

B1. Line reactors / input reactors - routine tests

Standard Approach

Line reactors may use IEC/EN 60076-6 - Reactors as the main technical standard. IEC 60076-6 applies to shunt reactors, series reactors, current-limiting reactors, filter reactors and similar reactor types. For small LV reactors, IEC/EN 61558-1 + IEC/EN 61558-2-20 may be used for the safety approach; IEC 61558-2-20 covers the special requirements and tests for the safety of small reactors.

1. Routine Tests

1 Winding resistance measurement - each phase separately

Main standard	IEC/EN 60076-6; IEC/EN 61558-1 and IEC/EN 61558-2-20 for small LV reactors
Construction / method standard	DC resistance measurement; manufacturer routine test procedure
Explanation for line/input reactor	L1, L2 and L3 phase windings are measured separately. Connection errors, contact resistance, incorrect conductor cross-section and turn differences can be detected in this test.

2 Resistance balance between phases

Main standard	IEC/EN 60076-6
Construction / method standard	Comparison of DC resistance values between phases
Explanation for line/input reactor	In a three-phase reactor, phase resistances should be balanced. Phase differences may cause unbalanced heating and voltage drop differences.

3 Inductance measurement - at nominal frequency

Main standard	IEC/EN 60076-6
Construction / method standard	50/60 Hz inductance measurement with an LCR meter, power analyzer or AC test setup
Explanation for line/input reactor	This is the main functional test of the reactor. The OMSAN renewable systems document specifically states that the required inductance in LV reactors must be correctly determined according to system analysis.

4 Inductance measurement - each phase separately

Main standard	IEC/EN 60076-6
Construction / method standard	L measurement for each phase under the same test current/frequency condition
Explanation for line/input reactor	In a three-phase reactor, L1-L2-L3 inductance values should be balanced within the design tolerance. Phase inductance differences may cause imbalance in VFD input currents.

5 Inductance tolerance control

Main standard	IEC/EN 60076-6; customer specification
Construction / method standard	Comparison of the measured L value with the design/catalog tolerance
Explanation for line/input reactor	The acceptance limit should be clearly stated in the order specification. For example, tolerances such as +/-5% or +/-10% are determined according to the customer or design standard.

6 Impedance / Z% verification

Main standard	IEC/EN 60076-6
Construction / method standard	Impedance calculation based on measured inductance or voltage drop
Explanation for line/input reactor	The Z%2 or Z%4 product distinction is verified here. In the OMSAN technical glossary, percentage impedance is defined as a design parameter expressing the reactor voltage drop under nominal operating conditions as a percentage.

7 Z%2 / Z%4 product distinction control

Main standard	IEC/EN 60076-6; customer specification
Construction / method standard	Voltage drop or XL calculation at nominal current
Explanation for line/input reactor	The Z% value on the reactor nameplate must match the measurement result. As Z% increases, the protection effect increases; however, the voltage drop and size effect also increase.

8 Impedance verification according to nominal current

Main standard	IEC/EN 60076-6
Construction / method standard	Voltage drop measurement or calculation verification at nominal current
Explanation for line/input reactor	Reactor impedance should be reported according to nominal current and nominal frequency conditions. It is very clear if "In, f, L, XL, Z%" are given together in the test report.

9 Loss measurement - copper loss

Main standard	IEC/EN 60076-6
Construction / method standard	I ² R calculation based on DC resistance and current; AC load test if required
Explanation for line/input reactor	Copper loss is the I ² R loss caused by current flowing through the winding and is one of the basic losses determining temperature rise. Copper loss is defined this way in the OMSAN technical glossary.

10 Loss measurement - total loss in core-type reactor

Main standard	IEC/EN 60076-6
Construction / method standard	Power measurement under nominal current/frequency condition
Explanation for line/input reactor	In iron-core reactors, core loss and stray losses are considered in addition to copper loss. In the OMSAN technical glossary, total loss is defined as the sum of copper loss, core loss and stray losses.

11 Insulation resistance - winding/enclosure

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
Explanation for line/input reactor	Measurement is made between windings and enclosure/chassis/PE. It should appear in the routine report for metal-enclosed and panel-mounted products.

12 Insulation resistance - phase/phase

Main standard	IEC/EN 60076-6; IEC/EN 61558-1 depending on design
Construction / method standard	Insulation resistance measurement
Explanation for line/input reactor	If phase windings are designed to be insulated from each other, phase-to-phase insulation is measured. Even in common-core/common-structure designs, terminal and winding insulation should be checked.

13 Dielectric withstand test - winding/enclosure

Main standard	IEC/EN 60076-6; IEC/EN 61558-1 / 61558-2-20
Construction / method standard	AC withstand / hipot test
Explanation for line/input reactor	Main insulation is verified. The test level is selected according to the product voltage class, insulation class and customer specification.

14 Dielectric withstand test - phase/phase, if required

Main standard	IEC/EN 60076-6; IEC/EN 61558-1
Construction / method standard	AC withstand test
Explanation for line/input reactor	It should be applied if there is a separate insulation barrier between phases. Phase-to-phase distance and insulation are verified, especially in compact three-phase reactors.

15 Linearity / saturation control - simple current point

Main standard	IEC/EN 60076-6
Construction / method standard	Inductance measurement at the specified current point
Explanation for line/input reactor	In routine testing, a single-point check near nominal current may generally be sufficient. In the OMSAN technical glossary, saturation current is defined as the current level at which the reactor core starts to deviate from linear behavior.

16 Linearity / saturation control - multi-point measurement

Main standard	IEC/EN 60076-6; customer specification
Construction / method standard	Measurement of L variation at points such as 25% / 50% / 100% / 150% In
Explanation for line/input reactor	In special designs, the change of inductance with current should be reported. Saturation limits must be carefully managed in iron-core reactors; the OMSAN technical glossary also states that saturation limits are critical in iron-core reactors.

17 Noise and mechanical tightness control

Main standard	IEC/EN 60076-6; IEC/EN 60076-10 if numerical sound measurement is required
Construction / method standard	No-load/load visual-listening control; mechanical tightness control
Explanation for line/input reactor	Air gap, core tightness, coil fixing, connection bars and vibration are checked. IEC 60076-10 defines sound pressure/sound intensity measurement methods for transformers and reactors.

18 Air gap control - in core-type reactor

Main standard	IEC/EN 60076-6
Construction / method standard	Visual/mechanical measurement, production drawing check
Explanation for line/input reactor	Air gap tolerance directly affects inductance, saturation and sound behavior. In the OMSAN LV reactor document, precise control of air gap tolerances is specified as a production criterion.

19 Temperature sensor function test - if available

Main standard	IEC/EN 60076-6; IEC/EN 61558-1
Construction / method standard	PTC/PT100/thermostat continuity and contact function test
Explanation for line/input reactor	Sensor leads, alarm/trip contact and terminal numbers are checked. A function test is recommended if it is used together with a panel or drive protection circuit.

20 Nameplate control - current, voltage, frequency

Main standard	IEC/EN 60076-6; IEC/EN 61558-1
Construction / method standard	Marking and documentation control
Explanation for line/input reactor	Nominal current, system voltage, frequency and number of phases must be consistent with the nameplate/technical sheet/test report.

21 Nameplate control - Z%, inductance, insulation class

Main standard	IEC/EN 60076-6; customer specification
Construction / method standard	Cross-check of nameplate, technical sheet and measurement result
Explanation for line/input reactor	Z%2 / Z%4, mH/uH value, insulation class, temperature rise and cooling information must be clearly stated.

22 Connection and terminal control

Main standard	IEC/EN 60076-6; IEC/EN 61558-1
Construction / method standard	Terminal block, busbar, input/output markings, torque and continuity control
Explanation for line/input reactor	Since the line reactor is connected in series, input-output terminal markings should be clear. Reverse connection does not create a functional difference in most reactors, but correct marking is important for panel installation and service.

2. Optional / Special Tests

1 Temperature rise test

Main standard	IEC/EN 60076-6; IEC/EN 61558-2-20 for small LV reactors
Construction / method standard	Steady-state temperature rise measurement at nominal current
When is it recommended?	Recommended for continuous full load, closed panels, high ambient temperature, high harmonic current or high-power VFD applications. The OMSAN quality document specifically mentions heating and performance tests for line reactors.

2 Saturation curve test

Main standard	IEC/EN 60076-6
Construction / method standard	L measurement at different current points and plotting the L-I curve
When is it recommended?	Recommended in iron-core reactors when transient, start-up, high RMS current or drive input pulses are important.

3 Sound level test

Main standard	IEC/EN 60076-10
Construction / method standard	IEC 60076-10 sound pressure / sound intensity measurement
When is it recommended?	Recommended for indoor buildings, hospitals, offices, data centers or quiet technical rooms. IEC 60076-10 also covers reactors.

4 Vibration test

Main standard	IEC 60068-2-6; IEC 61373 may be auxiliary for railway systems
Construction / method standard	IEC 60068-2-6 sinusoidal vibration test
When is it recommended?	Recommended for machinery, mobile systems, railway systems, marine or high-vibration facilities. IEC 60068-2-6 provides a standard test method to determine the ability of the specimen to withstand sinusoidal vibration of specified severity.

5 Heating test under high harmonic current

Main standard	IEC/EN 60076-6; IEC 61000-4-7 / IEC 61000-4-30 for harmonic measurement
Construction / method standard	Temperature measurement with THD current or equivalent RMS/harmonic loading
When is it recommended?	Recommended in VFD, rectifier, inverter and renewable energy applications. The OMSAN document states that LV reactors limit harmonic components and protect inverter semiconductors.

6 Harmonic reduction performance test

Main standard	IEC/EN 60076-6; IEC 61000-4-7 / IEC 61000-4-30 for power quality measurement
Construction / method standard	THDi comparison with and without reactor
When is it recommended?	Applied when the customer wants to see harmonic reduction performance at the VFD input. In the OMSAN quality document, harmonic reduction tests are listed as a product group test for line reactors.

7 IP test - in enclosed products

Main standard	IEC/EN 60529
Construction / method standard	IEC 60529
When is it recommended?	Applied if an enclosure protection class such as IP20, IP23, IP54 or IP55 is declared.

8 Thermal camera test

Main standard	IEC/EN 60076-6 thermal performance approach
Construction / method standard	IR thermography at nominal current
When is it recommended?	Local heating is checked around terminals, busbars, winding exits, core clamping points and air gaps.

9 Short-time overcurrent test

Main standard	IEC/EN 60076-6; customer specification
Construction / method standard	Loading with a specified current/time profile
When is it recommended?	Recommended if short-time high current is expected due to drive input pulses, transient conditions or start-up scenarios.

10 Magnetic stray field control

Main standard	IEC/EN 60076-6; customer specification
Construction / method standard	Field measurement nearby or layout analysis
When is it recommended?	Recommended for air-core reactors or installations close to sensitive electronic equipment inside a panel. The OMSAN technical glossary states that the effect of stray field on nearby conductive parts and electronic equipment should be considered in design.

3. Lines Recommended to Be Added to the Test Report

Report row	Recommended content
Product type	Line reactor / input reactor
Nominal values	Voltage, current, frequency, number of phases
Inductance	L value for each phase, measurement frequency, tolerance
Impedance / Z%	Z%2 / Z%4, calculated/measured result at nominal current
Resistance balance	DC resistance value of each phase and phase-to-phase deviation
Loss	Copper loss; total loss in core-type products
Saturation / linearity	L-I check at nominal current or multi-point control
Insulation / hipot	Winding-enclosure and phase-phase results
Mechanical control	Air gap, core tightness, vibration, connection torque
Thermal sensor	Available/not available; contact or resistance test result
Nameplate control	Current, voltage, frequency, Z%, inductance, insulation class, connection

Report row	Recommended content
Optional performance	THDi reduction, temperature rise, sound level, IP test