A3. Autotype transformers - three-phase and single-phase

Test standards for autotype transformers

For autotransformers, the main standard should be selected according to the product power, voltage and application character. For LV autotransformers / general-purpose products up to 1100 V, IEC/EN 61558-1 + IEC/EN 61558-2-13 is the most appropriate safety standard family. IEC 61558-2-13 covers special requirements and tests for general-purpose autotransformers and power supplies incorporating autotransformers. For dry-type autotransformers with power-transformer characteristics, IEC/EN 60076-1 may be used as the main general standard. IEC 60076-11 applies to dry-type power transformers and includes autotransformers in its scope; however, because it requires at least one winding to operate above 1.1 kV, it should be used carefully for LV/LV products, under customer specification or power-type evaluation. For dielectric/insulation levels, IEC/EN 60076-3 is used in the power-transformer approach; this standard defines insulation requirements, dielectric tests and clearances for power transformers.

1. Routine Tests

This section summarizes the basic test headings that may be applied for post-production verification and quality control of autotype transformers.

1

1. Winding resistance measurement

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-13; IEC/EN 60076-1 for power-type products	**Construction / method standard**	IEC 61558-1 / IEC 60076-1
Note	Common winding and series winding/tap ends should be measured with separate logic. In single-phase units, the common winding and output taps are checked; in three-phase units, the relevant branches of U-V-W phases are checked.		

2

2. Input-output tap verification

Main standard	IEC/EN 61558-2-13; IEC/EN 60076-1 for power-type products	**Construction / method standard**	Manufacturer connection diagram, IEC 61558-1 marking/connection verification approach
Note	The input and output terminals are verified for each tap. Incorrect tap connection may create overvoltage or undervoltage risk.		

3

3. Voltage ratio / tap ratio test

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-13; IEC/EN 60076-1 for power-type products	**Construction / method standard**	IEC 61558-1 / IEC 60076-1 ratio measurement approach
Note	The Vin/Vout ratio is measured for each tap. In three-phase units, phase-to-phase ratios and phase balance should be evaluated together.		

4

4. No-load output voltage

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-13; IEC/EN 60076-1 for power-type products	**Construction / method standard**	Measurement of secondary/tap output at nominal input voltage under no-load
Note	In an autotransformer, input and output share a common reference. The test report should include the note “no galvanic isolation”.		

5

5. No-load current and no-load loss

Main standard	IEC/EN 61558-1; IEC/EN 60076-1 for power-type products	**Construction / method standard**	IEC 61558-1 / IEC 60076-1 loss measurement method; IEC 60076-19-1 may be used as an auxiliary reference for measurement uncertainty
Note	Important for core quality, saturation and lamination stacking. OMSAN technical notes state that P0 and Pk values are evaluated for design/preselection, while final losses depend on voltage ratio, material, cooling and design.		

6

6. Short-circuit impedance and load loss

Main standard	IEC/EN 60076-1; IEC/EN 60076-11 as supporting reference for dry-type power products	**Construction / method standard**	IEC 60076-1 short-circuit impedance and load loss measurement method
Note	Z% is important for load sharing, short-circuit current and regulation. OMSAN technical notes state that impedance and no-load/load losses are included among IEC 60076 routine tests.		

7

7. Tap connection check

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-13	**Construction / method standard**	Connection diagram, continuity measurement, terminal/tap function check
Note	Tap ends, bridges, connection busbars and terminal designations are checked. In multi-tap products, each position should be marked separately.		

8

8. Phase sequence check - for three-phase products

Main standard	IEC/EN 60076-1; IEC/EN 61558-2-13	**Construction / method standard**	Phase sequence measurement, connection verification
Note	In a three-phase autotransformer, the input and output phase sequence must be maintained. U-V-W / u-v-w or L1-L2-L3 markings are verified according to the customer diagram.		

9

9. Phase balancing check - for three-phase products

Main standard	IEC/EN 60076-1	**Construction / method standard**	Three-phase no-load voltage measurement, comparison of phase voltage/current under load
Note	The voltage ratio and voltage drop between phases should be balanced. Manufacturing error, tap mismatch or connection error can be detected with this test.		

10

10. Insulation resistance - winding/enclosure

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-13; IEC/EN 60076-3 for power-type products	**Construction / method standard**	IEC 61558-1; IEC 61557-2 as an auxiliary reference for practical measurement
Note	In an autotransformer, the primary and secondary are not separately insulated; therefore insulation resistance should mainly be evaluated between the active part and enclosure/PE.		

11

11. Insulation resistance - tap terminals/enclosure

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-13	**Construction / method standard**	IEC 61558-1 / IEC 61557-2
Note	Insulation of tap ends, connection busbars and accessible conductive parts against the enclosure is checked.		

12

12. Primary-secondary insulation evaluation

Main standard	IEC/EN 61558-2-13	**Construction / method standard**	Product structure declaration and report note
Note	A primary-secondary insulation test should not be applied as if it were a conventional isolation transformer. In an autotransformer, primary and secondary partially use a common winding and do not provide full galvanic isolation; the OMSAN technical glossary also states that the autotransformer provides size/cost advantage but does not provide full galvanic isolation.		

13

13. Applied voltage test - active part/enclosure

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-13; IEC/EN 60076-3 for power-type products	**Construction / method standard**	IEC 61558-1 dielectric strength test; IEC 60076-3 separate-source AC withstand test
Note	The test should be performed between all active winding/tap terminals, accepted as a common electrical circuit, and the enclosure/PE. It should not be tested using the insulation-transformer logic between primary and secondary.		

14

14. Earth continuity / PE continuity

Main standard	IEC/EN 61558-1; IEC 60204-1 or IEC 61439-1 as auxiliary reference for enclosed products	**Construction / method standard**	Low-resistance continuity measurement
Note	The PE terminal, enclosure, cover, lifting lug and any screen/chassis connections are checked.		

15

15. Nameplate check - “no galvanic isolation” warning

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-13	**Construction / method standard**	IEC 61558-1 marking and documentation check
Note	The nameplate should include power, voltages, frequency, tap information, connection diagram, CE, serial number and especially the warning “no galvanic isolation / autotransformer”. The OMSAN selection table also includes the notes “no galvanic isolation” and “select an isolation transformer if EMC/grounding is critical”.		

2. Optional / Special Tests

These tests may be recommended according to customer specification, operating environment, safety level, enclosure construction or special application requirements.

1 1. Temperature rise test

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-13; IEC/EN 60076-11 for power-type dry-type products	**Construction / method standard**	IEC 61558-1 temperature rise tests; IEC 60076-11 for power-type products
When is it recommended?	Recommended for high power, enclosed cabinet, continuous full load, ambient temperature above 40 C, harmonic load and customer specification. OMSAN technical notes take 40 C as the reference ambient temperature and state that derating is required above 40 C.		

2 2. Short-time overload test

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-13; IEC/EN 60076-5 as auxiliary reference for power-type evaluation	**Construction / method standard**	IEC 61558-1 abnormal operation/overload test approach; IEC 60076-5 for short-circuit withstand
When is it recommended?	Recommended for motor supply, starting loads, machine applications and systems exposed to temporary peak currents.		

3 3. Tap switching / connection endurance test

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-13	**Construction / method standard**	Mechanical-continuity test, thermal check, connection torque check; customer procedure
When is it recommended?	Used to verify manual taps, bridge connections, busbars or terminal structures against loosening, overheating and wrong position.		

4 4. Noise measurement

Main standard	IEC/EN 60076-10	**Construction / method standard**	IEC 60076-10
When is it recommended?	Recommended for indoor, office, hospital, data center and noise-sensitive applications. IEC 60076-10 defines methods for determining sound power level by sound pressure/sound intensity methods for transformers, reactors and cooling equipment.		

5 5. Parallel operation suitability check

Main standard	IEC/EN 60076-1	**Construction / method standard**	Comparison of voltage ratio, impedance, connection/phase sequence and phase displacement
When is it recommended?	For autotransformers that will operate in parallel, ratio, tap, impedance and phase sequence compatibility should be checked. The OMSAN technical glossary states that voltage ratio, impedance and vector group compatibility are mandatory in parallel operation.		

6 6. Voltage regulation measurement according to customer system

Main standard	IEC/EN 61558-1; IEC/EN 60076-1 for power-type products	**Construction / method standard**	Output voltage measurement under load; IEC 60076-1 load loss/impedance approach
When is it recommended?	Output stability is verified according to the real load profile in machine, motor, UPS, solar energy or special process loads.		

7

7. IP protection test - enclosed products

Main standard	IEC/EN 60529	**Construction / method standard**	IEC 60529
When is it recommended?	Applied if an enclosure rating such as IP23, IP44, IP54 or IP55 is declared. IEC 60529 classifies degrees of protection provided by enclosures against dust/liquid ingress and access to hazardous parts using the IP code.		

8

8. Leakage current / touch current measurement

Main standard	IEC/EN 61558-1	**Construction / method standard**	IEC 60990
When is it recommended?	Because of the common winding structure in autotransformers, system grounding and leakage current behavior differ from isolation transformers. Recommended for sensitive devices, panel use and CE technical file checks.		

9

9. Humidity / environmental withstand test

Main standard	IEC/EN 61558-1; IEC 60068 series for environmental testing	**Construction / method standard**	IEC 60068-2-30 or IEC 60068-2-78
When is it recommended?	Recommended for outdoor, humid facilities, marine or enclosed environments with condensation risk.		

10

10. Short-circuit withstand verification

Main standard	IEC/EN 60076-5	**Construction / method standard**	IEC 60076-5; calculation/verification in most projects, type test in special projects
When is it recommended?	Evaluated for networks with high short-circuit power, large-kVA autotransformers and when required by the customer specification.		