

Omsan Test & Quality Procedures

Routine tests, optional special tests and brief standard summary

This document summarizes the routine test steps, optional special tests and related standard references that may be applied for Omsan product groups in a simple and readable A4 format.

1. Routine Test Procedures

This section includes the main routine test headings used for post-production verification of transformers and dry-type power products.

1. Winding resistance measurement

| | |
|---------------------------------------|---|
| Main standard | IEC/EN 60076-1, IEC/EN 60076-11 |
| Construction / method standard | IEC 60076-1 test clauses; IEC 60076-1 / IEC 60076-11 approach for temperature correction |
| Note | U, V, W primary; u, v, w secondary are measured separately. Phase-to-phase imbalance is checked. Report values should preferably be corrected to the reference temperature. |

2. Voltage ratio / TTR test

| | |
|---------------------------------------|--|
| Main standard | IEC/EN 60076-1 |
| Construction / method standard | IEC 60076-1; connection group verification and measurement at each tap if taps are available |
| Note | The primary/secondary ratio is measured for each phase. If taps are available, all tap positions are reported. |

3. Vector group / phase displacement check

| | |
|---------------------------------------|--|
| Main standard | IEC/EN 60076-1 |
| Construction / method standard | IEC 60076-1; verification of connection symbols and phase displacement |
| Note | Dyn, Yyn, Dd or any special vector group is verified. This is critical for transformers that will operate in parallel. |

4. Neutral continuity / connection accuracy

| | |
|---------------------------------------|---|
| Main standard | IEC/EN 60076-1; if a cabinet/panel is present, IEC 61439-1 may be used as a supporting reference |
| Construction / method standard | Continuity measurement, connection diagram and terminal verification |
| Note | If the neutral is brought out, the star point, N terminal and absence of confusion with PE are checked. |

5. No-load output voltage measurement

| | |
|---------------------------------------|--|
| Main standard | IEC/EN 60076-1, IEC/EN 60076-11 |
| Construction / method standard | IEC 60076-1; secondary voltage measurement at nominal primary voltage |
| Note | Phase-to-phase and, if available, phase-to-neutral output voltages are measured. Phase imbalance is checked. |

6. No-load current and no-load loss measurement

| | |
|---------------------------------------|--|
| Main standard | IEC/EN 60076-1, IEC/EN 60076-11 |
| Construction / method standard | IEC 60076-1 measurement method; IEC 60076-19-1 may be used as a supporting reference for measuring instrument accuracy |
| Note | This should appear in the report in terms of core quality, lamination stacking, magnetic saturation and efficiency. |

7. Short-circuit impedance and load loss measurement

| | |
|---------------------------------------|--|
| Main standard | IEC/EN 60076-1, IEC/EN 60076-11 |
| Construction / method standard | IEC 60076-1; IEC 60076-19-1 as a supporting reference for loss measurement uncertainty |
| Note | Z%, copper/load loss and design value are compared. This is very important for transformers that will operate in parallel. |

8. Insulation resistance

| | |
|---------------------------------------|---|
| Main standard | IEC/EN 60076-1, IEC/EN 60076-3, IEC/EN 60076-11 |
| Construction / method standard | IEC 60076-3 dielectric test preparation; IEC 61557-2 / manufacturer procedure for practical measurement |
| Note | Primary-secondary, primary-frame, secondary-frame are measured; if a shield winding exists, shield-frame and shield-winding are measured. |

9. Applied voltage test / separate-source AC withstand test / hipot

| | |
|---------------------------------------|--|
| Main standard | IEC/EN 60076-3, IEC/EN 60076-11; IEC/EN 61558-1 and IEC/EN 61558-2-4 for applicable products |
| Construction / method standard | IEC 60076-3 dielectric test levels and methods |
| Note | Main insulation between winding-frame and between windings is verified. IEC 60076-3 covers insulation levels, dielectric tests and clearances. |

10. Induced voltage test

| | |
|---------------------------------------|--|
| Main standard | IEC/EN 60076-3, IEC/EN 60076-11 |
| Construction / method standard | IEC 60076-3; applied with suitable frequency and duration |
| Note | Inter-turn insulation is verified. Voltage level and duration should be selected according to the customer specification/standard. |

11. Earth continuity / protective circuit continuity

| | |
|---------------------------------------|---|
| Main standard | IEC/EN 60076-11; IEC 60204-1 or IEC 61439-1 as supporting references for products with cabinets |
| Construction / method standard | Low-resistance continuity measurement; production procedure |
| Note | Cabinet, cover, lifting lug, shield connection and PE terminal are checked. |

12. Visual noise and vibration check

| | |
|---------------------------------------|---|
| Main standard | IEC/EN 60076-1, IEC/EN 60076-11 |
| Construction / method standard | Manufacturer procedure in routine inspection; IEC 60076-10 if numerical sound measurement is requested |
| Note | Numerical acoustic measurement may not be mandatory in routine testing; abnormal sound, looseness and vibration are checked during no-load operation. |

13. Fan function test

| | |
|---------------------------------------|--|
| Main standard | IEC/EN 60076-11; IEC 60076-22 series as supporting reference for fan/auxiliary equipment |
| Construction / method standard | Function test, direction check, start/stop control |
| Note | In AF-cooled products, fan direction, supply, thermal relay and automation are checked. |

14. PTC / PT100 / thermostat alarm test

| | |
|---------------------------------------|--|
| Main standard | IEC/EN 60076-11; IEC 60076-22 series as supporting reference for accessories |
| Construction / method standard | Continuity, resistance/characteristic and alarm-contact function test |
| Note | Sensor continuity, alarm/trip contact and terminal accuracy are reported. |

2. Optional / Special Tests

These tests may be recommended according to the customer specification, operating environment, reliability level or special application need.

1. Temperature rise test

| | |
|---------------------------------------|---|
| Main standard | IEC/EN 60076-11 for dry-type transformers; IEC 60076-2 is mainly for oil-immersed transformers |
| Construction / method standard | IEC 60076-11 temperature rise test method |
| When is it recommended? | For high power ratings, enclosed cabinets, high ambient temperature, harmonic loads and special customer specifications. IEC 60076-11 covers dry-type transformers. |

2. Partial discharge test

| | |
|---------------------------------------|--|
| Main standard | IEC/EN 60076-3, IEC/EN 60076-11 |
| Construction / method standard | IEC 60270 For high reliability, railway systems, medical applications, special insulation and high voltage level requirements. IEC 60270 defines charge-based measurement of partial discharge under AC/DC voltage. |
| When is it recommended? | AC/DC voltage. |

3. Lightning impulse test

| | |
|---------------------------------------|--|
| Main standard | IEC/EN 60076-3 |
| Construction / method standard | IEC 60076-3 |
| When is it recommended? | In applications close to HV, if requested by the customer or if insulation coordination requires it. |

4. Sound level measurement

| | |
|---------------------------------------|---|
| Main standard | IEC/EN 60076-10 |
| Construction / method standard | IEC 60076-10 In acoustically sensitive areas such as hospitals, offices, indoor building areas and data centers. IEC 60076-10 defines sound pressure/sound intensity measurement methods for transformers, reactors and cooling equipment. |
| When is it recommended? | |

5. Harmonic load / K-factor verification

| | |
|---------------------------------------|---|
| Main standard | IEC/EN 60076-1, IEC 60076-8 application guide; IEEE C57.110 may be used as a project-based supporting reference |
| Construction / method standard | Harmonic current simulation with power analyzer, temperature/loss verification |
| When is it recommended? | For non-linear loads, UPS, drives, inverters, data centers and K-factor transformers. |

6. IP protection test

| | |
|---------------------------------------|--|
| Main standard | IEC/EN 60529 |
| Construction / method standard | IEC 60529 |
| When is it recommended? | For cabinet products such as IP23 or IP55 according to customer request. IEC 60529 classifies protection degrees of electrical equipment enclosures against dust, water and access to hazardous parts using the IP code. |

7. Salt mist / humidity / environmental test

| | |
|---------------------------------------|--|
| Main standard | IEC 60068 series |
| Construction / method standard | IEC 60068-2-52 for salt mist; IEC 60068-2-30 or IEC 60068-2-78 for humidity/temperature cycles |
| When is it recommended? | For marine, outdoor, aggressive industrial environments and coastal regions. IEC 60068-2-52 describes cyclic salt mist testing for resistance to salt-laden atmospheres. |

8. Vibration test

| | |
|---------------------------------------|--|
| Main standard | IEC 60068-2-6 for general environmental testing; IEC 61373 for railway systems |
| Construction / method standard | IEC 60068-2-6 or IEC 61373 |
| When is it recommended? | For railway systems, marine, generator-mounted, mobile systems and high-vibration facilities. IEC 60068-2-6 defines the sinusoidal vibration test method, while IEC 61373 defines shock and vibration tests for railway vehicle equipment. |

3. Brief Standard Summary

The following summary quickly shows the scope in which the main standards mentioned in the document are referenced.

IEC/EN 60076-1: Power transformers - general rules, ratings, connections and routine test framework.

IEC/EN 60076-3: Insulation levels, dielectric tests, applied/induced voltage and impulse tests.

IEC/EN 60076-11: Dry-type power transformers; especially temperature, insulation and test requirements for dry-type products.

IEC/EN 61558-1 + IEC/EN 61558-2-4: Safety standard for general-purpose isolation transformers; product scope and power/voltage limits should be checked.

IEC/EN 60529: IP protection class.

IEC 60076-10: Sound level measurement.

IEC 60270: Partial discharge measurement.

IEC 60068 series: Environmental tests, salt mist, humidity and vibration.

IEC 61373: Shock and vibration for railway system equipment.