

Motors and generators should be installed so that they will be readily accessible for routine inspection and maintenance. They are suitable for use in ambient temperatures from 0°C (32°F) to 40°C (104°F). An adequate supply of clean, dry room air is required for self-ventilated, separately ventilated and blown motors. Where motors must operate in dirty, wet or contaminated environments, protection in the form of filters or totally enclosed construction must be used to obtain long life with normal maintenance.

Do not obstruct ventilating openings.

When filters are supplied, service them regularly. Dirty filters shut off ventilating air.


Beware of recirculation. Install motors so that hot exhaust air will not re-enter the motor.

 Warning	<p><i>The use of electrical equipment in hazardous locations is restricted by the National Electrical Code, Article 500. Original equipment manufacturers and user customers must read, understand and apply these rules for installation and use of all equipment in such locations and consult local code inspection and enforcement agencies, as necessary, to ensure compliance. Motors listed by Underwriters Laboratories, Inc. for use in specific locations have been designed, tested and approved for use in such locations only.</i></p> <p><i>Sections 501-8 and 502-8 now permit the use of totally enclosed motors with positive pressure ventilation or totally enclosed inert-gas-filled motors (Class I locations only), when installation and operation conform to certain requirements.</i></p> <p><i>Motors for Class I locations must have leads sealed at the frame exit and an explosion-proof conduit box. See Sections 501-4 and 501-5.</i></p> <p><i>Motors for Class II locations must have leads sealed at the frame exit and a dust-ignition-proof conduit box. See Sections 502-4 and 502-5.</i></p>
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B. Mounting

Motors and generators should be mounted on rigid and solid foundations. Level the base (or the machine). Hold-down bolts should be inspected regularly and kept tight. The feet of the machine may be doweled to the foundation plates or base when alignment procedures are completed. Sliding bases, when used, should be securely anchored to the foundation.

Motors are mechanically suitable for mounting with shaft horizontal or vertical on floor, ceiling or sidewall. When sidewall or ceiling mounted, special provisions must be made to maintain the integrity of dripproof enclosures.

 <p>Warning</p>	<p><i>When motor is sidewall or ceiling mounted, lifting points in addition to the standard lifting lugs may be required. Lifting, in these cases should be done by experienced riggers to avoid injury to personnel and damage to the motor.</i></p>
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C. Alignment

 <p>Caution</p>	<p><i>Be sure to align or check alignment carefully on either motors or motor generator sets. Misalignment can cause excessive vibration and damaging forces on shafts and bearings.</i></p>
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Time taken to assure good alignment will be returned in reduced downtime.

1. Coupled Drive

When a motor is used to drive a unit, flexible couplings must be used to facilitate alignment. Three-bearing construction requires a rigid coupling.

 <p>Caution</p>	<p><i>Careful alignment of machines when using either solid (rigid) or flexible couplings is essential to prevent excessive vibration and bearing or shaft failures.</i></p>
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a. Alignment Procedure Flexible Coupling, Non-Self-Supporting Bases

Before grouting the base, the coupling should be checked as follows:

1. Slide the sleeve from the coupling so that the hub faces are exposed.
2. Check that the coupling hub spacing is in accordance with the outline dimensions with the units in the mechanical center of their end play.
3. Check parallel alignment by using a straightedge across the hubs at both vertical and horizontal locations, or by clamping a dial indicator to one hub and indicating the other hub on its outside diameter. Be sure that the dial indicator supports do not bend or sag, since this will give inaccurate readings.
4. Use a dial indicator at hub faces and rotate both units together 90°, 180°, 270° and 360° or measure the gap at each position by inserting a feeler gage. The reading should not vary more than 0.002”.
5. Correct any vertical misalignment by shimming between the base and the foundation.

Horizontal alignment should be corrected by shifting machines on the base.

b. Alignment Procedure
Flexible Couplings, Self-Supporting Bases

Before operating the machine, the base should be bolted down and the alignment checked as follows:

1. Remove all of the coupling bolts and slide the shells back so that the hub faces are exposed.
2. Check the coupling hub spacing in accordance with the outline dimensions with the units in the mechanical center of their end play.
3. Check parallel alignment by using a straightedge across the hubs at both vertical and horizontal locations or by clamping a dial indicator to one hub and indicating the other hub on its outside diameter. Be sure that the dial indicator supports do not bend or sag, since this will give inaccurate readings.
4. Use the dial indicator at hub faces and rotate both units together 90°, 180°, 270° and 360° or measure the gap at each position by inserting a feeler gage. The readings should not vary more than 0.002”.
5. Correct any vertical misalignment by shimming under the units. Horizontal alignment should be corrected by shifting machine on the base.

2. Grouting

On concrete foundations, a minimum of 1” should be allowed for grouting.

A rich, non-shrink grout should be used. High-grade grout mixtures are available commercially. If the grout is to be prepared at the site, a cement-sand ratio of 1:2 is recommended. No more than enough water should be used to give a stiff mixture. The clean but rough surface of the foundations should be wet and the grout forced or puddled under the base.

3. V-Belt Drives

The V-belt system produces a heavy shaft and bearing loading, making it necessary that these factors be considered carefully for proper application. Since belt drives impose a bending moment on the motor shaft, it is always desirable to have the motor sheave located as close to the motor bearing as possible to minimize both bearing load and shaft stress. This will result in increased bearing life. For the load centered 2” in toward the bearing from the end of the shaft instead of at the end of the shaft, the bearing load is reduced by 10% and the life increased by 33%. The bearing life curves that follow assume the load is centered at the end of the shaft. New improved V-belts are now on the market that significantly reduce the number and size of belts required for a given load. These new belts should always be considered, since the sheave will be shorter and the load centered closer to the bearing.

The standard NEMA shaft extension is designed for belted loads. Dimensions are provided on the standard dimension sheets. A sliding base is available as an accessory to facilitate belt adjustment.

4. Bearing Life

Bearing life for belted drives is determined by calculating the radial load at the end of the shaft.

The radial load, W , produced by the belts when tightened just enough to transmit the load without slipping is given by the relation:

$$W = \frac{126,000 \times \text{HP}}{D \times \text{RPM}} \times K_b, \text{ lbs}$$

Where:

D = Sheave pitch diameter in inches for V-belt application

$\frac{\text{HP}}{\text{RPM}}$ = Maximum ratio of horsepower, **including overloads**, to the minimum speed at which that power occurs.

K_b = Belt tension factory from table below:

Belt Tension Factor, K_b	
K_b	Description
1.0	Chain and Sprocket Drive
1.2	Timing Belt
1.5	V-Belt, 1:1 Ratio
1.8	V-Belt, 2:1 Speed Decreased Ratio
2.0	Flat Belts

The curves that follow can be used to determine the anticipated L10 life, which is the life in hours that 90% of bearings with this load would be expected to exceed without failure. The standard ball bearing and standard shaft option will be the most economic, if acceptable life is obtained from the curve. A good commonly used design figure is 20,000 hours. However, applications with a calculated life of as low as 5,000 hours have sometimes been necessary to limit belt speeds to 6,000 feet per minute. The curves are drawn for 1750 RPM average speed. If the application has some other average speed, the life can be adjusted by multiplying by the bearing life factor.

It is important to know that bearing life for V-belt applications is independent of the motor load. Once the belts have been tightened just enough to prevent slipping when the maximum torque is being delivered by the motor the radial load, W , on the shaft and bearing is there and remains constant regardless of whether the motor is even turning. For timing belts and chain drives, the radial load, W , does not vary somewhat with motor load. Therefore, the motor load duty cycle as well as the average speed should be considered to estimate bearing life.

Belt tension should be checked and adjusted following the belt manufacturers' recommendations.

If slippage occurs after the belt tension has been correctly adjusted, the belts and pulleys have not been chosen properly for the application.

 Caution	<p><i>Over-tightening to avoid this slippage may result in early failures of belts, shafts and bearings.</i></p>
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There is normally a drop in tension during the first 24 to 48 hours of operation. During this "run in" period, the belts seat themselves in the sheave grooves and initial stretch is removed. Belt tension should be re-checked after a day or two of operation.

Matched belts run smoother and last longer. Longer belt life results if the belts and sheaves are kept clean and the belts are prevented from rubbing against the belt guards or other obstructions.

Mounting may be either horizontal or vertical for these bearing life determinations, as long as no axial load (i.e., suspended load) other than the weight of the armature is present if vertical.

5. Special Load Considerations

Where the load is overhung beyond the motor shaft extension or greater bearing life is desired, the application should be referred to GE Industrial Systems.

6. Pinion Drives

While Kinamatic® motors are not designed for overhung pinion drives, they may be successfully applied under suitable conditions. In addition to a radial load, some gears produce thrust load on the bearing. Complete details of the proposed gearing should be referred to GE Industrial Systems in all cases.

7. Thrust Loads

Due to the mounting position or type of drive arrangement, a thrust load may be applied to the motor shaft. The Kinamatic® motor is designed to permit a limited amount of thrust load. This permissible load will vary by mounting position and direction of the load due to the weight of the armature. The permissible load in **Table 2** is tabulated by frame diameter and mounting position. These apply to ball bearings only.


For applications combining thrust and radial loads or where thrust loads exceed the values shown in **Table 2**, refer all details to GE Industrial Systems.


Table 2
Maximum Continuous Thrust Capacity, Lbs.*


Frame	Bearing Size	Horizontal Mounting	Vertical Mounting	
			Thrust Load Up	Thrust Load Down
2512	Std-309	350	465	235
2512	O/S-310	400	515	285
2513	Std-309	350	485	215
2513	O/S-310	400	585	265
2812	Std-310	400	550	250
2812	O/S-311	500	650	350
2813	Std-310	400	585	215
2813	O/S-311	500	685	315

*Based on L10 life of 20,000 hours and an average speed not exceeding 2500 RPM.

IV. OPERATION

 Warning	<p><i>Disconnect power before touching any internal part. High voltage may be present even when the machine is not rotating. If used with a rectified power supply, disconnect all AC line connections to power supply. With other power supplies, disconnect all DC line and field connections. Also disconnect power from auxiliary devices.</i></p>
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 Warning	<p><i>Ground the machine properly to avoid serious injury to personnel. Grounding must be in accordance with the National Electrical Code and consistent with sound local practices. One of the bolts holding the conduit box to the unit, accessible from inside the conduit box, is identified and may be used for attaching a grounding cable.</i></p>
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 <p>Warning</p>	<p><i>Before starting the motor, remove all unused shaft keys and loose rotating parts to prevent them from flying off.</i></p>
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A. Inspection Before Starting

These inspection procedures should be followed before starting the machine for the first time, after an extended shutdown or after a teardown for extensive maintenance or repair.

1. Bearings and Couplings

Machines with ball or roller bearings are greased at the factory and will need no attention until relubrication is necessary as suggested in the **Maintenance** section of this instruction book.

If the flexible couplings are a lubricated type, they should be checked to see that they contain the proper amount of lubricant.

Make sure that all grease plugs are tight.

2. Commutator and Brushes

Brushes should be worn in to have at least 85% contact over the brush surface and continuous contact from heel to toe. The commutator surface and undercut mica should be clean and free from dirt, grease, paint spots or brush dust.

Brushes should be free to move in the holders and all springs should be down and latched. Brush pigtail connections should be tight and the pigtails should not interfere with the action of the spring or brush and should be clear of any other part of the machine.

B. Rectified Power Supplies

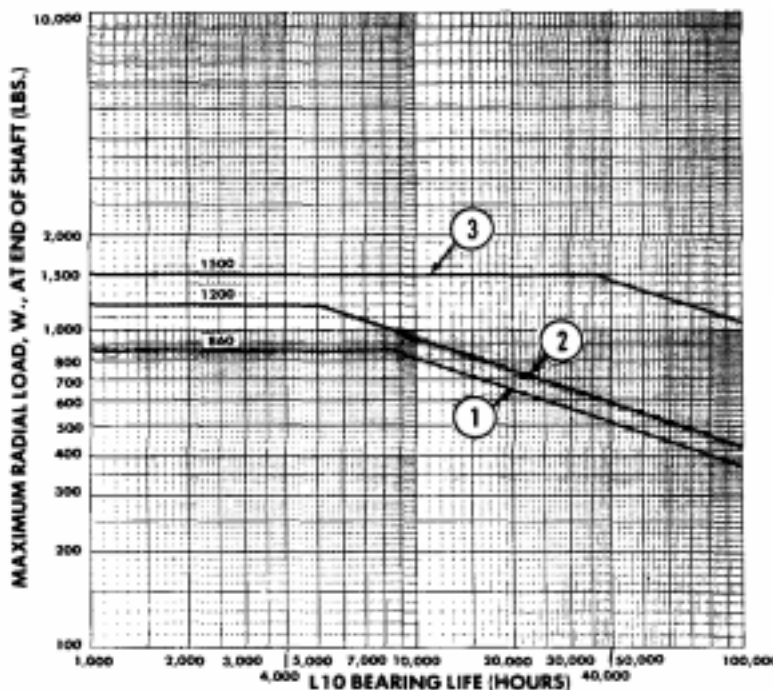
When DC motors are operated from rectified power supplies, the pulsating voltage and current wave forms affect the motor performance by increasing motor heating and degrading commutation. Because of these effects, it is necessary that the motors be designed or specially selected to suit this type of operation.

The ratings of DC motors intended for operation from rectified power supplies are based upon motor tests using a suitable power supply. The specific characteristics for three-phase rectified power supplies described in the **Power Supply Identification** section are in common use. For operation of motors from rectified power supplies other than those given in this section, refer to GE Industrial Systems.

A motor may, under some conditions, be operated from a power supply different from that indicated on the nameplate. Letters used to identify power supplies in common use have been chosen in alphabetical order of increasing magnitude of ripple current. Power supply compatibility can be judged by **Table 4**.

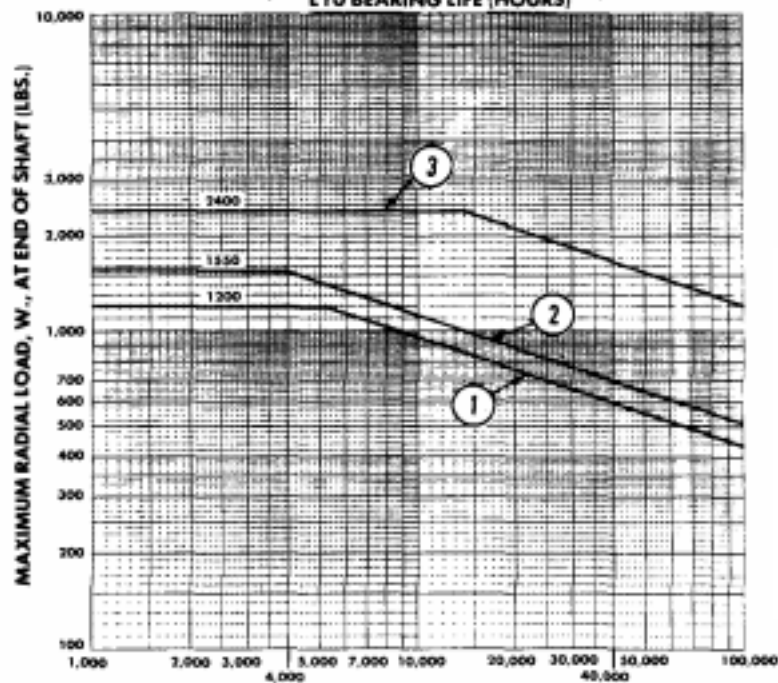
Table 3
Bearing Life at 1750 RPM Average Speed Vs. Load, W
 (For other average speeds, multiply life by life factor)

Speed	Less Than 500	650	850	1150	1500	2000	2500	3000	4000	5000
Life Factor	2.15	1.83	1.55	1.29	1.10	.92	.80	.72	.60	.55



Frame Sizes
CD2512AT and CD2513AT

Curve	Description		
	Bearing	Shaft Diameter	Shaft Material
1	Standard Ball (309)	Standard (1-5/8)	Standard
2	Oversize Ball (310)	Oversize (1-7/8)	Standard
3	Oversize Roller (310)	Oversize (1-7/8)	Special



Frame Sizes
CD2812AT and CD2813AT

Curve	Description		
	Bearing	Shaft Diameter	Shaft Material
1	Standard Ball (310)	Standard (1-7/8)	Standard
2	Oversize Ball (311)	Oversize (2-1/8)	Standard
3	Oversize Roller (311)	Oversize (2-1/8)	Special

Table 4
Power Supply Available

NP Rating Code	A	C	D	E	K
A	√	*	*	*	*
C	√	√	*	*	*
D	√	√	√	*	*
E	√	√	√	√	*
K	√	√	√	√	√

√ Compatible power supply.

* External inductance may be necessary to limit ripple current.

C. Power Supply Identification

The nameplates of DC motors intended for operation from rectified power supplies will be stamped with a power supply identification as described below.

1. **When the test power supply used as the basis of rating is one of the five described below, a single letter "A", "C", "D", "E" or "K" will be used to identify the test power supply.**

a. Power Supply Identification Letter "A"

This designates a DC generator, battery or any power supply with enough series inductance to result in no more than 6% peak-to-peak armature current ripple.

b. Power Supply Identification Letter "C"

This designates a three-phase, 60 hertz input, full-wave power supply having six total (controlled) pulses per cycle. The power supply has no free-wheeling and no series inductance. The input line-to-line AC voltage to the rectifier shall be 230 volts for 240 volt DC motor ratings, and 460 volts for 500 or 550 volt DC motor ratings.

c. Power Supply Identification Letter "D"

This designates a three-phase, 60 hertz input, semi-bridge power supply having three-controlled pulses per cycle. The supply has free wheeling with no series inductance added externally to the motor armature circuit. The input line-to-line AC voltage to the rectifier shall be 230 volts for 240 volt DC motor ratings and 460 volts for 500 or 550 volt DC motor ratings.

d. Power Supply Identification Letter "E"

This designates a three-phase, single-way (half-wave) power supply having three total pulses per cycle and three-controlled pulses per cycle. The power supply has no free wheeling and no series inductance added externally to the motor armature circuit inductance. The input line-to-line AC voltage to the rectifier shall be 460 volts for 240 volt DC motor ratings.

e. Power Supply Identification Letter "K"

This designates a single-phase, full-wave power supply having two total (controlled) pulses per cycle with free wheeling 60 hertz input and no series inductance added externally to the motor armature circuit. The input AC voltage to the rectifier shall be 230 volts for 180 volt DC ratings.

2. **When intended for use on a power supply other than “A”, “C”, “D”, “E” or “K”, the motor will be identified as follows:**


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 AC 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 inductance.


D. Connections

Terminal connections should be checked against the connection diagram shipped with the machine. Bolted connections must be tight. All exposed connections in the conduit box must be insulated. When more than one terminal is marked with the same identification, they should be joined in the same connection. (Refer to **Table 6** for identification of wiring leads.)

E. Protective Devices

 Caution	<p><i>Make certain that all protective devices (overspeed devices, bearing temperature relays, etc.) are connected and function properly. Also, make certain that all coupling guards, shaft protectors, grounding connectors, covers and other safety devices are properly attached.</i></p>
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F. Motor Field Heating

 Caution	<p><i>MOTOR FIELD HOUSING – Unless specifically ordered, motors are NOT capable of continuous standstill excitation at rated field current. When the motor is shut down for more than 30 minutes, one of the following options must be used:</i></p> <ol style="list-style-type: none"> <i>1. De-energize the fields completely.</i> <i>2. Use field economy relays to limit the field current to a maximum of 50% of the nameplate rating.</i> <i>3. When applicable, fields may remain fully energized if the motor ventilation system (blower or customer duct) remains in operation.</i>
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G. Thermostats

The thermostat is a device that may be used in alarm or protective relay circuits within rating limits shown in **Table 5**. It is not intended to limit motor loading or provide normal insulation life. When supplied, it is mounted to a commutating coil which is the only accessible part of the armature circuit. Since factors such as shaft speed, ventilation (blower or shaft fan), current ripple (SCR phase-back) and short-time overload affect the temperature relationship between armature and commutating field, complete protection from all conditions resulting from over-temperature is not possible. The device is intended to guard against complete loss of normal ventilation air, high ambient temperature, and prolonged operation of self-ventilated motors at very low speeds.


 Warning	<p>Thermostats automatically reset after the motor has cooled somewhat. In order to prevent property damage or injury to personnel, the control circuit should be designed to prevent re-energizing of the motor when the thermostat resets.</p>
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Table 5
Maximum Current Ratings for Thermostats
on Dripproof and Totally Enclosed Motors
 (Normally open or normally closed contacts)

Load	125 VAC	250 VAC	600 VAC	30 VDC
	Do not use above 600 VAC or 30 VDC			
Resistive	5 Amps	2.5 Amps	1 Amp	5 Amps
Inductive*	3 Amps	1.5 Amps	0.5 Amps	1.5 Amps

*Suitable for pilot duty only (relay coils).

H. Speed Limit Device

The mechanical speed limit device is non-adjustable. Tripping speed is specified by a note on the print certification for each specific order.

The speed limit electrical contacts are normally closed and are usually connected in relay or holding circuits. Current ratings are the same as those listed in **Table 5**.

A speed limit device is furnished on machines only when ordered.


 Warning	<p>The contacts of the speed limit device automatically reclose after the speed has fallen below the trip value. In order to prevent property damage or injury to personnel, the control circuit should be designed to prevent re-energizing the motor until the cause of the overspeed has been corrected.</p>
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Table 6
Lead Markers

Function	Winding
Armature	A1, A2
Field (Shunt)	F1, F2, F3, F4, etc.
Stator, AC Machines Only (Type AN Tachometer Generator)	T1, T2, T3, T4, etc.
Accessories & Special Device Markings	
Tachometer Generator, Direct Current, to Terminal Board	A1, A2
Brake Coil Leads	B1, B2, B3, B4, etc.
Heater, Brake Space Heater	BH1, BH2, BH3, BH4, etc.
Brake Interlock Switch	BS1, BS2, BS3, BS4, etc.
Heater, Space Heater in the Machine	H1, H2, H3, H4, etc.
Thermostat	P1, P2, P3, P4, etc.
Resistance Temperature Detector (RTD)	R1, R2, R3, R4, etc.

I. Space Heater

When furnished, see Print Certification for Electrical Rating.

Space heaters are furnished in machines when ordered. They should be energized with the correct AC voltage as shown on the nameplate.

 <p>Warning</p>	<p><i>The surface of a space heater block becomes hot when the heater is energized. The temperature rise above the ambient temperature may be as high as 400°C. Avoid touching heater blocks which have recently been energized to prevent burns. Also, to prevent fire or explosion, ignitable dust or lint should not be allowed to collect around the surface of the heaters.</i></p>
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J. Ventilation System

Blowers or central systems must be in operation to supply cooling air before loading force ventilated machines. Air filters should be in place. Blowers should be checked for correct rotation. See outline or rotation arrow.

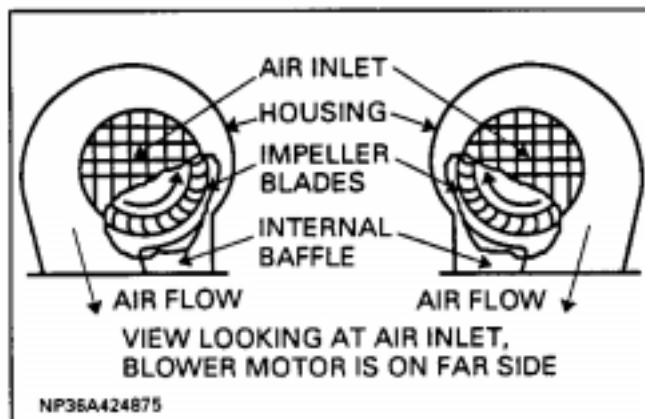


Figure 1
Correct Arrangement Of Blower Housing, Impeller Blades,
And Direction Of Rotation To Obtain Proper Pressure And Air Flow

K. General Mechanical Inspection

Check the inside of the machine for tools, metal chips or any other foreign material that may have accumulated during storage or installation. Make sure that all rotating parts have clearance from any stationary parts. Turn the machine over by hand, if possible, and check for scraping noises or any other sign of mechanical interference. Check the tightness of the bolts in the feet, couplings, bearing housings and any other bolts that may have been disturbed.


 <p>Caution</p>	<p><i>Standard motors, as shipped, are assembled with bolts without lubricant (dry threads). When necessary, bolts may be replaced with bolts with dry threads or with bolts lubricated with a motor oil or other suitable thread lubricant. When lubricated threads are used, reduce torque to 65% of the value shown. The torque values shown, when applied to bolts with lubricated threads, can cause excessive bolt tension and possible bolt breakage.</i></p>
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Table 7
Bolt Tightening Torque Values

Thread Sizes (UNC-2A)	Hex Head (C1C5) Grade 5 Medium Carbon Steel (Without Lubricant)	
	Lb-Ft	N-m
1/4-20	7-9	10-12
5/16-18	13-17	18-23
3/8-16	24-30	33-40
1/2-13	60-75	80-100
5/8-11	120-150	160-200
3/4-10	210-260	280-350

For lubricated bolts, use 65% of value shown in **Table 7**.

L. Accessory Mounting


Provisions for mounting accessories on the commutator endshield is a standard feature. The rabet has NEMA type C-Face mounting dimensions, including the mounting bolt holes. The standard stub shaft also permits coupling certain accessories.

 Warning	<p><i>To prevent injury from the rotating shaft, the stub shaft cover must be maintained in position when the accessory mounting is not used.</i></p>
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Standard accessories are available as kits. These include a variety of tachometers, speed limit switches and brakes. A mounting adapter, which can be machined for various accessories, can be ordered separately.

M. Brakes

Flange mounted brakes may be mounted on the accessory rabet. Since the accessory stub shaft is not suitable for use with a brake, the standard NEMA commutator end shaft extension should be ordered when such use is planned. Standard brakes are designed for horizontal floor mounting only. When motors are sidewall or ceiling mounted, the brake must be reassembled to maintain its relation to the horizontal. Where motors are to be mounted with the shaft greater than 15° from the horizontal, special brakes should be specified.

 Warning	<p><i>Improper selection or installation of a brake and/or lack of maintenance may cause brake failure, which can result in damage to property and/or injury to personnel. (Refer to the separate instruction book pertaining to the brake furnished.)</i></p>
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N. Inspection After Starting

The following items should be checked after the machine is running:

1. Bearings

Ball bearing or roller bearing housing temperature should be no more than 80°C (176°F). Excessive bearing temperature may be caused by misalignment or improper greasing (Refer to **Alignment and Bearing Maintenance** sections.)

2. Noise and Vibration

Check for unusual vibration or noises that might indicate rubbing or interference.

Vibration of new machines at the bearing housings, as measured by a vibration meter, should not exceed the values shown in **Table 8**. (Measurements are according to NEMA MG 1-12.06 and MG 1-12.07.)

The most likely cause of vibration in new machines is misalignment due to improper installation, loose foot bolts, uneven shimming under feet, or damage to machine during shipment or installation. Current ripple due to a rectified power supply may also be a source of vibration and audio noise.

Table 8




RPM	Maximum Amplitude (in Inches) (Peak to Peak)
3000-4000 incl.	.001
1500-2999 incl.	.0015
1000-1499 incl.	.002
999 and below	.0025

3. Inspection After Short Time in Service

New machines may smell warm or have the odor of varnish, but should not smell scorched.

After a machine has been operating for a short time, an inspection should be made to ascertain that there have been no changes since installation. Check for increased vibration, signs of change in alignment or foundation settling, bolts that may have loosened, rubbing parts, loose connections and worsened commutation. Proper steps must be taken to correct the trouble. Also, check the condition of air filters on blower ventilated machines. The amount of dirt in the air varies widely between installations.

V. MAINTENANCE

 Warning	<p><i>High voltage electric shock may cause serious or fatal injury. Disconnect power before touching any internal part. High voltage may be present even when the machine is not rotating. If used with a rectified power supply, disconnect all AC line connections to the power supply. With other power supplies, disconnect all DC line and field connections. Also, disconnect power from auxiliary devices.</i></p>
 Warning	<p><i>Ground the machine properly to avoid serious injury to personnel. Grounding must be in accordance with the National Electrical Code and consistent with sound local practices.</i></p>
 Warning	<p><i>Replace covers and protective devices before operating.</i></p>

A. Disassembly

The following procedure should be used for disassembly:

1. Remove all covers.
2. Disengage brush springs.
3. Remove complete brushholder assemblies.
4. Remove four (4) nuts on CE bracket.
5. Remove commutator end cover plate, if fitted.
6. Remove four (4) CE bearing cap bolts.
7. Using a soft mallet, tap on CE bracket to remove it.
8. Remove four (4) DE bearing cap bolts.
9. If the machine is not filled with an internal fan, pull the armature out of the commutator end.
10. If the machine has an internal fan, remove four (4) 3/8" through studs from the commutator end.
11. Remove DE bracket.
12. Pull armature out from drive end.

B. Reassembly

The following procedure should be used for reassembly:

1. Place armature into frame.
2. Install DE bearing bracket and bearing cap.
3. Install the four (4) 3/8" through studs into DE bracket.
4. Install CE bearing bracket and bearing cap.
5. Loosely tighten four (4) nuts on the 3/8" through studs.
6. Set machine on a flat, true surface to align feet on both brackets.


NOTE: If **Step 6** is not performed, distortion or breakage of brackets may occur during bolt-down of the motor.

7. Torque four (4) nuts on CE bracket.
8. Reinstall brushholders and engage brush springs.
9. Replace all covers.

C. Bearings

Ball bearing and roller bearing housings are packed with grease at the factory. Therefore, greasing is not required before the motor is put into service. Since the oil in the grease will ultimately become depleted, it is necessary to relubricate ball bearing and roller bearing motors periodically, depending on the size and type of service (refer to **Table 9**).

Avoid mixing different kinds of grease. Lubricate the motor at standstill. Make sure the top grease fitting is clean and free from dirt. Remove one of the lower grease relief plugs. Free the relief hole from any hardened grease. Use a hand-operated grease gun **only**. Pump in grease until new grease appears at lower grease hole. After greasing, allow the motor to run about ten minutes before replacing the grease relief plug to permit excess grease to drain out.

 Warning	<p><i>Extreme pressure (EP) greases should not be used in DC machines. Insulation deterioration and increased brush wear may result from the presence of silicones.</i></p>
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D. Replacement of Bearings

After the bearing brackets have been removed, a bearing puller may be used to pull the bearings from the shaft. Protect the shaft center while using the puller. Discard the old bearing. The new bearing and all mating parts should be kept extremely clean during reassembly.

To install a new bearing, heat the bearing to 116-127°C (240-260°F) in oil or in an oven, then slip or press the bearing on the shaft. The bearing should be mounted tightly against the shoulder on the shaft.

After the bearing has cooled, reinstall the retaining ring where used. Fill the grease reservoir in the inner bearing cap or cartridge 1/3 to 1/2 full of grease, butter the bearings and fill the grease reservoir in the bearing bracket 1/3 to 1/2 full of grease.

**Table 9
Recommended Regreasing Periods**

Frame Size	Average RPM	Relubrication Interval In Hours Of Operation	
		Ball Bearing	Roller Bearing
CD2512AT- CD2813AT	500	36000	18000
	1150	15000	7500
	1750	10000	5000
	3000	5000	2500


**Table 10
Standard Bearings for CD2512AT-CD2813AT Motors**


Frame Size	Commutator End Standard Ball		Drive End					
			Standard Ball		Oversize Ball		Oversize Roller	
	Basic Brg. No.	AFBMA	Basic Brg. No.	AFBMA	Basic Brg. No.	AFBMA	Basic Brg. No.	AFBMA
25XX	307	35BC03X3	309	45BC03X3	310	50BC03X3	310	50RU03X3
28XX	309	45BC03X3	310	50BC03X3	311	55BC03X3	311	55RU03X3

Table 11
Sources of Supply for Bearing Greases

Temperature	GE Designation	Supplier	Supplier's Designation
<u>Standard Temperature</u> 15°F to 212°F -10°C to 100°C	D6A2C5	GE Supply 158 Gaither Drive Mt. Laurel NJ 08054 1-800-341-1010	GE Ball Bearing Grease (supplied in In small tubes and cans)
		Shell Oil Company P.O. Box 2463 One Shell Plaza Houston TX 77002 (713) 241-4201	Alvania No. 2
		Texaco, Inc. 200 Westchester Avenue White Plains NY 10650 (914) 253-4000	Regal AFB-2
<u>Low Temperature</u> -60°F to 200°F -51°C to 93°C	D6A4	Shell Oil Company P.O. Box 2463 One Shell Plaza Houston TX 77002 (713) 241-4201	Aeroshell No. 7
<u>High Temperature</u> -20°F to 350°F -28°C to 176°C	D6A2C13	Standard Oil Company 225 Bush Street San Francisco CA 94120 (415) 894-7700	Chevron "SRI II"

E. Brushes (Refer to Figure 2)

 Warning	<p><i>High voltage and rotating machinery can cause serious or fatal injury. Brushes may not be touched or replaced while the machine is energized or rotating.</i></p>
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 Caution	<p><i>DC motors and generators operated for long periods of time at light loads or in contaminated atmospheres may be subject to abnormal brush and commutator wear. This can result in commutator damage and/or the need for excessive maintenance. If the application requires operation under these conditions, GE Industrial Systems will be pleased to suggest a change in brush grade or other measures to minimize the problem.</i></p>
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1. Brush Removal
With Machines Stopped and Power Off:


The following procedure should be used to remove brushes:

- a. Unfasten pigtail.
- b. Release spring by pushing in slightly to disengage locking tab, then pull spring back.
- c. Remove brush.


2. Brush Installation


The following procedure should be used to install brushes:


- a. Place brush in holder with bevel towards spring. Brushes should move freely in holder.
- b. Push spring into position until lock tab engages slot and locks.
- c. Connect pigtail.

 Caution	<p><i>The presence of silicone in DC motors, particularly with totally enclosed constructions, will cause rapid brush wear. Sources of silicone include oils, RTV compounds, hand creams, mold release agents, grease and some insulating varnishes. These silicone substances must be avoided to ensure proper motor performance.</i></p>
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Brushes should have their commutator contact surfaces curved to exactly fit the commutator surface. This is accomplished by “sanding in” the brushes in each brushholder separately. Draw a sheet of **coarse** non-metallic sandpaper under the brushes with the rough side toward the brush, while the brushes are pressed firmly toward the commutator. **Do not use emery cloth.** When sanding brushes, do not get carbon dust into the windings. The motor should be thoroughly blown out after sanding the brushes. This can be accomplished by cleaning the dust from the commutator, brushholders and adjacent parts with a vacuum cleaner, air blast or other suitable means. After the rough sanding, the brushes should be finely ground to fit using a brush seater. Rotate motor at around nameplate RPM. Make sure there is no load on the machine (armature current is nil). Carefully and lightly rub the brush seater across the entire commutator surface for 10 or 15 seconds. Repeat between each and every set of brush studs. Reverse motor rotation and repeat. Stop motor and cut all power to the motor and check brush face. Continue seating until brush face is 85% seated. Again, the motor must be thoroughly blown out after brush seating, the same as with sanding.

 Caution	<p><i>Avoid inhaling carbon and seater dust. GE Industrial Systems recommends using a dust mask during sanding, seating and blowing or vacuuming.</i></p>
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 Warning	<p><i>High voltage and rotating parts can cause serious or fatal injury. The use of all electric machinery, like all other utilization of concentrated power and rotating equipment, can be hazardous. Installation, operation and maintenance of electric machinery should be performed by qualified personnel. Familiarization with NEMA Safety Standards for Construction and Guide for Selection, Installation and Use of Integral HP Motors and Generators, National Electrical Code and sound local practices is recommended.</i></p>
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 Caution	<p><i>Do not use liquid solvents of any kind. Solvents will not remove carbon dust accumulations, but will spread and wash them into critical areas.</i></p>
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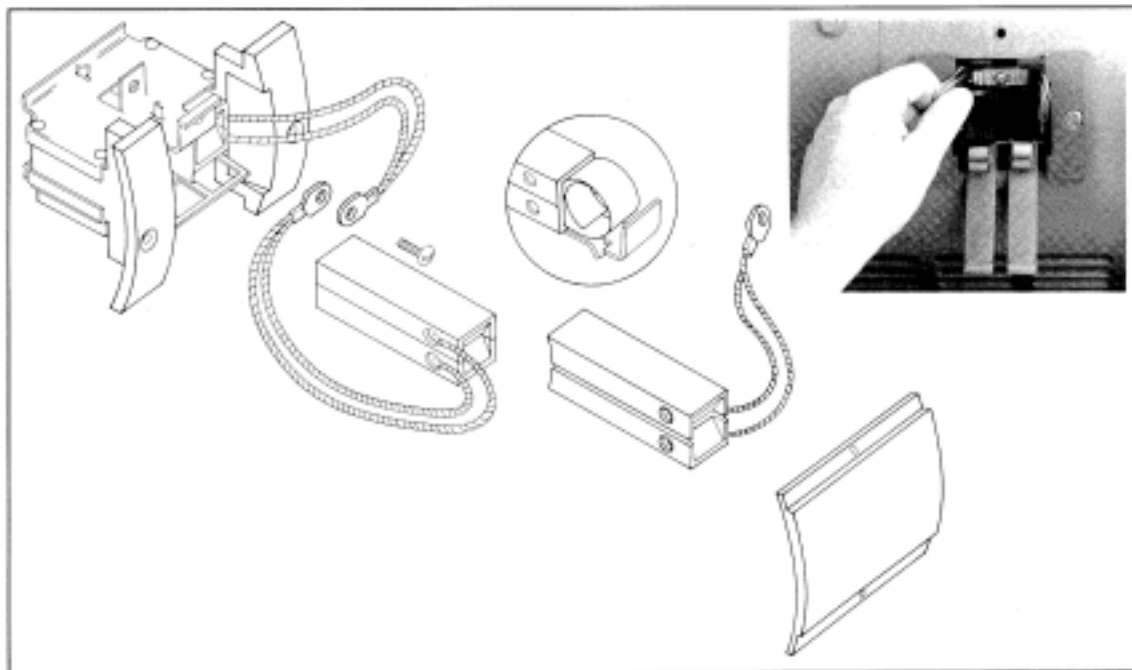


Figure 2
Brush Assembly

F. Commutator

Keep the commutator clean. Ordinarily, the commutator will require only occasional wiping with a piece of canvas or other nonlinting cloth. **Do not use lubricant or solvent on the commutator.** Check the commutator for roughness while running by feeling the brushes with a fibre stick, avoiding contact with live electrical or moving mechanical parts. Chattering brushes give advance warning of deterioration of the commutator surface. (Refer to the Commutator Check Chart (GEA-7053) for commutator surface marking and causes of poor commutator condition.) Commutator runout over .003" T.I.R. (Total Indicator Reading) and bar-to-bar readings over .003" indicate need for repair. (Refer to **Table 12.**)


 Caution	<p><i>The presence of silicone in DC motors, particularly with totally enclosed constructions, will cause rapid brush wear. Sources of silicone include oils, RTV compounds, hand creams, mold release agents, grease and some insulating varnishes. These silicone substances must be avoided to ensure proper motor performance.</i></p>
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Table 12
Commutator Diameters (In Inches)

Frame	Start	Min.	Wear
CD2512AT CD2513AT	5.30	5.02	0.140
CD2812AT CD2813AT	5.96	5.66	0.150

G. Mechanical

Check the condition of air filters and replace filters if they are dirty. Check for unusual noises which were not present when the unit was originally installed. Check all electrical connections for tightness. Clean out any dirt from screens, louvers, etc. which would interfere with the flow of cooling air.

H. Shaft End Play

The CD2512AT-CD2813AT designs use a wavy washer (preload spring) to eliminate endplay.

I. Waterproof Machines


Waterproof machines require the use of sealing devices to exclude water from the bearings and from entering openings in the magnet frame. When a waterproof machine has been disassembled, it will be necessary to remove the old sealing compound from around the mating surfaces of the bearing brackets and magnet frame, from underneath the field pole bolt heads and bearing cap to bearing bracket bolt heads, and from around the conduit box adapter threads to the magnet frame. Reapply new sealant (use Tite Seal T20-66, light weight, GE Part No. 905A999AC009) to these areas and wipe excess sealant with a clean rag slightly dampened with mineral spirits. **Do not use silicone sealants.** When accessories such as brakes and tachometers are disassembled, it will be necessary to reseal at the accessory mounting face. Prior to reassembly, inspect for damage at the gaskets around enclosure covers and at the shaft rubbing seals located in the bearing caps.

J. Lubrication of Flexible Couplings

Flexible couplings are normally lubricated with a semi-fluid grease or an oil. The coupling manufacturers' instructions should be followed in choosing a lubricant and setting relubrication intervals. GE ball bearing grease D6A2C5 is a suitable lubricant for flexible couplings in most applications.

Flexible couplings which join a small machine to a large machine may have two different size coupling halves joined by an adapter plate. Couplings of this type have a separate lubricant supply for each half. Therefore, both halves must be lubricated separately.

K. Insulation

 Caution	<p><i>Eliminate sources of contamination and moisture for maximum insulation life. Air filters for blowers, air piped from cleaner locations, shielding from water leads or spray, proper use of space heaters during downtime, etc., will all help to prolong insulation life.</i></p>
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Contamination includes excessive moisture, oily vapors, conducting and non-conducting dust, chips and chemical fumes. Contamination is best avoided by proper enclosure and ventilation. Filters, ventilation from a remote clean air source, unit coolers and a totally enclosed construction are all possible means of protecting DC machines in adverse environments. Space heaters protect against moisture damage by maintaining the machine above dew-point during storage or when idle. Space heaters should be arranged so that they are automatically energized whenever power is removed from the motor. Space heaters do not supply enough heat for drying out windings which have been water-soaked.

Mechanical factors include shock, vibration, overspeed, etc. Maintaining machines in good mechanical repair, including isolation from excessive external shock and maintenance of smooth running conditions, will contribute to long insulation life.

The insulation system in these machines is capable of withstanding some short time periods of operation at temperatures higher than than used for the basis of machine rating. Prolonged or excessively high temperature will cause the insulation to become brittle and crack, leading to premature failure. Application data is available from GE Industrial Systems for any particular machine giving suggested maximum loads for various operating conditions. Operation within these maximum loads will limit the temperature to suitable val-

ues.

For maximum insulation life, these three causes of insulation failures should be prevented:

1. Contamination.
2. Mechanical factors.
3. High temperatures.

L. Testing Methods

1. Visual Inspection

In addition to collecting contaminants, insulation shrinks, cracks and becomes brittle with heat and age. These changes allow movement of coils, loose filler strips, loose ties, chafing and abrasion, all of which can be picked up by visual inspection.

Experience and judgement can be gained by careful observation and comparing results of visual inspections with insulation resistance measurement. GE Service Shops have personnel who can inspect equipment and point out potential trouble areas. Their services can help build experience and judgement for future visual inspections.

2. Insulation Resistance Measurement

A method of measuring the insulation resistance is described in **Report 43, "Recommended Practice for Testing Insulation Resistance of Rotating Machinery"**, published by IEEE, 345 E. 47th Street, New York, NY 10017. The resistance measurements should be taken with a 500 or 1000 volt megger and corrected to 104°F (40°C).

The insulation resistance measurements are affected by the following:

- a. Magnitude of test voltage.
- b. Time the test voltage is applied.
- c. Temperature.
- d. Surface condition (contaminants).
- e. Moisture.

When a 1000 volt megger is used, taking readings of one minute and converting the data to 40°C (104°F), the data will evaluate the other two factors, i.e., the contaminants and the moisture present.

The insulation resistance varies inversely with the winding temperature. That is, as the temperature decreases, the insulation resistance increases in accordance with **Table 13**.

Table 13
Effect of Temperature on Insulation Resistance

Winding Temperature (Degree C)	Multiplying Factor to Obtain Insulation Resistance at 40°C (104°F)
80	10.00
70	5.50
60	3.10
50	1.70
40	1.00
30	0.55
20	0.31
10	0.17

Note that for a 104°F (40°C) decrease in temperature, the insulation resistance is increased by a multiplier of ten.

The insulation resistance of a machine is affected by its design. The insulation resistance of the armature circuit, corrected to 104°F (40°C), should measure at least 1.5 megohms. If measured value is below 1.5 megohms, clean and re-test.

If the measurements are less than this limit, the machine should be dried or cleaned to attempt to increase the insulation resistance. Regular, periodic measurements of insulation resistance can give a useful indication of the rate of insulation system deterioration. External connections should be removed to isolate the windings to be tested and megger value logged. A sudden drop or consistent trend toward low values of insulation resistance, although possibly caused by moisture or contamination, generally gives evidence the insulation system is deteriorating and that failure may be imminent.

High-potential tests are not recommended on machines which have been in use. If such a test is made immediately after installation, the test voltage should not exceed 85% of the original factory test of two times the rated volts plus 1000 volts.

NOTE: Surge testing and AC impedance tests of windings to detect shorts should be performed by trained personnel only.

M. Cleaning of Windings

If windings become contaminated, suitable cleaning methods can be used to alleviate the problem.


The machine should be de-energized and slowly rotated by hand to permit maximum dust removal. Dry dirt, dust or carbon should first be vacuumed – without disturbing adjacent areas or redistributing the contamination. Use a small nozzle or tube connected to the vacuum cleaner to enter into narrow openings (i.e., between commutator risers). A soft brush on the vacuum nozzle will loosen and allow removal of dirt more firmly attached.


This vacuum cleaning may be supplemented by blowing with compressed air (air pressure should be in accordance with OSHA standards), which has passed through a dryer to remove moisture before entering the motor.


Dirt can collect on the inside surface of the drive end coil support and on the underside of the armature coils. This dirt can be easily removed with compressed air or a vacuum.


It is important to realize that when blowing out a machine, dirt may settle in a previously cleaned area and it may be necessary to repeat the cleaning process to ensure that a thorough job is done.

Dirt can be removed from stationary parts of the machine by either compressed air or a vacuum nozzle or a combination of both. Air should be directed between the stator coils, into the pocket corners of bearing brackets, around the cables and onto the brush rigging. Special care should be taken to keep the commutator clean. The commutator should be wiped with a clean lint-free cloth after blowing out.

 <p>Warning</p>	<p><i>Safety glasses and/or other protective equipment should be used to prevent injury to eyes and respiratory organs.</i></p>
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 <p>Warning</p>	<p><i>High voltage electric shock can cause serious or fatal injury. Electrical circuits must be de-energized prior to cleaning or other maintenance activities. Ground electrical circuits prior to cleaning or maintenance to discharge capacitors. Failure to observe these precautions may result in injury to personnel.</i></p>
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 <p>Caution</p>	<p><i>Liquid solvents should not be directly applied to the commutator, armature, field coils or any electrical part of a DC machine. Liquid solvents carry conducting contaminants (metal dust, carbon, etc.) deep into hidden areas to produce shorts and grounds, thus causing machine failure. Mechanical components may be cleaned by a wiping rag barely moistened (not wet) with a solvent.</i></p>
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 <p>Warning</p>	<p><i>Solvents may be flammable and moderately toxic. The usual precautions for handling chemicals of this type must be observed. These include:</i></p> <ol style="list-style-type: none"> <i>1. Avoid excessive contact with skin.</i> <i>2. Use in well ventilated areas.</i> <i>3. Take necessary precautions to prevent fire or explosion hazards.</i>
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1. Oily Dirt

The presence of oil makes thorough, effective cleaning of machines in service virtually impossible and service shop conditioning is recommended. Oil on a surface forms a “fly paper effect”, which attracts and holds firmly any entrained dust. Neither suction nor compressed air is effective. Consequently, only accessible areas may be cleaned. First, remove as much of the dirt as possible by scraping or brushing the dirty surfaces. Then, wipe away as much dirt as possible with dry rags. For surfaces not readily accessible, a rag on a hook wire can be used to clean dirt out of holes and crevices. Rags should be changed frequently for clean ones so that contamination picked up from one area is not carried to other less dirty areas.

 <p>Warning</p>	<p><i>While FREON TF® is considered to be nonflammable and has a relatively low order of toxicity, it should be used only in well ventilated areas that are free from open flames. Avoid prolonged exposure to vapors. Failure to observe these precautions may result in injury to personnel.</i></p>
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FREON TF is the only recommended solvent for cleaning because it is nonflammable, has good solvency for grease and oil, is considered safe with most varnishes and insulations and has a low order of toxicity. Stoddard solvent has good solvency, but is flammable and moderately toxic. Before using any solvent, consult the Material Safety Data Sheet. Steam cleaning is not recommended because, as with liquid solvents, conducting contaminants may be carried deep into inaccessible areas resulting in shorts and grounds.

 Caution	<p><i>FREON TF is a chlorofluorocarbon. Chlorofluorocarbons have been identified as upper atmosphere ozone depleters. The use of Freon in industry is expected to be greatly reduced in the future. The availability of Freon may be limited, and its use could be prohibited by regulations.</i></p>
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 Caution	<p><i>Carbon brush performance may be ruined by absorbed solvents. Remove brushes prior to solvent wiping.</i></p>
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N. Drying of Windings

Drying of machines is most effectively done by application of heat. The windings and insulation should be heated so that their temperature does not exceed 225°F (125°C) at any location. (Do not make local hot spots.) The machine's own frame and the addition of some covers usually will make an effective enclosure to contain the heat, if an oven cannot be used. Some flow of air is desirable to allow moisture to be carried away. Methods of generating heat include blowing hot air through the machine, heating with heat lamps, passing current through the main field coil windings, etc.

If temperatures as high as 225°F (125°C) can be attained, they should be limited to six or eight hours duration. Lower temperatures will cause correspondingly longer drying times.


Drying out can be ended when the insulation resistance to ground (corrected to 40°C) is restored to a satisfactory value as described in the **Insulation Resistance** section. If these values do not reach a proper level, then a thorough cleaning or complete reconditioning may be necessary.


O. Service Shop Cleaning


When the cleaning or drying methods described in preceding paragraphs do not result in restoration of acceptable insulation resistance and/or when machines are extremely dirty or contaminated, it is recommended that the reconditioning services of a GE Service Shop be obtained. Service shops are knowledgeable and equipped for more sophisticated restoration methods, such as hot water detergent wash, solvent and abrasive cleaning, revarnishing and rewinding, if necessary.


P. Repair

Repairs should be made only by qualified personnel using the materials and processes for which the motor was designed. To protect the warranty during the warranty period, all repairs must be made in a GE Service Shop or approved repair facility. Many repairs can be easily performed with only assembly operations, if GE replacement parts are available. If major repairs are undertaken (such as rewinding an armature), proper facilities should be used and suitable precautions observed.

 Warning	<p><i>When burning off old insulation materials or when welding near insulation during rewinding, adequate ventilation must be provided to avoid exposing personnel to noxious fumes. Combustion of exhaust fumes must be complete and adequately vented to the outside atmosphere.</i></p>
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 Warning	<p><i>Exposure of personnel to airborne inorganic fibers must be avoided by adequate ventilation or by wetting the remaining insulation components following the burning off of the organic materials.</i></p>
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 Warning	<p><i>An extreme overload or electrical failure may result in heating or arcing, which can cause the insulation to give off noxious fumes. All power should be removed from the motor circuit as a precaution, even though the circuit has overload protection. Personnel should not approach the motor until adequate ventilation of the area has purged the air of fumes. When covers of a totally enclosed</i></p>
<p><i>motor are removed after a failure, care should be observed to avoid breathing fumes from inside the motor. Preferably, time should be allowed for the motor to cool before attempting any examination or repair.</i></p>	

 Warning	<p><i>Water should not be applied to any electrically energized equipment because electric shock could result in serious or fatal injury. In case of fire, disconnect all power and use a carbon dioxide extinguisher to quench the flame.</i></p>
<p><i>Before operating any motor after a suspected failure, it should be inspected for damage. Remove covers and make visual inspections of the brushes, commutator, connections and windings. Electrical tests of each winding to check for open or short circuit or grounds should be made. Any arc damage should be cleaned up and repaired as necessary. Brushes may need reseating before operation.</i></p>	

VI. RENEWAL PARTS

Using genuine GE renewal parts assures continued high performance and the full benefits of the long operating life designed into your GE motor.

Downtime can be minimized by having a protective stock of parts available for replacement. (Refer to **Table 14.**)

The permanently attached nameplate on your GE motor displays the model and serial number, providing all the information needed for ordering. Parts are available directly from authorized GE Industrial Systems parts distributors. Direct electronic access to the factory database of motor information and warehouse inventories enables distributors to quickly identify part numbers, delivery times and order status.

A. Storage of Renewal Parts

Store supply parts in a clean, dry, ventilated place, protected from rodents and termites, to prevent damage or loss. Slush all finished iron or steel surfaces with heavy oil or compound to protect them from corrosion. The parts should be inspected occasionally to ensure their continuous usability.

Table 14
Recommended Spare Parts

Description	Number of Duplicate Motors in Service				
	1	2-4	5-10	10-20	More Than 20
With or Without Electrical Shop Facilities					
Complete Machine	---	---	---	1	2
Ball Bearing (Sets)	1	1	1	2	3
Brushes (Sets)	2	4	6	8	10
Brushholders (Sets)	---	1/2	1/2	1	1
Brushholder Springs (Sets)	1/2	1	1	2	2
Armature (Complete) *	---	1	1	2	2
Wound Frame **	---	---	1	2	2
Blower Ventilating Motors: Blower Motors	---	1	1	2	2
With Electrical Shop Facilities:					
Shaft	---	---	---	1	1
Armature Rewinding Supplies	---	1	1	2	3

* If shop facilities are available, the quantity of armatures may be reduced by stocking the armature parts listed in the second group.

** Factory wound frames are wound using specialized equipment and then varnish dipped. Although it is physically possible for a motor shop to rewind a failed field winding, experience has shown that rewinds cannot offer an acceptable service life due to the difficulty in winding the many turns of small diameter wire without damage.

Commutator Check Chart

For Comparing Commutator Surface Markings

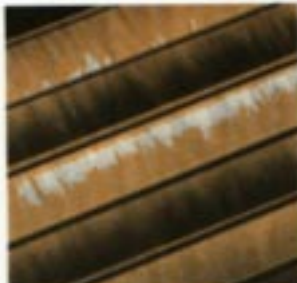
SATISFACTORY COMMUTATOR SURFACES



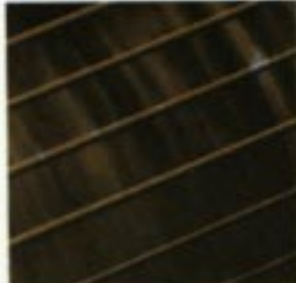
LIGHT TAN FILM over entire commutator surface is one of many normal conditions often seen on a well-functioning machine-



MOTTLED SURFACE with random film pattern is probably the most frequently observed condition of commutators in industry.



SLOT BAR-MARKING, a slightly darker film appears on bars in a definite pattern related to number of conductors per slot.



HEAVY FILM can appear over entire area of efficient and normal commutator and, if uniform, is quite acceptable.

WATCH FOR THESE DANGER



STREAKING on the commutator surface signals the beginning of serious metal transfer to the carbon brush. Check the chart below for possible causes.



THREADING of commutator with fine lines results when excessive metal transfer occurs. It usually leads to resurfacing of commutator and rapid brush wear.



GROOVING is a mechanical condition caused by abrasive material in the brush or atmosphere. If grooves form, start corrective action.



COPPER DRAG, an abnormal build-up of commutator material, forms most often at trailing edge of bar. Condition is rare, but can cause flashover if not checked.



PITCH BAR-MARKING produces low or burned spots on the commutator surface. The number of these markings equals half or all the number of poles on the motor.



HEAVY SLOT BAR-MARKING can involve etching of trailing edge of commutator bar. Pattern is related to number of conductors per slot.

CAUSES OF POOR COMMUTATOR CONDITION

Frequent visual inspection of commutator surfaces can warn you when any of the above conditions are developing so that you can take early corrective action. The chart below may indicate some possible causes of these conditions, suggesting the proper productive maintenance.

	Electrical Adjustment	Electrical Overload	Light Electrical Load	Armature Connection	Unbalanced Shunt Field	Brush Pressure (Light)	Vibration	Type of Brush In Use		Contamination	
								Abrasive Brush	Porous Brush	Gas	Abrasive Dust
Streaking			X			X		X	X	X	X
Threading			X			X			X	X	
Grooving								X			X
Copper Drag						X	X	X		X	
Pitch Bar-Marking				X	X	X	X	X			
Slot Bar-Making	X	X								X	

HOW TO GET THE MOST VALUE FROM THIS CHART

The purpose of the Commutator Check Chart is to help you spot undesirable commutator conditions as they develop so you can take corrective action before the condition becomes serious. This chart will also serve as an aid in recognizing satisfactory surfaces.

The box chart above indicates the importance of selecting the correct brush and having the right operating conditions for optimum brush life and commutator wear.

For additional information or help with carbon brush application or commutation problems. Contact your nearest GE Sales Office or Distributor.

The Following Noise Levels Have Been Measured On Typical Machines Of The Listed Frame size And Are Not Guaranteed Limits.

NOISE LEVEL FOR TYPICAL DPFG DC MOTORS OPERATED FROM MG SET SUPPLY

- A — WITH INTERNAL FAN
- B — WITHOUT INTERNAL FAN (ENCLOSED SEPARATELY VENTILATED BUT WITHOUT EXTERNAL AIR SUPPLY)
- C — WITH MOTOR MOUNTED BLOWERS WITH OR WITHOUT FILTER (WITHOUT INTERNAL FAN)

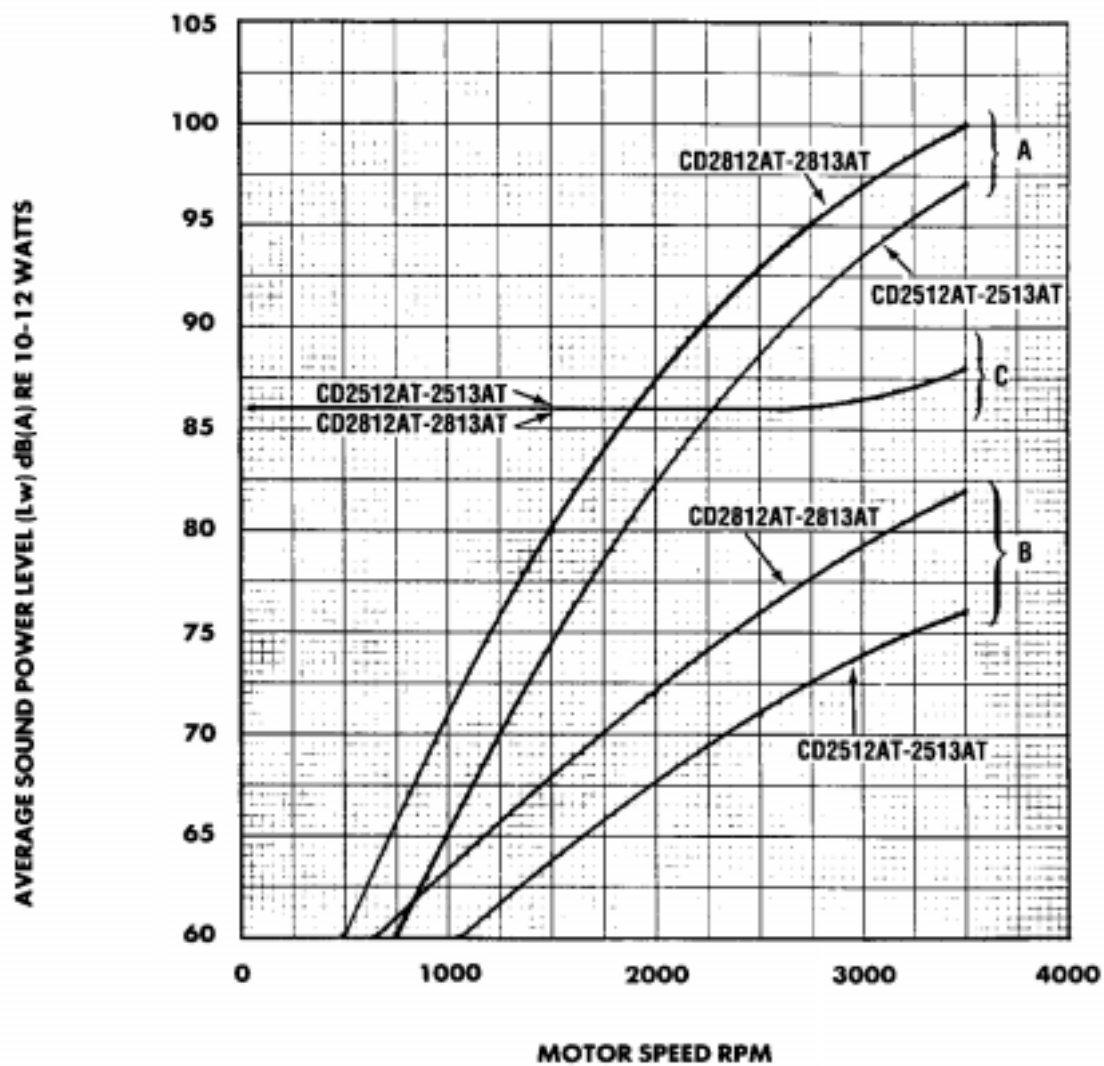
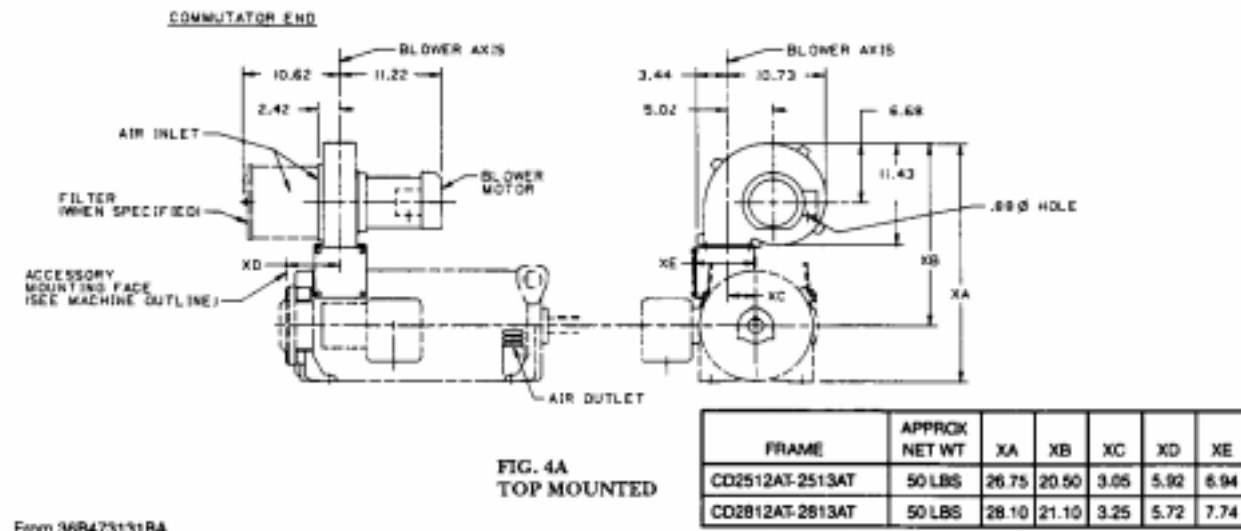
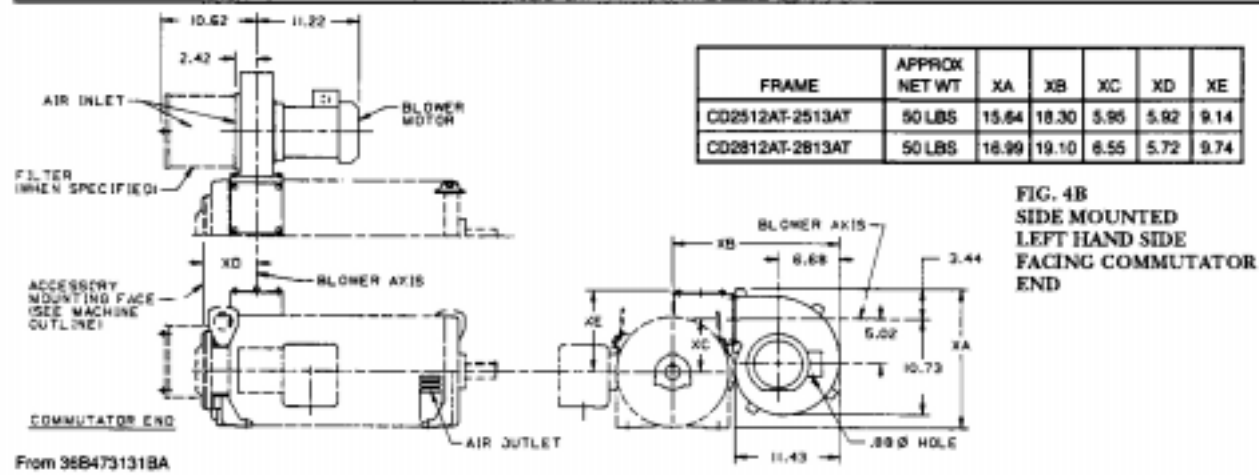


Figure 3
Application Information for CD2512AT – CD2813AT Frames

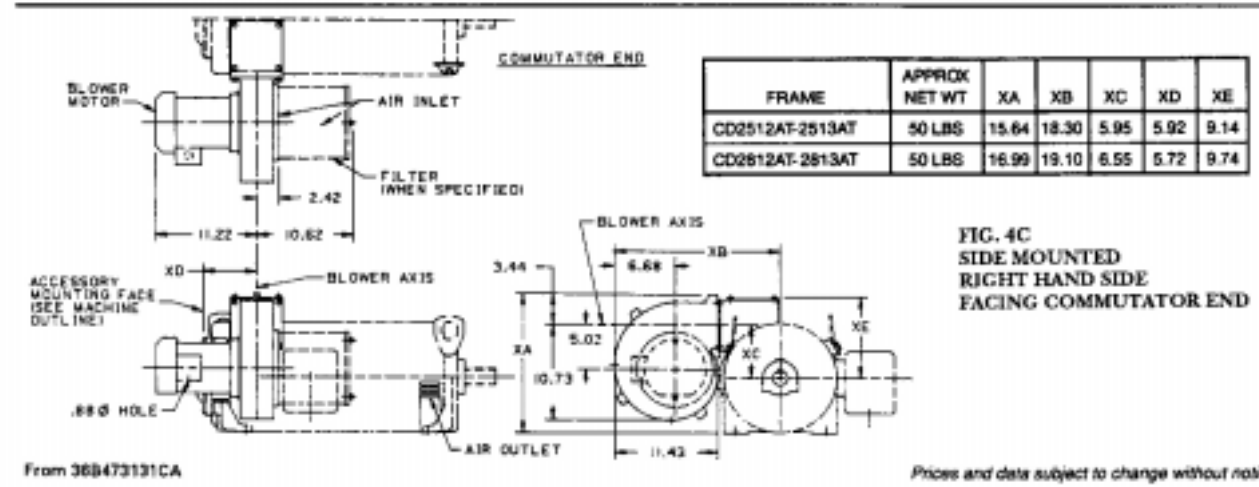
DIMENSIONS — For ESTIMATING ONLY unless endorsed for construction



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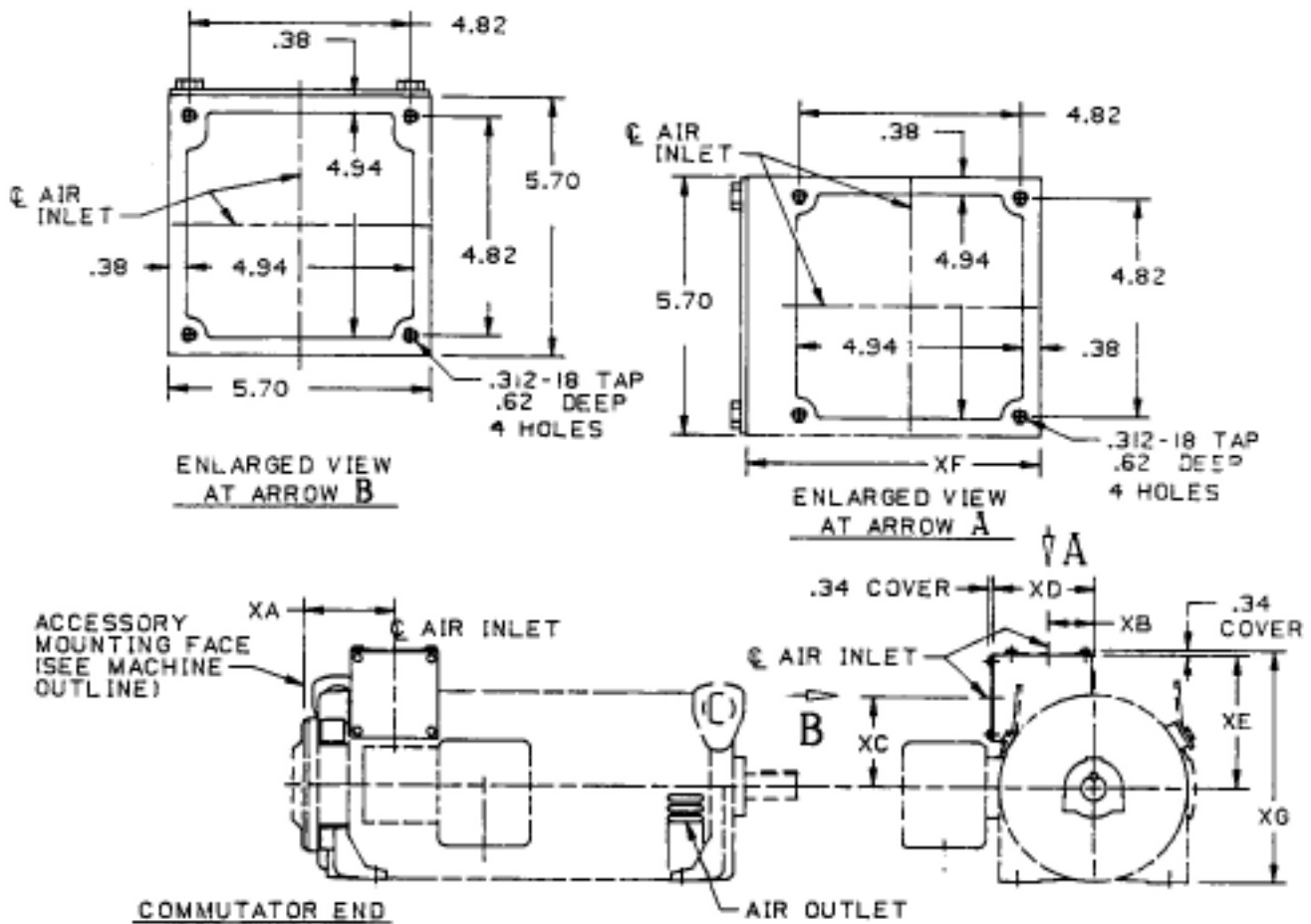


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Prices and data subject to change without notice.

**Figure 4
Blower Unit, Commutator End Mounted for Use With CD2512AT – CD2813AT Frames**

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FRAME	APPROX NET WT	XA	XB	XC	XD	XE	XF	XG
CD2512AT CD2513AT	9 LBS	5.92	3.05	5.95	6.60	8.80	6.40	15.39
CD2812AT CD2813AT	10 LBS	6.72	3.25	6.55	7.40	9.40	7.00	16.74

Use either top or side air inlet by removing cover. Air inlet adapter may be mounted on opposite side of machine centerline.

Oversize conduit box restricts access to side air inlet if both on same side.

Figure 5
Dimensions, Air Openings for CD2512AT – CD2813AT Frames

Table 15
Air Flow Requirements
For Separately Ventilated Motors

Frame	Base Speed RPM	CFM	Static Pressure Inches of Water	
			A	B
			Standard Separately Ventilated	Enclosed Separately Ventilated
2512AT, 2513AT	All	380	4.85	6.1
2812AT, 2813AT	All	455	4.8	5.64

A. Standard Separately Ventilated

Air in one CE opening with solid covers on other CE openings.
Standard louvered covers on DE air outlets.

B. Enclosed Separately Ventilated (Air Ducted In and Air Ducted Out)

Air in one CE opening with solid covers on other CE opening.
Air out one DE opening.

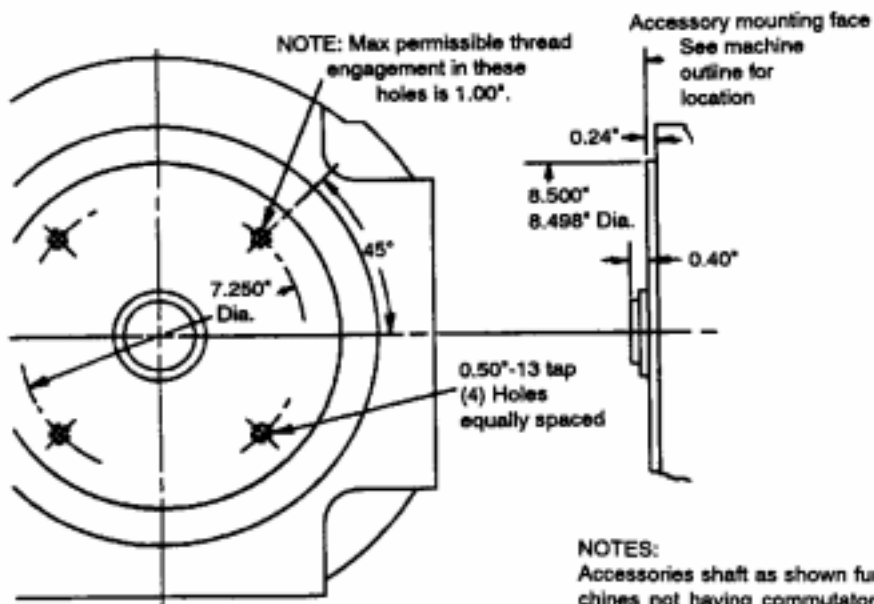
Table 16
Renewal Parts
For CD2512AT – CD2813AT Frames

Quick Kit Reference					
Frame Series	Blower Kit Less Filter *	Blower Kit With Filter *	C-Face Kit ** 8.5" Rabbet	PY Tach Kit Less Tach	BC Tach Kit Less Tach
CD25XX	36A171113AAG01	36A171113AAG01	36A172476AAG01	36A171269AAG01	36A171270AAG01
CD28XX	36A171114AAG02	36A171114AAG01	36A167477AAG01	36A171269AAG01	36A171270AAG01
DC PY Tach Only (Fits PY Kit)		DC BC-42 Tach Only (Fits BC Kit)		DC BC-46 Tach Only (Fits BC Kit)	
50V/1000 RPM	897A594-002	50V/1000 RPM	897A590-032	50V/1000 RPM	897A591-041
100V/1000 RPM	897A594-001	100V/1000 RPM	897A590-024	100V/1000 RPM	8971591-029
Frame Series	AN-AC Tach 45/90V/1000 RPM	AN-DC Tach 20V/1000 RPM	AN-DC Tach 50V/1000 RPM	ANDG240A4*** 240 PPR	ANDG240D4*** 240 PPR
CD25XX	36A167715AAG01	36A167714AAG01	36A167714ADG01	36A167712AAG04	36A167713AAG04
CD28XX	36A167715AAG01	36A167714AAG01	36A167714ADG01	36A167712AAG04	36A167713AAG04

* Blower motor is 230/460 volt AC, 3 phase, 60 hertz.

*** Requires motor disassembly by qualified service facility to install.

*** Bi-directional, dual output.



NOTES:
Accessories shaft as shown furnished on all machines not having commutator end shaft extensions.

Accessories shaft is suitable for driving tachometer and speed limit switch.

For brake application a keyed commutator end shaft extension is required.

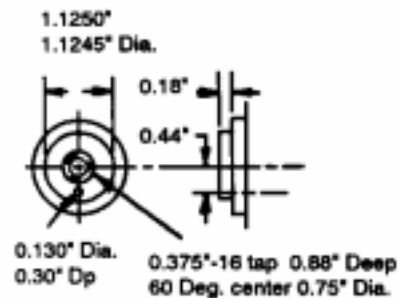
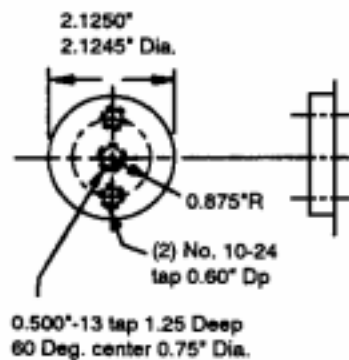
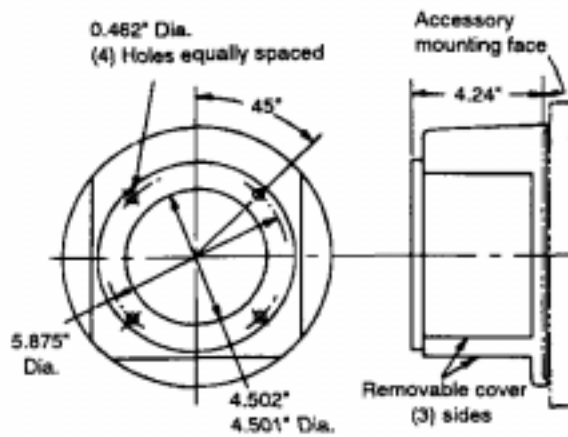
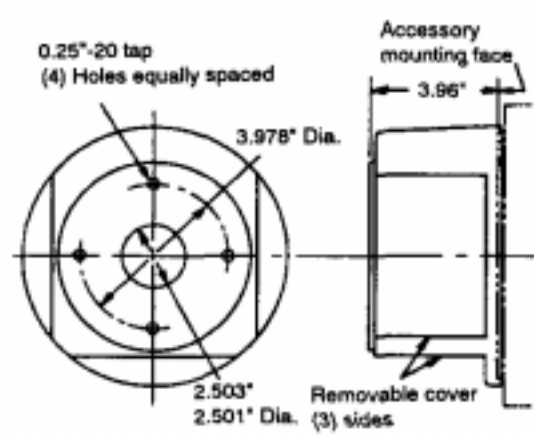


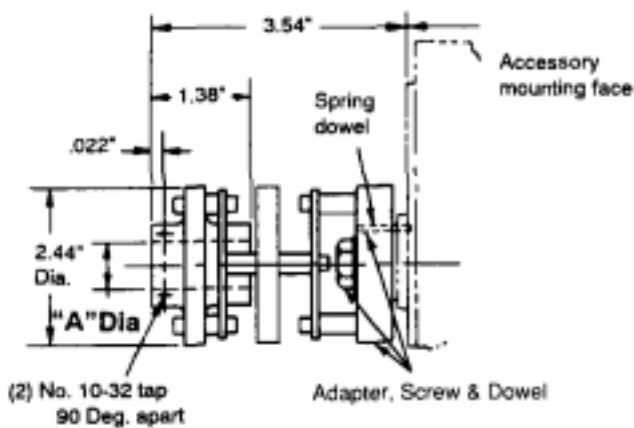
Figure 6
Accessory Mounting CD2512AT – CD2813AT



BC42/BC46 Tachometer adapter mounts on bracket shown in Fig. 6



Form "Y" Tachometer adapter mounts on bracket shown in Fig. 6

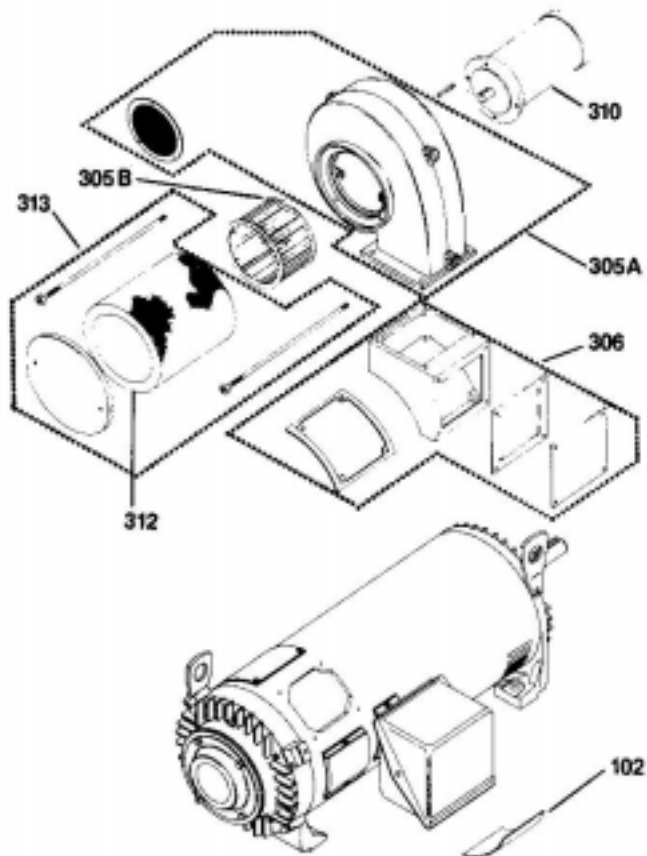


"A"	KEY WAY	
	WIDTH	DEPTH
.6255	.1875	.0937
.6250		
.7505	.1875	.0937
.7500		
.5005	OMIT	
.5000		
.3130	OMIT	
.3125		

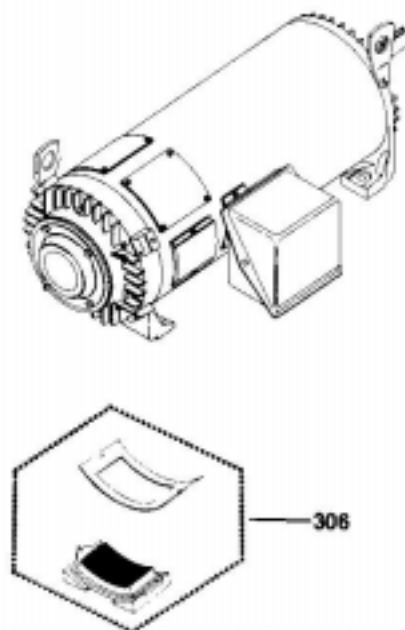
Torsionally rigid coupling rated at .17 HP per 100 RPM.

Figure 7
Accessory Mounting CD2512AT – CD2813AT

BLOWER VENTILATED



SEPARATELY VENTILATED FROM EXTERNAL SOURCE



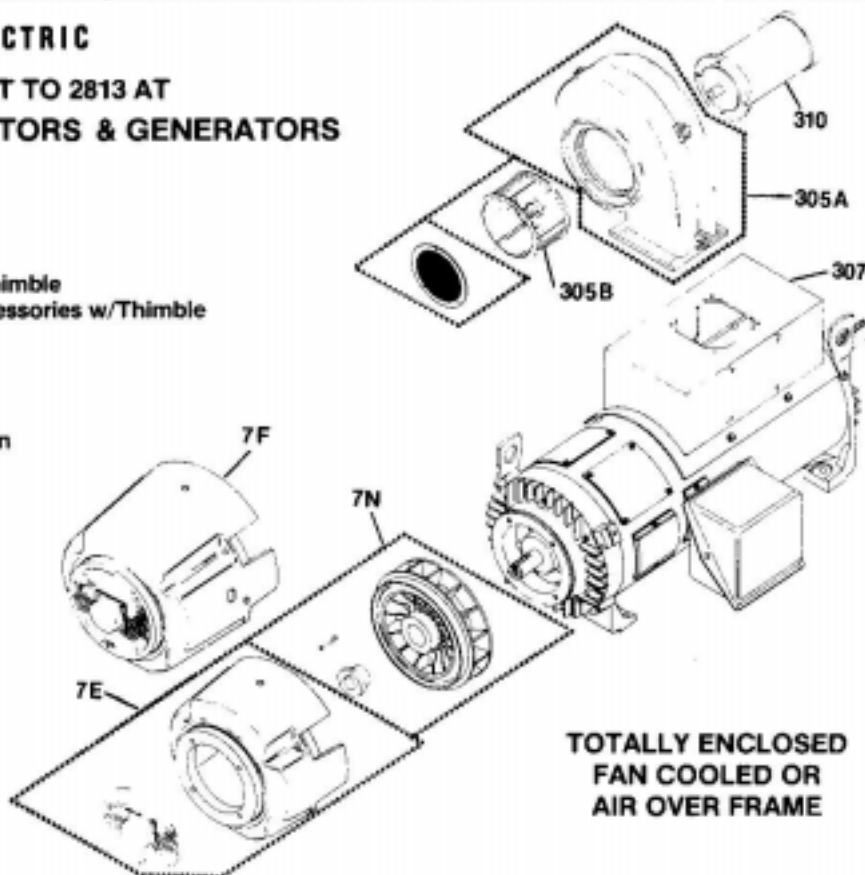
May be one or more per motor.
Position(s) may be other than shown.

GENERAL ELECTRIC

**TYPE CD, FRAMES 2512 AT TO 2813 AT
DIRECT CURRENT MOTORS & GENERATORS**

REF. NO. DESCRIPTION

- 7E External Fan Guard w/Thimble
- 7F External Fan Guard, Accessories w/Thimble
- 7M Fan Hub Key
- 7N External Fan Kit
- 7P External Fan Hub
- 102 Cover, Bottom CE
- 305A Blower Housing w/Screen
- 305B Blower Impeller
- 306 Frame Adapter Kit
- 307 Frame Shroud, TEAO
- 310 Blower Motor
- 312 Blower Filter
- 313 Blower Filter Kit



**TOTALLY ENCLOSED
FAN COOLED OR
AIR OVER FRAME**

Type CD Frames 2512AT – 2813AT DC Motors & Generators

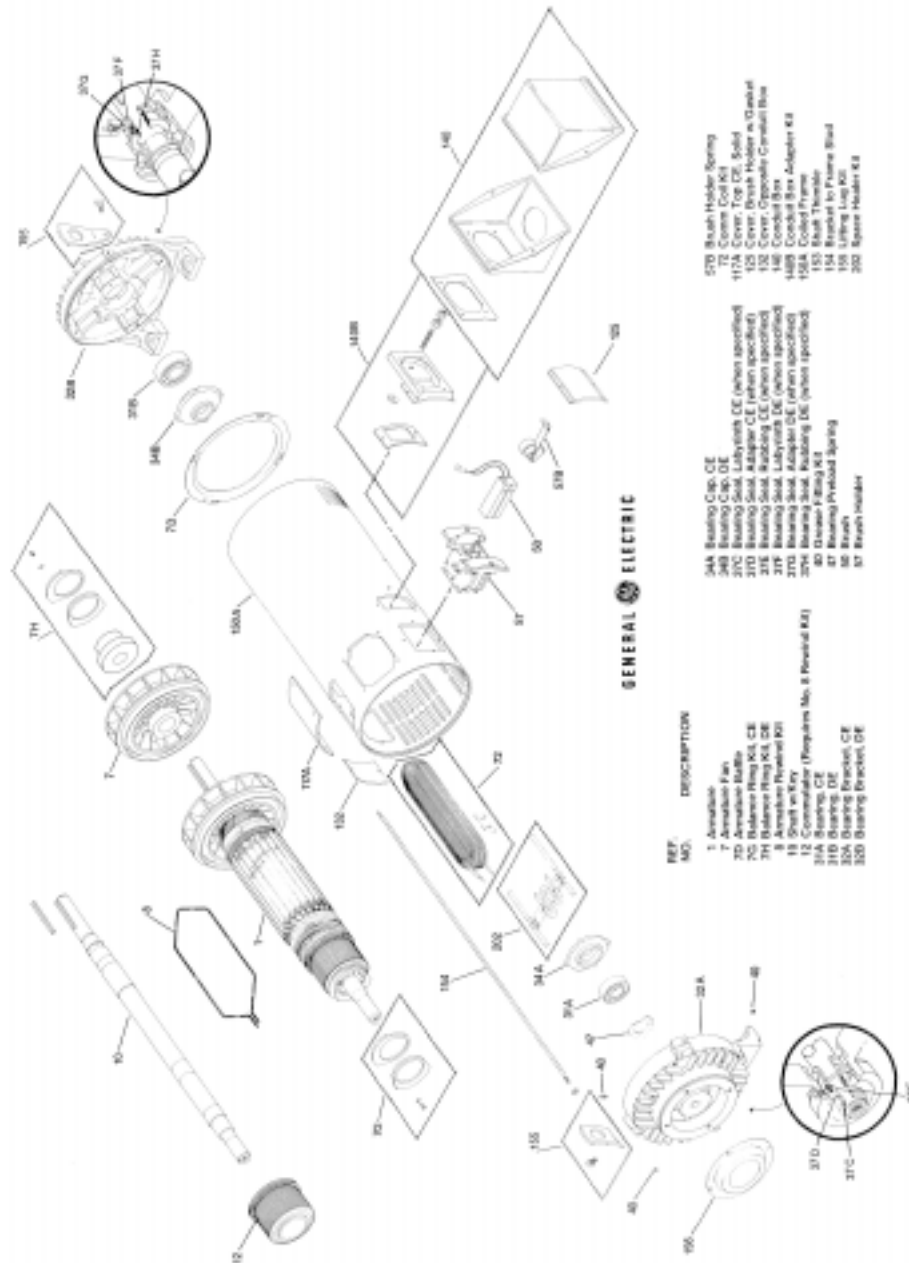


Figure 8
Type CD Frames 2512AT – 2813AT



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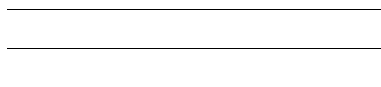
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