

B5. Shunt reactors - single-phase / three-phase

Standard Approach

For shunt reactors, the main product standard should be IEC/EN 60076-6 - Reactors. IEC 60076-6 directly covers shunt reactors as well as series reactors, filter reactors, current-limiting reactors and similar reactor types. For small LV reactors, IEC/EN 61558-1 + IEC/EN 61558-2-20 may be used as an auxiliary reference for safety requirements; IEC 61558-2-20 covers the special safety requirements and tests for small reactors.

Routine tests

1. Routine Tests

1

Winding resistance

Main standard	IEC/EN 60076-6; IEC/EN 61558-1 / 61558-2-20 for small LV reactors
Construction / method standard	DC resistance measurement; manufacturer routine test procedure
Description for shunt reactor	For single-phase products, winding resistance is measured; for three-phase products, each phase is measured separately. Phase resistance differences are evaluated in terms of incorrect winding, loose connection, contact resistance or conductor cross-section difference.

2

Inductance measurement

Main standard	IEC/EN 60076-6
Construction / method standard	Measurement at rated frequency with an LCR meter, AC test setup or power analyzer
Description for shunt reactor	This is the main functional parameter of the shunt reactor. The inductance value directly determines the inductive current to be drawn and the kVAr value.

3

Reactive power verification - kVAr value

Main standard	IEC/EN 60076-6
Construction / method standard	Calculation from measured L, rated voltage and frequency; preferably verification by current measurement at rated voltage
Description for shunt reactor	The kVAr value on the nameplate is verified. Calculation must be made according to phase-neutral or phase-phase voltage connection for single-phase products, and according to connection type for three-phase products.

4

Reactive power verification - at rated voltage and frequency

Main standard	IEC/EN 60076-6
Construction / method standard	Measurement of current and power by applying rated U and f
Description for shunt reactor	Since the shunt reactor operates like a parallel-connected inductive load, it is important to perform the test under rated voltage and frequency conditions. If the frequency changes, current and kVAr change due to $X_L = 2\pi fL$. The technical glossary also states that reactor impedance increases with frequency.

5

Current measurement - current drawn at rated voltage

Main standard	IEC/EN 60076-6
Construction / method standard	RMS current measurement by applying rated voltage
Description for shunt reactor	This is the most practical field equivalent of kVAr verification. The measured current is compared with the design/nameplate current.

6

Phase balance - in three-phase products

Main standard	IEC/EN 60076-6
Construction / method standard	Comparison of R, L and current at rated voltage on each phase
Description for shunt reactor	In a three-phase reactor, L1-L2-L3 currents must be balanced. Imbalance affects compensation/reactive power balance, phase currents and heating.

7

Loss measurement

Main standard	IEC/EN 60076-6
Construction / method standard	I ² R copper loss calculation from DC resistance; total loss by AC power measurement in core-type products
Description for shunt reactor	Copper loss, core loss and stray losses are evaluated for thermal design. The technical glossary defines copper loss, core loss and total loss as basic inputs for reactor temperature rise and thermal design.

8

Insulation resistance

Main standard	IEC/EN 60076-6; IEC/EN 61558-1 / 61558-2-20
Construction / method standard	Insulation resistance measurement; IEC 61557-2 as an auxiliary reference for practical measurement
Description for shunt reactor	Winding-to-frame and, depending on the design, phase-to-phase insulation are measured. In metal-framed and panel/enclosed products, the insulation result against the frame should appear in the report.

9

Dielectric withstand / hipot

Main standard	IEC/EN 60076-6; IEC/EN 61558-1 / 61558-2-20
Construction / method standard	AC withstand test; test level selected according to product voltage, insulation class and customer specification
Description for shunt reactor	The main insulation of winding-to-frame and, if required, phase-to-phase is verified.

10

Noise and vibration check

Main standard	IEC/EN 60076-6; IEC/EN 60076-10 if numerical sound test is requested
Construction / method standard	Listening and mechanical visual check at no-load/rated voltage; sound measurement if required
Description for shunt reactor	Since a shunt reactor may remain energized continuously, checking core tightness, air gap, coil fixing and mechanical vibration is important. IEC 60076-10 defines sound pressure/sound intensity measurement methods for determining the sound level of transformers and reactors.

11**Thermal protection function test - if present**

Main standard	IEC/EN 60076-6; IEC/EN 61558-1 auxiliary
Construction / method standard	PTC/PT100/thermostat continuity, resistance or contact function test
Description for shunt reactor	Sensor leads, alarm/trip contact and terminal numbers are verified.

12**Nameplate check - kVAr**

Main standard	IEC/EN 60076-6
Construction / method standard	Cross-check of nameplate, technical datasheet and test report
Description for shunt reactor	The nameplate kVAr value must be compatible with the measured/calculated reactive power.

13**Nameplate check - voltage, frequency, current**

Main standard	IEC/EN 60076-6
Construction / method standard	Marking and documentation check
Description for shunt reactor	Rated voltage, frequency and drawn rated current must be clearly written.

14**Nameplate check - connection type**

Main standard	IEC/EN 60076-6; customer specification
Construction / method standard	Connection diagram, terminal marking and nameplate check
Description for shunt reactor	Single-phase, three-phase star/delta, phase-neutral or phase-phase connection information must be clear. Incorrect connection changes the kVAr value and winding voltage.

15**Terminal / connection tightness check**

Main standard	IEC/EN 60076-6
Construction / method standard	Visual inspection, torque check, continuity and terminal marking check
Description for shunt reactor	Since the shunt reactor draws continuous current, loose terminal and busbar connections may cause local heating.

16**Final mechanical check**

Main standard	IEC/EN 60076-6; OMSAN quality process
Construction / method standard	Visual-mechanical inspection, core/winding fixing, air duct and frame check
Description for shunt reactor	In the OMSAN general quality flow, visual/mechanical inspection, winding-connection checks and final quality control are given as part of the routine process.

2. Optional / Special Tests

1

Temperature rise test

Main standard	IEC/EN 60076-6; IEC/EN 61558-2-20 auxiliary for small LV reactors
Construction / method standard	Steady-state temperature measurement by continuous operation at rated voltage
When is it recommended?	This test is very valuable because shunt reactors may remain energized for long periods. Recommended for enclosed panels, high ambient temperature, high kVAr or continuous service conditions.

2

Sound level test

Main standard	IEC/EN 60076-10
Construction / method standard	Determination of sound power level by sound pressure or sound intensity method
When is it recommended?	Recommended for indoor, hospital, office, shopping mall, data center or quiet technical rooms. IEC 60076-10 also covers reactors.

3

Long-term operation test at rated voltage

Main standard	IEC/EN 60076-6; customer specification
Construction / method standard	Monitoring current, temperature, sound and mechanical condition for a specified duration under rated voltage/frequency
When is it recommended?	Recommended for compensation/reactive balancing applications that will remain continuously in service.

4

Voltage tolerance test

Main standard	IEC/EN 60076-6; customer specification
Construction / method standard	Current and kVAr measurement at points such as 90% / 100% / 110% Un
When is it recommended?	Useful in facilities with variable grid voltage. Since current and kVAr change with voltage in a shunt reactor, the system balancing effect can be seen with this test.

5

Outdoor / IP test

Main standard	IEC/EN 60529
Construction / method standard	Protection test against dust, water and access to hazardous parts according to the IP code
When is it recommended?	Applied if declarations such as IP23, IP44, IP54 or IP55 exist for enclosed or outdoor products. IEC 60529 classifies enclosure protection against dust/water ingress and access to hazardous parts with the IP code.

6

Thermal camera test

Main standard	IEC/EN 60076-6 thermal performance approach
Construction / method standard	IR thermography after operating for a specified time at rated voltage
When is it recommended?	Hot spots are checked on terminals, busbars, winding outlets, core/air gap, mounting points and frame.

7

System test with compensation panel

Main standard	IEC/EN 60076-6; IEC 61439-1 and customer specification auxiliary for panel/compensation system
Construction / method standard	Commissioning inside the panel; contactor/breaker, protection, current, kVAr, temperature and connection check
When is it recommended?	Recommended if the shunt reactor is switched by automation inside a compensation panel. If it operates on the same busbar with capacitor groups, resonance and incorrect step combination must also be evaluated.

8

Operation evaluation in harmonic environment

Main standard	IEC/EN 60076-6; IEC 61000-4-7 / IEC 61000-4-30 auxiliary for power quality measurement
Construction / method standard	Evaluation of RMS current, additional losses and heating through a harmonic analysis report
When is it recommended?	Recommended if the shunt reactor will remain continuously connected in a harmonic network. The technical glossary states that harmonic effects may increase winding losses and cause additional heating.

9

Saturation / magnetic linearity test

Main standard	IEC/EN 60076-6
Construction / method standard	Measurement of L and current variation at different voltage or current points
When is it recommended?	Recommended if there is a saturation risk in iron-core shunt reactors under voltage rise or transient conditions. The technical glossary states that when saturation current is exceeded, inductance decreases and the protection effect weakens.

10

Vibration test

Main standard	IEC 60068-2-6; customer specification in special applications
Construction / method standard	Sinusoidal vibration test or customer vibration profile
When is it recommended?	Recommended for marine, railway, machine-mounted or high-vibration facilities.

11

Protection coordination check

Main standard	IEC/EN 60076-6; IEC 61439-1 auxiliary for panel system
Construction / method standard	Checking fuse/breaker/thermal protection settings, rated current and short-circuit condition
When is it recommended?	Performed to ensure that the shunt reactor operates safely together with protection elements. The technical glossary defines protection coordination as the reactor operating compatibly with the fuse, circuit breaker and other protection elements.

3. Lines Recommended to Be Added to the Test Report

Report line	Recommended content
Product type	Single-phase / three-phase shunt reactor
Rated values	kVAr, voltage, frequency, current, number of phases
Connection type	Single-phase, three-phase star, three-phase delta, phase-neutral or phase-phase
Inductance	L value, measurement frequency and tolerance for each phase
Current at rated voltage	RMS current for each phase
Reactive power verification	Calculated/measured kVAr, target kVAr, deviation %
Phase balance	R, L and current phase deviations in three-phase products
Loss	Copper loss, total loss in core-type products
Insulation / dielectric	Winding-to-frame, phase-to-phase test results
Noise / vibration	Routine visual check or numerical sound level
Thermal protection	Present/absent, PTC/PT100/thermostat function result
Nameplate check	kVAr, voltage, frequency, current, connection type, insulation class, IP
Optional system test	Operation with panel, voltage tolerance, temperature rise, thermal camera