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INSTRUCTIONS FOR THE INSTALLATION, OPERATION AND MAINTENANCE OF ELEKTRIM

THREE PHASE INDUCTION MOTORS

447 Frame
PER NEMA STANDARDS
Type Sgm TEFC IP55
A-240/1/1

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2015 S. Mitchell Blvd., Schaumburg, IL 60193
+1-847-524-1074 • +1-855-463-5358
Fax +1-847-524-9996 • support@elektrimmotors.com

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1. TECHNICAL DESCRIPTION

This Instruction Manual covers Three-phase, induction, squirrel-cage, horizontal, foot-mounted motors, with single shaft extension /F1 per NEMA MG1-1987/, totally enclosed (IP55), fan cooled, for continuous duty, type „Sgm", frame number 447T.

The „Sgm" motors are for general industrial applications and are used to drive various machines of continuous service with no frequent starts and reversals. The motors are suitable for the clockwise /cw/ or counter clockwise /ccw/ direction of rotation: normal is cw when facing the motor drive end.

The motors meet requirements of the NEMA /National Electrical Manufacturers Association/ MG1-1987 Standard.

Fig. 1 represents a sectional view of a „Sgm" motor. Although the „Sgm" motors are totally enclosed it is recommended to operate them in locations where dust amount is less than 10mg/m^3 and free from aggresive atmospheres such as corrosive, fumes. They must not be operated in hazardous locations i.e. those with flammable vapours or gases or those where combustible or electrically conductive dusts are present.

It is recommended to use at least a local roof, to protect the motor against rain or snow-fall and direct sun rays, when operation in open areas is required.

The following are the required service conditions:

- ambient temperature: -4° F to +104°F (-20°C to +40 °C)
- relative air humidity: less than 95%
- altitude: not greater than 3300ft /1000m/ above sea level.

When other service conditions are to be considered please contact the Manufacturer.

Please also refer to tables 1 and 2 for reduced loading at higher than +104 40°C temperatures and greater than 3300 ft altitudes.

TABLE 1

Ambient temperature	°F °C	104 40	112 45	122 50	131 55
Reduced loading in percent of rated (100%) loading	%	100	96,0	90	86,5

TABLE 2

Altitude above sea level	ft	3300	4950	6600	8250	9900	11550	13200
	m	1000	1500	2000	2500	3000	3500	4000
Reduced loading in percent of rated /100%/ figure at +40°C	%	100	97	94,5	92	89	86,5	83,5

Permisssible variations in supply voltage are ±10% of rated voltage at rated frequency and permissible variations in supply frequency are ±5% of rated frequency at rated voltage.

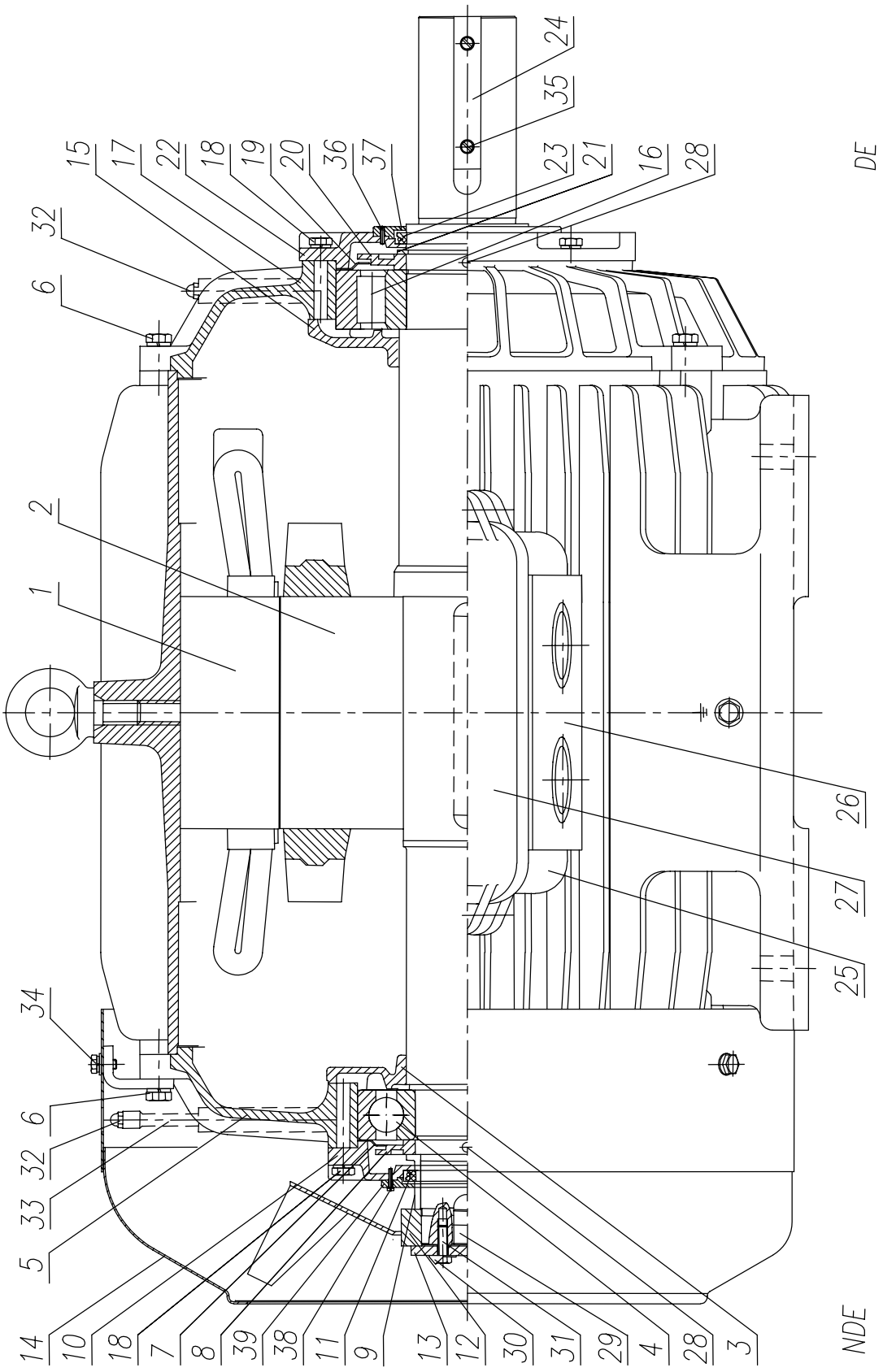


Fig.1. Half Sectional–View of type "Sgm" frame number 447T TEFC (IP55) motor

2. DESIGN

The stator body, complete with feet and ribs is of cast construction. Two drain apertures, for draining the condensate, are located at the body lowest point.
The stator laminations are of magnetic, siliconized, cold-rolled and suitably insulated sheet steel.
The stator winding is of round copper, double enamel insulated wire. Class of insulation is F.
An earthing terminal is located under and a protective terminal inside the motor terminal box. The rotor laminations are placed directly on the shaft.The rotor is a cast aluminium unit. It is balanced with a half key on the shaft free end.
The motor bearings are of the anti-friction type. Roller bearings are provided at the drive end while ball bearings are used on the non-drive end. Automatic regulation of grease amount in the bearing chambers is included. The bearings can be lubricated when the motor is running.
Refer to Table 3 below for details of the bearings.

TABLE 3

Frame number	*Number of poles*	*Drive end bearing*	*Non-drive end bearing*
447T	4, 6, 8	NU 320 EM1C3	6317 C3

* - *Mark acc. to FAG*

The „Sgm" motors are provided with self-cooling system, suitable for either cw /clockwise/ or ccw /counter clockwise/ rotation. The cooling is by means of a non-drive end fan and suitable vanes on the rotor rings. The air inlet is suitably protected by a wire. Fan quard of external fan can be made of steel sheet or as iron casting.
The air outlet is directed towards the shaft free end. The terminal box is normally on left when facing the motor drive end /F1 acc. to NEMA/ but can be provided on right when requested /F2 acc. to NEMA/.
The box is provided with two cable entries, normally directed to the bottom and suitably plugged for shipment. The cable entries can be reoriented through 4×90^{o}. The box has no terminal boards - there are only 12 winding copper outlets, marked T1 through T12, suitably galvanized and isolated for direct connection with line terminals.
Terminals of winding temperature sensors marked 1, 2 and heaters terminals marked 5, 6, 7, 8 are inside terminal box.
Leeds for connection stator thermal protection are let in by opening on the left side of terminal box, and heaters on the right side.

3. SHIPMENT AND STORAGE

The motors are suitably packed for long distance sea and rail road shipment.
The motor bearings are locked. Remember to unlock them before mounting the coupling. Non operated motors should be stored in closed locations, free from dust and corrosive fumes and vapours. The motors are shipped in crates, suitable for prolonged storage.

4. INSTALLATION

Remember that the ambient temperature at the installation site should not exceed $+104^{o}F$ /$+40^{o}C$/, and that easy, unobstructed access to the motor must be provided.
The installation is to be carried out by appropiately qualified personnel only.
The motors are mounted on foundation plates or other suitable structure, placed in turn a concrete or brick foundation. For fixing use anchor bolts inserted through the foot holes. The foundation level should be from 10 to 20 cm above the floor level to protect the motor against dirt. For coupling the motor witg a driven machine, a suitable, statically balanced coupling, is to be used. To mount the coupling:

- remove the bearing locking device,
- remove protective paint from the motor drive and by means of acetone or other suitable solvent,
- apply grease or oil to the free drive end,

- preheat coupling to approx. 185°F(85°C) and press it onto the shaft /by using a suitable drawing device/; support other end when doing so, to prevent axial forces to act on the bearing.

Never use a sleeve and a hammer for driving the coupling on - bearings are easily damaged when such a procedure is applied. Correct alignment of the motor and driven machine is of utmest importance. To check the parallelism of the coupling halves place a rule against the outer cylindrical surfaces. Repeat this for several positions of the coupling and shaft /e.g. every 1/4 of a turn/. Clearance between the coupling faces must also be uniform.
When a belt drive is to be used selection of proper pulleys must receive due attention. Smaller than required pulleys tend to damage the bearing and the shaft drive end. Please refer to Fig. 2 for allowable radial forces applied to the shaft drive end. Assume that the F_R force is applied at the middle of a pulley rim.
Pulleys of larger diameters provide better, trouble-free performance of the drives.
Avoid excessive tension of the belt.

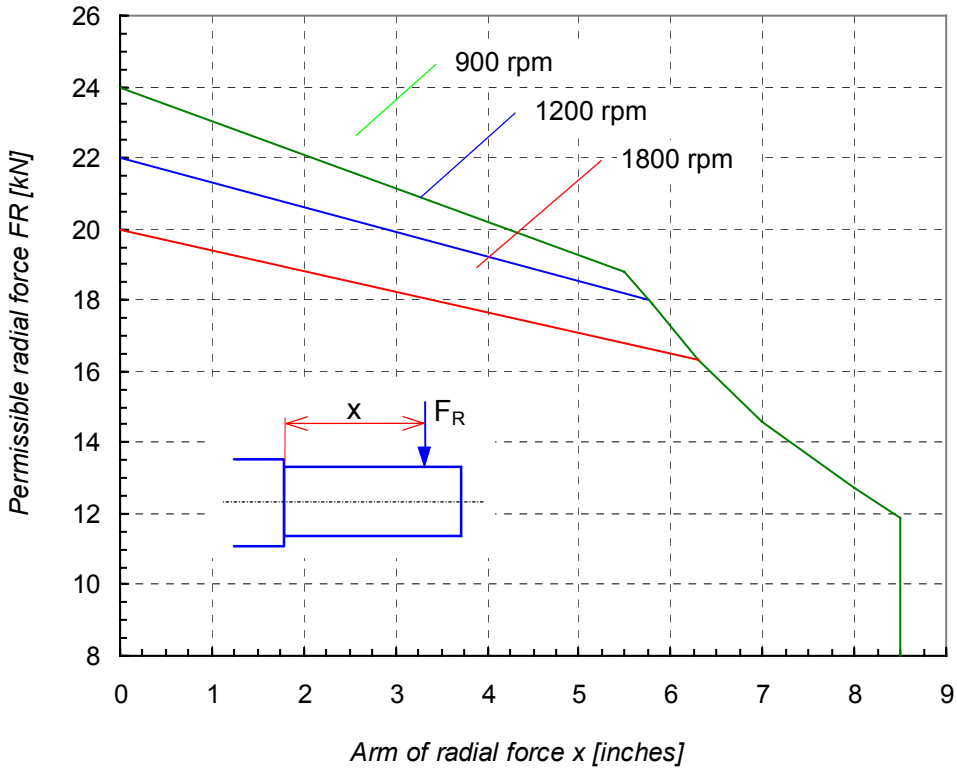


Fig. 2.

Min. pitch diameter of a pulley can be determined from the following formula:

$$D > 6 \cdot 10^5 \frac{c \times P}{F_R \times n}$$

where:
- D - pulley pitch diameter in inches
- P - max. HP
- n - rated speed /rpm/
- F_R - allowable radial force /N/ per Fig.2
- c = 3 for a flat belt drive without a tension roll
- c = 2 for a flat belt drive with a tension roll
- c = 2,2 for a v-belt drive

Prior to starting-up check:
a) if rotor rotates freely,
b) tightening of keys, anchor bolts, frame bolts, etc; tighten when required,
c) winding insulation resistance /use a 500V megger and messure the resistance between lines and between each line and frame. The reading must not be less than 1MOhm. In the case the insulation resistance is lower than required dry-out the motor by circulating preheated air through its winding. Remember that the temperature of the heated parts must not exceed 185°F(85°C). Stop drying with the resistance figure steady.
d) replace grease in bearings, using grades specified under 6 below, if the erection takes place after more than 1,5 years from the date of delivery,
e) check earthing or null earthing /if the latter is applied/. For earthing use the earthing terminal under the terminal box and for null earthing the protective terminal found inside the terminal box.

5. CONNECTING-UP AND STARTING -UP

To select the best starting method take into account the following:
- local mains available,
- drive torque required,
- motor size, etc.

Refer to Figs.3, 4 and 5 for the starting possibilities.

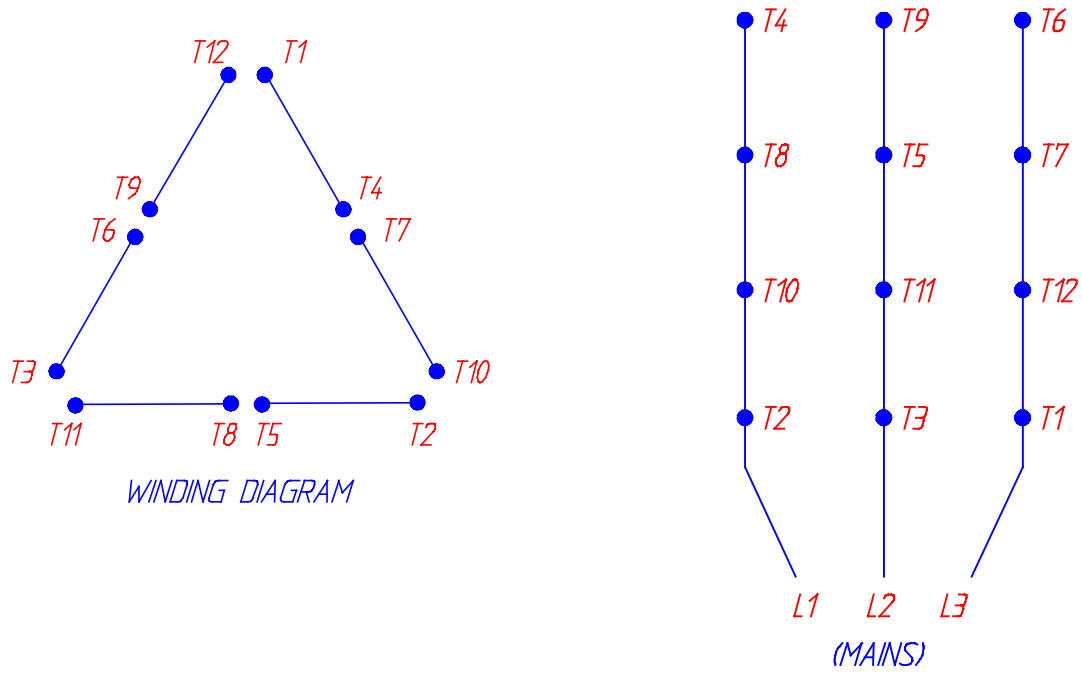


Fig. 3. ACROSS-THE-LINE STARTING

Contact	Starting	Running
M1	closed	closed
M2	open	closed
S	closed	open

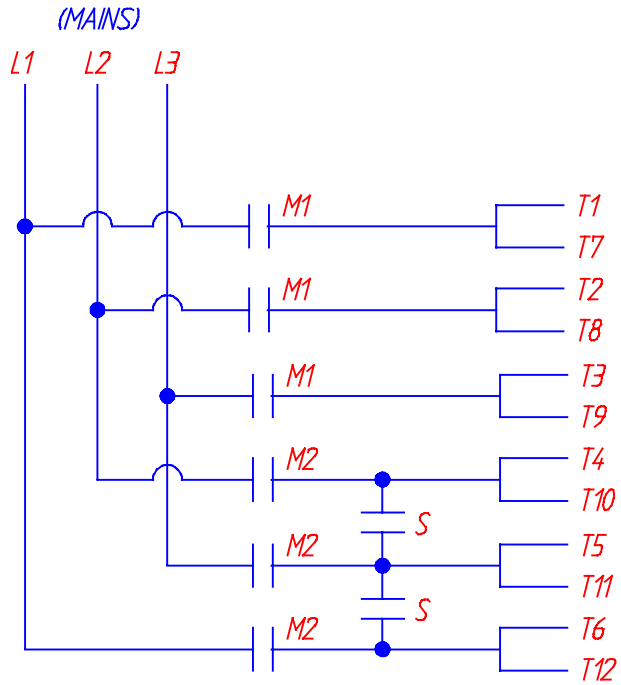


Fig. 4. WYE-DELTA STARTING

Contact	Starting	Running
M1	closed	closed
M2	open	closed

Contact M2 must close within 2 sec. of closing contact M1

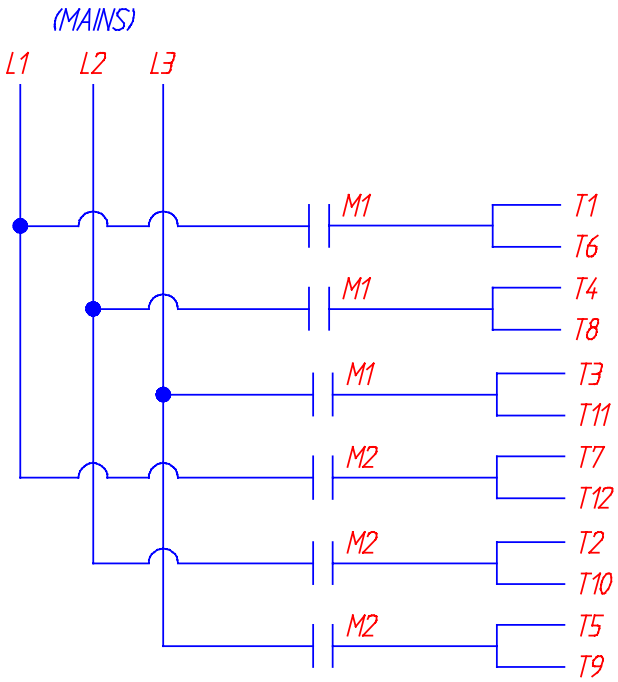


Fig. 5. PART-WINDING STARTING

Max. external moments of inertia /WK^2/ referred to the motor shaft should not exceed figures specified in Table 4. For WK^2/ listed, the motors are capable of two successive starts from cold state and one from warm state.
The values given have been specified for load torques varying with square of the motor speed.

TABLE 4

HP	WK^2 /Lb·Ft²/		
	1800 rpm	*1200 rpm*	*800 rpm*
125	-	-	4580
150	-	2690	5450
200	1090	3350	-
250	1400	-	-

To reverse the motor rotation reverse any two incoming mains leads.

6. MAINTENANCE LUBRICATION

Cleanliness of the motor must receive particular attention. Never allow your motor to be covered with a layer of dirt and never allow water or oil to enter the motor.
It is advisable to have at least one ammeter installed for checking the motor actual leading. Mark rated current of the motor on the ammeter scale.
For lubrication of the motor anti-friction bearings use lithiumbase greases e.g. Alvania 2, Mobillux2, Mobillux 3, Chevron SRI 2.
Life of the bearings is about 25.000 hours provided the shaft drive end is loaded with forces /F_R/ shown in Fig. 2. For making-up use grease guns-grease is charged through bearing caps; shutting-down of the motor is not required for greasing.
Grease after passing through the bearing is rejected to empty chambers of the bearing outer cap. Replenish grease as indicated in Table 5. Do not apply grease in amounts other than recommended.
Lubrication information plates with recommended lubrication intervals, grease amounts and max. number of replenishment are provided on the bearing caps.

TABLE 5

Frame number	*Number of poles*	*Drive end bearing*		*Non-drive end bearing*		*Max.number of replenishments*
		Lubrication intervals	*Grease amount [oz.]*	*Lubrication intervals*	*Grease amount [oz.]*	
447T	4	3000h	2	5000h	2	4
	6, 8	5000h	2	10000h	2	4

Once every 2.5. to 3 years the bearings and their housings should be cleaned out with petrol and regreased /use a elean paintbrush for cleaning/. Such inspections and cleanings must be carried out irrespective of the motor operating hours and must include replacement of the V-rings /V-85A at the non-drive end, V-100A at the drive end/.
When regreasing with another compatible grade, remember to thoroughly clean the bearings and grease chambers. Apply new grese to the bearings and to approx. 2/3 of the bearing inner caps. Do not fill chambers of the outer caps.
Under running conditions check regularly:
a) temperature of the bearings /should not exceed 212°F(100°C),
b) the bearings for whistling or excessive hums.

Please refer to Item 8e for symptoms, probable causes and remedies of the bearing troubles.
Check regularly all threaded joints for proper tightening. Pay particular attention to line terminals, to bolts on the bearing discs and rotating parts and to the earthing/null earthing terminal.

7. ROUTINE EXAMINATIONS

To provide the most effective and trouble-free running of the motor rectify currently any, even very small, malfunction.
Irrespective of this carry-uot the following routine examinations:
a) minor examinations - at six monthly intervals,
b) major examinations /overhauls/ at 3 yearly intrervals.

7.1. Minor Examinations

The minor examinations cover the following:
a) visual inspection and cleaning /see Item 6 above/; this may lead to further inspection of the disassembled motor,
b) measurement of the winding insulation resistance /Item 4/,
c) checking the condition of all connections incl. the earthing terminal; tighten when required /Item 6/.
d) mausuring insulation resistance of the thermal protecting equipment to the stator winding and to the frame,
e) inspecting the starting, protecting and control equipment,
f) checking the coupling with the driven equipment (see Item. 4.)
g) checking the heaters circuit- circuit resistance should be according to „Motor accessories" (Item.11.)
h) checking the resistance of thermal protection circuit at ambient temperature.

Resistance measured between terminals 1–2 at cold state, i.e. at temperature + 68°F(20°C) should be $\leq$ 750 Ω..

Note
To measure the resistance use arbitrary method but observe that voltage applied to thermistor circuit cannot be greater than 4,5 V. Greater voltages could cause domage to stator winding thermal protection.

7.2. Major Examinations /Overhauls/

The major examinations cover the following:
a) motor disassembly /see 7.3 below/,
b) removal of the rotor,
c) examination of the stator, followed by measurement of the winding insulation resistance /Item 4/,
d) examination of the rotor with detailed inspection of the winding, balancing weights and fans,
e) examinations of the bearings complete with cleaning and regreasing /see 7.4 below/,
f) examinations of starters and protective gear.

Rectify all detected defects and /or malfunctions and replace worn-out components/ parts with new enes. It is also advisable to repair the paint finishes.

7.3. Motor Disassembly

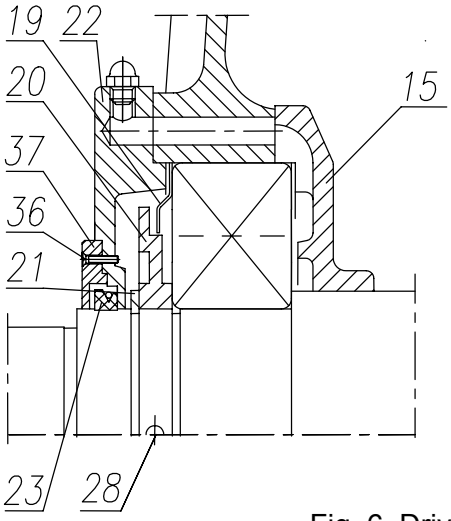
To disassemble the motor proceed as follows /look Fig.1/:
- remove coupling from the shaft end by means of a puller; remove key 24,
- unscrew quard fastening screws 34 and remove outer fan guard 14,
- deflect tab washer 30, unscrew four bolts 31 and remove lock-washer 13,
- pull-out outer fan 12 and remove fan key 29,
- remove V-ring 11,
- unscrew four bolts 18, remove bearing outer cap 10,
- remove neck bush 9 and pull-out grease deflector 8,

- remove the bearing inner ring 7 and grease deflector pin 28,
- unscrew bolts 6, pressing disc 5 /non-drive end/ to the frame and pull-out the disc,
- remove V-ring 23 /drive end/,
- unscrew four bolts 18, fixing the drive end bearing cap 22, remove the circlip 21 and pull-out grease deflector 20,
- remove the inner ring 19 and grease deflektor pin 28,
- unscrew bolts 6, pressing disc 17 /drive end/ to the frame and pull-out the disc,
- carefully remove rotor 2 by sliding it out towards the non-drive end; be sure no damage is done to the stator winding.

Reverse this procedure for assembling.

7.4. Removal of Bearings

7.4.1. Removal of the Drive end Bearing /Fig. 6./



15 - bearing inner cap
19 - inner ring
20 - grease deflector
22 - bearing outer cap
21 - grease deflector circlip 100z
23 - V-ring 100A
28 - grease deflector locating pin (8h8×16)
36 – bolt M3x10
37 – cap

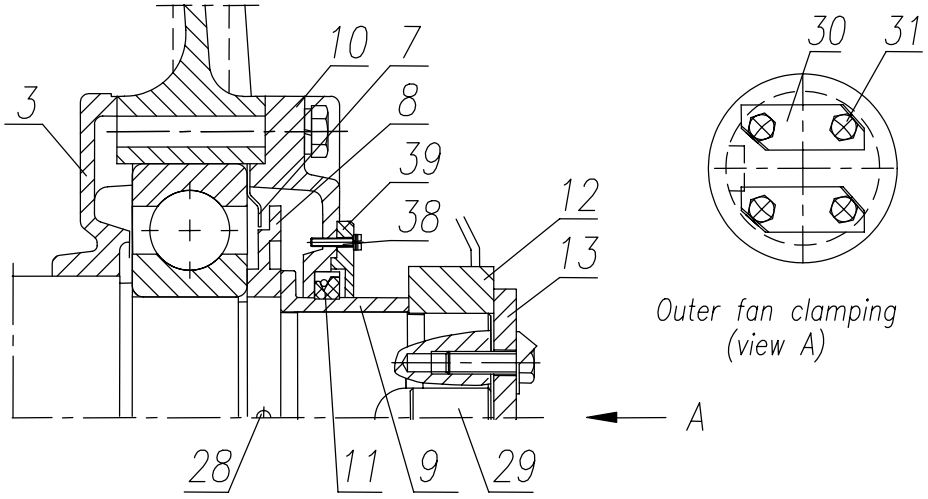
Fig. 6. Drive End Bearing

- remove V-ring 23,
- unscrew the fixing bolts 18 and remove bearing cap 22,
- remove circlip 21, grease deflector 20 and inner ring 19,
- remove grease deflector pin 28,
- unscrew four bolts 6 pressing the bearing disc to the frame, remove the bearing outer ring,
- move aside the bearing inner cap 15 and pull-out, by means of a puller, the roller bearing inner ring.

Reverse the above procedure when replacing the bearing.
It is recommended when replacing the inner ring or the ball bearing to preheat it an oil bath to 70-80^{o}C.

7.4.2. Removal of the Non-drive End Bearing /Fig. 7/

- unscrew quard fastening screws 34 and remove outer fan guard 14,
- deflect tab washer 30, unscrew four screws 31 and remove lock-washer 13,
- pull-out outer fan 12 and remove fan key 29,
- remove V-ring 11,
- unscrew four bolts 18 and remove bearing outer cap 10,
- remove neck bush 9,
- remove grease deflector 8 and the bearing inner ring 7,
- remove grease deflector pin 28,
- unscrew four bolts 6, pressing disc 5 to the frame and pull-out the disc,
- move aside inner cap 3 and remove the ball bearing from the shaft /place the puller fingers en the inner ring/.



3 - bearing inner cap,
7 - inner ring,
8 - grease deflector,
9 - neck bush,
10 - bearing outer cap,
11 - V-ring 85A,
12 - outer fan,
13 - lock-washer,
28 - grease deflector locating pin (8h8×16),
29 - outer fan key,
30 - tab washer,
31 - bolt M8×20
38 - bolt M3x16
39 - cap

Fig. 7. Non-drive End Bearing

8. TYPICAL TROUBLES CAUSES AND REMEDIES

To avoid severe damage of your motor check regularly its performance and currently rectify any noted defect or malfunction. Please refer to the table below for typical troubles, probable causes and recommended corrective measures.

Symptom	*Probable cause*	*Remedy*
a/ Motor fails to start	– Blown-out fuses	Replace with new ones
	– Wrong relay setting	Check and correct
	– Wrong stator connection	Check and rectify
	– Motor or driven machine locked	Unclock
	– Open circuit	Check with a magger /with supply off/ and rectify
	– Overload	Reducy load
b/ Reduced speed	– Incorrect voltage	Check voltage /line and load sides/
	– One-phase open circuited	Rewind
	– Motor not large enough	Replace with a larger one
c/ Excessive heating	– As under b/ above	
	– High suuply voltage	Check stator connection
	– Restricated cooling air flow	Clean with dry compressed air
	– High ambient temperature	Reduce loading in acc. with Table 1
	– Motor winding short-circuited	Locate short circuit and rectify

Symptom	*Probable cause*	*Remedy*
d/ Vibrations	– Incorrect coupling with driven machine	Check alignment and recitify
	– Incorrect levelling of motor	Insert suitable sheet metal liners under the motor feet
	– Worn-out bearings	Check axial and radial end plays. If detectable replace bearings with now ones.
	– Defective driven machine	Rectify or replace
e/ Excessive /above 100°C/ heating of bearings	– Grease in excess	Rectify
	– Incorrect grease grade	Replace with a correct one /see 6/
	– Incorrect assembly	Check alignment and rectify if requred
f/ Low insulation resisatance	– Dirty windings	Clean with compressed air
	– Moisture	Dry-out as out-lined under 4
	– Mechanical defects	Locate and rectify

9. S A F E T Y

All safety requirements found on warning plates fixed to your motor, must be strictly obeyed.
The personnel is to be familiarized with general safety rules and regulations re electrical equipment.
Remember to inspect regularly your motor earthing /null earthnig installation.

10. PARTS LIST OF „Sgm" MOTORS FRAME NUMBER 447T (Reference: Fig. 1)

Item	*Description*	*Q-ty*
1.	Motor frame complete with stator winding	1
2.	Wound rotor compete with shaft	1
3.	Non-drive end bearing cap	1
4.	Non-drive end bearing (∅180/85×41)	1
5.	Non-drive end bearing disc	1
6.	Fixing bolt (M12×50)	8
7.	Bearing inner ring	1
8.	Grease deflector	1
9.	Neck bush	1
10.	Non-drive end bearing outer cap	1
11.	V-ring V-85A	1
12.	Outer fan	1
13.	Outer fan circlip	1
14.	Outer fan guard	1
15.	Drive end bearing inner cap	1
16.	Drive end bearing	1
17.	Drive end bearing disc	1
18.	Fixing bolt (M10×70)	8
19.	Bearing inner ring	1
20.	Grease deflector	1
21.	Grease deflector circlip	1
22.	Drive end bearing outer cap	1
23.	V-ring 100A	1
24.	Key	1
25.	Terminal box body	1
26.	Gasketed plate	1
27.	Terminal-box cover	1
28.	Locating pin 8h8×16	2
29.	Outer fan key	1
30.	Tab washer	1
31.	Bolt M8×20	4
32.	Lubrication nipple (M10×1)	2
33.	Lubrication tube	2
34.	Screw M8×16	4
35.	Screw M6×16	2
36.	Bolt M3x10	4
37.	Cap	1
38.	Bolt M3x16	4
39.	Cap	1

NOTE:

When ordering spare parts please specify: part name, quantity, motor frame number, motor HP, motor speed, motor serial No.

11. MOTOR ACCESSORIES

11.1. THERMAL PROTECTION

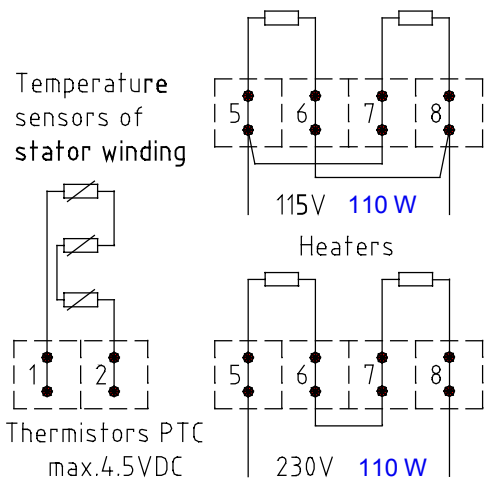
The motors described in this Instruction Manual are equipped with stator winding thermal protection against slow changing overload.
Stator winding protection consists of temperature sensors type PTC.
The applied protection is one level thermal. There are three pieces of the thermal sensors in the stator winding (one piece per phase) all connected in series. The sensors circuit ends are led into the terminal strip located in the main terminal box, the terminals designation symbols 1 and 2 (see the connection diagram on the below figure).
The applied triple thermal sensor of triggering temperature TNF311°F(155°C). Resistance of three connected in series thermal sensors at temperature range 4°F to (TNF-68)°F should amount to ≤750Ω. When operating at triggering temperature TNF, the thermal sensors should have resistance which rises up to 4000 Ω which activates the control circuit.
For co-operation with the thermal protection only type Mark A control circuits must be applied (not delivered with the motor).
The maximum DC voltage permissible for the temperature sensors circuit is 4,5 V.
Routine service consists of:

- protection circuit continuity measured at motor cold state or checking control system according to Producer Instruction
- protection circuit resistance to motor frame and stator winding (required value min. 0.5 MΩ)

Sensors connection is made by supply cable, which is let in by R 0,75”opening on the left side of therminal box.

11.2. ANTI-CONDENSATION HEATERS

During long standstill of the motor it is recommended to switch on anti-condensation heaters in order to prevent water condensation in motor winding.
The heaters are to be supplied 2 x 55 W, 115V/230 V AC |1
Heaters leads are led into auxiliary terminal box and are connected to terminals marked with letters 5, 6, 7 and 8.
Heaters resistance at the terminals 5- 6 and 7- 8 ,and non-warmed state equals to 240 Ω ±10% |1



<u>Heaters should be switched on only during standstill of the motor!</u>

For safety operation, during routine inspections, it is recommended to periodically check the continuity of heaters circuit and resistance of heaters insulation to motor frame.
The insulation resistance should not be lower than 3 MΩ.
Connecting anti-condensation heaters are done by means of control cables. Control cables are inserted to auxiliary terminal boxlet in by R 0,75”, placed on the right side of therminal box. |1

|1 introduced changes (04.2002)