E13 Test requirements for Rotating Machines

(1996) (Rev.1 May 2001) (Corr.1 May 2004) (Rev.2 Aug 2015) (Corr.1 June 2018)

1. General

All machines are to be tested by the manufacturer.

Manufacturer's test records are to be provided for machines for essential services, for other machines they are to be available upon request.

All tests are to be carried out according to IEC ~~Publication~~ 60092-301.

All machines of 100kW and over, intended for essential services, are to be surveyed by the Society during test and, if appropriate, during manufacturing.

Note: An alternative survey scheme may be agreed by the Society with the manufacturer whereby attendance of the Surveyor will not be required as required above.

2. Shaft Material

Shaft material for electric propulsion motors and for main engine driven generators where the shaft is part of the propulsion shafting is to be certified by the Society.

Shaft material for other machines is to be in accordance with recognised international or national standard.

3. Tests

Type tests are to be carried out on a prototype machine or on the first of a batch of machines, and routine tests carried out on subsequent machines in accordance with Table 1.

Note: Test requirements may differ for shaft generators, special purpose machines and machines of novel construction.

Note:

1. Rev.2 of this UR is to be uniformly implemented by IACS Societies for rotating machines:

   i) when an application for certification of a rotating machine is dated on or after 1 January 2017; or

   ii) which are installed in new ships for which the date of contract for construction is on or after 1 January 2017.

2. The "contracted for construction" date means the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. For further details regarding the date of "contract for construction", refer to IACS Procedural Requirement (PR) No. 29.

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Table 1

No.	Tests	A.C. Generators		Motors	
		Type test[1)]	Routine test[2)]	Type test[1)]	Routine test[2)]
1.	Examination of the technical documentation, as appropriate and visual inspection	x	x	x	x
2.	Insulation resistance measurement	x	x	x	x
3.	Winding resistance measurement	x	x	x	x
4.	Verification of the voltage regulation system	x	x[3)]		
5.	Rated load test and temperature rise measurements	x		x	
6.	Overload/overcurrent test	x	x[4)]	x	x[4)]
7.	Verification of steady short circuit conditions[5)]	x			
8.	Overspeed test	x	x	x[6)]	x[6)]
9.	Dielectric strength test	x	x	x	x
10.	No-load test	x	x	x	x
11.	Verification of degree of protection	x		x	
12.	Verification of bearings	x	x	x	x

1) Type tests on prototype machine or tests on at least the first batch of machines.

2) The report of machines routine tested is to contain the manufacturer's serial number of the machine which has been type tested and the test result.

3) Only functional test of voltage regulator system.

4) Only applicable for machine of essential services rated above 100kW.

5) Verification of steady short circuit condition applies to synchronous generators only.

6) Not applicable for squirrel cage motors.

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4. Description of the test

4.1 Examination of the technical documentation, as appropriate and visual inspection

4.1.1 Examination of the technical documentation

Technical documentation of machines rated at 100kW and over is to be available for examination by the Surveyor.

4.1.2 Visual inspection

A visual examination is to be made of the machine to ensure, as far as is practicable, that it complies with technical documentation.

4.2 Insulation resistance measurement

Immediately after the high voltage tests the insulation resistances are to be measured using a direct current insulation tester between:

a) all current carrying parts connected together and earth,

b) all current carrying parts of different polarity or phase, where both ends of each polarity or phase are individually accessible.

The minimum values of test voltages and corresponding insulation resistances are given in Table 2. The insulation resistance is to be measured close to the operating temperature, or an appropriate method of calculation is to be used.

Table 2

Related Voltage Un (V)	Minimum Test Voltage (V)	Test Minimum Insulation Resistance (MΩ)
Un ≤ 250	2 x Un	1
250 < Un ≤ 1000	500	1
1000 < Un ≤ 7200	1000	(Un / 1000) + 1
7200 < Un ≤ 15000	5000	(Un / 1000) + 1

4.3 Winding resistance measurement

The resistances of the machine windings are to be measured and recorded using an appropriate bridge method or voltage and current method.

4.4 Verification of the voltage regulation system

The alternating current generator, together with its voltage regulation system shall, at all loads from no-load running to full load, be able to keep rated voltage at the rated power factor under steady conditions within ± 2.5%. These limits may be increased to ± 3.5% for emergency sets.

When the generator is driven at rated speed, giving its rated voltage, and is subjected to a sudden change of symmetrical load within the limits of specified current and power factor, the voltage is not to fall below 85% nor exceed 120% of the rated voltage.

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The voltage of the generator is then to be restored to within plus or minus 3% of the rated voltage for the main generator sets in not more than 1.5 s. For emergency sets, these values may be increased to plus or minus 4% in not more than 5 s, respectively.

In the absence of precise information concerning the maximum values of the sudden loads, the following conditions may be assumed: 60% of the rated current with a power factor of between 0.4 lagging and zero to be suddenly switched on with the generator running at no load, and then switched off after steady - state conditions have been reached. Subject to Classification Society's approval, such voltage regulation during transient conditions may be calculated values based on the previous type test records, and need not to be tested during factory testing of a generator.

4.5 Rated load test and temperature rise measurements

The temperature rises are to be measured at the rated output, voltage, frequency and the duty for which the machine is rated and marked in accordance with the testing methods specified in IEC ~~Publication~~ 60034-1, or by means of a combination of other tests.

The limits of temperature rise are those specified in Table 1 of IEC ~~Publication~~ 60034-1 adjusted as necessary for the ambient reference temperatures specified in UR M40.

4.6 Overload/overcurrent tests

Overload test is to be carried out as a type test for generators as a proof of overload capability of generators and excitation system, for motors as a proof of momentary excess torque as required in IEC ~~Publication~~ 60034-1. The overload test can be replaced at routine test by the overcurrent test. The over current test shall be the proof of current capability of windings, wires, connections etc. of each machine. The overcurrent test can be done at reduced speed (motors) or at short circuit (generators).

4.7 Verification of steady short-circuit conditions

It is to be verified that under steady-state short-circuit conditions, the generator with its voltage regulating system is capable of maintaining, without sustaining any damage, a current of at least three times the rated current for a duration of at least 2 s or, where precise data is available, for a duration of any time delay which will be fitted in the tripping device for discrimination purposes.

In order to provide sufficient information to the party responsible for determining the discrimination settings in the distribution system where the generator is going to be used, the generator manufacturer shall provide documentation showing the transient behaviour of the short circuit current upon a sudden short-circuit occurring when excited, and running at nominal speed. The influence of the automatic voltage regulator shall be taken into account, and the setting parameters for the voltage regulator shall be noted together with the decrement curve. Such a decrement curve shall be available when the setting of the distribution system's short-circuit protection is calculated. The decrement curve need not be based on physical testing. The manufacturer's simulation model for the generator and the voltage regulator may be used where this has been validated through the previous type test on the same model.

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4.8 Overspeed test

Machines are to withstand the overspeed test as specified in to IEC ~~Publication~~ 60034-1. This test is not applicable for squirrel cage motors.

4.9 Dielectric strength test

Machines are to withstand a dielectric test as specified in IEC ~~Publication~~ 60034-1.

For high voltage machine an impulse test is to be carried out on the coils according to UR E11.

4.10 No load test

Machines are to be operated at no load and rated speed whilst being supplied at rated voltage and frequency as a motor or if a generator it is to be driven by a suitable means and excited to give rated terminal voltage.

During the running test, the vibration of the machine and operation of the bearing lubrication system, if appropriate, are to be checked.

4.11 Verification of degree of protection

As specified in IEC ~~Publication~~ 60034-5.

4.12 Verification of bearings

Upon completion of the above tests, machines which have sleeve bearings are to be opened upon request for examination by the Classification Society Surveyor, to establish that the shaft is correctly seated in the bearing shells.

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