A6. Control transformers - routine tests

Test standards and report annexes for control transformers

1. Routine Tests

This section summarizes the routine test headings for control transformers, such as primary/secondary winding checks, output voltage, regulation, insulation, terminal and nameplate checks.

1 Primary winding resistance

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2
Construction / method standard	IEC 61558-1 routine test approach; manufacturer measurement procedure
Explanation for control transformer	The DC resistance of the primary winding is measured. In products of the same series, it is compared with the reference value for production consistency and incorrect winding control.

2 Secondary winding resistance

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2
Construction / method standard	IEC 61558-1; manufacturer measurement procedure
Explanation for control transformer	The DC resistance of the secondary winding is measured. In multi-output products, each secondary must be checked separately.

3 No-load output voltage

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2
Construction / method standard	IEC 61558-1 voltage verification / no-load operation approach
Explanation for control transformer	Nominal primary voltage is applied and the secondary no-load voltage is measured. Nameplate and tolerance are checked for control voltages such as 24 V, 48 V, 110 V and 230 V.

4 Output voltage under load

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2
Construction / method standard	Output voltage measurement at nominal VA load
Explanation for control transformer	The main purpose of a control transformer is to provide stable voltage to relays, contactors, timers and automation components. Therefore, the secondary voltage at nominal load must be checked.

5 Voltage ratio

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2
Construction / method standard	IEC 61558-1; where necessary, the IEC 60076-1 ratio measurement approach may be used as support
Explanation for control transformer	The primary/secondary ratio is verified. If there is a multi-tap primary or multi-output secondary, each combination must be measured separately.

6 Insulation resistance

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2
Construction / method standard	IEC 61558-1; IEC 61557-2 as a supporting reference for practical measurement
Explanation for control transformer	Measurement is performed between primary-secondary, primary-frame and secondary-frame. Frame/PE control is especially important for metal-cased, rail-mounted or panel-installed products.

7 Dielectric withstand test / hipot

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2
Construction / method standard	IEC 61558-1 dielectric withstand test
Explanation for control transformer	The withstand capability of the main insulation is verified. The test level must be selected according to primary/secondary voltage, insulation type and the standard table.

8 Induced voltage / inter-turn insulation test

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2
Construction / method standard	IEC 61558-1; if necessary, the IEC 60076-3 induced-voltage approach may be used as support
Explanation for control transformer	Applied to check for weak inter-turn insulation, incorrect winding, varnishing/impregnation problems or short-circuit risk.

9 Inter-turn short-circuit check

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2
Construction / method standard	No-load current, no-load loss, induced voltage and/or surge test manufacturer procedure
Explanation for control transformer	In small control transformers, abnormal no-load current, overheating, noise and output voltage deviation may indicate an inter-turn short circuit. A surge/impulse winding tester may be used in serial production.

10 Regulation check - no-load output

Main standard	IEC/EN 61558-2-2
Construction / method standard	No-load voltage measurement
Explanation for control transformer	The no-load secondary voltage is recorded. In control transformers, the no-load voltage may be higher than nominal; the acceptance limit must be determined according to the product standard and design.

11 Regulation check - output at nominal load

Main standard	IEC/EN 61558-2-2
Construction / method standard	Secondary voltage measurement at nominal VA load
Explanation for control transformer	Regulation is calculated from the voltage difference between no-load and nominal load. OMSAN documentation specifically mentions voltage regulation tests for control transformers.

12 Observation of starting / inrush behavior

Main standard	IEC/EN 61558-2-2; IEC 60947-4-1 as a supporting reference for contactor applications
Construction / method standard	Observation of primary current during energization, fuse/breaker coordination, and contactor pull-in behavior
Explanation for control transformer	In control transformers feeding contactors, the secondary voltage must not drop during initial energization current and sudden loading. On the contactor and motor starter side, IEC 60947-4-1 is used for low-voltage switchgear and controlgear.

13 Terminal connection check

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2
Construction / method standard	Connection diagram, continuity and visual inspection
Explanation for control transformer	Primary/secondary separation, multiple input taps, common terminals, bridges and secondary outputs are checked against incorrect connection.

14 Terminal numbering check

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2; IEC 60204-1 as support in panel/machine applications
Construction / method standard	Nameplate, connection diagram and terminal marking check
Explanation for control transformer	For ease of maintenance and error prevention inside the panel, terminal numbers must match the diagram exactly. IEC 60204-1 is used as the basic safety standard for electrical equipment of machines.

15 PE continuity - in metal-cased products

Main standard	IEC/EN 61558-1; IEC 60204-1 as support inside machinery/panels
Construction / method standard	Low-resistance continuity test
Explanation for control transformer	Continuity is checked between the metal frame, mounting foot, rail connection and PE terminal. Under IEC 60204-1, verification of the continuity of the protective bonding circuit is one of the basic checks.

16 Nameplate check - VA

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2
Construction / method standard	Marking and documentation check
Explanation for control transformer	The rated power must be shown in VA. In control transformers, the VA value is critical information for selecting contactor pull-in power and continuous coil load.

17 Nameplate check - input/output voltage

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2
Construction / method standard	Cross-check of nameplate and connection diagram
Explanation for control transformer	Primary voltages, secondary voltages, multi-tap/multi-output information must be clearly written.

18 Nameplate check - frequency

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2
Construction / method standard	Marking check
Explanation for control transformer	50 Hz, 60 Hz or 50/60 Hz information must be indicated. A frequency error directly affects no-load current and heating.

19 Nameplate check - insulation class

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2
Construction / method standard	Material/nameplate/technical datasheet check
Explanation for control transformer	The insulation class such as B, F, H or the permitted temperature information must be consistent with the design file.

20 Nameplate check - duty type

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2
Construction / method standard	Marking and technical document check
Explanation for control transformer	Usage information such as continuous duty, short-time duty or intermittent duty must be specified. In transformers feeding contactors, short-time high-load capability may also be defined.

21

CE conformity document check

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2; EU LVD/EMC legislation
Construction / method standard	Technical file, declaration of conformity, nameplate and test report check
Explanation for control transformer	In OMSAN documentation, CE conformity checks are listed as a product group test for control transformers.

2. Optional / Special Tests

These tests may be recommended for projects with enclosed panels, high ambient temperature, contactor/relay supply, OEM machinery, HVAC, EMC expectations or customer specifications.

1

Temperature rise test

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2
Construction / method standard	IEC 61558-1 temperature rise test method
When is it recommended?	Recommended for enclosed panels, high ambient temperature, continuous nominal load, HVAC panels or products with high VA density.

2

Short-time overload test

Main standard	IEC/EN 61558-2-2
Construction / method standard	IEC 61558-2-2 control transformer special test approach; manufacturer/customer procedure
When is it recommended?	Applied when short-time high current is drawn simultaneously by a contactor, relay group or coils. For control transformers, this test is strong from a sales perspective.

3

Short-circuit withstand test / behavior against short circuit

Main standard	IEC/EN 61558-1, IEC/EN 61558-2-2
Construction / method standard	IEC 61558-1 abnormal operation / short-circuit condition tests
When is it recommended?	Applied when secondary short circuit, protective device selection, thermal protection or self-protected design needs to be verified.

4

IP test - for enclosed/covered products

Main standard	IEC/EN 60529
Construction / method standard	IEC 60529
When is it recommended?	Applied when a protection class such as IP20, IP23, IP44, IP54 or IP55 is declared. IEC 60529 classifies degrees of protection provided by enclosures against ingress of dust/liquids and access to hazardous parts using the IP code.

5 Vibration test - in machine/OEM panels

Main standard	IEC 60068-2-6; IEC 61373 may be used as support in rail systems
Construction / method standard	IEC 60068-2-6 sinusoidal vibration test
When is it recommended?	Recommended for machines, OEM panels, compressors, HVAC, mobile equipment or vibrating industrial lines. IEC 60068-2-6 provides the standard test method for determining equipment resistance to sinusoidal vibration at specified severities.

6 EMC immunity test

Main standard	IEC 61000-6-2; if there is a product/panel-specific standard, that standard has priority
Construction / method standard	IEC 61000-4 series immunity tests; IEC 61000-6-2 industrial environment limits
When is it recommended?	Recommended when the transformer is sold together with an electronic control panel, PLC, drive, HVAC automation or power supply module. IEC 61000-6-2 covers EMC immunity requirements for electrical/electronic equipment in industrial environments.

7 EMC emission test

Main standard	IEC 61000-6-4; IEC 61000-6-3 may be considered for residential/commercial environments
Construction / method standard	IEC 61000-6-4 industrial environment emission standard
When is it recommended?	A control transformer alone is often not an emission source as a passive product; however, emission testing may be required when it is sold together with an electronic circuit, power supply, panel or control unit. IEC 61000-6-4 covers emission requirements for industrial environments.

8 Contactor pull-in/drop-out function test

Main standard	IEC/EN 61558-2-2; IEC 60947-4-1 as support on the contactor side
Construction / method standard	Function test with an actual contactor coil or equivalent load
When is it recommended?	In control transformers feeding contactors, secondary voltage drop may prevent the contactor from pulling in or may cause chatter. Therefore, a function test with the actual load is recommended.

9 Thermal camera hot-spot check

Main standard	IEC/EN 61558-1 thermal safety approach
Construction / method standard	IR thermography at nominal load; manufacturer procedure
When is it recommended?	Local heating is checked at terminals, connection bridges, coil surface, core clamping laminations and mounting points. It is useful as a special quality control, not as a routine test.

10

Flammability / material verification test

Main standard	IEC/EN 61558-1; IEC 60695 series for plastic/insulation materials
Construction / method standard	IEC 60695 glow-wire / flammability tests
When is it recommended?	Recommended for terminals, coil bobbins, plastic covers and insulation parts in panel, indoor, HVAC and OEM machine applications.

11

Leakage current / touch current test

Main standard	IEC/EN 61558-1; IEC 60990 for measurement
Construction / method standard	IEC 60990 touch current measurement
When is it recommended?	May be applied according to customer specification in metal-cased, electronic-module or user-accessible control transformer assemblies.

3. Recommended Additional Lines for the Test Report

Adding the following lines to the classic routine test report for control transformers enables clearer tracking of VA load, regulation, insulation, terminal and nameplate verifications.

1

No-load secondary voltage

Measured value, nominal value, tolerance

2

Secondary voltage at nominal load

Measured value under VA load

3

Regulation

Value calculated from the difference between no-load and nominal-load output voltage

4

Short-time load capacity

If contactor pull-in load or customer load profile is available

5

Primary/secondary insulation

Insulation resistance and dielectric test result

6

PE continuity

Measured continuity value in metal-cased products

7

Terminal check

Input/output terminals, bridges, numbering

8

Nameplate check

VA, input/output voltage, frequency, insulation class, duty type, CE

9

Application note

If suitable for contactor/relay supply, note on short-time inrush/starting behavior