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SERVICE AND EXPLOITATION INSTRUCTION MANUAL

for squirrel - cage induction motors
three-phase,
single-phase with run capacitor,
series "Sg", "Sh", "SIE"
general destination,
of frame size 56, 63, 71, 80, 90
according to requirements of
PN-EN 60034-1
IDT EN 60034-1; EQV IEC 60034-1

1. TECHNICAL DESCRIPTION

The squirrel-cage induction motors of frame size 56, 63, 71, 80, 90 are low power, enclosed motors. In standard execution they are in IP 54 degree of protection or IP 56 (as requested). They are intended for continuous running S1.

Parts of motor housing are made of aluminium alloy EN AC-44300 (AK 11) apart from the fan cover which is made of steel sheet.

In the terminal box there is a terminal board which is used for connecting the motor to the mains and the neutral terminal PE which is used for connecting the protective conductor "PE" or protective-neutral conductor "PEN" which is indispensable in protection by automatic disconnection of supply in systems TN, TT, IT. The terminal box is equipped with a gland M20x1,5 through which the power lead should be inserted and sealed.

In single-phase motors the capacitor made of metalized paper is connected in series with winding of auxiliary phase. It is also connected to terminals of the terminal board.

Motors are intended to work in a horizontal position of the shaft. They can work in perpendicular position, with the shaft end downwards or upwards provided the axial load of the bearings is not too large and originates from the weight of a rotor, a pulley or toothed wheel, relatively light clutch or the fan which is fixed on the motor shaft.

Marine motors can only work in a horizontal position with the terminal box upwards. That is because of the location of drain holes.

Motors are equipped with the self-cooling.

Maximal temperature of the environment, in which the motors operate, depends on the climatic execution and cannot be higher than

313 K (+ 40°C) for the temperate climate N/2, N/3 and the tropical climate TH/2 and TH/3,

318 K (+ 45°C) for the marine climate MU/2 and MU/3.

2. OPERATING CONDITIONS

Squirrel cage induction motors series „g” and „h” (frame size 56, 63, 71, 80, 90) are general destination products provided for driving various machines and devices.

The motor housing, made in the degree of protection IP 54 (IP 55 or IP 56), protects the motor from being penetrated by a solid body or water in the range defined in Polish Standard PN-IEC 60034-5. It is recommended to use a cover or a roof during long lasting exposure of the motor to rainfall. Draining of condensation water every 12 months, while exploiting under difficult conditions every 3 months.

Marine motors made according to the requirements of Polish Register of Shipping are manufactured in the degree of protection IP 55.

Direct-on starting is used in motors. They can operate when voltage deviations do not exceed $\pm 10\%$ of the motor rated voltage. All of the rated data refer to the rated voltage.

If voltage deviations exceed $\pm 10\%$ of the rated voltage motors should not be started. This rule can be omitted only if motor has a suitable heat reserve for the specific application. Maximal heating temperature of the motor winding can not exceed + 155°C (for insulation class F). Having carried out tests only the branch specialist can decide about it; using Polish Standard PN-89/E-05012 is recommended.

Each motor must be protected against overload and short-circuit by protections selected by an user in accordance with Polish Standard PN-89/E-05012 and recommendations of BESEL.

Usage of neutral terminal depends on measure of protection against electric shock which is use in accordance with Polish Standard PN-IEC 60364-4-41.

Parts of driven device coupled to the motor shaft directly should be balanced dynamically with an accuracy of 5 μm , not less.

2.1. ACTIVITIES BEFORE THE INSTALLATION OF A MOTOR

Before you mount the motor to a motored device:

- a) check if the rotor turns freely,
- b) check if parts of the device which is coupled to the motor shaft are balanced dynamically with the required accuracy,
- c) put on parts of a motored device sliding or pushing them lightly without exerting pressure on bearings. Otherwise you will cause damage. At the same time the motor shaft should be supported on the non-drive end stiffly so that the pressure should not cause either damage of bearings or damage of a spring washer which cancels axial play of the rotor,
- d) after fixing the motor in a device check whether there is the minimal distance (14 mm) between the fan cover and other parts, whether the holes in the cover are not stopped down.

Caution:

Access of cooling air to the motor housing cannot be made difficult.

2.2. CONNECTING THE MOTOR TO THE MAINS

2.2.1. Three-phase motors made for voltage base 230/400 V or 220 ÷ 240 / 380 ÷ 420 V can be connected:

- a) to the mains with line-to-line voltage: 3 x 400 V, 3 x 380-420 V when the motor winding is star connected,
- b) to the mains with line-to-line voltage: 3 x 230 V, 3 x 220-240 V when the motor winding is delta connected.

Three-phase motors of frame size 80, 71 are made as:

- a) single-speed with the pole number $2p = 2, 4, 6, 8$
- b) two-speed with the pole number:

$$\left. \begin{array}{l} 2p = 4 / 2 \\ 2p = 8 / 4 \end{array} \right\} \text{ - single-winding}$$

$$\left. \begin{array}{l} 2p = 8 / 6 \\ 2p = 6 / 4 \end{array} \right\} \text{ - double-winding}$$

and with other number of poles - as requested.

Three-phase motors of frame size 63 and 56 are made as:

- a) single-speed with pole number $2p = 2, 4$.

The ways of winding connection and connecting them to the mains are presented on wiring diagrams in the annex No. 1 of this Manual. The wiring diagram is on the inside of the lid of a terminal box. Motors made for specific voltages can be connected to the mains with line-to-line voltage corresponding to the voltage placed on a rating plate.

2.2.2. Single-phase motors with run capacitor made for the voltage 230 V 50 Hz can be connected to the mains of voltage 230 V 60 Hz

Single-phase motors with a run capacitor, frame size 56, 63, 71, 80 and 90 are made as single-speed with the number of poles $2p = 2$ and $2p = 4$.

The winding and capacitor connexions on the terminal board, connecting them to the mains for clockwise and anticlockwise rotation are presented on wiring diagrams on the annex No.1 of this Manual. Wiring diagrams are on the inside of the lid of a terminal box.

Motors made for specific voltages can be connected to the mains of rated voltage corresponding to the voltage marked on the rating plate of the motor.

2.2.3. Before you connect the motor check:

- a) if the rated voltage of the motor corresponds to voltage of the mains (deviations of the voltage of the mains cannot exceed $\pm 10\%$ of the rated voltage),
- b) if winding connections on the terminal board are consistent with a wiring diagram ,
- c) if neutral earthing and protective grounding of the motor is correct and firm,
- d) if the motor has the right overload protection (thermal),**
- e) if the motor has the right protection against short circuit (a fuse or an electromagnetic breaker),**
- f) if resistance of the motor insulation in the cool state is not lower than 20 Mohm,
- g) if the direction of motor rotation is consistent with the direction of motored device rotation , in typical motors the direction is clockwise when you look from the shaft end,
- h) if the capacitor (in single-phase motors) is not damaged (that is, whether the capacitor cover is not damaged or if there are not any dents).

Cautions:

In case of moistening (when the resistance of the motor insulation is lower than 20 Mohm) dry in the temperature not higher than 353 K (+ 80°C).

Neutral earthing of the motor must be made by connecting a neutral wire to a neutral terminal on the marked riser head, which is placed on the motor housing inside the terminal box.

When the motor operates pay attention to how it works and disconnect the motor from the mains in following cases:

- over-oscillation of the motor (excessive oscillation),
- considerable decrease of rotational speed,
- overdue heating of the motor or bearings.

3. PERIODICAL INSPECTIONS AND MAINTENANCE OF A MOTOR

Each operating motor should be inspected periodically:

- minor inspection - every 12 months,
- main inspection :
 - motors of synchronous rotational speed $n_s = 3000$ rpm after 4000 working hours ,
 - motors of synchronous rotational speed $n_s = 1500$ rpm after 6000 working hours
 - motors of synchronous rotational speed

$$\left. \begin{array}{l} n_s = 1000 \text{ obr / min} \\ n_s = 750 \text{ obr / min} \end{array} \right\} \text{ – after 7000 working hours}$$

but at least every 3 years

3.1. MINOR INSPECTION

Minor inspection includes the following activities:

- a) visual inspection and cleaning of the motor and protecting apparatus without disassembly if visual inspection does not reveal such necessity,
- b) measurement of the resistance of motor winding insulation,
- c) measurement of the effectiveness of neutral earthing or the resistance of protective grounding,
- d) measurement of the resistance of feed installation insulation,
- e) draining of condensation water:
 - in order to drain condensation water unplug the rubber plug from a drain hole;
 - in IP 55 execution it is in the drive end shield, in IP 56 execution in the drive and nondrive end shield.

3.2. MAIN INSPECTION

Main inspection includes the following activities:

- a) disassembly of the motor consists in performing operations mentioned below in the following order:
 - unscrewing of the three screws that fasten the fan cover
 - removing of the fan from the shaft by means of a puller,
 - unscrewing of the three bolts that fasten bearing shields,
 - removing of bearing shields by means of special bearing puller or by tapping a wooden hammer on riser heads that stick out of shields,
 - removing of the motor and bearings,
 - taking off bearings from the motor shaft by means of a bearing puller only in case they must be replaced (they are damaged or used up).In motors two ball bearings type 2Z are applied. They do not need lubricating (bearings are lubricated during manufacturing).
- b) checking the conditions of a stator winding which must be cleaned carefully and blown through with compressed air. On winding ends there must not be any damaged places, windings ends must be stiffen. They should be covered with insulating varnish and dried in the temperature not higher than 373 K (+ 100°C),
- b) checking of insulation resistance between particular phases of the windings and between windings and a motor housing,
- c) in case of repair of the windings (re-winding the resistance of the winding insulation should be checked according to the previous item, afterwards a high-voltage test must be carried out. The test is conducted by using proof voltage $(2U + 1000) \times 0,8$ for a minute between particular phases of the windings as well as between the windings and a neutral terminal of proof voltage. The high-voltage test is not carried out if winding damage was not found and repaired during an inspection.

Caution:

A high-voltage test can be conducted only by a specialist who has required authorization.

- e) motor reassembling. Motor reassembling is performed in reverse order than the disassembly. All activities connected with disassembly, inspection and reassembling should be performed without damaging of windings and other parts of the motor.

4. ACCEPTANCE TEST AFTER INSPECTION OR REPAIR

After inspection and remounting the motor should be subjected to the following examinations:

- a) to measure winding resistance,
- b) to control if the connections are correct,
- c) to measure insulation resistance in cool state,
- d) to carry out a 2 hours' no-load running test of the motor and if it is possible to carry out a test of a rated loaded motor:

The test must be long enough for the motor temperature to stop rising in a visible way.

The above researches must be conducted according to the PN-EN 60043-1.

5. TRANSPORT

Motors must be transported only under cover that protects them against getting wet or damp.

Motor cartons should guarantee appropriate protection against mechanical damages, shocks and dust.

During transport they should guarantee proper protection against damages of the shaft end, terminal box, fan cover and varnish coat.

Motors should be transported in crates, metallic pallets or carton boxes. Motors must not move inside containers which must be stuck.

5.1. MOTOR WEIGHTS

Motor weights are different for different types of the same frame sizes - according to output, different mounting systems and other added specific details.

The table below contains maximal (approximate) motor weights as function of stacking length (A,B,C).

Frame size of motors	Motors				
	3-phase		1-phase		
	A	B	A	B	C
56	3,0	3,4	3,0	3,5	3,9
63	3,6	4,2	3,8	4,4	5,2
71	5,3	6,2	–	6,8	8,0
80	7,9	9,4	8,5	10,6	12,4
90	–	–	12,0	13,6	–

You can receive more accurate weights for particular motors in BESEL.

6. STORAGE

Motors should be stored in dry airy containers free from gases, liquids and caustic vapours which are harmful for the winding insulation and parts of the motor.

Motors must not be kept in rooms where fertilizers, chlorinated lime, acids and chemical agents etc. are gathered. The temperature of the environment where motors are stored must not be lower than 278 K (+ 5°C) and relative humidity must not exceed 70 %.

Motors stored more than 2 years since the production date (after warranty period) should be renovated, what includes:

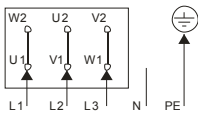
- outside cleaning of the motor,
- checking if bearings operate in a correct way and, if not, damaged bearings must be replaced,
- measurement of the winding insulation resistance (in cool state) and if it is lower than 20 MΩ motors must be dried in a temperature not higher than 353 K (+80°C).

The shaft end must be protected against corrosion by the layer of corrosion preventing grease or easily removed varnish.

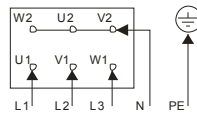
Annex No. 1

1. 3-phase single-speed induction motors type S(K,L)g (h)80 ÷ 71 numbers of poles:
 $2p = 2, 2p = 4, 2p = 6, 2p = 8$

DELTA CONNEXION

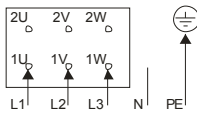


STAR CONNEXION

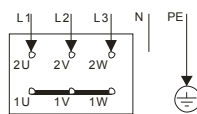


2. 3-phase two-speed induction motors type:
 – S(K,L)g(h) 80 ÷ 71-4/2 and 8/4 numbers of poles: $2p = 4/2$ and $2p = 8/4$ (single-winding)

**2p = 4(8)
 DELTA CONNEXION**

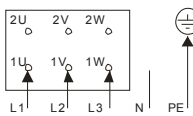


**2p = 2(4)
 DOUBLE-STAR CONNEXION**

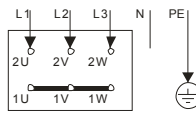


- S(K,L)g(h) 80 ÷ 71-4/2.W and 8/4.W
 number of poles $2p = 4/2$ and $2p = 8/4$ (single-winding , for ventilator drive)

**2p = 4(8)
 STAR CONNEXION**

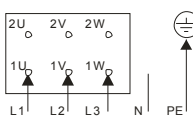


**2p = 2(4)
 DOUBLE-STAR CONNEXION**

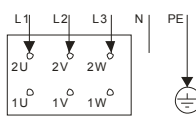


- S(K,L)g(h) 80 ÷ 71-6/4 and 8/6 number of poles $2p = 6/4$ and $2p = 8/6$
 (double-winding)

**2p = 6(8)
 STAR CONNEXION**

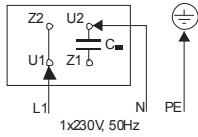


**2p = 4(6)
 STAR CONNEXION**

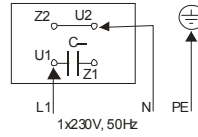


3. 1-phase induction motors type SE(M)(K,L)g(h) .. with run capacitor

clockwise rotation



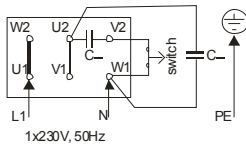
anticlockwise rotation



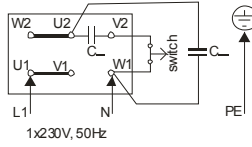
C_B - run capacitor

4. Single-phase induction motors type SE(M)(K,L)g(h) ...F with two capacitors
- run, start and centrifugal switch

clockwise rotation



anticlockwise rotation



C_A - start capacitor

C_B - run capacitor