A10. Motor starting autotransformers - routine tests

Routine tests, optional special tests and recommended lines to be added to the test report for motor starting autotransformers.

1. Routine Tests

1. Winding resistance

Main standard	IEC/EN 60076-1; IEC/EN 61558-1 and IEC/EN 61558-2-13 in the LV autotransformer safety approach	**Construction / method standard**	IEC 60076-1 winding resistance measurement method
Description	Each phase and each tap winding branch is checked. Resistance balance between phases is important in terms of connection error or loose tap connection.		

2. Tap ratio test - 50% / 65% / 80%, etc.

Main standard	IEC/EN 60076-1; IEC/EN 61558-2-13	**Construction / method standard**	IEC 60076-1 ratio test; IEC 61558-2-13 autotransformer safety test approach
Description	The output voltage is verified at each starting tap. For example, if 50%, 65% and 80% taps are available, all of them must be measured separately. IEC 61558-2-13 covers the special requirements and tests for general-purpose autotransformers.		

3. No-load output voltage

Main standard	IEC/EN 60076-1; IEC/EN 61558-1 / 61558-2-13	**Construction / method standard**	Measurement of each tap output at rated input voltage
Description	It is evaluated together with the tap ratio test. It shows that the voltage to be applied to the motor terminals at the starting tap is correct.		

4. Verification of tap terminals

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-13; IEC/EN 60076-1 in power-type evaluation	**Construction / method standard**	Connection diagram, continuity test, terminal check
Description	Terminals such as 50% / 65% / 80%, bridges, contactor connection ends and common winding points are verified according to the diagram. Incorrect tap connection directly impairs motor starting torque and current.		

5. Short-time duty suitability check

Main standard	IEC/EN 61558-2-13; IEC 60947-4-1 on the motor starter/panel side	**Construction / method standard**	Check of operating time, number of starts/hour, duty information and thermal design
Description	These transformers may be designed not for continuous rated load, but for a defined starting duration and frequency. The starting duration and repetition frequency must be stated on the nameplate or technical datasheet. IEC 60947-4-1 applies to electromechanical contactors and motor starters.		

6. Insulation resistance

Main standard	IEC/EN 60076-3; IEC/EN 60076-1; IEC/EN 61558-1 / 61558-2-13	**Construction / method standard**	IEC 60076-3 dielectric test preparation; IEC 61557-2 as an auxiliary reference for practical measurement
Description	Because it is an autotransformer, it is not evaluated like a conventional isolation transformer for primary-secondary insulation. Insulation resistance must be measured between the live winding/tap terminals and frame/PE.		

7. Applied voltage test / hipot

Main standard	IEC/EN 60076-3; IEC/EN 61558-1 / 61558-2-13	**Construction / method standard**	IEC 60076-3 separate-source AC withstand test or IEC 61558-1 dielectric withstand test
Description	The test must be carried out between the live part, accepted as a common electrical circuit, and frame/PE. IEC 60076-3 defines insulation requirements and related dielectric tests for power transformers.		

8. Induced voltage / inter-turn insulation check

Main standard	IEC/EN 60076-3; IEC/EN 61558-1	**Construction / method standard**	IEC 60076-3 induced AC voltage approach
Description	It may be applied to check inter-turn weakness, incorrect tap winding or local short-circuit risk.		

9. Ground continuity / PE continuity

Main standard	IEC/EN 61558-1; IEC 60204-1 auxiliary reference inside panel/machine	**Construction / method standard**	Low-resistance continuity measurement
Description	Continuity is checked between the frame, cover, mounting foot, lifting lug and PE terminal. It is good for this to appear in the routine report for metal-framed and panel-mounted products.		

10. Thermal sensor / thermostat function check

Main standard	IEC/EN 61558-1 / 61558-2-13; IEC 60947-4-1 auxiliary on the panel-control side	**Construction / method standard**	Continuity, contact function and alarm/trip terminal verification
Description	If PTC, PT100, thermostat or thermal contact is present, connection terminals, contact status and alarm/trip circuit are checked. The OMSAN quality document specifically includes thermal protection checks for this product group.		

11. Nameplate check - motor power

Main standard	IEC/EN 61558-1 / 61558-2-13; IEC/EN 60076-1 marking approach	**Construction / method standard**	Cross-check of nameplate, technical datasheet and order form
Description	The appropriate motor power, transformer power or starting capacity must be clearly stated on the nameplate.		

12. Nameplate check - starting tap

Main standard	IEC/EN 61558-2-13; customer specification	**Construction / method standard**	Nameplate and connection diagram check
Description	Starting taps such as 50% / 65% / 80% must appear with the same designation on the nameplate and connection diagram.		

13. Nameplate check - operating time/frequency

Main standard	IEC/EN 61558-2-13; IEC 60947-4-1 auxiliary for motor starter system	**Construction / method standard**	Check of duty information, starting duration and number of starts/hour
Description	This information must be critical on a motor-starting autotransformer. Limits such as "10 s starting / X starts per hour" must be stated according to the customer project.		

14. Nameplate check - autotransformer warning

Main standard	IEC/EN 61558-2-13; IEC/EN 60076-1	**Construction / method standard**	Marking and safety warning check
Description	The nameplate must include the warning "autotransformer / no galvanic isolation". OMSAN LV autotransformer notes state that an autotransformer has a common primary-secondary structure and does not provide galvanic isolation.		

15. Starting voltage verification

Main standard	IEC/EN 61558-2-13; IEC 60947-4-1 on the panel/starter side	**Construction / method standard**	Output voltage measurement for each tap
Description	Starting voltage tests are given as a separate heading for motor starting transformers in the OMSAN quality document.		

16. Connection diagram and contactor terminal check

Main standard	IEC/EN 61558-1 / 61558-2-13; IEC 60947-4-1 auxiliary	**Construction / method standard**	Diagram, terminal, bridge and contactor connection verification
Description	In an autotransformer starter circuit, line contactor, starting contactor and bypass contactor connections must be correctly named. Even if the transformer is supplied alone, the panel connection terminals must be clearly defined.		

2. Optional / Special Tests

1. Starting cycle heating test

Main standard	IEC/EN 61558-2-13; IEC/EN 60076-11 in power-type evaluation; customer specification	**Construction / method standard**	Cyclic loading with the specified starting duration and number of repetitions; winding/terminal temperature measurement
Description	Highly recommended if the motor power is high, the starting duration is long, frequent start-stop operation will be performed or the unit will operate inside an enclosed panel. The OMSAN technical glossary states that the hot spot is the critical region determining insulation life.		

2. Short-time overcurrent test

Main standard	IEC/EN 61558-2-13; IEC/EN 60076-5 auxiliary; IEC 60947-4-1 on the starter side	**Construction / method standard**	Loading with the specified current and duration; voltage drop and temperature check
Description	Applied when short-time thermal and mechanical withstand is to be verified, because several times the rated current occurs during motor starting.		

3. Function test with customer motor

Main standard	IEC 60947-4-1; customer specification	**Construction / method standard**	Measurement of starting current, starting voltage, transition time and bypass behavior with the actual motor or an equivalent load
Description	One of the most valuable tests if the project is critical. The adequacy of motor load torque, starting duration and tap ratio is verified close to real conditions.		

4. Interlock test together with contactor/panel

Main standard	IEC 60947-4-1; IEC 60204-1 auxiliary for machine/panel	**Construction / method standard**	Mechanical/electrical interlock, time relay and transition sequence test with line, start and bypass contactors
Description	Definitely recommended if the autotransformer starter panel is supplied together. Incorrect interlock may create a tap short-circuit or open-transition risk.		

5. Thermal camera test

Main standard	IEC/EN 61558-1 thermal safety approach; IEC/EN 60076-11 auxiliary	**Construction / method standard**	IR thermography after starting cycle or rated test
Description	Hot spots are checked at tap terminals, contactor connections, winding exits, busbars and PE connections.		

6. Short-circuit withstand verification

Main standard	IEC/EN 60076-5	**Construction / method standard**	Calculation, design verification or special type test
Description	May be requested in facilities with high short-circuit power or in high-power motor starter applications. OMSAN autotransformer selection notes state that thermal and short-circuit checks are required before quotation.		

7. Sound and vibration check

Main standard	IEC/EN 60076-10 for sound; IEC 60068-2-6 auxiliary for vibration	**Construction / method standard**	Listening at no-load/starting; numerical sound and vibration measurement if necessary
Description	Recommended for high-power indoor applications or machines sensitive to mechanical vibration.		

8. IP test - for panel/enclosure delivery

Main standard	IEC/EN 60529	**Construction / method standard**	IEC 60529
Description	Applied if the product is delivered inside a panel/enclosure and an IP declaration is made.		

9. Site commissioning check

Main standard	IEC 60204-1; IEC 60947-4-1; customer specification	**Construction / method standard**	Check of motor direction, starting current, transition time, bypass, thermal protection and emergency stop
Description	Recommended if the transformer will be commissioned on site as part of the motor starter panel.		

3. Lines Recommended to Be Added to the Test Report

Report line	Recommended content
Product type	Motor starting autotransformer
Autotransformer warning	No galvanic isolation
Motor information	Motor power, motor voltage, frequency
Tap ratios	50% / 65% / 80% or project-specific taps
Starting voltage	Output voltage measured at each tap
Duty type	Starting duration, starts/hour, cooling time
Thermal protection	PTC/PT100/thermostat/thermal contact result
Insulation / hipot	Live part-frame insulation and dielectric result
PE continuity	Frame, cover, chassis, PE terminal
Contactor/panel note	Interlock and bypass function result if supplied with panel

Report line	Recommended content
Short-time test	Starting cycle heating or overcurrent test if available