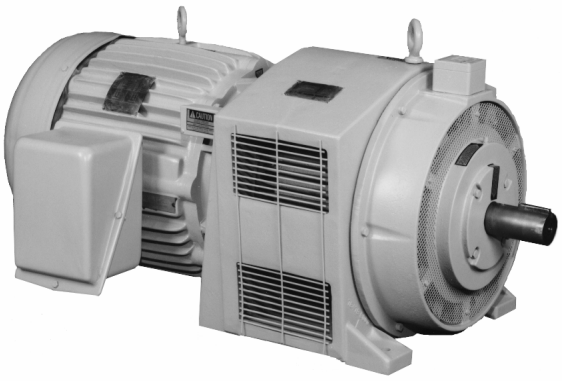
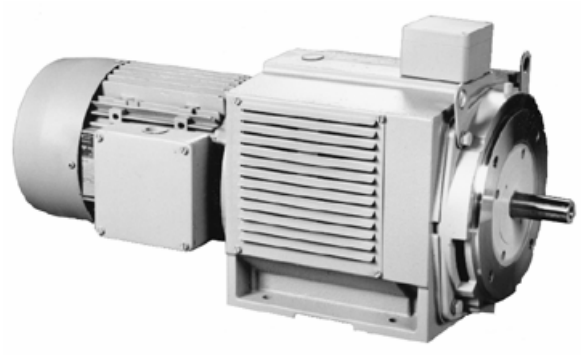
AT Line Air Cooled Drives
Model AT-14 through AT-440

INSTRUCTION MANUAL

(Revised 02/04)





DRIVE SOURCE INTERNATIONAL INC.

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Application Engineering ☆ Quality Products ☆ Total Solution

⚠ Caution

Please Observe the Following Safety Guidelines

Allow Installation and Service by Qualified Personnel Only
Electrical rotating equipment and associated controls can be dangerous. Therefore, it is essential that only trained personnel be allowed to work with this equipment, under competent supervision. The danger is increased when the equipment is not handled, installed, maintained or used property. This equipment must be installed, adjusted and serviced only by qualified personnel familiar with the construction and operation of the equipment and the hazards involved. Failure to observe this precaution could result in personal injury and/or equipment damage.

Read Instructions and Warnings
These instructions should be read and clearly understood before working on the equipment. Become especially familiar with all safety instructions and procedures. Read and heed all danger, warning and caution notices contained in this manual and attached to the equipment and be sure to instruct others in their meaning and importance.

Danger, High Voltage
Disconnect Power before Servicing Equipment
Various component parts and terminals of the drive equipment are at or above line voltage when AC power is connected to the input terminals. All ungrounded conductors of the AC power line must be disconnected before it is safe to touch any internal parts of this equipment. Some control equipment may contain capacitors that retain a hazardous electrical charge for a period of time after power is removed. After power is removed, wait at least two minutes to allow capacitors to discharge before touching any internal parts of the equipment Failure to observe these precautions could result in fatal injury.

Precautions when working On Live Circuits
Stand on an insulating mat. Make a habit of using only one hand. Make sure that there is another person nearby in case emergency assistance is required.

Application of Equipment and Safety Devices
The adjustable speed drive and all components of the drive system, such as operator control devices, electrical power distribution equipment, the motor and mechanical power transmission equipment, must be properly selected and applied to assure a safe and reliable installation. Each individual installation has unique requirements for safety equipment such as emergency stop pushbuttons, pre-start alarms, motor and power disconnect devices and guards on mechanical power transmission apparatus. The party responsible for the overall design and operation of the facility must make sure that qualified personnel are employed to select and apply all components of the drive system including appropriate safety devices.

Hazard of personal injury or equipment damage exists if the drive and/or the driven machine are operated above their rated speed due to mis-adjustment or electronic failure. Be sure to consider this factor in selecting gear ratios and safety devices.

Always Wear Safety Glasses
Safety glasses should be worn by all personnel involved in installing or maintaining the equipment. This applies equally to all electrical and mechanical workers. Other safety clothing should be selected as appropriate to the task and work environment.

Handle With Care
Handle the equipment carefully to avoid personal injury or damage to the unit.

Provide Appropriate Guards Around Moving Parts
Before operating the equipment, make sure that appropriate guards and other safety devices are in place. Refer to OSHA rules and regulations, paragraph 1910.219 for guards on mechanical power transmission apparatus.

Observe Requirements of the National Electrical Code
All wiring must be in accordance with the National Electrical Code (NEC) and/or other codes as required by the authority having jurisdiction. The electrical connections completed by the installer must conform to the instructions and diagrams supplied.

National Electrical Code Article 430-102 requires a disconnecting means for each motor and controller located in sight from the motor, controller and driven machinery locations or capable of being locked in the open position if not located in sight. This disconnecting means is not included with the drive equipment unless specifically ordered.

Not for Use in Hazardous Locations
Unless specifically labeled as approved for such use, this equipment is not suitable for use in an explosive atmosphere or in a "Hazardous (Classified) Location" as defined in article 500 of the National Electrical code.

Provide Adequate Ground Connections
For personnel safety and reliable equipment operation, firmly earth ground each piece of equipment as directed in this manual and shown on the connection diagrams provided. The ground conductor should be the same size as the incoming power wires or sized according to NEC table 250-95. A copper or aluminum conductor must be used. Grounded conduit connections are not adequate for use as equipment ground connections.

Instruction Material and Drawings
In addition to this manual, data sheets, drawings, supplementary instruction sheets and errata sheets may be included in the package of instruction material that is furnished for each drive. Be sure to save each of these items for future reference. The drawings and data included in this manual are generally representative of the product line, but do not accurately include every detail pertaining to specific equipment provided for an individual customer order. Drawings and data sheets that are identified by PRO/Serial number as pertaining to a specific piece of equipment take precedence over this manual.

Note: The information furnished may not cover changes made to the equipment after shipment. **All data is subject to change without notice.**

Technical Assistance
It is best to request assistance through DSI/Dynamtic's Service Repair Department, 1-800/548-2169.

Table of Contents

Table of Contents (continued)

Section 1

General Information

Introduction
This manual provides general information and operating instructions for Dynamatic air cooled, adjustable speed drives, consisting of a magnetic clutch and a flange mounted, AC motor. This manual generally covers all model numbers beginning with the letters AT, followed by a hyphen and a number between 140 and 440, and ending with a hyphen followed by a number between 4041 and 4181. Section 2 of this manual provides detailed information regarding the various models covered.

All drives covered by this manual require a separately mounted Dynamatic electronic controller to provide the necessary DC coil excitation and closed loop speed or torque control (see the particular controller manual for details).

The information, drawings and data included in this manual are generally applicable to the products covered, but may not include every detail pertaining to specific equipment provided for an individual customer order. Certified drawings and other information provided for specific items of equipment shall take precedence over this manual when the two differ in content.

The instructions given are arranged in the order they would normally be used. They begin with general information and proceed from receiving, handling and storage, through installation, operation, start-up and maintenance to modifications.

Technical Assistance
While every effort has been made to provide a complete and accurate instruction manual, there is no substitute for trained, qualified personnel to handle unusual situations. It is best to request assistance through ***DYNAMATIC Corporation's*** Service Repair Department, 1-800/548-2169.

Safety
Electrical rotating equipment and associated controls can be dangerous. Therefore, it is essential that only trained personnel be allowed to work with this equipment, under competent supervision. The danger is increased when the equipment is not handled, installed, maintained or used properly.

Read appropriate sections of this manual before beginning work. Become especially familiar with all safety instructions and procedures. Heed any hazard labels on the equipment and be sure to instruct others in their meaning and importance. The various types of labels used to alert personnel of hazards and their degree of hazard potential are as follows:

DANGER: Used to call attention to an immediate hazard, where failure to follow instructions could be fatal.

WARNING: Identifies hazards having possibilities for injury to personnel.

CAUTION: Used to warn of potential hazards and unsafe practices.

INSTRUCTION NOTE: Used where there is a need for special instruction relating to safety, proper operation or maintenance.

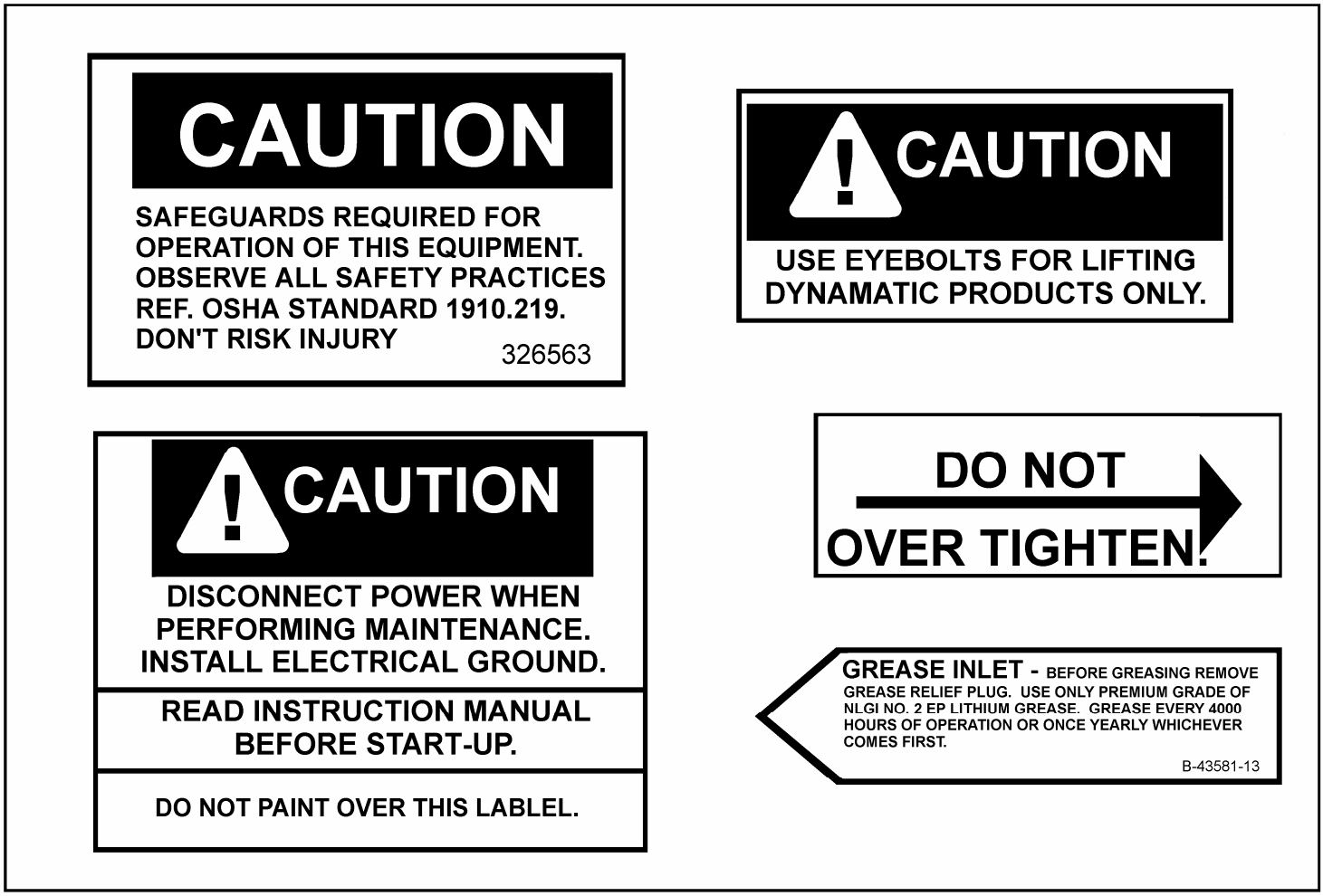
Hazard Label Examples
See Figure 1-1 for examples of the hazard labels that may appear on this equipment. Study them carefully; they are put on the unit for safety. Acquaint maintenance and operating personnel with their appearance and content.

Training
Training programs are an essential part of safe and correct operation. Training provides the knowledge necessary to obtain top performance from your equipment. ***DYNAMATIC Corporation*** recognizes this fact and conducts training schools to educate your plant personnel in safe maintenance and operating procedures. Special training schools structured around your specific equipment can be arranged.

Receiving and Damage Claims
This equipment is assembled and tested prior to shipment to make sure it functions property. After testing, the unit is carefully packed for shipment, using approved packaging methods. The carrier, in accepting the shipment, agrees that the packing is proper and assumes the responsibility for safe delivery.

Although every precaution is taken to assure that your equipment arrives in good condition, a careful inspection should be made on delivery. Check all items against the packing list to be sure the shipment is complete; then carefully inspect for damage. Any evidence of rough handling may be an indication of hidden damage.

NOTE: Shipping damages are not covered by the warranty; the carrier assumes responsibility for safe delivery. If you note damage or missing items, **IMMEDIATELY** file a claim with the carrier. At the same time, notify ***DYNAMATIC Corporation's*** customer service department. To expedite this service, refer to your equipment by purchase order, model, PRO and serial number.



Hazard Label Examples Figure 1-1

The following check list is included to assist with the receiving inspection:

1. Inspect the packaging, covering and skid for signs of mistreatment.
2. Inspect the housing to make sure there is no damage.
3. Manually rotate both shafts to be sure they are free from binding and noise. The AC motor rotor and clutch drum should rotate independently of the output shaft. Independent rotation can be checked by rotating the clutch drum with a small rod inserted through the grille while holding the output shaft. Do not use the rod against any electrical winding.
4. Check for moisture and foreign material in the unit, especially on electrical windings, around the shaft and bearing caps and in accessories.

Warranty

Your new Dynamatic® adjustable speed drive is covered by a 2-year warranty against any manufacturing defect in either material or workmanship. This warranty starts on the day of shipment from our factory. The complete warranty is contained in the Standard Terms and Conditions of Sale printed in the ***DYNAMATIC Corporation*** Adjustable Speed Drives Catalog. If a warranty failure occurs, contact your local ***DYNAMATIC Corporation*** sales office or the factory's Service Department directly, for instructions on how to obtain the required repair. All repair arrangements must be approved by ***DYNAMATIC Corporation*** in advance of returning any products to the factory. Note that freight charges, both ways, are your responsibility. For additional information, refer to Section 7, "Service and Renewal Parts".

Handling

Only skilled personnel, following standard safety practices, should handle this equipment. Avoid jarring or pounding on shaft. Do not attempt lifting by the output shaft. Handling is best accomplished with a forklift or crane. When using a forklift, be sure the unit is well supported, with the forks adequately spread and centered under the skid.

The units can also be lifted by a crane. To avoid damage, attach the crane cables to all eyebolts provided on the unit. When two or more cables are used, maintain a near-vertical pull on the eyebolts. If near-vertical pull is not possible, use a spreader bar to take side pull off of the eyebolts. Approximate weight tables are included in Section 2 of this manual.

Units mounted on a common base with other equipment may be lifted with a suitable sling under the base or by attaching cables to eye bolts designed and installed into the base for lifting the complete assembly. Refer to the certified drawings. Do not use the eyebolts on the unit if the unit is attached to another piece of machinery or gearbox, unless the drawings show they were designed for lifting the assembly.

CAUTION: Lifting lugs are designed to handle the weight of the unit and any accessory mounted on the unit. Do not use these lugs to lift a unit attached to other equipment.

Storage

When the unit is not put to immediate use, store it in a clean, dry and protected area. Do not store unit where it would be subjected to corrosive atmospheres or high levels of moisture, shock or vibration. Excessive moisture content of the air is detrimental. Maintain the temperature between 32º and 104ºF (0º and 40ºC).

If the storage period exceeds three months, or when the unit must be stored in an unprotected area, special storage procedures are required. Coat all external unprotected machined surfaces with a rust preventive solution. Cover the unit to protect it from dirt, moisture and debris, but leave air openings at the bottom to permit air circulation. Do not try to seal the unit in plastic wrapping with a moisture absorbent, as the integrity of the seal cannot be assured.

Use screens around openings to prevent rodents from nesting inside. When the ambient temperature is not controlled, install and energize space heaters to keep the unit's temperature above freezing and always above the dew point.

Long-time storage requires special attention to bearings and lubricants. To minimize brinelling and rusting, rotate shafts once every three months to redistribute the lubricant and re-coat bearing surfaces. Mark the shaft to stop in a different position each time. The bearing chambers of grease lubricated machines are packed with grease at assembly and should not require additional grease unless unusually severe environmental conditions exist. Refer to Section 6 for grease specifications and procedure to follow if periodic greasing is necessary. Consult the Service Department at the factory whenever a question exists regarding long-time storage.

Placing unit into service after storage requires careful inspection. Look for signs of damage and moisture.

CAUTION: Do not apply power to the motor, clutch or other electrical devices if moisture is detected. Dry them thoroughly. Consult the factory or one of the authorized service shops for assistance to dry out a unit.

Correct any deficiency observed. Check the insulation resistance of the motor stator, clutch coil and brake coil (if used), as described in Section 6. When storage exceeds one year, add grease, as described in Section 6, before starting. If storage was three years or longer, the bearings should probably be replaced, or at least inspected.

List of Patents

Dynamatic® Ajusto-Spede® drives are manufactured under one or more of the following patents:

U.S. Patents:

3,624,433	3,624,436	3,641,375	3,742,270
3,845,337	3,863,083	3,996,485	4,138,618
4,446,392	4,469,968	4,362,958	4,476,410
4,520,284	4,757,225	4,780,637	4,853,573

Canadian Patents:

931,514/73	962,3l2/75	983,081/76	1,009,064/77
1,022,984/77	1,170,301/84	1,201,801/86	

Other U.S. and Canadian Patents Pending.

Section 2

Equipment Description

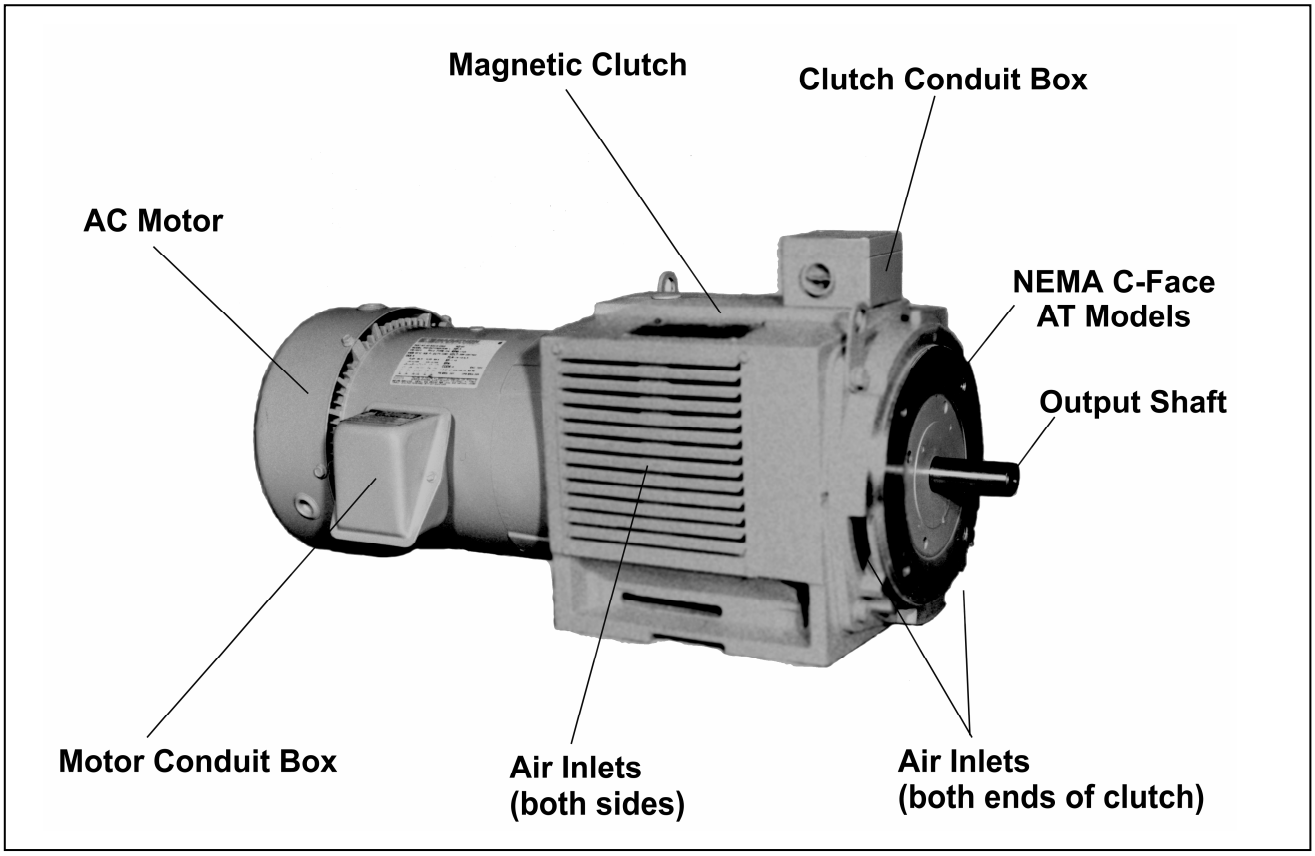
Introduction

The AT Line adjustable speed drive is an integral combination of an air-cooled magnetic clutch and an AC motor. Models covered in this manual use a C-Face or D-Flange, AC induction motor attached to the input end of the clutch housing. The input member of the clutch is a steel drum that is driven at a constant speed by the AC motor. The output member of the clutch is a rotor and shaft assembly that is driven by a magnetic field that transmits torque from the drum to the rotor. The magnetic field is created by a clutch excitation coil that is energized by an electronic speed or torque controller that provides the necessary DC coil excitation. The various size units available are similar in design, construction, performance and appearance, except that the output end bracket of the AT-140 through 280 models is a C-Face that provides a surface on which to easily add accessories. Primary differences between models are size and torque capacity. Figure 2-1 shows a typical drive.

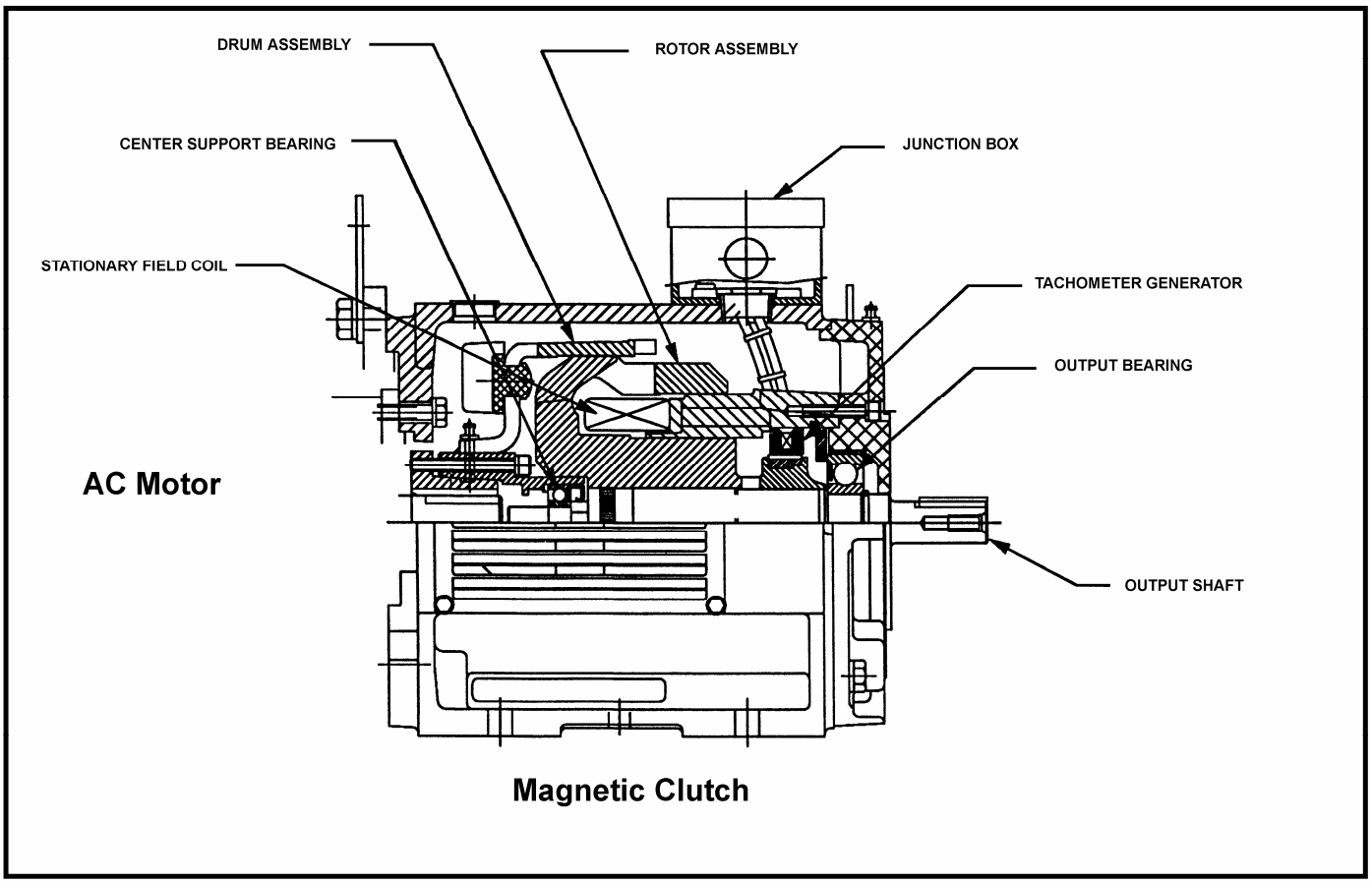
Ratings and Model Numbers

A magnetic clutch is simply a torque transmitter. Appropriate clutch frame sizes have been selected for various standard motors by matching the torque ratings of the motors to the clutch ratings, taking into consideration starting torque, overload torque, speed range and thermal limits. The resulting motor and clutch combinations comprise the adjustable speed drive product line. Standard horsepower and speed range selections, specifications, application engineering data and outline drawings can be found elsewhere in this section of this manual. Tables list the horsepower ratings, speed ranges and model numbers for various drives covered by this manual. The model numbers consist of a two letter prefix followed by a hyphen and a six digit number, then another hyphen and a four digit number. The following paragraphs describe the major design types.

Model AT drives are general-purpose models furnished with NEMA standard motors. The last four digits of the model number designate the speed range and other design characteristics as listed in the rating tables, marked on the nameplate or described in other documentation provided for specific equipment furnished for an individual customer order.



Typical Dynamatic AT Adjustable Speed Drive **Figure 2-1**



Typical Dynamatic Model AT Adjustable Speed Drive - Cutaway View **Figure 2-2**

Description of Operation

The eddy-current principle is utilized to transmit power from the AC induction motor to the load. The clutch input and output members have no physical contact between each other, except for the center support bearing. The clutch couples the motor to the load through a magnetic field. The motor runs at full speed; it is not stopped or started each time the load is stopped and started. This prolongs motor and starter life and it permits the motor to be started under no-load conditions. The only parts subject to wear during normal operation are the bearings.

The two major parts of the eddy-current clutch are the drum assembly and the output rotor and shaft assembly (see Figure 2-2). The AC motor rotates the drum at a constant speed, while the rotor and shaft assembly remains stationary until voltage is applied to the field coil. With no load attached to the output shaft, bearing friction and grease in the center support bearing, and windage between the drum and rotor assembly may produce some minimal torque and could cause the output shaft to rotate. The driven load is usually sufficient to hold the output shaft stationary.

Energizing the field coil produces magnetic flux. This flux crosses the air gap from the rotor assembly poles to the drum assembly, passes along the drum assembly axially and returns across the air gap back to the rotor assembly poles. This magnetic flux path is disrupted when the drum is rotating relative to the rotor assembly. As a result, eddy-currents are generated in the inner surface of the drum. These eddy-currents produce a series of magnetic poles on the drum surface that interact with the electromagnetic poles of the rotor assembly to produce torque. It is this torque that causes the rotor assembly and output shaft to rotate with the motor.

To generate eddy-currents and produce torque, there must be a relative speed difference between the clutch drum and rotor assembly. This speed difference is called “slip”. With zero slip, there are no eddy-currents generated and no torque produced. As slip increases, torque increases. Similarly, torque is increased by increasing field coil current. This torque versus slip, with various current relationships, is shown in Figure 2-3. Because some slip must occur to produce the required torque, no torque is produced at zero rpm. For this reason, maximum output speed is always less than motor speed.

Since the eddy-current clutch is a torque transmitter, it has no inherent speed sense. Without external control, output speed depends on load. This feature is frequently used to advantage in helper drives, tensioning drives and winder applications where torque is the prime requirement. When speed control is needed, a

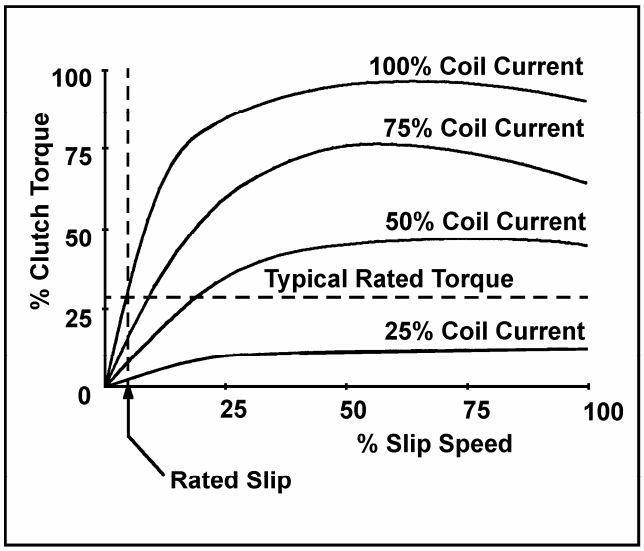
tachometer generator provides velocity feedback to an electronic controller. The controller varies field coil current to match torque output with load demand to hold desired preset speed.

A tachometer generator is included in each clutch for velocity feedback. The rotor, a permanent magnet with alternating poles around its outer diameter, is locked to the output shaft near the output end of the clutch. The rotor is positioned inside a laminated field winding. An AC voltage proportional to speed is generated in the field winding.

Construction

The input drum of the magnetic clutch is mounted directly on the motor shaft and it is supported by the motor bearings. The output rotor and shaft assembly is supported by a bearing on the end of the motor, or input shaft, and a bearing in the output end bracket. They are referred to as the center support bearing and output bearing, respectively.

In the cutaway view in Figure 2-2, note that the clutch excitation coil is mounted on a stationary ring that extends into a hollow space in the output member. This allows the coil leads to be wired directly to the conduit box without requiring slip rings and brushes.



Typical Torque/Slip Curves **Figure 2-3**

Cooling

Eddy-currents in the inner surface of the drum produce heat. This heat is proportional to slip and is sometimes referred to as "slip heat." The greater the load and the slower the speed, the greater the heat generated. Conversely, very little heat is produced at full speed.

Air is used to cool the clutch. The input drum acts as a fan, drawing air in through the output end bracket and across both sides of the drum. Air is discharged through openings on both sides of the housing. Since the drum is driven by the motor at a constant speed, maximum cooling is achieved.

Each clutch frame size has a thermal dissipation capability based on the motor speed or the air volume available. Smaller size clutches can generally dissipate full load slip losses. However, as frame size increases, the maximum airflow cannot completely cool the unit over the full speed range. Because of this, a thermal limit is established for each clutch frame size with different motor speeds. The nameplate of each unit is stamped to show the minimum operating speed at full load. The minimum speed can be reduced when the load is also reduced.

Tables found elsewhere in this section list the horsepower capacities and speed ranges of standard drives. For other ratings, consult the factory. The formula shown below is used to calculate the minimum continuous operating speed for a given load torque and horsepower dissipation capacity.

$$\text{RPM min.} = \text{RPM mtr.} - \frac{(\text{HPd} \times 5250)}{T}$$

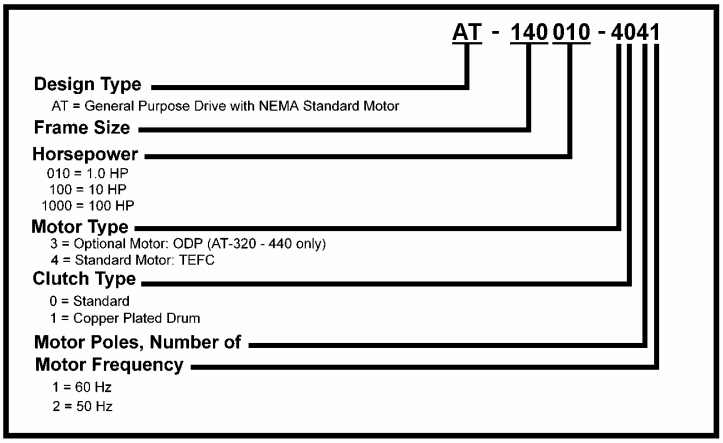
Where:

RPM min. = Minimum operating speed
RPM mtr. = Full load speed of the AC motor
HPd = HP dissipation of the specific unit
T = Maximum load torque at which RPM min. is required, in lbs. ft.

Catalog Data

The information contained on the following pages has been excerpted from the ***DSI / Dynamatic*** Adjustable Speed Drives Catalog and reprinted here for reference. **Ratings, weights and dimensions listed are approximate and should not be used for construction purposes.** Drawings giving exact dimensions are available upon request. All listed product specifications and ratings are subject to change without notice.

Contact the factory for weights, dimensions, overhung load ratings and other engineering data for model/motor frame combinations and other configurations not listed.



Model Number Decoding **Figure 2-4**

The basic Model AT drive includes a TEFC AC induction motor flange mounted to an eddy-current clutch. Table 2-1 lists units requiring a 230/460 VAC, 3 phase, **60 Hz**, 1.15 SF input. Table 2-2 lists units requiring a 220/380 VAC, 3 phase, **50 Hz**, 1.0 SF input. NEMA design B, Class F insulation is used in all motors.

All drives have 100% rated motor torque continuously available over the speed range shown in the tables below. A 45 volt controller is required; use a 4.3 Amp controller for AT-140 through AT-250 drives and an 8 Amp controller for AT-280 drives. Controllers are covered in separate instruction manuals.

60 Hz. Drives **Table 2-1**

HP	Speed Range RPM	TEFC Model Number	TEFC Motor Frame Size
1	1690-50	AT-140010-4041	145TC
2	1650-50	AT-140020-4041	145TC
3	1680-50	AT-180030-4041	182TC
5	1650-50	AT-180050-4041	184TC
7.5	1660-350	AT-180075-4141	213TC
	1680-50	AT-210075-4041	213TC
10	1655-175	AT-210100-4041	215TC
15	1625-700	AT-210150-4141	254TC
	1690-50	AT-250150-4041	254TD
20	1665-350	AT-250200-4041	256TD
25	1675-630	AT-250250-4141	284TD
	1670-50	AT-280250-4041	284TD
30	1695-175	AT-280300-4141	286TD
40	1680-569	AT-280400-4141	324TD
50	1655-805	AT-280500-4141	326TD

50 Hz. Drives **Table 2-2**

HP	Speed Range RPM	TEFC Model Number	TEFC Motor Frame Size
1	1390-50	AT-140010-4042	145TC
2	1358-50	AT-140020-4042	145TC
3	1383-50	AT-180030-4042	182TC
5	1348-50	AT-180050-4042	184TC
	1405-50	AT-180050-4142	184TC
7.5	1363-50	AT-210075-4042	213TC
10	1358-321	AT-210100-4042	215TC
	1358-321	AT-210100-4142	215TC
	1408-50	AT-250100-4042	215TC
15	1378-97	AT-250150-4042	254TD
20	1378-437	AT-250200-4142	256TD
25	1403-58	AT-280250-4142	284TD
30	1383-292	AT-280300-4142	286TD
40	1358-583	AT-280400-4142	324TD

Model AT-320 through AT-440 Drive Ratings

The basic Model AT drive includes a TEFC AC induction motor flange mounted to an eddy-current clutch. Table 2-3 lists units requiring a 230/460 VAC, 3 phase, **60 Hz**, 1.15 SF input. NEMA design B, Class F insulation is used in all motors.

All drives have 100% rated motor torque continuously available over the speed range shown in the table below. A 45 volt, 8 Amp controller is required. An internal 115 VAC center-tapped transformer winding is included in the motor for controller power. Controllers are covered in separate instruction manuals.

HP	Speed Range RPM	TEFC Model Number	TEFC Motor Frame Size	ODP Model Number	ODP Motor Frame Size
20	795-50	AT-320200-4081	326T	AT-320200-3081	326T
25	1092-50	AT-320250-4061	326T	AT-320250-3061	326T
	820-50	AT-320250-4181	326T	AT-320250-3181	326T
30	1705-50	AT-320300-4041	326T	AT-320300-3041	326T
	1097-50	AT-320300-4161	326T	AT-320300-3161	326T
	785-160	AT-320300-4181	365T	AT-320300-3181	365T
40	1665-50	AT-320400-4041	326T	AT-320400-3041	326T
	1082-233	AT-320400-4161	365T	AT-320400-3161	365T
	825-50	AT-360400-4181	365T	AT-360400-3181	365T
50	1700-175	AT-320500-4141	326T	AT-320500-3141	326T
	1122-50	AT-360500-4161	365T	AT-360500-3161	365T
	800-193	AT-360500-4181	405T	AT-360500-3181	405T
60	1690-438	AT-320600-4141	365T	AT-320600-3141	365T
	1670-50	AT-360600-4041	365T	AT-360600-3041	365T
	1102-214	AT-360600-4161	405T	AT-360600-3161	405T
	795-131	AT-440600-4081	445T	AT-440600-3081	445T
75	1665-700	AT-320750-4141	365T	AT-320750-3141	365T
	1705-163	AT-360750-4141	365T	AT-360750-3141	365T
	1097-156	AT-440750-4161	405T	AT-440750-3161	405T
	820-280	AT-440750-4181	445T	AT-440750-3181	445T
100	1675-560	AT-361000-4141	405T	AT-361000-3141	405T
	1685-175	AT-441000-4041	405T	AT-441000-3041	405T
	1112-408	AT-441000-4161	445T	AT-441000-3161	445T
125	1650-798	AT-361250-4141	445T	AT-361250-3141	445T
	1690-490	AT-441250-4141	445T	AT-441250-3141	445T
	1097-560	AT-441250-4161	445T	AT-441250-3161	445T
150	1695-700	AT-441500-4141	445T	AT-441500-3141	445T
200	1660-963	AT-442000-4141	449T	AT-442000-3141	449T

Model AT-320 through AT-440 Drive Ratings

The basic Model AT drive includes a TEFC AC induction motor flange mounted to an eddy-current clutch. Table 2-4 lists units requiring a 220/380 VAC, 3 phase, **50 Hz**, 1.0 SF input. NEMA design B, Class F insulation is used in all motors.

All drives have 100% rated motor torque continuously available over the speed range shown in the table below. A 45 volt, 8 Amp controller is required. An internal 115 VAC center-tapped transformer winding is included in the motor for controller power. Controllers are covered in separate instruction manuals.

HP	Speed Range RPM	TEFC Model Number	TEFC Motor Frame Size	ODP Model Number	ODP Motor Frame Size
25	932-50	AT-320250-4162	326T	AT-320250-3162	326T
30	1383-50	AT-320300-4042	326T	AT-320300-3042	326T
	917-97	AT-320300-4162	365T	AT-320300-3162	365T
40	1403-50	AT-320400-4142	326T	AT-320400-3142	326T
	917-50	AT-360400-4162	365T	AT-360400-3162	365T
50	1383-321	AT-320500-4142	326T	AT-360500-3042	365T
	1408-50	AT-360500-4042	365T	AT-360500-3162	405T
	907-146	AT-360500-4162	405T	--	--
60	1398-50	AT-360600-4142	365T	AT-360600-3142	365T
	922-65	AT-440600-4162	405T	AT-440600-3162	405T
75	1388-311	AT-360750-4142	405T	AT-360750-3142	405T
	917-246	AT-440750-4162	445T	AT-440750-3162	445T
100	1358-598	AT-361000-4142	445T	AT-361000-3142	445T
	1398-321	AT-441000-4142	445T	AT-441000-3142	445T
125	1393-548	AT-441250-4142	445T	AT-441250-3142	445T
150	1363-700	AT-441500-4142	449T	AT-441500-3142	445T

Standard AT Adjustable Speed Drive Data

Model	Clutch Torque Lb. Ft. at Slip RPM of ❶					Rated Dissipation HP at Input RPM of❷					Inertia Lb. Ft. ² Output Member
	50	75	100	150	1750	900	1000	1200	1500	1800	
AT-140	4.5	6.0	7.2	9.5	25.0	1.6	1.8	2.0	2.6	3.0	0.9
AT-140C ❺	6.0	7.5	9.0	12.0	27.0	1.6	1.8	2.0	2.6	3.0	0.9
AT-180	10.0	13.5	16.0	21.0	46.0	3.3	3.6	4.1	5.2	6.0	2.0
AT-180C	13.0	17.5	21.5	26.0	50.0	3.3	3.6	4.1	5.2	6.0	2.0
AT-210	19.0	25.0	32.0	44.0	74.0	5.0	5.3	6.2	7.8	9.0	3.6
AT-210C	23.0	33.0	38.0	50.0	78.0	5.0	5.3	6.2	7.8	9.0	3.6
AT-250	42.0	56.0	68.0	82.0	115.0	8.8	9.5	11.0	14.0	16.0	6.2
AT-250C	60.0	80.0	92.0	110.0	130.0	8.8	9.5	11.0	14.0	16.0	6.2
AT-280	56.0	73.0	85.0	105.0	195.0	15.0	17.0	20.0	24.0	27.0	15.9
AT-280C	100.0	128.0	160.0	200.0	230.0	15.0	17.0	20.0	24.0	27.0	15.9
AT-320	70.0	110.0	140.0	185.0	460.0	24.5	27.0	32.0	39.0	45.0	30.5
AT-320C	140.0	200.0	250.0	300.0	550.0	24.5	27.0	32.0	39.0	45.0	30.5
AT-360	130.0	170.0	210.0	250.0	640.0	39.0	42.5	49.0	59.0	68.0	55.0
AT-360C	230.0	320.0	370.0	440.0	700.0	39.0	42.5	49.0	59.0	68.0	55.0
AT-440	325.0	380.0	415.0	485.0	860.0	51.0	56.0	65.0	78.0	90.0	123.0
AT-440C	450.0	575.0	650.0	760.0	1060.0	51.0	56.0	65.0	78.0	90.0	123.0

Standard AT Adjustable Speed Drive Data

Model	Motor Frame	Overhung Load Lbs. at Output RPM of ❸						45V Clutch Coil Current (Hot Amps)	Weight Lbs.❹
		900		1200		1800			
		Std.	Spher.	Std.	Spher.	Std.	Spher.		
AT-140	143T/145T	378	-	378	-	378	-	3.40	160
AT-180	182T/215T	281	-	281	-	281	-	3.90	259
AT-210	213T/254T	790	-	790	-	680	-	3.90	434
AT-250	254T/286T	682	-	682	-	664	-	4.20	619
AT-280	284T/326T	1124	1124	1116	-	961	1124	7.20	1012
AT-320	326T/365T	1490	1739	1341	1739	1156	1739	7.04	1200
AT-360	365T/405T	2012	2796	1811	2796	1560	2796	8.37	1800
AT-440	405T/447T	3372	3372	3372	3372	3372	3372	8.23	2700

❶ Values are for four-pole motor speeds.
❷ Indicates maximum HP that can be safely dissipated at a given input speed. Dissipation should be de-rated 10% for each 10° F (5.5° C) above 100° F (38° C) ambient, to 150° F (71° C) maximum ambient.
❸ Values are based on B-10 bearing life of 15,000 hours. For 20,000 hours use 91% of the values shown. The figures are the maximum weights at the center of a standard output shaft keyway perpendicular to the axis. Ratings are for ball bearings or spherical roller bearings, as noted.
❹ Approximate weight of brake.
❺ Copper plated drum.

Adjustable Torque Brake Data

Model	Brake Torque in Lb. Ft. at Output RPM of Model				Brake Dissipation HP at Brake RPM of				Brake Rotor Inertia Lb. Ft^2	45 V Brake Coil Current (Hot Amps)	Wt. Lbs.❹
	600	900	1200	1800	600	900	1200	1800			
AT-320B	120	138	147	153	3.3	5.0	6.7	10.0	7.1	5.5	150
AT-360B	120	138	147	153	3.3	5.0	6.7	10.0	7.1	5.5	150
AT-440B	120	138	147	153	3.3	5.0	6.7	10.0	7.1	5.5	150

Adjustable Speed Drive With Adjustable Torque Brake Data

Model	Motor Frame	Drive With Motor Overhung Load in Lbs. at Output RPM of ❸		
		900 Spherical	1200 Spherical	1800 Spherical
AT-320B	326T/365T	1739	1739	1739
AT-360B	365T/405T	2796	2796	2796
AT-440B	405T/445T	3372	3372	3372

Adjustable Speed Drive With Friction Brake Data

Model	Motor Frame	Electrically Engaged			Drive with Overhung Load in Lbs. at Output RPM of			Weight Lbs. ❹
		Static Torque Lb. Ft.	Inertia Lb. Ft.²	Brake Model	900	1200	1800	
AT-320F	326T/365T	240	1.06	310	1490	1340	1155	30
AT-360F	365T/405T	465	2.14	312	2010	1810	1560	50
AT-440F	405T/445T	-	-	-	-	-	-	-

❸ Values are based on B-10 bearing life of 15,000 hours. For 20,000 hours use 91% of the values shown. The figures are the maximum weights at the center of a standard output shaft keyway perpendicular to the axis. Contact the factory for overhung load ratings on model/motor frame combinations and other configurations not listed.

❹ Approximate weight of brake.

NOISE LEVELS - AT ADJUSTABLE SPEED DRIVES

These sound pressure levels are **typical** values given for engineering information only, and it is **not guaranteed** that any particular production unit will exceed these values.

Microphone 3 feet from side of drive, tested in a semi-anechoic chamber above reflecting plane per IEEE-85. All readings are sound pressure level, dB; reference 20 micro-Newton's per square meter. Average sound pressure in a 3 foot radius hemispherical free field. Noise level for 1200 RPM drives will be 9 dB less than 1800 RPM values shown, and for 3600 RPM the noise level will be 15 dB greater.

Model	RPM	Sound Pressure dB	
		Output Rating	Output Stalled
AT-140	1800	65.0	-
AT-180	1800	72.0	-
AT-210	1800	72.0	-
AT-250	1800	76.0	-
AT-280	1800	78.0	-
AT-320	1800	83.2	86.4
AT-360	1800	85.9	87.3
AT-440	1800	87.1	89.0

FULL LOAD MOTOR CURRENTS

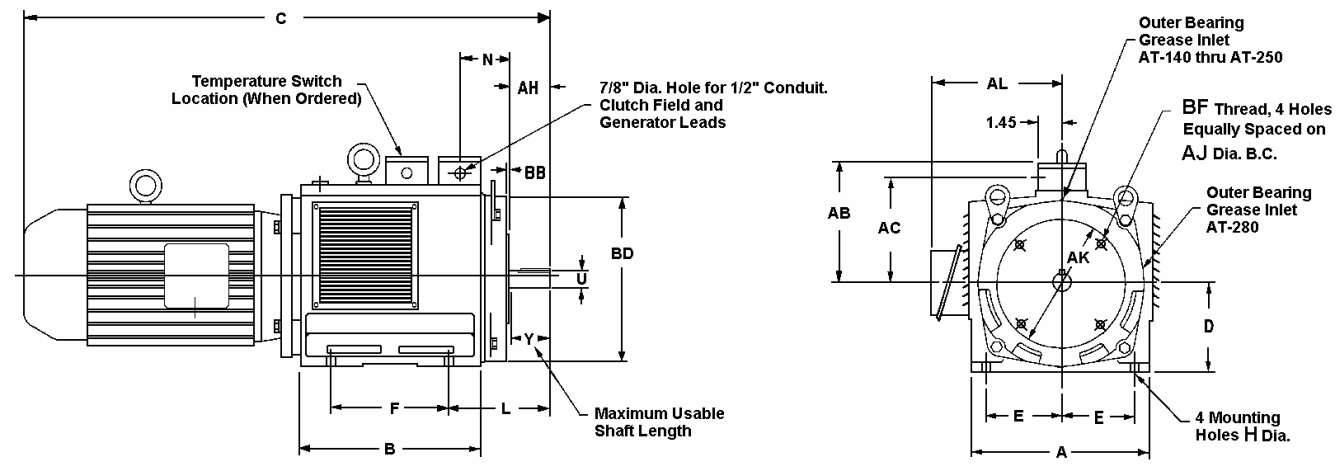
The full load motor currents shown in the following table are typical values for 4-pole motors. Full load current for 6-and 8-pole motors will typically be higher than the values listed for 4-pole motors. This table is intended for use as an aid in sizing motor branch circuit components. For setting motor over-current protection devices, consult the motor nameplate. For full load motor currents of 200 and 208 volt motors, increase the corresponding 230 volt motor full load current by 15% and 10% respectively. Multi-speed motors will have the full load current varying with speed in which case the nameplate rating shall be used.

HP	Full Load Amperes for 4 pole Motors at				
	230V 60Hz	460V 60Hz	575V 60Hz	220V 50Hz	380V 50Hz
1	3.4	1.7	-	3.69	2.1
1.5	5.2	2.6	-	5.48	3.2
2	6.4	3.2	-	6.99	4.0
3	8.8	4.4	-	9.83	5.7
5❶	13.2	6.6	-	-	-
7.5	204	10.2	-	-	11.7
10	262	13.1	-	-	15.8
15	36.2	18.1	-	-	22.0
20	46.0	23.0	-	-	29.0
25	58.0	29.0	-	-	36.0
30	66.0	33.0	-	-	42.0
40	104.0	52.0	41.0	-	-
50	130.0	65.0	52.0	-	-
60	152.0	76.0	61.0	-	-
75	184.0	92.0	74.0	-	-
100	240.0	120.0	96.0	-	-
125	296.0	148.0	118.0	-	-
150	344.0	172.0	138.0	-	-
200	448.0	224.0	179.0	-	-

❶ 184TC Frame

Outline Drawings

Dynamatic Model AT-140 through AT-280



D-81430

Model	Motor Frame	A	B	C①	D②	E	F	H	L	N	Shaft Extension U③	Shaft Extension Y④	Shaft Extension KEY	AB	AC	AH
	143TC			22.40									.18 Sq. x			
140	145TC	8.68	8.41	24.90	4.50	3.75	5.12	.50	5.00	2.96	.875	1.94	1.38 Lg.	6.81	5.56	2.00
	182TC			27.94									.25 Sq. x			
180	184TC	10.25	10.07	28.94	5.25	4.25	6.25	.50	6.25	3.18	1.125	2.50	1.75 Lg.	7.75	6.50	2.62
	213TC			30.56												
	213TC			32.06									.31 Sq. x			
210	215TC	12.00	10.96	33.56	6.25	5.00	6.50	.62	7.62	3.81	1.375	3.00	2.38 Lg.	8.63	7.38	3.12
	254TC			36.43												
	254TD			38.79									.38 Sq. x			
250	256TD	14.00	12.52	40.54	7.00	5.50	7.25	.62	8.75	3.41	1.625	3.62	2.88 Lg.	9.63	8.38	3.75
	284TD			40.41												
	284TD			42.91												
280	286TD	18.00	13.00	44.41	9.00	7.50	8.12	.75	10.00	5.35	1.875	3.83	.50 Sq. x	12.09	10.84	3.83
	324TD			45.30									3.50 Lg.			
	326TD			46.80												

Model	Motor Frame	AJ	AK⑤	AL	BB	BD	BF
	143TC						
140	145TC	5.88	4.499	5.56	.12	8.38	3/8 - 16
	182TC						
180	184TC	7.25	8.499	7.19	.25	10.06	1/2 - 13
	213TC			7.50			
	213TC						
210	215TC	7.25	8.499	7.50	.27	11.82	1/2 - 13
	254TC			8.10			
	254TD						
250	256TD	7.25	8.499	10.00	.27	13.32	1/2 - 13
	284TD			12.31			
	284TD						
280	286TD	9.00	10.499	12.31	.25	15.20	1/2 - 13
	324TD						
	326TD			14.38			

❶ **C** is approximate overall dimension dependent on motor specified.

❷ **D** dimension will never be exceeded. When exact dimension is needed shims up to .03 may be required.

❸ **U** shaft diameter tolerance 1.50" and smaller +.0000/-.0005, over 1.50" +.000/-.001.

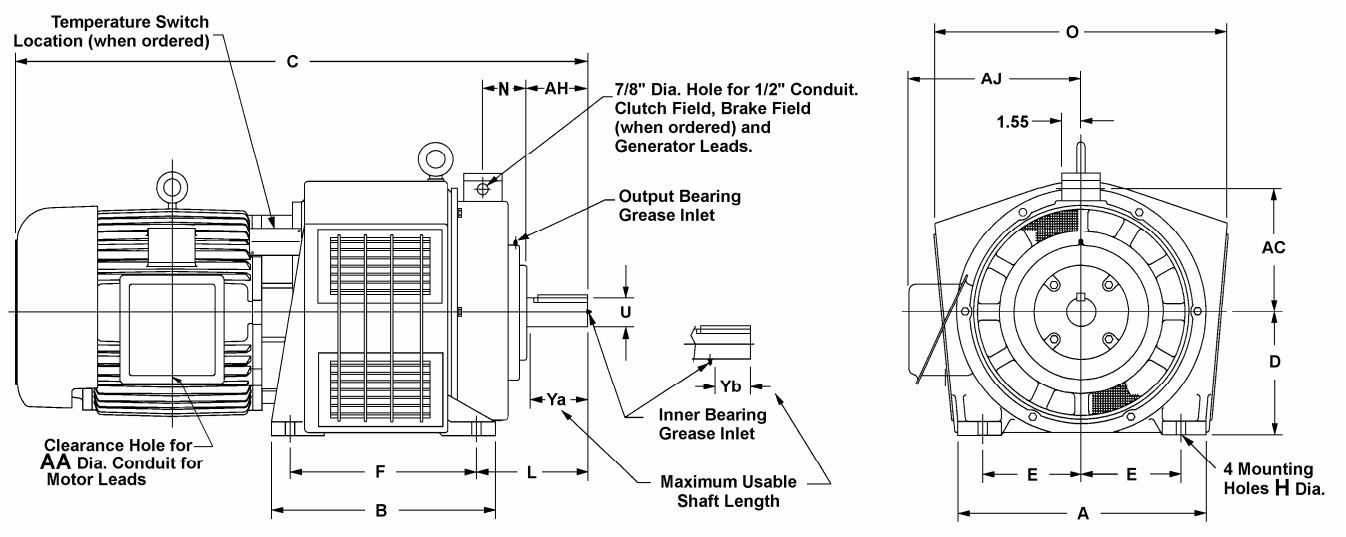
❹ **Y** is maximum useable shaft length.

❺ **AK** Pilot diameter tolerance +.000/-.002.

DIMENSIONS ARE IN INCHES

Outline Drawings

Dynamatic Model AT-320 through AT-440



C-92190/C-92191, C-93190/C-93191, C-94190/C-94191

Model	Motor Frame	A	B	C	D❶	E	F	H	L	N	O	Shaft Extension U❷	Shaft Extension Ya❸	Shaft Extension Yb❸
320	326T			47.57										
(STD)	365T	20.00	18.00	49.19	10.00	8.00	15.00	.75	9.00	3.29	23.60	2.375	4.75	2.88
360	365T			56.18										
(STD)	405T	22.00	23.00	59.62	11.00	9.00	20.00	.88	14.00	5.78	25.76	2.875	6.44	4.62
	445T			64.24	10.97									
440	405T			64.02										
(STD)	445T	24.00	24.00	68.64	12.00	10.00	21.00	.88	17.14	6.80	28.72	3.375	8.26	5.62
	449T			77.14	11.97									

Model	Motor Frame	KEY	AA❹	AB	AC	AH	AJ	WEIGHT – LBS. w/o Brake	WEIGHT – LBS. w/Int. Brake
320	326T		2.00				13.18	1490	1590
(STD)	365T	.62 Sq. x 4.00 Lg.	3.00	11.25	10.00	4.88	16.68	1765	1865
360	365T						16.68	2475	2575
(STD)	405T	.75 Sq. x 6.00 Lg.	3.00	12.37	11.12	6.57	17.68	2785	2885
	445T						19.75	3325	3425
440	405T						17.94	3325	3425
(STD)	445T	.88 Sq. x 7.50 Lg.	3.00	13.87	12.62	8.58	19.56	3875	3975
	449T						19.56	4575	4675

❶ **D** dimension will never be exceeded. When exact dimension is needed, shims up to .03 inch may be required.
❷ **U** shaft diameter tolerance: +.000/-.001 inch. Diameter shown is standard. Smaller diameter shafts of 2.125 for Model 320 and 2.375 for Model 360 are available upon request.
❸ **Y** Dimensions are usable shaft lengths: **Ya** grease fitting on end; **Yb** grease fitting on side.
❹ Conduit box can be turned to any of four positions: horizontally, vertically, opposite side or on top upon request.

DIMENSIONS ARE IN INCHES

Section 3

Installation

Proper operation and long life of the eddy-current unit depend on its installation, location and environment. These instructions are intended as a guide for safe and proper installation, but do not cover all possible situations that may arise. Refer any questions to ***DSI / Dynamatic*** 1-800/548-2169.

Location and Environment
The clutch is an open, drip-proof, self-ventilated unit that should be installed in an area suitable to its design. An adequate supply of clean, dry cooling air is required. Locate the unit away from any obstruction, usually at least twelve inches from a wall, to permit free air movement and accessibility for routine maintenance and inspection. Do not obstruct ventilating openings or mount the unit within the base of a machine without making provisions for adequate inlet and outlet of cooling air.

CAUTION: Beware of re-circulation of cooling air. Hot air discharge must not be allowed to re-enter the unit or any adjacent air cooled unit.

These units are designed to operate under standard service conditions unless purchased for certain specific environmental conditions. Standard service conditions are listed in Table 3-1. If purchased for special environmental conditions, consult the contract papers for the unit.

Standard Service Conditions **Table 3-1**

Altitude	not exceeding 3300 ft. (1000 meters)
Ambient Temperature	32ºF to 104ºF (0ºC to 40ºC)
Coil Voltage	not exceeding 10% over nameplate rating
Environment	clear of dust, dirt, high moisture and vapors
Line Voltage Variation	+/- 10% of nameplate rating

Operation in ambients above 104ºF (40ºC) requires the HP dissipation to be de-rated 10% for each 10ºF (5.5ºC) interval to a maximum ambient of 148ºF (65ºC). For operation above 3300 feet (1000 meters), it is necessary to de-rate the HP dissipation 5% for each 1100 foot (330 meter) interval to an altitude of 10,000 feet (3000 meters). Alternative altitude and ambient temperature ratings can also be calculated by decreasing the maximum ambient temperature rating by 4.6ºF per 1000 feet (8.33ºC per 1000 meters) above 3300 feet (1000 meters).

The unit should never be placed in any hazardous location restricted by the National Electrical Code, Article 500, unless it is specifically designed for a specific hazardous service and it is approved for such service conditions by the local code inspection and enforcement agencies.

Site Preparation
Before installation, make sure the jobsite is free of debris and all heavy construction, especially overhead. Provide protection for all personnel and equipment in the area, as required by the conditions. Clean up construction dust, dirt and scrap material so they are not pulled into the unit by cooling fan suction.

CAUTION: Electric welding equipment must be solidly earth grounded. Do not use clutch or motor as a current path. Serious bearing and insulation damage may result.

When planning the installation, be sure to include access for maintenance, the correct size, number and location of conduits, and adequate electrical service for the equipment. Remember, the location should provide adequate space for the removal of the unit or a component of it.

Mounting surfaces must be machined flat and level to support all feet evenly and be rigid enough to prevent flexing or resonance. As a general rule, the base plate should be at least as thick as the mounting feet or flange. Do not set the unit directly on a wood or concrete floor. Consult the factory for weight and center of gravity data.

The unit must be mounted with its shaft in a horizontal position unless it is a vertical model that is specifically designed for vertical mounting and operation. Other models must be mounted horizontally unless certified drawings or other documentation, furnished for equipment supplied for a specific customer order, indicates that the equipment is designed for vertical mounting and operation.

Unit Preparation
Move the unit to the jobsite using proper handling procedures. Refer to Section 1, "Handling," for more information. If the unit has been stored in a cool location, allow it to reach room temperature before removing packing material. Then remove all temporary screens, cover plates, tie down bolts and banding. Before proceeding, review the application requirements and check the unit nameplate to be sure the correct unit is being installed and electrical service is correct.

Examine the unit for damage or lost accessories. The following check should be made before installation:

1. Turn shafts by hand and observe any binding, rubbing or noise that may indicate damage to bearings or other components.

2. Use a light to check inside openings for foreign material.
3. Open junction box covers and check continuity and leakage to ground.
4. If unit has been stored outdoors and especially in humid climates, check for condensation and water damage to insulation and bearings.
5. Make sure accessory equipment is complete and undamaged. Movable devices should be operated to determine if they function freely and correctly.

Correct any deficiency and remove dirt, rust and protective coatings. Use a safe solvent to clean shaft, flange face and mounting feet. Remove burrs with a fine file or scraper. Do not use emery cloth, sandpaper or any other abrasive.

Sizing Sheaves and Sprockets (Overhung Load)

Before a sheave or sprocket is installed on the shaft, make sure it does not exceed the minimum diameter limitation. This is a limitation established by the overhung load capacity of the unit. Too small a sheave may result in early bearing failure or a broken shaft. Calculate the minimum sheave diameter using the following formula:

$$PD\ min. = \frac{(126{,}000 \times HP \times Lf \times Tf)}{(OHL \times Pf \times RPM)}$$

Where:

PD min. = Minimum pitch diameter, in inches.

HP = Rated horsepower of clutch from clutch nameplate.

Lf = Load factor of clutch is a ratio of maximum expected load to rated load, usually at least a factor of 1.5. See Table 3-2.

OHL = Overhung load capacity of shaft in pounds. Obtain from Section 2 of this manual. Contact your local sales office for configurations that are not listed.

Tf = Tension factor for type of bell drive used. See Table 3-3.

Pf = Position factor, a factor, used to correct overhung load capacity when the center of belt pull is not on the center of the shaft keyway extension. Location "L" is on the center of keyway. See Table 3-4 and Figure 3-1.

The pitch diameter of the sheave or sprocket must be equal to or larger than the minimum calculated. When a smaller diameter must be used, mount the pulley on a separate jackshaft, supported by separate bearings. Align the jackshaft to the unit's shaft as described for directly connected shafts.

The overhung load ratings listed in Section 2 are for units with a standard length output shaft and either standard output ball bearing or optional/standard output spherical roller bearing, as indicated in the tables. Units with an external brake have a longer shaft. Separate overhung load rating tables are provided for units with a brake. For non-standard models, contact ***DSI / Dynamatic*** to obtain the overhung load rating. To determine if your unit is standard, compare its dimensions (shaft length) and the model number imprinted on its nameplate with the model numbers and engineering data tables in Section 2 of this manual.

Note that OHL is in pounds force at the center of the shaft keyway. Positioning the pulley so the center of belt pull is not at the center of the keyway changes the OHL capacity. Table 3-4 lists the Position Factors used to correct the OHL. Factors are provided for 1 inch closer to the bearing (L-1); and 1 inch (L+1), 2 inches (L+2) and 3 inches (L+3) further away from the bearing. If belt center is on the keyway center, Position Factor L is 1.0.

Load Factors **Table 3-2**

Type of Load	Lf
Load never exceeds full load	1.00
Load sometimes equals 125% of full load	1.25
Normal loads	1.50
Occasional loads equal to 200% of full load	2.50

Tension Factors **Table 3-3**

Tension Factors	Tf
Chain and sprocket	1.00
Pinion or gear	1.25
V-belt and sheave	1.50
Flat belt and pulley	2.50

Position Factors (Pt) **Table 3-4**

Standard Output Ball Bearings				
Model	**L-1”**	**L+1”**	**L+2”**	**L+3”**
AT-140	1.05	.94	.90	N/A
AT-180	1.05	.96	.92	N/A
AT-210	1.04	.96	.92	N/A
AT-250	1.04	.96	.92	N/A
AT-280	1.08	.89	.77	.67
AT-320	1.07	.94	.88	.84
AT-360	1.06	.95	.90	.86
Output Spherical Bearings				
Model	**L-1”**	**L+1”**	**L+2”**	**L+3”**
AT-320	1.19	.86	.76	.68
AT-360	1.22	.85	.74	.65
AT-440	1.16	.88	.79	.71

Installing Sheaves, Sprocket or Couplings

Coupling halves, sheaves, sprockets or gears should be installed on the shaft before mounting the unit. Before installing these hubs on the shaft, inspect the shaft and its key. Remove any burrs using a fine file. Do not use emery cloth or other abrasives. Also, be sure the key fits snugly to the sides of the keyways on both the shaft and device hubs. Some clearance between the top of the key and the hub keyway is acceptable and will make installation easier.

Note: Model AT-320 through AT-440 Drives are shipped with a grease fitting installed in the end of the output shaft. If this fitting interferes with installation or will be inaccessible when installation is complete, relocate it by interchanging the grease fitting with the plug installed in the cross-drilled hole on the side of the shaft.

Generally, the device should be installed on the shafts by following the device manufacturer's instructions. Devices with split hubs or light interference fits that use set screws should not present any problems. Devices with hubs that rely on heavy interference fits, however, must be installed with care. Do not pound such hubs in place. Instead, heat the hub in an oil bath or oven to 275ºF (135ºC) to expand the bore. Then, after coating the shaft with a light film of oil, slip the hub on the shaft. Be very careful to stop the hub at the correct position on the shaft, as it will quickly shrink once the heat is transferred to the shaft.

Initial Mounting

After preparing the site and unit, place the unit on a metal mounting base or plate. Then proceed as follows:

1. One or more mounting feet on the unit may not contact their mounting pads. With a feeler gauge, find and measure gap between each foot and its pad.
2. Place slotted shim, equal in thickness to measured gap, under each high mounting foot.
3. Install mounting bolts or nuts finger tight.
4. Proceed with alignment as described below under "Alignment."

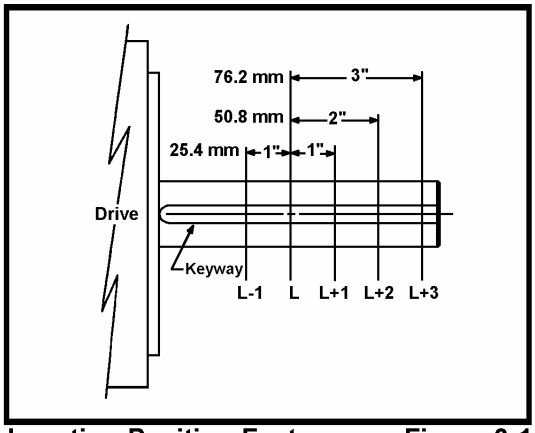
Any burrs or other irregularities that would prevent proper seating must be removed. Once base is determined to be level, set unit in place. Any high spots on the base should be scraped or filed.

Alignment

Proper alignment of this unit is a condition of its warranty. Misalignment between directly connected shafts will cause increased bearing loads and vibration, even when a flexible shaft coupling is used. After alignment, other factors can cause the alignment to change. For this reason, the original alignment should be as accurate as possible.

Direct Coupled Shafts

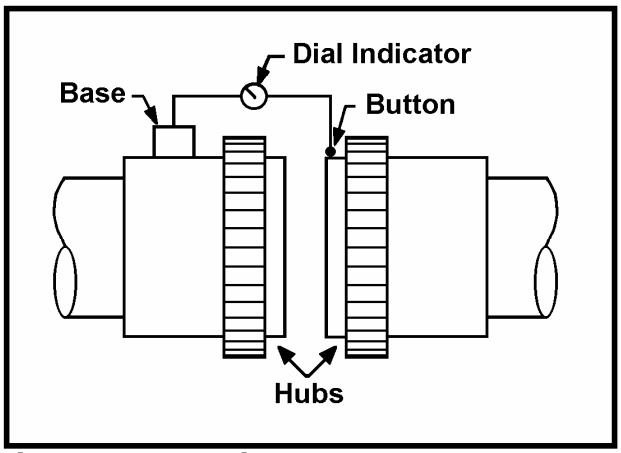
All couplings, even flexible couplings, are designed to permit only a limited amount of misalignment. Generally,



Locating Position Factors on Standard Shafts **Figure 3-1**

a coupling manufacturer specifies limits for both angular and offset misalignment.

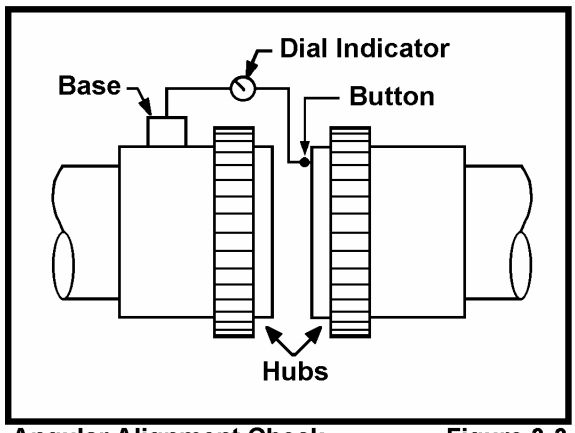
When using such limits in place of the values specified in this alignment procedure, remember that the limits are maximums and they cannot be used at the same time. If, as an example, angular misalignment is at its limit, then offset misalignment must be zero. Always use a dial indicator to check alignment.



Offset Alignment Check **Figure 3-2**

Note - Dial indicators used for alignment must be non-magnetic due to possible magnetism of the unit's shaft. If possible, rotate both shafts when required in procedure. If one shaft cannot be turned, alignment can still be checked by rotating the other shaft with indicator attached to it.

1. Clamp base of indicator to hub of unit's shaft and position its indicator button on machined outer diameter of other hub, as shown in Figure 3-2.
2. Scribe a mark to indicate position of button.
3. Read indicator dial. Zero if convenient. Then rotate both shafts equally, keeping button on scribe mark and noting dial readings. Locate position of maximum reading and record it. Then rotate shafts and take readings at each one-quarter revolution. The maximum difference, or run out, between any two readings should not exceed 0.002 inch. If it does, realign the units and repeat.
4. Once run out is acceptable, reposition indicator button on machined face of driven shaft hub as shown in Figure 3-3.
5. Scribe a mark to indicate position of button.
6. Read indicator dial. Zero if convenient. Then rotate both shafts equally, keeping button on scribe mark and noting dial readings. Locate position of maximum reading and record it. Then rotate shafts and take readings at each one-quarter revolution. Compare four readings and calculate maximum difference between any two readings. Divide resulting value by twice the distance from shaft centerline to button position. The final result, angular misalignment, should not exceed 0.002 inch per inch. If it does, realign units and repeat.



Angular Alignment Check **Figure 3-3**

The alignment check is done similarly for either horizontal or vertical shafts. Shimming to correct alignment is done somewhat differently.

For horizontal or foot mounted units, the shims are placed under the feet. Because of an uneven mounting surface, it may be necessary to install more shims at one end than at the other to reduce angular misalignment. The shims should be the same size as the mounting foot and slotted to permit inserting without removing the bolt. Try to obtain shims of the thickness required, or use as few thick shims as possible. Do not use many thin shims stacked to make up the thickness required. De-burr shim edges.

Vertical flange mounted drives require shims inserted between the flange faces. Use the following procedure when placing shims to avoid twisting the flange. De-burr shim edges and use as few thick shims as possible instead of many thin shims. See Figure 3-4.

1. Determine thickness of shim needed to correct angular alignment by calculation or trial and error. This shim is placed on the flange face at the point where the smallest misalignment reading was taken.

2. Shim should not be wider than the distance from the outer flange edge to the bolt circle of the hold down bolts and the length should be twice the width. Notch for bolt.
3. Cut two additional shims the same size but one half the thickness and place them 90º from the thick shim, on either side. Notch to clear hold down bolts, if necessary.

Parallel Connected Shafts

Parallel shafts must be aligned to prevent excessive thrust loads on the unit's shaft and to minimize belt or chain wear. To check parallel shaft alignment, simply place a straightedge across the faces of the two sheaves or sprockets as shown in Figure 3-5. When properly aligned, the straightedge should contact the faces of both devices squarely. The object is to have the belt leave or enter the groove without rubbing or thrusting against the side of the groove.

Quarter-twist belts are often used to transmit power between a horizontal and vertical shaft. These shafts must be perpendicular and aligned as shown in Figure 3-6 to minimize bell wear and bearing loads. When looking down, as shown in the top view, a line perpendicular to the horizontal sheave at the center of its sheave must pass through the center of the vertical shaft. When looking at the end of the horizontal shaft, as shown in the front view, a line perpendicular to the vertical shaft at the center of its sheave must pass a distance "Y" below the center of the horizontal shaft.

Belt Tension

Belt and chain drives are tensioned by sliding the unit sideways after loosening the hold down bolts. It is very important to establish the proper tension, which is one just above the point of slippage. Belts that are too loose will slip, preventing proper acceleration or full output speed while creating belt overheating and pulley grove wear. On the other hand, tightening the belt or chain more than is necessary increases wear of the belt, bearings and shaft.

When available, follow the belt manufacturer's instructions for optimum tensioning. When such instructions are not available and the belt and sheave are not sized marginally, a simple check may be made to determine belt tension. To perform this check, place thumb on belt at a point midway between the two sheaves and press downward. The belt should deflect a distance equal to one-half of its thickness for each 24 inches of distance between the sheaves.

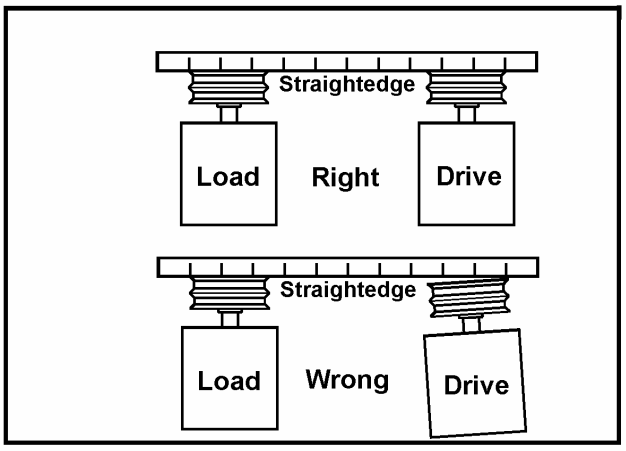
Because the simple check described above is not very precise, it is not recommended when the sheave is at or near the minimum size permitted by the unit's overhung load capacity. In such cases, even slight over-tightening of the belts can cause serious damage. To avoid these problems, check tension of marginally sized belts or sheaves with a belt tension gauge following the directions furnished with the gauge, or use the following procedure:

1. Calculate the value for a test weight or deflection pressure using the following formula:

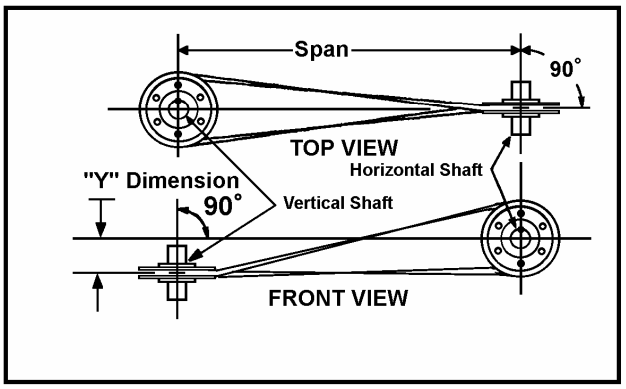
$$\text{Weight (Lbs.)} = \frac{(\text{OHL} \times \text{Pf} \times 0.03125)}{\text{No. of belts used}} + \text{Mf}$$

Where:

OHL = Overhung load capacity of shaft in pounds. Obtain from engineering data tables in section 2 of this manual. Contact your local sales office for configurations that are not listed.



Parallel Shaft Alignment **Figure 3-5**



Perpendicular Shaft Alignment **Figure 3-6**

Span		"Y" Dimension	
Inches	**mm**	**Inches**	**mm**
60	1525	2.50	63
80	2030	2.75	70
100	2540	3.00	76
120	3050	4.00	101
140	3560	5.25	133
160	4060	6.50	165
180	4570	7.75	200
200	5080	9.00	230
220	5590	10.50	270
240	6100	12.00	305

Pf = Position factor, a factor used to correct overhung load capacity when the center of belt pull is not on the center of the shaft keyway extension. Location "L" is on the center of keyway. See Table 3-4 and Figure 3-1.

Mf = Belt Modulus Factor from Table 3-5.

2. Apply deflection pressure by hanging a weight on each belt at the midpoint of the span as shown in Figure 3-7. Pressure can also be applied using a small spring scale. When properly adjusted, each belt should deflect "1/64" for each inch of span.
3. If belts slip after tension has been properly adjusted, sheaves or belts have been improperly sized.
4. With new belts, tensions should be checked and adjusted after each 24 hours of operation until belts are broken in.

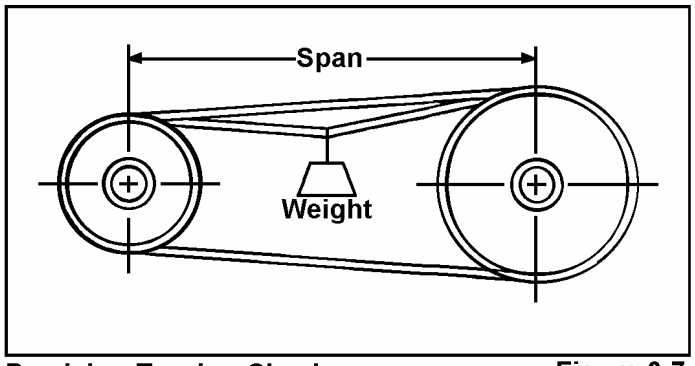
Final Mounting

After completing the initial mounting procedures and necessary alignment, secure the unit as follows:

1. Make sure unit is level and its feet are still in contact with the mounting pads. If a number of thin shims were installed during alignment, consider replacing them with thicker shims. A few thick shims are preferred to a large number of thin ones.
2. Tighten mounting bolts or nuts to secure unit to base. Recheck alignment and, if necessary, correct it. Tightening bolts may pull unit down, especially when many shims are used.
3. For directly coupled units, dowel all interconnected units to base to ensure that shaft alignment will be maintained. For belt coupled units, recheck belt tension arid correct it if necessary. Tightening bolts or nuts may have moved unit, causing over-tensioning, even though tension was proper before bolts were tightened.

Belt Modulus Factors (Mf) **Table 3-5**

Belt Type	Modulus Factor	Belt Type	Modulus Factor
A	0.500	E	5.938
B	0.813	3V	0.375
C	2.500	5V	0.750
D	5.000	8V	1.563



Precision Tension Check **Figure 3-7**

Lubrication

Bearings are grease lubricated and require no special attention unless stored for over one year. Consult the sections on "Storage" and/or "Maintenance" for greasing instructions.

Shaft and Belt Guards

Before applying power and starting the unit, install guards over all rotating shafts, couplings, belts and chain devices. Refer to OSHA rules and regulation, paragraph 1910.219 for requirements covering guards on mechanical power transmission apparatus. Be sure

machine is safe to operate and all safety devices have been installed, checked out and made operable.

> CAUTION: When designing belt and shaft guards, remember that bearings must be lubricated periodically. Grease fittings should be accessible through openings in guards and signs should indicate the exact location of each grease inlet and outlet.

Electrical Wiring

All wiring to the drive, including any accessories, must conform to the National Electrical Code and all other applicable state and local codes. Motor leads and transformer winding leads are terminated in a conduit box mounted on the side of the motor. Leads for the clutch and tachometer generator are terminated in a conduit box mounted on the clutch housing. Accessories may also be wired to the same conduit box or may be terminated in another conduit box attached to the accessory. Connections from the conduit boxes to the controller are made by connecting each lead or terminal to the appropriate lead or terminal in the controller as shown on the connection diagram furnished with the controller. Figure 3-8 shows typical connections for a standard drive without any modifications or accessories. Section 8 of this manual includes typical connection diagrams for common accessories. For specially modified drives, refer to the instructions furnished for the modification or added accessory and to the instructions and diagrams furnished with the controller. Tachometer generator leads and speed signal reference leads should not be run in the same conduit with motor power leads.

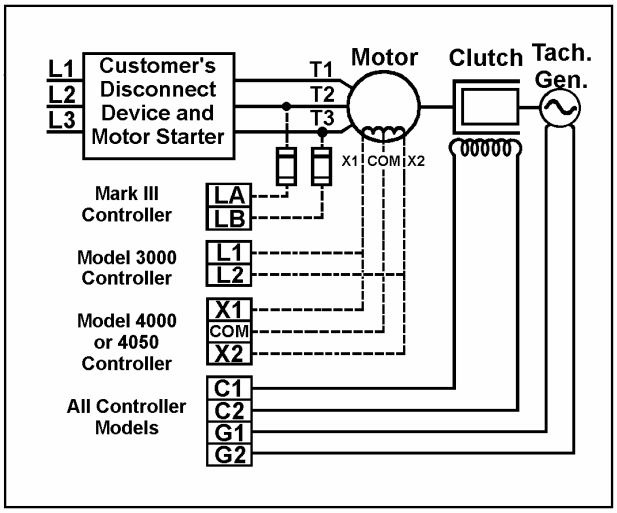
Transformer Winding (Applies to Models AT-320 through AT-440 ONLY)

The motor furnished with the drive includes a single phase, 115 volt, center tapped transformer winding that can be used as a power source for the external controller. The leads for this winding are labeled X1, X2 and COM (center tap). The Model 3000, 4000 and 4050 controllers must be connected to all three leads as shown in Figure 3-8. The Mark III controller requires a separate power source and is not connected to the transformer leads.

> CAUTION: When the transformer windings are not used, the leads for the winding in the conduit box must be individually taped to prevent a short circuit.

AC Motor Leads

The AC motor in the drive is connected like any other polyphase induction motor. As required by the National Electric Code (NEC) and/or other applicable codes, it is necessary to provide appropriate disconnect, control and protective devices for the motor. These devices and the motor conductors must be sized, applied and installed in conformance with the NEC and/or other applicable codes. Consult the instructions provided with these devices for additional information. All motor leads at the conduit box are gray or black. The motor nameplate and/or a decal near the nameplate show how to connect three phase power to the motor leads. Most motors are dual voltage (nine leads), but motors for single voltage (three leads) and multiple voltage (twelve leads) are sometimes used.



Typical Wiring Connections **Figure 3-8**

The motor nameplate lists the full load current for each of the rated supply voltages. Size the motor conductors in accordance with the full load current at the selected voltage.

Clutch and Brake Coil Leads

The coil leads for the clutch and brake (if furnished) is connected to a terminal block inside the conduit box located above the output shaft. The clutch coil leads are white and the terminals are marked C1 and C2. Leads from either an eddy-current or friction brake are orange and the terminals are marked B1 and B2. Connect the wires to terminals C1, C2, B1 and B2 in the eddy-current controller. Size the wires in accordance with the coil voltage and current ratings listed on the clutch nameplate. Refer to Section 8 of this manual for additional information regarding eddy-current and friction brakes. Refer also to the diagrams and instructions furnished with the eddy-current controller.

Tachometer Generator Leads

The tachometer generator leads are connected to the same terminal block as the clutch and brake leads described above.

Three tachometer generator leads are brought out to the conduit box in a shielded, insulated cable. Two of these leads are connected to terminals G1 and G2 according to maximum output speed as shown in Table 3-6. The leads are factory connected to suit the drive's nameplate RPM and should not need to be changed.

It is necessary to connect a shielded cable from the generator terminals in the conduit box to the controller and to any tachometer indicator that may be used. The

shielded cable should consist of a twisted, insulated pair of conductors having a continuous metallic shield around them with an insulating jacket over the shield.

In the conduit, cut back enough of the end of the shielded cable to expose sufficient conductor lengths to make required connections then tape the exposed shield to prevent grounding. In the controller enclosure, strip off enough of the outer jacket to expose several inches of shield. Expose enough conductor to make required connections. Unbraid the shield, twist the strands together to form a conductor and attach it to the ground post just below the terminal strip. Be careful to keep this ground conductor away from other terminals on the terminal strip. Shielded cable should only be grounded at one end, preferably the controller end.

Tach Generator Leads Table 3-6

Maximum Output RPM	Use Leads:
1200 or less	Black and white or yellow
Between 1200 and 1800	Red and white or yellow

When shielded cable is used, generator leads may be run in the same conduit as other conductors but not with the incoming power leads to the motor. If you prefer to not use shielded cable, run a twisted pair through separate conduit with no other conductors.

Modifications

The standard Ajusto-Spede® drive can be modified by adding an eddy-current or friction brake and several other auxiliary devices such as space heaters and thermal switches. Wiring instructions for these modifications are provided in Section 8 of this manual.

Section 4

Operation

Normal Operation

Before starting the unit, read these operating instructions. The AC motor is usually started first. In this way, the motor will accelerate to, and run at, its design speed under no load condition. This is the easiest and most efficient method. With the motor running and the clutch not energized, a slight torque may still be applied to the output shaft. This is normal, resulting from bearing friction and windage acting on the clutch output assembly. With no load, the torque may even start and accelerate the output shaft. The driven machine friction is usually enough to hold the output stalled.

To start the clutch, the controller is energized by the Start pushbutton. The speed setting potentiometer can then be set for the desired output speed, which causes excitation to the clutch coil. Coil current produces the magnetic field, resulting in eddy-currents being generated in the clutch. The resulting torque accelerates the output shaft.

As output shaft speed increases, the tachometer generator output signal also increases. This signal is fed back to the controller and it is used to regulate the current to the clutch coil. Modulation of coil current adjusts output torque to hold shaft speed constant under varying load conditions.

To maintain a set speed, the transmitted torque must match the requirements of the load. Load increases and decreases during operation will cause slight, momentary speed changes. Such changes are detected by the controller, resulting in adjustment of clutch coil current to change the torque to the level required for returning the output shaft to the set speed selected by the operator.

An alternative to speed control, as described above, is torque control. When the remote electronic controller is designed for torque or tension purposes, the clutch coil excitation is regulated to control output torque instead of speed. With this type of controller, the output shaft speed varies with the load being driven.

Operation is normal under the following conditions: motor load current is not more than full load nameplate rating; the speed or torque output is being controlled properly; the thermal rating is not exceeded; and the noise or vibration levels have not increased. Although continuous motor current should not exceed nameplate rating, momentary overloads may be applied during acceleration and sudden load changes. If the machine duty cycle requires frequent overloads or frequent motor stops, starts or reversals, the application should be reviewed and specific limits determined. Consult the factory.

Under normal speed control, the controller is constantly regulating clutch coil current to maintain set speed. Motor current and clutch coil excitation will vary in proportion to the amount of regulation required. This is normal; do not expect to measure a constant clutch voltage or current. The constant parameter should be speed or tachometer generator voltage.

Air discharge temperature from the clutch is an important consideration during operation. Air discharge temperature depends on inlet air temperature and operating parameters of the clutch. Operation below the minimum operating speed, as stamped on the nameplate, or running above rated load, will cause excessive heating, resulting in a thermal overload. Operation under these conditions should be avoided. Supply an adequate amount of clean, dry cooling air to the unit. Hot air discharge from any adjacent unit or from this unit must not be allowed to re-enter as cooling air.

Operating Limitations

The clutch, like any other machine, has certain limitations. With speed control, it is possible to select any speed between 0 and 100% of the maximum rated speed. Because of standard controller and tachometer generator characteristics, it is not normally possible to regulate speed below 50 rpm of the output shaft.

Torque can also be varied over the full torque range of the clutch. Eddy-current clutch capacity is much higher than the motor rating and can easily overload the motor if not limited. Remember that the AC motor used with the eddy-current clutch also has overload considerations.

Cooling capacity places another limit on the clutch. Do not operate it continuously below minimum rated speed stamped on the nameplate or air discharge temperature may become excessive.

Increased noise and vibration are indications of mechanical problems. The operating and maintenance personnel should be familiar with the normal noise and vibration levels. When an increase is detected, shut down the unit and correct the problem.

Note: There are no brakes on the standard unit. If clutch power is removed by turning off or stopping the controller, or lowering the speed setting, the clutch simply coasts to a stop or to the lower speed. The rate at which it decelerates is a function of internal and external inertia and friction.

CAUTION: When power is removed from the unit, causing the motor to stop, clutch coil excitation must also be removed, or excessive coil heating and possible damage may result.

Refer to Section 8 for operation of modifications.

Section 5

Start-Up

This section of the manual contains start-up procedures needed for the initial start-up of the eddy-current clutch. Before turning AC power ON, read these instructions and those provided with the controller. Refer any questions regarding start-up service to ***DSI / Dynamatic's*** Service Department. Do not proceed if you are unsure. These start-up procedures also apply to start-ups after the replacement or repair of a unit.

Preliminary Checks
Before starting the motor or applying power to the controller, make the following visual inspections. The disconnect switch should be locked out.

> **CAUTION**: Rotating machinery and above ground electrical potentials can be hazardous. Alert all personnel in the area that the unit is being checked out and should be considered running. Do not work alone. Your life may depend on prompt help: someone capable of stopping the machine, disconnecting the AC power and capable of providing life saving assistance. Know where the Stop pushbutton and disconnect switch are located.

1. Visually inspect the motor and clutch. Are they safe to operate; and are all required guards and safety devices installed and checked out?
2. Visually inspect all electrical connections. Make sure they are tight and not grounding or shorting. Look for individual strands of wire that may be sticking out of a lug or a terminal.
3. Visually compare the wiring with the connection diagrams and any other certified drawings supplied to make sure the unit is properly wired.
4. Visually inspect the starting equipment to make sure fuses, circuit breaker and motor overload heaters are sized and installed properly.
5. Visually inspect all safety interlocks and machine support equipment. Verify that all safety interlocks are connected and that they will perform their functions. Support equipment, such as blowers, heaters, handling equipment and any other devices required to permit the machine to operate, must be checked out prior to starting the clutch.

Initial Start-up
Do not apply power to any machine until this procedure instructs you to do so. Follow instructions; each step has a purpose.

1. Make sure the machine is ready to be started and all personnel in the area are alerted.
2. Prepare to start the AC motor to check the direction of rotation. If the driven machine can be damaged by reverse rotation, temporarily disconnect the output shaft. For checking rotation, it is recommended that two people be involved, one to operate the pushbuttons and the other to watch the motor. Turn AC power ON to the motor starting equipment. The electronic controller for the clutch should not be started yet.
3. Using a voltmeter, check the three phase power to determine that proper voltage is present at all three phases.
4. Bump the motor by starting and quickly stopping it. While the motor is coasting to a stop, observe the direction of rotation through the grille on clutch housing. If the direction is not correct, turn AC power OFF, lock out the disconnect switch and reverse any two of the three incoming power leads; then repeat the test to ensure proper rotation.
5. Start the AC motor and observe its operation. Listen for any abnormal noise or vibration. Using a clamp-on ammeter, check motor current. All three phases should be balanced. If any defect is detected shut it down immediately and correct the problem. If the output shaft was disconnected in Step 2, turn AC power, OFF, lock out the disconnect switch and reconnect the output shaft. Replace the guards.
6. Turn AC power ON and start the motor. Turn AC power ON to the clutch controller. Turn up the speed setting potentiometer until the clutch is running at a slow speed. If the unit does not run, consult the instruction manual for the eddy-current controller. Run the unit with no load and observe its operation. When normal operation is attained, increase its speed to above minimum and load the clutch. Observe motor current; it should be below the full load rating when at a steady-state condition.
7. A full load test should be run before turning the machine over to production. Run with a full load and observe all operating parameters. Check motor current and record it for future reference.

When the start-up is complete and normal operating conditions are attained, describe normal indicators to operating personnel so they will know how to detect abnormal operation. Be sure they know whom to advise when any abnormality arises. The following paragraph lists some of the indicators to watch for.

Signs of Trouble
There are several indications of trouble to watch for. Since most machines run the same product at the same speed, the operator should become familiar with normal conditions. An increase in air discharge temperature of the clutch could be an indication of blocked air passages or high temperature ambient. If high temperature is noted, the problem should be reported and investigated. Continuing to run may result in clutch damage.

Unusual noise or vibration is a sign of mechanical problems. There are a number of causes, such as a shift or loosening of the base, a broken or unbalanced component, impending bearing failure, bent shaft, damaged belt or foreign material inside the clutch. Periodically the operator should check for unusual noise or vibration. Prompt repair can prevent serious machine damage and costly downtime.

Erratic speed control or abnormal response will usually affect the product being manufactured. When the clutch does not seem to control the way it should, the problem can be either electrical or mechanical. When investigating, check for loose belts, loose setscrews, overloading and other mechanical problems. It is not always the fault of the controller. Motor current should be monitored; it can indicate mechanical binding or product overloading.

Section 6

Maintenance

Preventive Maintenance
The service life of the eddy-current clutch largely depends on routine maintenance received during its lifetime. Lax maintenance increases the probability of sudden, catastrophic failures, which are costly to repair and interrupt production schedules. Routine preventive maintenance is the best assurance of long uptime. The purpose of this maintenance section is to help you set up a good maintenance program. Many factors affect the service life of any machine. This manual cannot cover all contingencies, but it will assist experienced maintenance personnel in maintaining the unit. Refer any questions to the Field Service Department in Kenosha, Wisconsin.

Check List
A checklist provides a record of work completed and serves as a necessary reference for all areas to be checked. Each installation requires a unique checklist that includes all the equipment involved. The maintenance supervisor should prepare this checklist and include all maintenance checkpoints for that equipment, the frequency each item should be checked and the specific parameters that should be observed. Table 6-1 suggests items that may be included; each is followed by its specific parameters.

Inspection
During routine maintenance, perform visual checks for loose bolts, missing guards, lubricant leaks, excessive dirt on cooling surfaces and air inlets and any other abnormal condition. Question the operator to determine if any abnormal condition exists or if a change in operation has been noted. Compare the overall performance with previous reports. Investigate any changes noted. Specifically, check any brake or other support devices that are used.

Cleaning
Cleaning should be performed as often as dictated by the environment of the unit. The more severe (dirty or hot) the conditions are, the more often these tasks must be performed. Before doing any work, turn AC power OFF, and lock out disconnect switch.

Clean accumulated dust and dirt from the unit and immediate area. Pay special attention to air intake areas under end bracket. Dirt allowed to accumulate there can easily obstruct airflow or be drawn into the unit to cause overheating or mechanical binding.

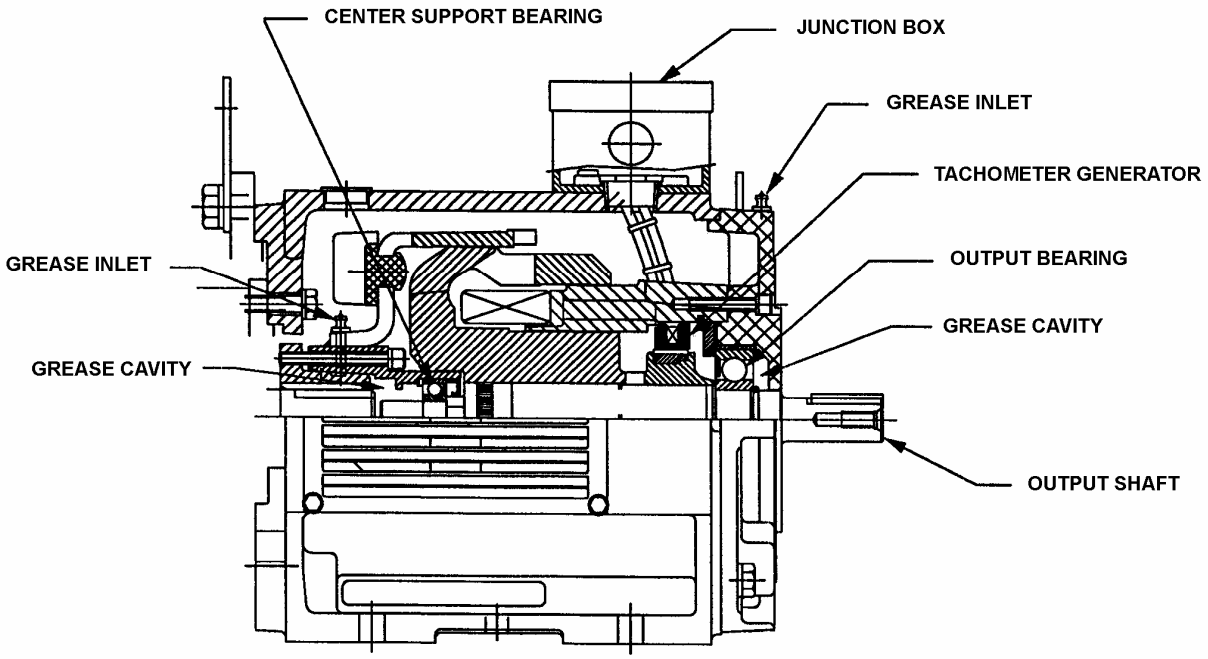
If unit has a friction brake attached to it, particles will rub off the friction surfaces and collect inside brake cover. Remove cover and clean the brake. Check brake operation to determine if it operates freely. Check to see if parts are worn and need replacing.

If dirt and other contaminants are drawn into the unit with the cooling air, the unit may eventually require internal cleaning. Since internal cleaning requires disassembly, the work should be performed by a qualified service shop.

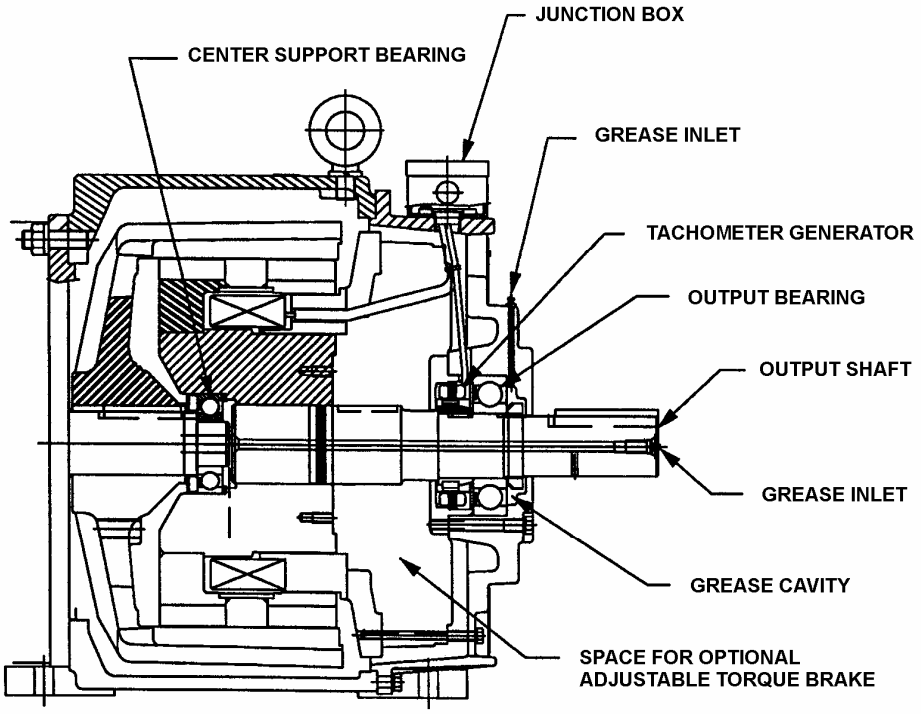
Refer to the paragraphs under the headings "Repair Service" and “Repair Instruction” in Section 7 of this manual.

Maintenance Check List **Table 6-1**

Items to be Included	Description
1. Nameplate Data	Complete nameplate data for reference.
2. List of Drawings	Complete lists of applicable drawings and where located.
3. Operating Speed Range	Minimum and maximum speed normal to machine.
4. Load Range	Minimum and maximum motor current normal to machine or to product.
5. Electric Service	Voltage and current.
6. Coil Ratings	Voltage and current for the clutch and brake coils (when used).
7. Lubrication	Type grease, frequency and amount to be used.
8. Safety Devices	Type and setting of each.
9. Alignment Data	Angular and offset maximum limits.
10. Vibration	Normal readings, where taken and frequency of checking.
11. Service Record	Date and initials of person making periodic check. Space for comments should be provided.
12. Repair Record	Date and description of problem and items repaired or replaced.



Typical Assembly Drawing of AT-140 through AT-280 Drives Figure 6-1



Typical Assembly Drawing of AT-320 through AT-440 Drives Figure 6-2

Lubrication
The only parts in the clutch requiring lubrication are two bearings. Standard units are grease lubricated and are provided with large grease chambers next to the bearings to permit a long period of operation before greasing is required. Grease fitting locations are shown in Figures 6-1 and 6-2.

The center support bearing in Models AT-140 through 280 is greased through a grease fitting located on the drum hub, as shown in Figure 6-1; a plug button must be removed from the housing to reach the grease fitting. In Models AT-320 through 440, this bearing is greased through a rifle-drilled hole through the output shaft, as shown in Figure 6-2, and is relieved through a lip seal located beside the bearing.

The outboard bearing is greased through a grease fitting located over the bearing in the output end bracket. The motor bearings are greased through grease fittings located in the end brackets over the bearings. Plugged relief vents are located below the bearings. Smaller motors have permanently sealed non-regreaseable bearings.

Since the two most prevalent causes of bearing failure are contamination and over greasing, do not over grease. For most operating conditions the bearings should not be greased more than twice a year. However, if the drive is to be run continuously or operated in a high ambient temperature [86ºF to 104ºF (30ºC to 40ºC)] or at a high slip RPM, re-greasing should be done more frequently.

The grease specification is per Dynamatic Engineering Standard MML 4-1.3. This is a premium grade of lithium base N.L.G.I. #2 EP grease. Recommended greases are listed in Table 6-2. Mobilux E.P. #2 is used at the factory. Recommended amounts of grease for the bearings are listed in Table 6-3. Any equivalent and compatible grease may be used. Special greases may be specified at the time of order entry. Consult your order papers if a special grease has been specified.

When lubrication is required, use the following procedure to grease the bearings:

1. Stop the motor and clutch and allow both to coast to a complete stop.

2. Wipe the surfaces on and around the grease fittings and relief holes clean. This is important and necessary to prevent contaminating the bearings.

3. Remove the plugs from the relief holes (when plugged). The relief hole for the center support bearing is inside the housing and is not accessible.

4. Lubricate the center support bearing. If the amount of grease applied for each stroke of the grease gun is not known, pump one stroke onto a piece of paper and weigh it. Then calculate the number of strokes required. ***For AT-140 through 280 drives****:* remove the plug button from the top of the housing. Position the grease fitting, located on the drum assembly, directly below the hole by rotating the drum slowly. Clean the grease fitting and pump the recommended amount of grease into it. Excess grease will be dispelled into the drive housing. ***For AT-320 through 440 Drives****:* Clean the grease fitting in the end of the output shaft or in the cross drilled hole on the side of the shaft and pump the recommended quantity of grease into it. Excess grease will be dispelled into the drive housing.

5. Pump specified amount of grease into output end bracket bearing through grease fitting above bearing. If the unit is a separate clutch (without a motor attached), pump two ounces of grease into each input shaft bearing.

6. Pump two ounces of grease into each motor bearing through grease fittings above the bearings. Smaller motors have permanently sealed non-regreaseable bearings

7. Allow the drive to run for 20 minutes with the relief plugs removed to expel excess grease.

8. Wipe off all excess grease. Replace the plug button if removed in step 4.

Recommended Greases **Table 6-2**

Grease Specification for Ball & Spherical Roller Bearings - N.L.G.I. Grade #2 EP - MML 4-1.3	
Approved sources:	
Shell	Alvania EP #2
Gulf	Gulfcrown EP #2
Texaco	Multifak EP #2
Mobil	Mobilux EP #2

Recommended Amount of Grease (Oz.) **Table 6-3**

Model No.	Center Support Ball Bearing	Output Standard Ball Bearing	Output Spherical Bearing
AT-140	1.5	1.4	N/A
AT-180	2.5	2.0	N/A
AT-210	1.5	2.7	N/A
AT-250	2.2	2.6	N/A
AT-280	3.5	4.2	N/A
AT-320	2.0	1.5	3.0
AT-360	3.0	3.0	5.5
AT-440	4.5	N/A	11.5

Insulation Testing
After long time storage and once each year, for preventive maintenance, insulation resistance of the motor stator, clutch coil and brake coil (if used) should be tested and data recorded. Decreasing megohm readings indicate that insulation has become wet or is starting to

fail. Use the recorded readings as a reference for the latest reading. Use a 500 volt hand cranked megger, cranking at full speed, until a good, stable reading is obtained. Follow the instructions supplied with the megger.

CAUTION: Make sure the AC power to the motor is turned OFF and locked out before attempting to make the test. Disconnect the motor and coils and be sure that control circuits and other electronic devices are disconnected, as they will be damaged by the high voltage. Tachometer generator and other auxiliary devices must not be checked with a megger. Use an ohmmeter for these devices.

A minimum reading of 2 megohms is acceptable for motors with input of 575 volts or less, and 200,000 ohms for clutch and brake coils. Whenever lower megohm readings are found, an authorized service shop or the Field Service Department at Kenosha, Wisconsin should be consulted.

Motors and coils that have become wet due to water spray or condensation should be dried out before applying power or subjected to an insulation test. Consult the factory or one of the authorized service shops for assistance to dry out a unit.

Troubleshooting

The possibility of a component failure or other problem always exists. This section of the manual is intended to provide assistance in finding the fault. Check the obvious first; then follow the Troubleshooting Guide, Table 6-4.

CAUTION: Turn AC power to the unit and controller OFF before making tests. When a voltage measurement is necessary, only qualified personnel, fully acquainted with safety procedures and making power ON tests, should be allowed to service this equipment.

Troubleshooting Guide **Table 6-4**

PROBLEM	POSSIBLE FAULT
Motor does not start.	1. Lost power or phase -- blown fuse.
	2. Wiring loose, incorrect, grounded or shorted.
	3. Open or defective switch, circuit breaker or motor starter.
	4. Open or defective overload or safety interlock.
	5. Defective start/stop buttons or control circuit wiring.
	6. Motor winding grounded, shorted or otherwise defective.
	7. Mechanical defect inside motor or clutch.
Motor does not run properly; noisy, erratic, imbalanced currents etc.	1. Lost Phase -- blown fuse.
	2. Incorrect voltage or frequency.
	3. Intermittent problem as described above for failure to start.
	4. Overload or problem with driven equipment.
	5. Motor winding grounded, shorted or otherwise defective.
	6. Mechanical defect inside motor or clutch.
Motor runs too hot.	1. Overload.
	2. Frequent starts or reversals.
	3. Lost phase -- blown fuse.
	4. Incorrect voltage or frequency.
	5. Inadequate ventilation.
	6. Dirt in motor.
	7. Electrical or mechanical defect inside motor.
Motor runs, but no output.	1. No coil voltage, check controller.
	2. Loose or incorrect wiring.
	3. Open safety interlock.
	4. Open or defective clutch coil.
	5. Brake not releasing.
	6. Machine jammed.
Clutch stops during operation.	1. Controller malfunction, check controller.
	2. Clutch is overloaded.
	3. Safety interlock is open.
	4. Loss of-AC power.
	5. Loose connection.
	6. Open or defective clutch coil.

Troubleshooting Guide (continued) **Table 6-4**

PROBLEM	POSSIBLE FAULT
Excessive noise or vibration.	1. Rotating parts imbalanced due to build up of dirt.
	2. Impending bearing failure.
	3. Unit improperly mounted.
	4. Unit misaligned.
	5. Shaft coupling or hub loose or defective.
	6. Interference between clutch drum and rotor.
	7. Bent shaft.
Unit overheats.	1. Overload.
	2. Operating below minimum speed.
	3. Air passage blocked.
	4. Recirculating cooling air or ambient temperature.
	5. Brake not releasing.
Bearing overheats.	1. Bearing failing.
	2. Excessive thrust or overhung load.
	3. Lack of, excessive, or wrong lubricant.
	4. Unit misaligned.
	5. Bent shaft.
Erratic operation.	1. Controller malfunction, check controller.
	2. Cyclic or shock loading.
	3. Bearing failure.
	4. Velocity feedback malfunction (Tach. Gen.).
	5. Electric noise or radio frequency interference.
	6. Loose wiring connection.
Runs at full speed only.	1. Controller malfunction, check controller.
	2. Loss of velocity feedback signal (Tach. Gen.).
	3. Mechanical lock up of clutch drum and rotor.
	4. Center support bearing failure.

Section 7

Service & Renewal Parts

DSI / Dynamatic provides a total service program to ensure your satisfaction with its products by maintaining an Aftermarket Sales & Service Department which offers the following services to you: Technical Assistance, Field Service, Training, Factory Repair Service and Renewal Parts.

The Company also maintains a world-wide network of Authorized Service Centers, Major Parts Distributors, Drive Distributors and Field Service Engineers. For locations of those nearest you, contact ***DSI / Dynamatic*** at 1-800/548-2169.

Field Service
Trained service engineers, located at the factory and in key industrial centers around the world, are available to provide technical assistance to you. These engineers provide technical advice and counsel relating to the installation, maintenance, adjustment, modification and repair of the equipment.

This assistance may be offered over the telephone or, if required, by a trip to your plant. Requests for field service assistance should be made through the Field Service Department in Kenosha, Wisconsin.

Repair Service
Repair and overhaul or rebuild services are provided by the Repair Service Department at the Kenosha factory. These services are also available through Authorized Service Centers located in key industrial centers around the world.

Note: All warranty work must be approved and authorized by the Field Service Department at the factory.

Note: Do not return any item to the factory without authorization. Comply with the "Return Instructions" that follow.

Any non-warranty item returned will be repaired on a time and material basis if deemed repairable unless a fixed quotation is requested before authorizing the repair. Contact the Repair Services Manager at the factory for quotations at: 1-800/548-2169.

Return Instructions

Items being returned for repair, including warranty repairs, require a Repair Instruction (RI) Form. Contact your local Sales Office for the form and return authorization. Provide all the information requested on the form and return it with the equipment and your purchase order.

Those items not manufactured by ***DSI / Dynamatic*** such as instruments, meters and digital counters, are repaired by the vendor. Returning them to the factory will only delay the repair. Contact the Repair Service Department at the factory for shipping instructions.

Any return for reasons other than repair requires a Return Authorization (RA) form, available from your local Sales Office or the factory.

Repair Instructions
Customers wishing to repair or overhaul Ajusto-Spede® drives should contact ***DSI / Dynamatic*** to obtain detailed instructions, bills of material, specifications and drawings. To ensure that the correct information is furnished, the model number, PRO number and serial number must be obtained from the nameplate of the specific unit for which information is being requested.

Renewal Parts
A list of Dynamatic sales offices are available by calling 1-800/548-2169. Order renewal parts from a Major Parts Distributor or Drive Distributor located in your area. If none are available, contact your local Sales Office or the Renewal Parts Department in Kenosha, WI.

Note: To ensure that correct parts are furnished, include complete nameplate data from your specific unit, a purchase order number, description of the part and the quantity required. The nameplate lists the model number, PRO number and serial number. These numbers are necessary to identify the units and to establish the correct parts for your unit(s).

Renewal parts will be shipped from the distributor's stock, from factory inventory or will be manufactured on receipt of an order, depending on availability. Inventory quantity and location is based on the level of demand for individual items. Renewal parts are covered by the standard renewal parts warranty, as published in the Company Terms and Conditions of Sale for Renewal Parts.

Lists of recommended spare parts, complete parts lists and other renewal parts information are available on request.

Section 8

Modifications

Introduction

The equipment covered by this manual is available with a number of factory installed modifications. This section of the manual covers the most commonly ordered modifications. Included are eddy-current and electromagnetic friction brakes, space heaters and thermal switches. For information regarding modifications or special features not covered here, refer to the drawings, supplementary instructions and other documentation provided for the specific equipment furnished for the individual customer order.

Eddy-Current Brakes

(For AT-320 - 440 drives only) Since the eddy-current brake, also called adjustable torque brake, is assembled inside the clutch housing, the standard outline and mounting dimensions apply. Refer to the engineering data tables in Section 2 of this manual for other brake specifications.

Eddy-current brakes are applied by connecting the brake coil to a DC power source. Frictionless brake torque is provided throughout most of the deceleration range, but it starts to lose torque as the output shaft nears zero speed. At standstill, no brake torque is generated, and therefore this brake is not a holding brake. However, smooth controlled braking is possible with this type of brake without the wear experienced by friction brakes. Controlled deceleration and holdback tension, or anti-overhauling, of the clutch by a load are important features of this type of brake.

Electromagnetic Friction Brakes

(For AT-320 - 440 drives only) Refer to Section 2 of this manual for other brake specifications. The function of the brake is to stop shaft rotation. A friction brake can be mounted on the output shaft against the output end bracket to provide stopping by friction, or rubbing, between two brake members. In the electromagnetic friction brake, stopping is accomplished by energizing the coil with a DC voltage; and it is released by spring action when the DC excitation is removed. This brake provides high brake torque down to zero speed and can function as a holding brake only as long as electric power is connected. It will not furnish braking torque during a power outage.

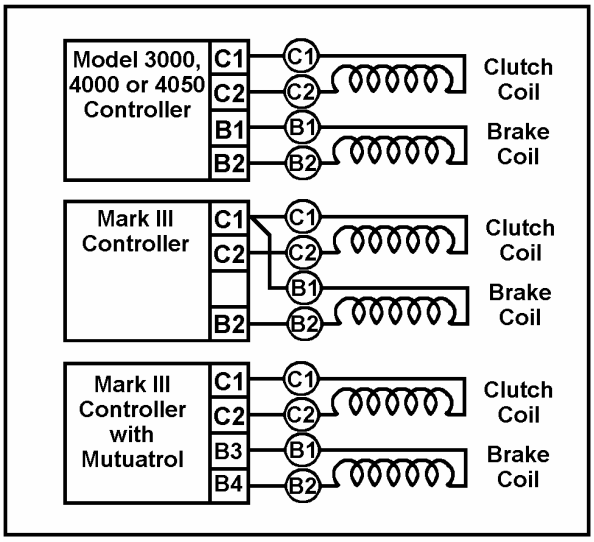
Installing Drives With Brakes

Installation of units equipped with a brake is the same as for units without a brake, except that with a friction brake, the overhung load ratings are reduced because the output shaft is longer than standard. For overhung load ratings, refer to Section 2 of this manual. Follow the installation instructions in Section 3 of this manual.

Brake Wiring Connections

To complete installation, connect brake leads from the drive to a suitable power source. Figure 8-1 shows typical connections to a Dynamatic eddy-current controller having brake control circuitry. Controllers equipped with Mutuatrol® are designed for use with eddy-current brakes only. Other brake control arrangements can be used with either eddy-current or friction brakes. Refer to the control and connection diagrams for detailed information.

If the eddy-current controller does not include brake control circuitry, select a DC power source matched to the voltage and current rating listed on the nameplate of the brake. Connect the DC power source to the brake through a suitable switching device. The switching device should be interlocked so that power cannot be applied simultaneously to both the clutch and the brake. Accidental setting of the brake with the clutch engaged may seriously reduce the life of both units. To prevent overheating the brake coil, power should not be applied to the brake for an extended period of time.



Typical Brake Wiring Connections Figure 8-1

Brake Operation

When the brake is connected to a Dynamatic eddy-current controller with brake control circuitry, operation of the brake is automatic. Power to the brake is turned on and off by a relay within the controller. Power is applied to engage the brake when the Stop pushbutton on the controller is pressed and is removed when the Start pushbutton is pressed. Depending on the controller, the brake voltage may be fixed or adjustable. With adjustable braking, the controller output voltage is adjusted to obtain the desired torque, or stopping time.

Refer to the controller instructions for additional information.

After installation, check to make sure the clutch and brake are not energized at the same time. Operate the brake to make sure it functions properly. An eddy-current brake does not require any adjustments or break-in. Operate the clutch and test the brake action during stopping.

An electromagnetic friction brake should have a 0.06 inch air gap between friction surfaces. These brakes require break-in to obtain maximum torque. In order to obtain full rated torque and improved life, a short run-in, or burnishing, is recommended as follows:

1. Operate the brake at 5 to 15% excitation and either cycle the clutch by starting and stopping it or by using continuous slippage at some speed near or above 1,000 RPM.
2. Do not allow the brake to overheat. Monitor the brake field magnet temperature. It should not exceed 248ºF (120ºC) measured next to the friction surface.
3. Use clean, dry compressed air to remove wear particles and to help keep the temperature below 248ºF (120ºC). Continue burnishing until friction surfaces indicate uniform contact. Usually the surfaces appear shiny or glazed when properly burnished.

Normal operation will cause wear between the friction surfaces of the armature plate and friction face. The initial 0.06 inch air gap will be maintained by the Ajusto-Gap springs. The springs adjust the position of the armature plate in relation to the hub. The armature plate is worn when its thickness is reduced to a thin edge, approximately one-half of the original thickness.

Brake Coil Specifications **Table 8-1**

Model No.[1]	Coil Readings		
	Volts	Ohms[2]	Amperes[2]
AT-320B AT-360B	90	24.60	2.83
AT-320F	90	162.00	0.43
AT-360F	45	40.30	0.92
	90	173.00	0.40

NOTE:

[1] B suffix denotes eddy-current brake; F suffix denotes friction brake

[2] Resistance values are cold ohms at 68ºF (20ºC). Ampere ratings are continuous amps.

Troubleshooting Guide for Eddy-Current Brakes **Table 8-2**

Problem	Possible Fault
Brake does not slow load.	1. Loss of power to brake. 2. Controller malfunction; check controller. 3. Brake overload.
Excessive noise or vibration.	1. Brake drum unbalanced due to dirt buildup. 2. Interference between rotating and stationary members.
Brake overheats.	1. Brake coil excitation exceeding recommended safe value. 2. Air passages blocked. 3. Re-circulating cooling air or ambient temperature too high.
Erratic operation.	1. Controller malfunction. 2. Loose wiring connection.

Troubleshooting Guide for Electromagnetic Friction Brakes **Table 8-3**

Problem	Possible Fault
Brake does not release.	1. Coil energized; controller or wiring problem. 2. Broken or damaged parts; inspect armature plate, hub and armature plate rings.
Brake does not engage or hold.	1. Coil voltage not present, or too low. 2. Air gap too large; armature plate spring broken. 3. Friction material worn, wet or oily. 4. Coil defective. 5. Hub or bushing loosened or moved.
Friction material wears excessively	1. Abrasive materials in cooling air. 2. Coil voltage too high. 3. Overheating due to debris or lack of cooling air.

Brake Maintenance

Eddy-current brakes require very little maintenance. Keep the brake clean and observe the vibration and noise levels. Brake coil insulation resistance should be checked periodically. Refer to Section 6 of this manual for information on insulation testing.

Electromagnetic friction brakes require periodic cleaning and checking to make sure the Ajusto-Gap springs are compensating for wear. Do not allow grease, oil or excessive dust to enter the brake. Wipe debris off the exterior of the unit.

To remove grease or oil from friction material, use a cloth dampened with chlorothene, or an equivalent cleaning solution. Do not allow the solution to saturate the lining of the field magnet assembly. A brake of this type will normally wear with use. When worn out, the brake should replaced.

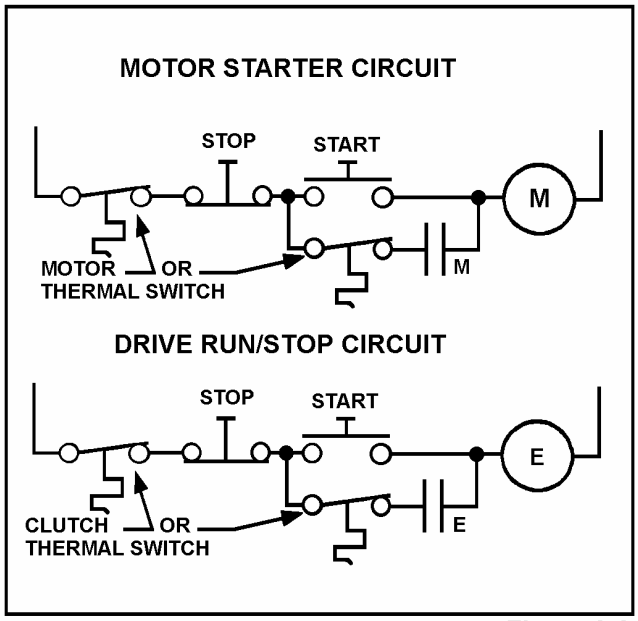
Brake Troubleshooting and Repair

Table 8-2 is a troubleshooting guide for eddy-current brakes and Table 8-3 is a troubleshooting guide for friction brakes.

Repair is accomplished by replacing worn or damaged parts. Refer to Section 7 of this manual for additional information regarding repair services and renewal parts.

Space Heaters

When space heaters are purchased, cartridge type heaters are mounted in the clutch end of the drive. A nameplate is attached to the unit, listing required voltage and wattage. Leads are wired to the conduit box and are usually marked 27 and 28. When the controller includes provisions for connecting the space heaters, the connections and lead markings will be shown on the connection diagram furnished with the controller. If the controller does not include provisions for the space heaters, connect the heaters to a suitable power source through a normally closed contact on the motor starter (furnished by the customer) so the heaters are energized whenever the motor is shut off.



Typical Temperature Switch Wiring **Figure 8-2**

Thermal Switches

When a clutch thermal switch is purchased, it is positioned to sense the air temperature near the clutch drum. The standard switch provides a normally closed contact that opens on high temperature. The leads are wired to the conduit box and are usually marked 21 and 22. The temperature switch should be wired to shut down the drive upon detecting high temperature. It is wired in series with the Stop pushbutton. Figure 8-2 shows typical wiring connections. For terminal markings and other wiring details, refer to the diagrams for the controllers.

When a motor temperature switch is furnished, it is imbedded in the windings of the motor. The normally closed switch contact opens on high motor temperature. The switch leads in the conduit box are usually marked P1 and P2. The temperature switch should be wired to shut down the motor upon detecting high temperature. It is wired in series with the motor Stop pushbutton. Figure 8-2 shows typical wiring connections. For terminal markings and other wiring details, refer to the diagrams for the motor starter.

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