AUDIT TESTS[3]

End-of-line Tests on each finished motor running in air	Red procedure[1a]	Yellow procedure[1b]	Green procedure[1c]
Tests on each finished 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
2.GROUND CONNECTION TEST (milliOhm).		●2	●2	●2
3.RESISTANCE TEST OF THE THERMAL SENSOR (Ohm for PTC and milliOhm for NCC).	●2	●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
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
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 77 kW - 50 Hz and 92 kW - 60 Hz.	●6			
8.CHECKING OF THE MARKING OF THE LEADS, through a cross surge test.	●7			
9.MEASUREMENT OF THE INSULATION RESISTANCES[1b, 1c], phase-to-phase (1-2, 2-3, 3-1) and phases-to-ground (1/2/3-GND), this test is effectuated only 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[1c]. This test is carried out only 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. I.e. we simulate in air the behavior of the motor in oil.				●7
11.ROTATION TO 105 % OF THE NOMINAL VOLTAGE[2].		●6	●7	●8
12.ROTATION TO 100 % OF THE NOMINAL VOLTAGE[2].		●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 orthogonality (or mechanical quadrature) 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 of the motor.		●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	●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.

[1b]**Yellow** procedure. This is carried out on the motors in the range 29÷77 kW - 50 Hz and on all motors at 60 Hz.

[1c]**Red** procedure. This is carried out on specific request of the customer in order to obtain the mathematical model of the motor (equivalent circuit). Pls. see at 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 iron (steel), into copper, and mechanical losses 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.

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*[4] emissions, **solventless**.

Note: [4]Volatile Organic Compound.