A2. Monophase isolation transformers - Test Standards

Routine tests and optional special tests for monophase isolation transformers

Monophase isolation transformers should generally be based on IEC/EN 61558-1 and IEC/EN 61558-2-4. This is because IEC 61558-1 covers safety requirements for dry-type transformers, reactors and power supply units; IEC 61558-2-4 defines particular requirements and tests for general-purpose isolation transformers. IEC/EN 60076-1 may also be referenced for power-transformer type products, higher power ratings or products requested in the customer specification; IEC 60076-1 applies to both three-phase and single-phase power transformers.

1. Routine Tests

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

1 Primary winding resistance

Main standard	IEC/EN 61558-1; IEC/EN 60076-1 for power-type products
Construction / method standard	IEC 61558-1 routine/conformity test approach; IEC 60076-1 winding resistance measurement approach
Note	The DC resistance value of the primary winding is measured. For higher power ratings, it is useful to report it together with temperature.

2 Secondary winding resistance

Main standard	IEC/EN 61558-1; IEC/EN 60076-1 for power-type products
Construction / method standard	IEC 61558-1; IEC 60076-1
Note	The secondary winding is measured separately. In identical design series, it is compared with the reference value for production consistency.

3 Voltage ratio test

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-4; IEC/EN 60076-1 for power-type products
Construction / method standard	IEC 61558-1 / IEC 60076-1
Note	The primary-secondary ratio is checked. In multi-tap products, all taps must be measured.

4 No-load output voltage

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-4
Construction / method standard	IEC 61558-1; IEC 60076-1 if required
Note	Nominal primary voltage is applied and the secondary no-load voltage is measured. It is compared with the nameplate voltage and tolerance.

5 No-load current

Main standard	IEC/EN 61558-1; IEC/EN 60076-1 for power-type products
Construction / method standard	IEC 61558-1 / IEC 60076-1
Note	This is a critical check for core saturation, lamination quality and signs of incorrect winding.

6 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; IEC 60076-19-1 may be used as a supporting reference for measurement accuracy
Note	It indicates the core loss characteristic. It is especially useful to include it in the report for products that will remain energized for long periods. The OMSAN technical glossary states that no-load loss affects operating cost.

7 Voltage drop under load / voltage regulation

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-4
Construction / method standard	IEC 61558-1 load/regulation test approach
Note	For small/medium power monophase isolation transformers, the secondary voltage drop under load is measured in practice.

8 Short-circuit impedance / Uk%

Main standard	IEC/EN 60076-1; may be used as design verification for IEC/EN 61558 products
Construction / method standard	IEC 60076-1 short-circuit impedance and load loss measurement method
Note	This is more meaningful for high-power monophase transformers and parallel/special applications. The OMSAN technical glossary states that impedance voltage is the main criterion limiting short-circuit current.

9 Insulation resistance - primary-secondary

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-4; IEC/EN 60076-3 for power-type products
Construction / method standard	IEC 61558-1; IEC 61557-2 as a supporting reference for practical measurement
Note	This is the main check of galvanic isolation. The test voltage should be selected according to the product voltage class and company procedure.

10 Insulation resistance - primary-frame

Main standard	IEC/EN 61558-1; IEC 60204-1 may be a supporting reference for products with cabinets/PE
Construction / method standard	IEC 61558-1; IEC 61557-2 measurement method
Note	Measurement is made between the primary and accessible metal body/chassis.

11 Insulation resistance - secondary-frame

Main standard	IEC/EN 61558-1
Construction / method standard	IEC 61558-1; IEC 61557-2
Note	The insulation of the secondary against the frame is verified. If one end of the secondary will be grounded, the test connection is arranged accordingly.

12 Dielectric withstand test / hipot / applied voltage test

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-4; IEC/EN 60076-3 for power-type products
Construction / method standard	IEC 61558-1 dielectric withstand tests; IEC 60076-3 separate-source AC withstand test
Note	The main insulation of primary-secondary, primary-frame and secondary-frame is verified. The test level should be selected according to product voltage, insulation class and the standard table.

13 Induced voltage / inter-turn insulation test

Main standard	IEC/EN 61558-1; IEC/EN 60076-3 for power-type products
Construction / method standard	IEC 61558-1; IEC 60076-3 induced AC voltage test approach
Note	Applied for inter-turn insulation, incorrect winding and weak varnish/insulation risk. Suitable frequency and duration should be selected.

14 Nameplate check

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-4; relevant EU directives for CE
Construction / method standard	IEC 61558-1 marking and documentation checks
Note	Power, primary/secondary voltage, frequency, connection, insulation class, serial number, CE, warnings and, if any, IP/thermal information are checked.

15 Connection diagram check

Main standard	IEC/EN 61558-1; customer specification
Construction / method standard	Manufacturer connection diagram and terminal verification procedure
Note	Terminal numbers, primary/secondary separation, shield, PE and thermal leads, if any, are checked.

16 PE continuity

Main standard	IEC/EN 61558-1; IEC 60204-1 as supporting reference for products installed in machinery/panels
Construction / method standard	Low-resistance continuity test
Note	Continuity between the PE terminal and body/chassis is checked.

17 Cover-chassis continuity for cabinet products

Main standard	IEC/EN 61558-1; IEC 61439-1 or IEC 60204-1 as supporting reference for cabinet/panel approach
Construction / method standard	Protective circuit continuity measurement
Note	Cover, hinge, body, lifting lug and PE connection are checked. Contact continuity is especially important on painted surfaces.

2. Optional / Special Tests

These tests may be recommended according to the customer specification, operating environment, safety level, cabinet structure or special application requirements.

1 Temperature rise test

Main standard	IEC/EN 61558-1; for power-type products, IEC/EN 60076-11 or IEC/EN 60076-2 is evaluated depending on the context
Construction / method standard	IEC 61558-1 temperature rise tests; IEC 60076-11 for dry-type power transformer character
When is it recommended?	Recommended for enclosed cabinets, high ambient temperature, continuous full load, indoor/panel applications and where customer specification requires it. IEC 60076-11 is the special standard for dry-type power transformers; however, since its scope requires at least one winding to operate above 1.1 kV, IEC 61558 should be evaluated first for LV/LV small isolation transformers.

2 Noise measurement

Main standard	IEC/EN 60076-10
Construction / method standard	IEC 60076-10
When is it recommended?	In acoustically sensitive areas such as hospitals, offices, indoor buildings, laboratories and data centers. IEC 60076-10 defines determination of sound power level through sound pressure/sound intensity for transformers and reactors.

3 Leakage current / touch current measurement

Main standard	IEC/EN 61558-1; IEC 60990 for measurement
Construction / method standard	IEC 60990
When is it recommended?	For non-medical sensitive device supply, panel safety, special customer specification or CE technical file verification. IEC 60990 defines measurement methods for touch current and protective conductor current.

4 IP test

Main standard	IEC/EN 60529
Construction / method standard	IEC 60529
When is it recommended?	Applied for cabinet products if declarations such as IP20, IP23, IP44, IP54, IP55 exist. IEC 60529 classifies protection degrees of enclosures against dust/liquid ingress and access to hazardous parts with the IP code.

5 Humidity test / moisture resistance

Main standard	IEC/EN 61558-1; IEC 60068 series for environmental verification
Construction / method standard	IEC 61558-1 humidity/moisture treatment; IEC 60068-2-30 or IEC 60068-2-78
When is it recommended?	Recommended for outdoor environments, humid facilities, marine applications, basement/technical rooms and long-term storage conditions.

6 Overload withstand test

Main standard	IEC/EN 61558-1; customer specification
Construction / method standard	IEC 61558-1 abnormal operation/overload test approach
When is it recommended?	Useful for control transformers, panel transformers, applications with short-duration peak loads and thermally protected products.

7 Flammability / material verification test

Main standard	IEC/EN 61558-1; IEC 60695 series for material; UL 94 may be a supporting reference for plastic material classification
Construction / method standard	IEC 60695-2-11 glow-wire test; IEC 60695-11-10 flammability classification tests
When is it recommended?	Recommended for plastic terminals, coil formers, covers, terminal blocks and insulation parts in panel, building, public/hospital/office applications. IEC 60695-2-11 is a test method for checking ignition/flame-spread tendency of the final product using a glow wire.