AUDIT TESTS[3]

End-of-line Tests on each finished 3-phase motor running in air

Red procedure[1d]
Yellow procedure[1c]
White procedure[1b]
Green procedure[1a]
Tests on each finished 3-phase stator before the impregnation process

1.DIMENSIONAL CHECKS of motor/pump coupling diameter on stator and of hole diameter on rotor (through an ELMO special tooling), to be able to carry out the following tests on the motor in rotation.		●1	●1	●1	●1
2.GROUND CONNECTION TEST (milliOhm).		●2	●2	●2	●2
3.RESISTANCE TEST OF THE THERMAL PROTECTOR/SENSOR (Ohm for PTC[5] and milliOhm for NCC[5]).	●2	●3	●3	●3	●3
4.MEASUREMENTS OF THE STATOR WINDINGS RESISTANCES, for each phase 1A-1B, 2A-2B, 3A-3B at 20 °C.	●1	●4	●4	●4	●4
5.PDIV TEST, that allows to measure the voltage of the partial discharge (*PDIV*, *Partial Discharge Inception Voltage*).	●3				
6.DIRECTION OF THE ROTATION. The right direction of the rotation (counter clock wise watching the motor front flange) is **automatically** checked through a magnetic field sensor.	●5	●5	●5	●5	●5
7.SURGE TEST, phase-to-phase 1A-1B, 2A-2B , 3A-3B. The test voltage is **3700 V** on motors up to 29 kW - 50 Hz and up to 37 kW - 60 Hz, while this is **4000 V** on motors with greater output power up to 105 kW - 50 Hz and 125 kW - 60 Hz.	●6				
8.CHECKING OF THE MARKING OF THE LEADS, through a cross surge test.	●7				
9.MEASUREMENT OF THE INSULATION RESISTANCES[1c, 1d], phase-to-phase (1-2, 2-3, 3-1) and phases-to-ground (1/2/3-GND), this test is only performed in **yellow** or **red** procedure. Calculation of the Polarization Index which is considered to be one of the most important parameters to analyze the expected reliability of an insulation system.				●6	●6
10.LOCKED ROTOR TEST[1d, 2]. This test is only performed in **red** procedure coupling the motor to a proper tooling which lock the rotation. A special mathematical model is able to estimate the behavior of the motor inside hydraulic oil, through a test in air. That is we simulate in air the behavior of the motor in hydraulic oil/fluid.					●7
11.ROTATION TO 105 % OF THE NOMINAL VOLTAGE[2].		●6	●6	●7	●8
12.ROTATION TO 100 % OF THE NOMINAL VOLTAGE[2].		●7	●7	●8	●9
13.MEASUREMENT OF THE MECHANICAL VIBRATIONS (axial, torsional, radial or transverse vibrations). Furthermore, this test is an indirect measurement of the mechanical squareness/orthogonality of the motor. The plane of the flange of the die casting at pump-side for the coupling to pump must be perpendicular to rotor-axis (mechanical axis) of the motor.		●8	●8	●9	●10
14.ROTATION TO 80% OF THE NOMINAL VOLTAGE[2].			●9	●10	●11
15.ROTATION TO 60% OF THE NOMINAL VOLTAGE[2].			●10	●11	●12
16.ROTATION TO 50% OF THE NOMINAL VOLTAGE[2].			●11	●12	●13
17.ROTATION TO 40% OF THE NOMINAL VOLTAGE[2].			●12	●13	●14
18.DIELECTRIC STRENGTH CONCLUSIVE TEST, phases-to-ground (1/2/3-GND) and phase-to-phase (1-2, 2-3, 3-1). Important: both the capacitive and the active component of the total leakage current are measured. The minimum test voltage is **2400 V**.	●4	●9	●13	●14	●15

Notes:

[1a] **Green** procedure: This is the *default* procedure and this is carried out on: the motors up to 24 kW - 50 Hz; the motors at 60 Hz type[4] A3, C3, F3, G3, H3, I3, J3, S1, S3, V1, V3, W3, X3, Z3, 62, 64, 83.

[1b] **White** procedure: This procedure is performed on: the motors type[4] B7, H7, J7, M7, P7, S7, V7, Z7, 22, 24; the motors at 60 Hz in the range 11÷37 kW type[4] A4, C4, G4, H4, Q4, S0, S4, V4, X4, Z4, 52, 84; the motors at 50 Hz in the range 28÷29.4 kW type[4] A4, C4, G4, H4, Q4, S4, V4, X4, Z4; the motors type[4] D4, D7; the motors type[4] K4, T4, T7; the motors type[4] Y4, Y7.

[1c] **Yellow** procedure: This procedure is only performed when specifically requested by the customer, in order to obtain the no-load curve[2] of the motor, the insulation resistances and the Polarization Index of the insulation system. Pls. see to Point **9**.

[1d] **Red** procedure: This procedure is only performed when specifically requested by the customer, for example, in order to obtain the mathematical model of the motor (equivalent circuit). Pls. see to Point **10**.

[2] These tests are carried out to check the electrical parameters, in order to evaluate the motor saturation and to have the losses separation, into the copper (stator windings), into the aluminum (squirrel-cage rotor), into the iron/steel (core losses), friction and hydraulic losses and stray-load loss, so to have a comparison with the design data.

[3] The symbol "●*N*", where *N* is an integer, means that the related test is made at nth position.

[4] The type is the string formed by the first two characters of the Part No. (P/N marked on the motor nameplate).

[5] Positive Temperature Coefficient *PTC thermistor*, bimetal detector break type Normal Closed Contact *NCC*.

IMPREGNATION "SMART" PROCESS OF THE WOUND STATOR

The **SMART Process** is a **multi-dip** impregnation system which has been realized and patented by ELMO (it is equivalent to 5-dips process) and this is completed with a conclusive **drying phase** (Joule's effect-based). Thanks to the Joule's effect the wound stators are electrically heated so that the residual moisture into winding is completely removed. Furthermore during the process the thermal protectors/sensors (Positive Temperature Coefficient *PTC thermistors* or bimetal Normally Closed Contacts *NCC*) are checked to be correctly located into each phase-winding, and the switching temperature (or response temperature) is checked to be in accordance with design data; after which the five dips with epoxy resin progressively begin. This process allows to realize a **high and uniform level of filling** into the stator slots and a **better coating** of the copper winding. The Joule's effect is regulated according to a temperature closed-loop control which allows to convert the electric energy into controlled thermal energy (or controlled heat). The control is implemented on a Windows OS-based Industrial Personal Computer. The motors made with wound stators, which have undergone SMART process, are suitable to be driven by an inverter VVVF (Variable Voltage Variable Frequency).

EPOXY RESIN: single component, epoxy resin suitable for use over 200 °C. This resin has a low viscosity (improved penetration) and cures to a tough resilient product which is resistant to paraffinic oils. **Environmentally friendly**, with low *V.O.C*[6] emissions, **solventless**.

Notes: [6] Volatile Organic Compound.