

B2. Motor protection / drive output reactors - routine tests

Standard Approach

IEC/EN 60076-6 - Reactors may be used as the main reactor standard. IEC 60076-6 covers 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 evaluated for the safety side; IEC 61558-2-20 covers the special safety requirements and tests for small reactors. If system verification will be performed together with the drive, IEC 61800-3 is used as an auxiliary reference systems for EMC requirements, and IEC 61800-5-1 is used for the electrical, thermal and energy safety requirements of adjustable speed drive systems.

1. Routine Tests

1

Winding resistance

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
Description for motor/drive output reactor	Each phase winding is measured separately. The resistance difference between phases is evaluated in terms of contact resistance, incorrect conductor cross-section or winding error.

2

Inductance measurement

Main standard	IEC/EN 60076-6
Construction / method standard	Measurement with an LCR meter, power analyzer or AC test setup
Description for motor/drive output reactor	This is the main functional test of the reactor. The OMSAN renewable systems document emphasizes that the required inductance in LV reactors must be correctly determined by system analysis.

3

Phase balance

Main standard	IEC/EN 60076-6
Construction / method standard	Comparison of L and R for each phase under the same frequency/current condition
Description for motor/drive output reactor	L1-L2-L3 inductance and resistance values must be balanced. Phase imbalance may cause imbalance in motor currents and additional heating.

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Impedance check

Main standard	IEC/EN 60076-6
Construction / method standard	$X_L = 2\pi fL$ calculation based on measured inductance or voltage drop measurement at rated current
Description for motor/drive output reactor	The reactance or impedance value given on the nameplate/technical datasheet is verified. The OMSAN technical glossary states that reactor impedance increases with frequency, and that percent impedance expresses the voltage drop under rated operating conditions.

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Loss measurement

Main standard	IEC/EN 60076-6
Construction / method standard	I ² R calculation from DC resistance; total loss measurement with AC load test for cored type
Description for motor/drive output reactor	Copper loss is the basic loss that determines reactor temperature rise. In iron-core reactors, core loss and stray losses are also added to the total loss.

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Insulation resistance

Main standard	IEC/EN 60076-6; IEC/EN 61558-1 / IEC/EN 61558-2-20
Construction / method standard	Insulation resistance measurement; IEC 61557-2 as an auxiliary reference for practical measurement
Description for motor/drive output reactor	Winding-to-frame insulation and, depending on the design, phase-to-phase insulation are measured. Due to the high dv/dt at the drive output, the insulation system must be evaluated more carefully than in an ordinary 50 Hz application.

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Dielectric withstand / hipot

Main standard	IEC/EN 60076-6; IEC/EN 61558-1 / IEC/EN 61558-2-20
Construction / method standard	AC withstand test; the voltage level is selected according to product voltage and customer specification
Description for motor/drive output reactor	Winding-to-frame and, if required, phase-to-phase main insulation are verified. In PWM-output systems, motor and cable insulation are stressed, so the reactor insulation withstand must be clearly shown in the report.

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Inter-layer winding insulation check

Main standard	IEC/EN 60076-6; IEC/EN 61558-1
Construction / method standard	Induced voltage, impulse/surge winding test or manufacturer procedure
Description for motor/drive output reactor	Because fast voltage edges are present at the drive output, inter-layer insulation check is important. Use of a surge tester is beneficial in serial production.

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Terminal connection check

Main standard	IEC/EN 60076-6; IEC/EN 61558-1
Construction / method standard	Terminal, busbar, terminal marking, torque and continuity check
Description for motor/drive output reactor	U-V-W input/output directions, PE connection, screen/thermal leads if present, and terminal torques are checked. Low contact resistance is important for thermal reliability.

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Thermal protection function test - if present

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

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Mechanical tightness check

Main standard	IEC/EN 60076-6
Construction / method standard	Visual inspection, core/winding tightness check, connection torque check
Description for motor/drive output reactor	At the drive output, PWM-induced electromagnetic forces and current pulses may create mechanical vibration. The OMSAN document specifically states winding symmetry, mechanical fixing, low contact resistance and noise/vibration control in reactor production.

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Vibration / abnormal noise visual check

Main standard	IEC/EN 60076-6; IEC/EN 60076-10 and IEC 60068-2-6 auxiliary if numerical testing is requested
Construction / method standard	Observation at no-load/load; vibration or sound measurement if necessary
Description for motor/drive output reactor	Numerical vibration measurement may not be mandatory in routine testing; however, loose core, coil, busbar and connection noise must be checked.

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Saturation / linearity check

Main standard	IEC/EN 60076-6
Construction / method standard	Inductance measurement at rated current or at several current points
Description for motor/drive output reactor	Saturation check is important in iron-core output reactors. The OMSAN technical glossary states that when the saturation point is exceeded, inductance decreases and the protective effect weakens.

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Nameplate check

Main standard	IEC/EN 60076-6; IEC/EN 61558-1
Construction / method standard	Cross-check of nameplate, technical datasheet and test report
Description for motor/drive output reactor	Current, voltage, frequency, inductance, impedance/Z%, insulation class, temperature rise, number of phases, connection and the drive output/motor reactor statement are checked.

2. Optional / Special Tests

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dv/dt reduction performance test

Main standard	IEC/EN 60076-6; IEC 61800-3 and IEC 61800-5-1 auxiliary for the drive system
Construction / method standard	Oscilloscope measurement at drive output and motor end with/without reactor; comparison of rise time, peak voltage and dv/dt
When is it recommended?	This is the strongest test showing the actual performance of the drive output reactor. It is recommended for long cable, old motor insulation, high switching frequency or critical motor applications.

2

Long cable simulation test

Main standard	IEC/EN 60076-6; IEC 61800-3 in system evaluation
Construction / method standard	Motor-end peak voltage measurement with a defined cable length or equivalent RLC model
When is it recommended?	In long motor cables, impedance mismatch may create voltage reflection and peak voltage at the motor end; the OMSAN technical glossary states that the motor reactor helps reduce this effect.

3

Real operation test with drive

Main standard	IEC 61800-5-1; IEC 61800-3 on the EMC side; IEC/EN 60076-6 for the reactor
Construction / method standard	Measurement of current, temperature, sound, peak voltage and protection behavior with an actual drive + motor or equivalent load
When is it recommended?	If the customer drive brand/model is known, this is the most accurate functional test. Drive switching frequency, cable length and motor insulation class must be included in the test plan.

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Temperature rise test

Main standard	IEC/EN 60076-6; IEC/EN 61558-2-20 for small LV reactors
Construction / method standard	Temperature rise measurement at rated RMS current or at the customer PWM/harmonic current profile
When is it recommended?	Recommended for continuous full load, enclosed panel, high ambient temperature or drives with high switching frequency. The OMSAN document lists thermal load, current density and temperature rise among the design criteria for reactors.

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Noise test

Main standard	IEC/EN 60076-10
Construction / method standard	Measurement by sound pressure or sound intensity method
When is it recommended?	Recommended for indoor, HVAC, pump station, hospital, office or noise-sensitive applications.

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EMC effect evaluation

Main standard	IEC 61800-3; IEC 61000 series auxiliary
Construction / method standard	Evaluation of conducted emission, common mode effect or panel-level EMC with/without reactor
When is it recommended?	The reactor does not replace an EMI filter on its own; however, it may contribute to reducing electromagnetic interference levels by shaping high-frequency components. The OMSAN technical glossary specifically states this point.

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Thermal camera test

Main standard	IEC/EN 60076-6 thermal performance approach
Construction / method standard	IR thermography at rated load or during real operation with drive
When is it recommended?	Hot spots are checked at terminals, busbars, winding exits, core/air gap, thermal sensor and mounting points.

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Loss test under harmonic/PWM current

Main standard	IEC/EN 60076-6; IEC 61000-4-7 / IEC 61000-4-30 auxiliary for measurement
Construction / method standard	Measurement of RMS current, loss and temperature under PWM or harmonic current
When is it recommended?	The current at the drive output is not a classical sine wave; therefore, the additional loss and heating effect of high-frequency components must be verified in critical projects.

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Saturation curve test

Main standard	IEC/EN 60076-6
Construction / method standard	Derivation of the L-I curve at different current points
When is it recommended?	Recommended for iron-core reactors if transient, overcurrent or high RMS current is expected.

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Vibration test

Main standard	IEC 60068-2-6; IEC 61373 auxiliary in railway systems
Construction / method standard	Sinusoidal vibration or vibration profile according to customer specification
When is it recommended?	Recommended for machine-mounted, compressor, pump, mobile system, railway or marine applications.

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IP test - for enclosed products

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

3. Lines Recommended to Be Added to the Test Report

Report line	Recommended content
Product type	Motor protection reactor / drive output reactor
Rated values	Voltage, current, frequency, number of phases
Inductance	L value for each phase, measurement frequency and tolerance
Impedance / Z%	Calculated or measured value under rated current/frequency conditions
Phase balance	Phase-based R and L deviation
Loss	Copper loss, total loss in cored type
Insulation / dielectric	Winding-to-frame, phase-to-phase and inter-layer winding test if required
Saturation / linearity	L-I check at rated current or at multiple points
Thermal protection	PTC/PT100/thermostat result
Mechanical check	Core, air gap, coil tightness, terminal torque
Optional performance	dv/dt reduction, motor-end peak voltage, long cable simulation
Nameplate check	Current, voltage, inductance, Z%, insulation class, connection, drive output use