ELEKTRIM® BRAKE SERVICE MANUAL

APPLICATION OF THE BRAKES

Spring actuated and electromagnetically released, the disk brakes are designed for braking rotating parts of machines. Their tasks include:

- Emergency braking to provide safety function of a drive,
- Immobilizing the actuators of machines to provide their positioning function,
- Reducing the coasting time of drives to a minimum (safety considerations supported by regulations and standards),
- Constructing a self-braking motor by building it onto the electric motor - a drive unit meeting the safety requirements of utilization and positioning.

Direct current brakes are characterized by simple construction, facility for regulating brake parameters such as braking torque, braking time, and the possibility of supplying from an alternating current source after connecting up to a rectifying system supplied on request together with the brake, an additional feature being its quiet operation, particularly important when equipment is operated by several drives, and operating with large frequency of actuations.

It is characterized by high operating reliability, stability of technical parameters and short braking and release times. The brakes are made for standard direct current voltages: 24, 96, 170, 190, 215, 270 volt enabling supply from alternating current sources of 24, 110, 220, 380, 440, 500 and 600 volt while utilizing an appropriate rectifier.

DESIGN AND OPERATING PRINCIPLE

Design of the brake type HPS is presented in Fig. 1.

The brake consists of the following main elements:

1	Body
2	Coil
3	Regulating Nut
4	Spring
5	Armature
6	Mounting Bolt
7	Brake Casing
8	Regulating Bolt
9	Mounting Disk
10	V-Ring
11	Brake Disk
12	Gear Wheel

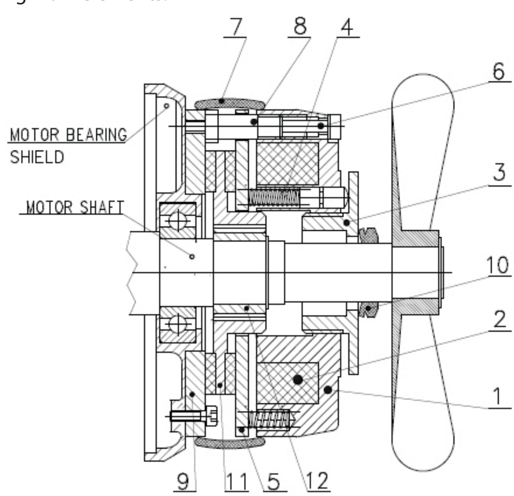


Fig. 1

The brake disk (11) has two friction linings situated between the mounting disk (9) and the armature (5). In brakes envisaged for direct mounting onto the motor bearing shield, the role of the mounting disk is performed by the motor bearing shield. Acting on the armature (5) is the force of spring (4) which, transferred onto the brake disk (11) friction linings, causes their friction against the surface of the mounting disk (9) and the armature (5) and generation of braking torque transferred onto the gear wheel (12) mounted on the motor shaft on a key and secured against axial shift by the circlip (13) - Fig. 2.

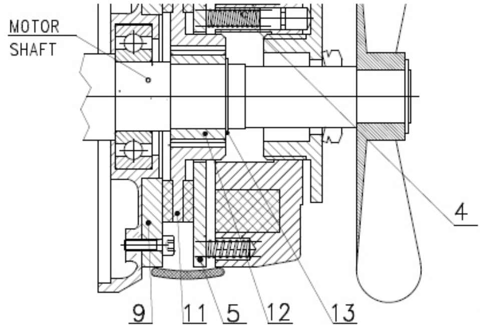


Fig. 2

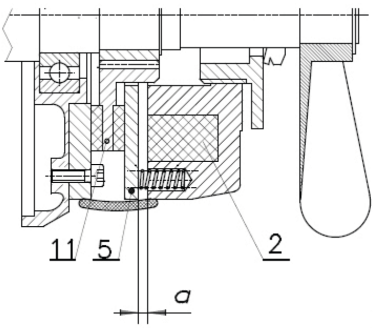


Fig. 3

Current fed to the brake electromagnetic coil (2) winding through a rectifier causes excitation of the electromagnet and attraction of the armature (5) along with simultaneous elimination of the air gap “a” (a=0) and spring pressure on the friction linings of the brake disk (11), and at the same time, releasing of the brake - Fig. 3.

The regulating bolts (8) screwed into the electromagnetic body (1) set the distance of the body from the face of the mounting disk (9) (or motor bearing shield), and at the same time set the value of the gap “a” - Fig. 4.

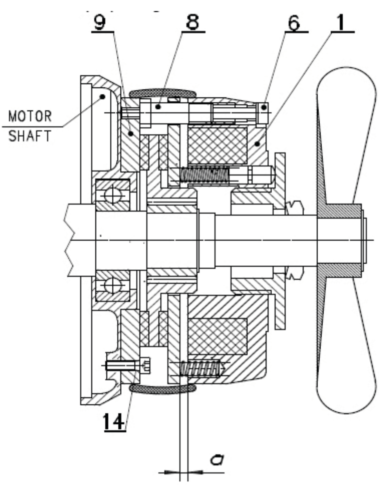


Fig.4

The brakes are secured to the motor bearing shield or the mounting disk (9) by means of the mounting bolts (6) spaced along the brake circumference. Before securing the brake to the mounting disk, first secure the disk (9) to the motor or the device cooperating with the brake, by means of bolts (14) - Fig. 4.

The brakes are provided with a casing (7) - Fig. 1. - enabling sealing of the brake, and with a V-Ring (10) - Fig. 1. - sealing the motor shaft passing through the brake. In this way, protection category IP 55 is assured. In the new brakes, the air gap “a” is factory set to the nominal value - see Table 1. As the friction linings wear, the gap may attain its highest value. Exceeding the value “a max.” - see Table 1, causes reduction in braking torque and deterioration of effective braking along with malfunctioning in brake operation through lowering of releasing parameters and in consequence the possibility of jamming of the brake. Hence, after the brake attains the air gap of maximum value (a max. according to Table 1) due to wear of the brake disk (11) - the air gap should be immediately adjusted. The admissible wear of the brake disk friction linings amounts to a few millimeters - which enables adjustment of the air gap several times.

TABLE 1

Parameter	HPS 06	HPS 08	HPS 10	HPS 12	HPS 14	HPS 16	HPS 18	HPS 20	HPS 25
“a” nom.	0.20	0.20	0.20	0.30	0.30	0.30	0.30	0.30	0.40
“a” max.	0.50	0.50	0.50	0.70	0.80	1.00	1.20	1.20	1.40

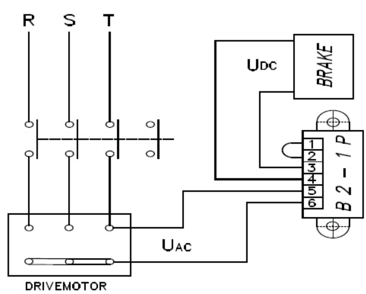
OPERATING ENVIRONMENT AND INSTALLATION

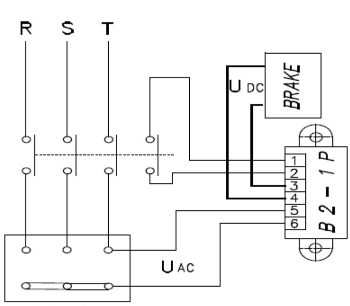
The brakes are adapted for operation in temperate climate with ambient temperature -40°C to +45°C. Special brake versions are envisaged for operation in marine and tropical climates. Operation of the brakes under other environmental conditions require agreement of the manufacturer. Operation in horizontal or vertical position has been foreseen; operation of the brake in vertical position is encumbered with only insignificant residual torque.

The electromagnet winding of the brake is designed for operation in Class F insulation. Supply occurs from a direct current source or through an appropriate rectifier from an alternating current source. The brake can be connected into the motor supply circuit according to the applications below.

When a direct current brake is to be connected to an alternating current source, rectifier circuits are utilized. The connected electromagnet circuit coil can be connected on the direct or alternating current side.

SWITCHING OFF ON ALTERNATING CURRENT SIDE
Switching off the magnetic field voltage, causes the coil current to be still flowing through the rectifier diodes and drops slowly. The magnetic field reduces gradually causing **extension of brake actuation time and simultaneously delayed rise in braking torque**. If actuating times are of no consequence because of simply connecting up and control of the brake, the brake should be connected on the alliterating current side.





SWITCHING OFF ON DIRECT CURRENT SIDE
Coil current is broken between the coil and the supply (rectifying) circuit. The magnetic field reduces very rapidly, **short time of brake actuation and consequently rapid growth of braking torque**. While switching off on DC voltage side, a high peak voltage forms in the coil causing faster wear of contacts due to sparking. For protecting the coil against peak voltages and for protecting the contacts against excessive wear, the rectifying circuits are provided with protective measures enabling actuation of the brake on the direct current side. The electromagnetic winding of the brake is adapted for continuous operation as well

as for interrupted operation. For this reason, the brake can be:

- Released electromagnetically for unlimited period both during resting of the drive system (n=0) as well as during rotation (n>0)
- Utilized in interrupted operation with large number of actuations (brakings)

The maximum speed at which the brakes can be utilized is 3000 RPM, any direction of rotation.

BRAKE INSTALLATION

Proceed with installation of the brake after checking:

- That the motor or equipment cooperating with the brake has the appropriate anti-friction surface for the brake disk, which is particularly important for brakes without the mounting disk, this surface should be free from dirt that could affect the braking torque, e.g. oil, grease, etc.
- For correct preparation of motor elements for mounting the brake, for brakes without the mounting disk the motor bearing shield (15) in Fig. 5. must have threaded holes for screwing in the brake mounting bolts, whereas for brakes cooperating with motors where a mounting disk is required - the bearing shield (15) must have threaded holes enabling screwing in the bolts securing the brake mounting disk (9) - Fig. 6.
- That the motor shaft has the thrust surface for mounting the brake gear wheel, along with slot and prismatic key of length not less than the length of the gear wheel,
- That the motor shaft has the groove and circlip securing the gear wheel against axial shifting,

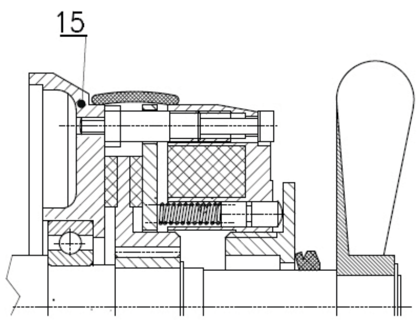


Fig. 5

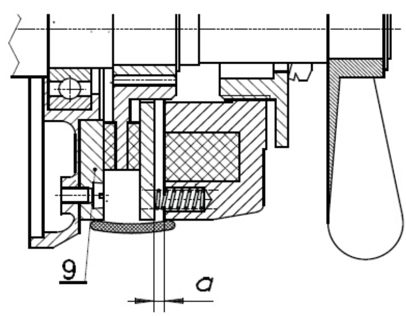


Fig. 6

- For conformity of brake rated voltage with the voltage available in the supply circuit,
- For the possibility of effective earthing or neutralizing by metallic connection of the brake with the motor or the equipment to which the protection conductor is connected,
- For complete set of parts and their technical state,
- For the capability of free flow of air cooling the self-braking motor.

After ascertaining that all the conditions for proper mounting are satisfied, proceed with installation of the brake. The sequence of tasks while installing the brake should proceed as follows:

1. Mount the gear wheel (12) onto the motor shaft on the key and secure it with the circlip (16) against any possibility of shifting - Fig. 7.

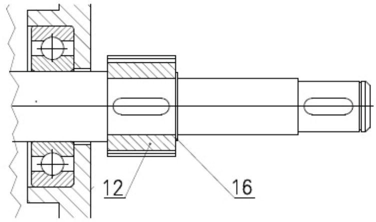


Fig. 7

2. Secure the brake mounting disk (9) to the motor bearing shield, apply the disk to the face of the motor on the opposite side of the drive, insert the bolts (14) into the securing holes and using a key for Allen bolts of size according to Table 2 - secure the disk onto the motor - Fig. 8. NOTE: The above installation point is obligatory only for brakes provided with a mounting disk.

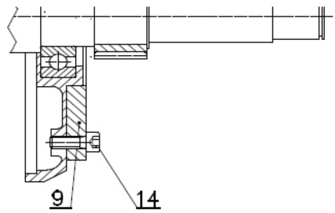


Fig. 8

Table 2

Key Size (mm)	HPS 06	HPS 08	HPS 10	HPS 12	HPS 14	HPS 16	HPS 18	HPS 20	HPS 25
	3	4	5	5	6	6	6	8	8

3. On the gear wheel (12) already mounted onto the motor shaft, assemble the brake disk (11) - check for free sliding of the brake disk along the gear teeth - Fig. 9.

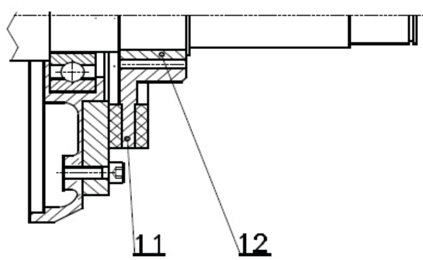


Fig. 9

4. Mount the body with the assembled elements onto the motor shaft according to the complete set as in Fig. 9, in place of mounted regulating bolts (8), insert the mounting bolts (6) into the body holes and by means of an Allen key of size according to Table 2, secure the brake body to the motor bearing disk surface, or if the brake is provided with a mounting disk, to the surface of the mounting disk - see Fig. 10.,

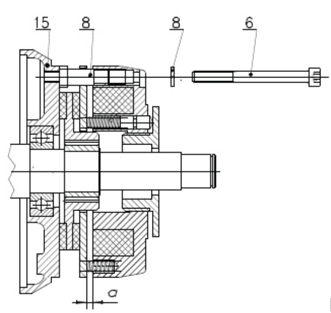


Fig. 10

5. Since, for proper operation of the brake, correct setting of the air gap between the armature and the electromagnet is indispensable, each time a brake is mounted or subassemblies replaced or inspection performed, check the brake and if necessary, adjust the brake air gap - perform the adjustment in accordance with the point: **BRAKE AIR GAP ADJUSTMENT**

6. After performing the inspection and adjusting the brake, mount the brake casing (7) and the sealing ring (10) of the motor shaft passing through the regulating nut (3) - Fig. 11.

7. The final stage of brake installation onto the motor is mounting the fan and inserting the brake supply cable into the motor terminal box,
8. Connect the brake supply cable inserted into the motor terminal box according to the diagram on the inside of the box cover, while connecting the brake with the motor maintain all the necessary safety measures and precautions pertaining to the handling of electrical equipment,
9. Mounting the motor casing onto the brake and fan completes installation of the brake.

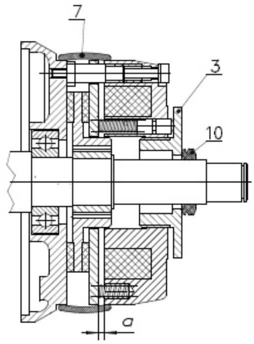


Fig. 11

BRAKE AIR GAP ADJUSTMENT

Adjustment of the air gap is performed each time after ascertaining that the brake air gap has attained the maximum value as in Table 1, and always after dismounting the brake and replacement or maintenance of damaged subassemblies.

For this purpose:

1. Dismount the motor casing,
2. Remove the brake casing (7),
3. Loosen the mounting bolts (6) using the Allen key of the size according to Table 2 - by unscrewing them half a turn,
4. Screw in the regulating bolts (8) into the electromagnet body by one turn, for screwing in the bolts use the flat key according to Table 3,

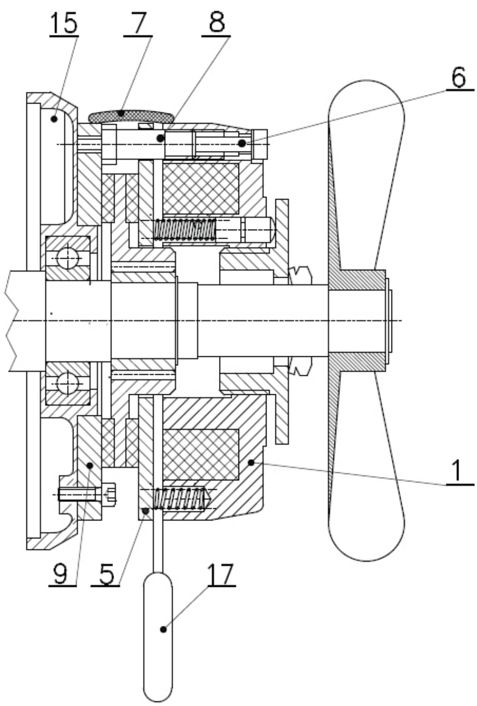


Fig. 12

Table 3

Key Size (mm)	HPS 06	HPS 08	HPS 10	HPS 12	HPS 14	HPS 16	HPS 18	HPS 20	HPS 25
	10	10	12	12	14	14	14	17	17

5. Place the gap gauge (17) of thickness equal to nominal gap of the brake according to Table 1, in the gap between the armature (5) and the body of the electromagnet (1),
6. By means of the mounting bolts (6), press the body (1) to the armature in such a way that the gap gauge can be removed with a slight resistance and with the same resistance insert it into the gap at places arranged every 120° from the place of the first measurement,
7. Unscrew the regulating bolts (8) to rest onto the motor bearing shield or in brakes provided with a mounting disk - onto the face of the brake mounting disk (9),
8. Tighten the mounting bolts (6) of the brake and check for correct adjustment with the gap gauge.

PERIODICAL INSPECTIONS

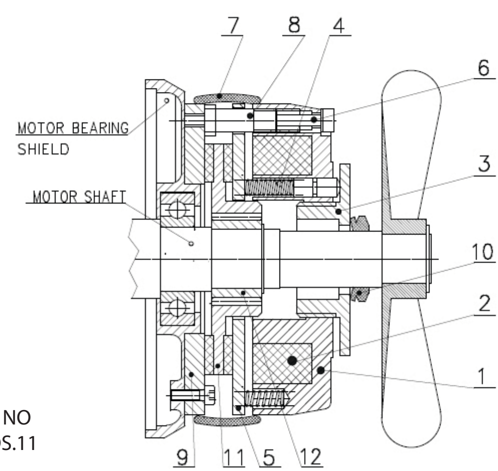
Every brake in operation should be subjected to inspections. The operating period after which inspections are required depends on intensity of operation and is given in the instructions of the final equipment, e.g. lifting equipment. During inspections (after removing the brake casing (7)), perform the following:

- Remove accumulated dirt from inside the brake,
- Check the degree of wear of friction linings and replace them with new ones if necessary,
- Check the size of the air gap and if ascertained that it has attained the maximum value or is approaching the limits of the maximum value, adjust the brake air gap,
- Perform a few trials and check the effectiveness of braking. If reduced effectiveness with respect to the original state is ascertained, dismantle the brake to check the state of brake disk friction linings, the state of friction surfaces of the armature and the motor bearing shield or brake mounting disk depending on the brake configuration.

SPARE PARTS

As a result of brake utilization, its subassemblies and parts undergo wear and are subject to replacement with new ones.

1. Body
2. Coil
3. Regulating Nut
4. Spring
5. Armature
6. Mounting Bolt
7. Brake Casing
8. Regulating Bolt
9. Mounting Disk
10. V-Ring
11. Brake Disk
12. Gear Wheel



Denotation of spare parts:

NAME OF PART - BRAKE TYPE - ITEM NO
Example: BRAKE DISK - HPS 16 - POS.11

BRAKE SELECTION

Selection of brake to suit individual requirements and operating conditions is done using the following procedure:

$$M_{erf} = M_a \cdot K$$

$$M_a = \frac{J \cdot n}{9{,}55 \cdot \left(t_3 - \frac{t_{12}}{2} \right)}$$

$$M_{erf} = \frac{J \cdot n}{9{,}55 \cdot \left(t_3 - \frac{t_{12}}{2} \right)} \cdot K$$

$$M_{erf} = (M_a \pm M_L) \cdot K \leq M_K$$

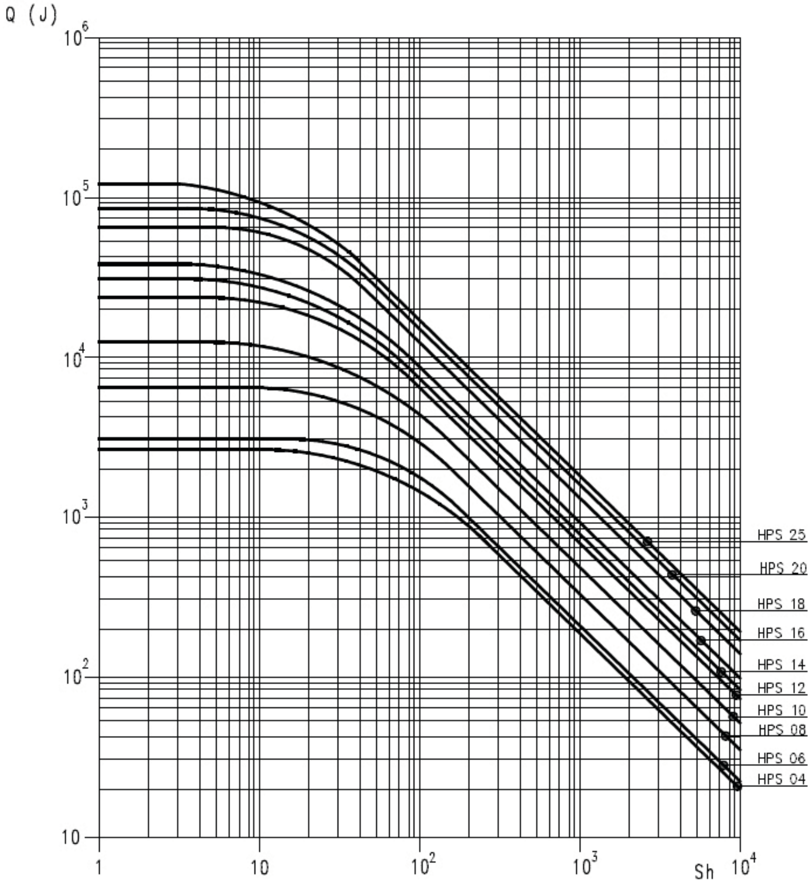
$$M_{erf} = \left(\frac{J \cdot n}{9{,}55 \cdot \left(t_3 - \frac{t_{12}}{2} \right)} \pm M_L \right) \cdot K \leq M_K$$

$$M_{erf} = 9550 \frac{P}{n} \cdot K \leq M_K$$

$$Q = \frac{J \cdot n^2}{182{,}5} \cdot \frac{M_{erf}}{M_{erf} \pm M_L}$$

Legend :

M_{erf} - dynamic load (Nm)
M_a - brake torque (Nm)
K - factor of safety
J - moment of inertia (kgm^2)
n - speed (min^{-1})
t_3 - braking time (slip) (s)
t_{12} - torque build-up time (s)
P - drive power (kW)
M_L - load torque (Nm)
M_K - rated torque of brake (Nm)
Q - friction work /energy/ (J)



CALCULATION EXAMPLE

Data :

$P = 3kW$
$n = 1450\ min^{-1}$
$J_{red} = 0{,}52\ kgm^2$
$t_3 = 2\ s$
$M_L = 15Nm$
$S_h = 6\ h^{-1}$
$K = 2$

Calculation :

$$M_{erf} = 9550\ \frac{P}{N} \cdot K$$

$$M_{erf} = 9550\ \frac{3}{1450} \cdot 2$$

$$M_{erf} = 40\ Nm$$

The above parameter is met by the brake HPS 14 whose rated braking torque amounts to 60Nm .

$$M_{erf} = \left[\frac{J_{red} \cdot n}{9{,}55 \cdot \left(t_3 - \frac{t_{12}}{2} \right)} \pm M_L \right] \cdot K$$

$$M_{erf} = \left[\frac{0{,}52 \cdot 1450}{9{,}55 \cdot \left(2 - \frac{0{,}05}{2} \right)} - 15 \right] \cdot 2$$

$$M_{erf} = 50Nm$$

$$M_K = 60Nm > M_{erf} = 50Nm$$

$$Q = \frac{J \cdot n^2}{182{,}5} \cdot \frac{M_{erf}}{M_{erf} + M_L}$$

$$Q = \frac{0{,}52 \cdot 1450^2}{182{,}5} \cdot \frac{50}{50 + 15}$$

$$Q \sim 4608{,}2\ J$$

From the diagram on page 16 we read that for brake HPS 14 with actuation frequency of 6 per hour, admissible friction work (energy) amounts to 30000J .

$$Q = 4608{,}2\ J < Q_{HPS14} = 30000\ J$$

For the assumed operating conditions, we can therefore use the brake HPS 14 .

NEMA 140 up to 280 Frame
INSTALLATION AND MAINTENANCE INSTRUCTIONS

INTRODUCTION

The purpose of this booklet is to help you install, operate and maintain ELEKTRIM Motors to assure that you will get full advantage of their built-in efficiency and reliability. Following the recommended installation and maintenance procedures will extend the service life of the motor and minimize downtime.

UPON DELIVERY

Upon receipt of your ELEKTRIM motor, visually inspect it for damage that may have occurred in shipment or storage. Turn the shaft manually to be sure that it runs freely, and check the nameplate data to be sure that specifications are in accordance with your order. Before installing the motor, inspect the windings for moisture.

Insulation resistance lower than 20 MOHMS - for 143T through 184T frame motors, and 2 MOHMS - for 213T through 286T (S) frame motors as measured with a 500V magneto - resistance control device between each phase and frame indicates excess moisture requiring that the windings be dried before installation.

MOUNTING

ELEKTRIM motors may be mounted horizontally or vertically provided that there is free movement of air for cooling. Ambient temperatures must not exceed 104°F (40°C). The motors are designed for NEMA F-1, W-2, W-3, W-6, W-8, and C-2 mounting assemblies. F1 assembly is standard. Motors should be mounted on a firm, flat base using the largest bolts that will fit the bracket holes. ELEKTRIM motors may be used with any type of drive provided that the motor is accurately aligned and within capacity parameters. Tighten belt sufficiently to prevent slippage, but avoid over-tightening which can lead to bearing damage. When mounting the motor make sure drain plugs are removed and drain holes are positioned to allow condensed moisture to drain off.

TO REDUCE MAINTENACE REQUIREMENTS

To reduce maintenance requirements and extend motor life, protect your Elektrim motor from:

a) Excessive moisture,

b) Excessive dirt which can reduce cooling effectiveness,

c) Overheating due to ambient temperature in excess of 104°C, blocked ventilation, and frequent or prolonged starting,

d) Inaccessible position that makes regular maintenance difficult.

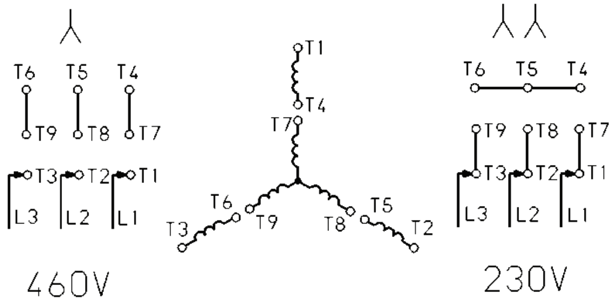
POWER SUPPLY AND CONNECTIONS

Power supply voltage should not vary more than ± 10% from the nominal voltage on the nameplate.

Starting controls and overload protection relays must be sized according to the motor ratings, National Technical Code, and recommendations of the control manufacturer.

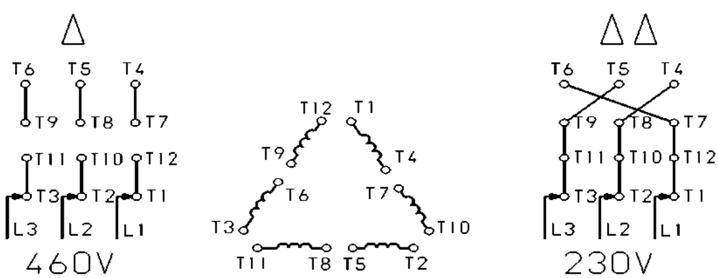
CONNECTING DATA AND METHODS OF STARTING

SIZE 143T -184T ACROSS THE LINE STARTING



TO REVERSE ROTATION INTERCHANGE ANY TWO LINES

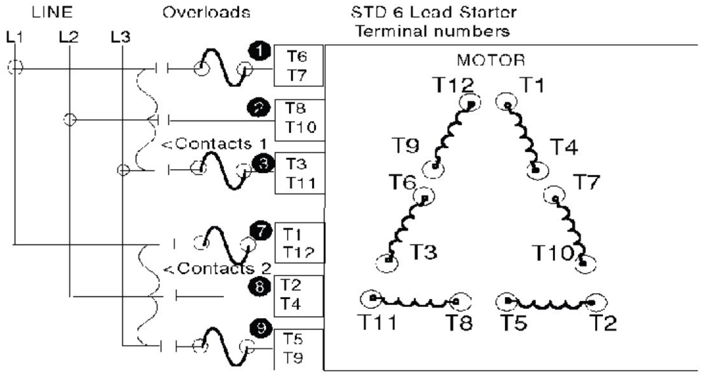
SIZE 213T - 286T (S) ACROSS THE LINE STARTING



WYE - DELTA Starting
CONNECT AS BELOW

Voltage	Connect to Starter	Link Together
460V	**T1, T2, T3, T10, T11, T12**	**T4-T7; T5-T8; T6-T9**
230V	**T1, T2, T3, T10, T11, T12**	**T1-T7; T2-T8; T3-T9 T10-T4; T11-T5; T12-T6**

PART WINDING STARTING / ON 230V ONLY



Note: Contacts 1 are closed first, followed shortly by contacts. The current rating of the overload heaters should be one half the motor F. L.C. for part winding starting.

MAINTENANCE

Elektrim NEMA standard motors are designed and built for maximum reliability and low maintenance requirements. Following these recommendations will assure you of full service life from your motor and minimize downtime:

1. Keep the motor clean and provide adequate ventilation.
2. Make sure all screens, covers and safety guards are in place.
3. Shut off power and discharge capacitors (except as indicated) before working or performing maintenance on the motor.

ASSEMBLY OF THE MOTOR

The permissible value of the screw-down torque for motor fixing screws.

140	30 ft. lbs.	250	45 ft. lbs.
180	40 ft. lbs.	280	45 ft. lbs.
210	40 ft. lbs.		

Please report any conclusions arising from use of the motors to Elektrim where they will be considered in order to better the quality and utility advantages of the motors.