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Reciprocating internal combustion engine driven alternating current generating sets —

Part 6: Test methods

Groupes électrogènes à courant alternatif entraînés par moteurs alternatifs à combustion interne —

Partie 6: Méthodes d'essai

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 8528-6 was prepared by Technical Committee ISO/TC 70, *Internal combustion engines*.

This second edition cancels and replaces the first edition (ISO 8528-6:1993), which has been technically revised.

ISO 8528 consists of the following parts, under the general title *Reciprocating internal combustion engine driven alternating current generating sets*:

— *Part 1: Application, ratings and performance*

— *Part 2: Engines*

— *Part 3: Alternating current generators for generating sets*

— *Part 4: Controlgear and switchgear*

— *Part 5: Generating sets*

— *Part 6: Test methods*

— *Part 7: Technical declarations for specification and design*

— *Part 8: Requirements and tests for low-power generating sets*

— *Part 9: Measurement and evaluation of mechanical vibrations*

— *Part 10: Measurement of airborne noise by the enveloping surface method*

— *Part 11: Rotary uninterruptible power systems — Performance requirements and test methods*[1)]

— *Part 12: Emergency power supplies to safety services*

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1) Part 11 will be published as ISO/IEC 88528-11.

Reciprocating internal combustion engine driven alternating current generating sets —

Part 6: Test methods

1 Scope

This part of ISO 8528 specifies the test methods to be used for characterizing an entire generating set. It applies to alternating current (a.c.) generating sets driven by reciprocating internal combustion (RIC) engines for land and marine use, excluding generating sets used on aircraft or to propel land vehicles and locomotives.

For some specific applications (e.g. essential hospital supplies, high-rise buildings) supplementary requirements may be necessary. The provisions of this part of ISO 8528 are intended as a basis for establishing any supplementary requirements.

For a.c. generating sets driven by other reciprocating type prime movers (e.g. steam engines), this part of ISO 8528 is intended as a basis for establishing these requirements.

NOTE Existing test methods for the engine (ISO 3046-1 and ISO 3046-3) and generator (IEC 60034-2) are applicable for those components. The generating set manufacturer is responsible for specifying these characteristics and the tests to be performed to verify them.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3046-1, *Reciprocal internal combustion engines — Performance — Part 1: Declarations of power, fuel and lubricating oil consumptions, and test methods — Additional requirements for engines for general use*

ISO 3046-3, *Reciprocating internal combustion engines — Performance — Part 3: Test measurements*

ISO 8528-1[2)], *Reciprocating internal combustion engine driven alternating current generating sets — Part 1: Application, ratings and performance*

ISO 8528-5[2)], *Reciprocating internal combustion engine driven alternating current generating sets — Part 5: Generating sets*

IEC 60034-2, *Rotating electrical machines — Part 2: Methods for determining losses and efficiency of rotating electrical machinery from tests (excluding machines for traction vehicles)*

IEC 60034-5, *Rotating electrical machines — Part 5: Classification of degrees of protection provided by enclosures for rotating machines*

IEC 60947-1, *Low-voltage switchgear and control gear — Part 1: General rules*

2) ISO 8528-1 and ISO 8528-5 are under revision.

3 Other regulations and additional requirements

For a.c. generating sets used on board ships and offshore installations which have to comply with rules of a classification society, the additional requirements of the classification society shall be observed. The classification society name shall be stated by the customer prior to placing the order.

For a.c. generating sets operating in non-classified equipment, any additional requirements are subject to agreement between the manufacturer and customer.

If special requirements from regulations of any other authority (e.g. inspecting and/or legislative authorities) have to be met, the authority name shall be stated by the customer prior to placing the order.

Any additional requirements shall be subject to agreement between the manufacturer and customer.

4 General test requirements

Generating sets shall be tested in accordance with either the ISO standard functional test (see Clause 5) or the ISO standard acceptance test (see Clause 6).

Subject to agreement between the generating set manufacturer and customer, any or all of the functional tests may be combined with the acceptance test.

The acceptance test shall be carried out at the manufacturer's works and/or installation site. The type of test to be performed shall be agreed in writing between the manufacturer and customer.

Detailed requirements for the generating set acceptance tests depend on the following principal areas:

a) its application;

b) its power output;

c) the extent of supply;

d) its use;

e) its performance class according to ISO 8528-1 and ISO 8528-5.

As a minimum, the generating set manufacturer test shall perform the ISO standard functional test in accordance with the correct rating and performance class of the generating set. A test report shall be prepared in accordance with the requirements of 5.5.

The ISO standard functional test procedure is intended for use with the generating set installed on the manufacturer's test bed. Subject to agreement between the manufacturer and customer, the functional and/or acceptance test may be performed at the customer's site or at a third party location.

5 ISO standard functional test

5.1 General

This functional test shall be performed on the generating set with it at the manufacturer's works under test-bed conditions. The rated power factor load is normally used for testing, with due regard paid to the rated active power and associated generator efficiency. Optionally, if this is not possible because of the test equipment used, this test may be performed at a power factor of unity. This shall be by agreement between the manufacturer and customer.

5.2 General inspection

A general inspection in order to establish compliance with specifications in accordance with the generator set manufacturer's instructions shall be carried out which shall cover (as a minimum):

a) completeness of the item supplied and to be tested;

b) alignment;

c) functional operations of the auxiliary equipment supplied (by agreement);

d) tightness of pipework joints and components;

e) degree of protection as described in IEC 60034-5 and IEC 60947-1;

f) operating and monitoring functions.

NOTE When measuring non-precision parts, such as a fan guard, a statistical approach to protection prediction is acceptable.

5.3 Measurements

The test shall be performed on generating sets that have reached their nominal operating temperature. The time required to warm up the generating set will vary. It is the responsibility of the test engineer to ensure that the set has run for an adequate time in order to stabilize temperatures.

The following data shall be recorded (as a minimum):

a) ambient temperature, humidity and barometric pressure;

b) generating set voltage, current and frequency at rated output;

c) generating set voltage, frequency and current while loading and unloading to assess transient behaviour;

d) the proper functioning of any monitoring and control equipment.

5.4 Measurement equipment accuracy

The minimum accuracy of the instrumentation used in the test shall be as shown in Table 1.

Measuring transformers and transducers should be of a corresponding accuracy class.

Table 1 — ISO standard acceptance test — Measurement equipment accuracy

Parameter	Unit	Accuracy (%)
Current	A	1,5
Voltage	V	1,5
Real power	W	1,5
Reactive power	kV·A	1,5
Power factor	—	3,0
Frequency	Hz	0,5

5.5 ISO standard functional test report

The ISO standard functional test report shall include the following information (as a minimum):

a) the generating set performance class in accordance with the requirements of ISO 8528-1;

b) the customer and order number (if known);

c) the manufacturer;

d) the engine, generator, controlgear and switchgear serial numbers;

e) technical data, both declared (rated) and measured, as follows:

   1) power;

   2) voltage;

   3) frequency;

   4) current;

   5) power factor;

   6) speed;

   7) circuit diagram number;

   8) type of cooling system.

f) enclosure protection;

g) test site ambient conditions:

   1) altitude;

   2) barometric pressure;

   3) temperature;

   4) relative humidity;

   5) inlet air temperature;

   6) inlet coolant temperature.

h) fuel type (specification number):

   1) density;

   2) calorific value (lower calorific value).

i) lubricating oil type (specification number).

6 Acceptance test

6.1 General

ISO 8528-1 to ISO 8528-5 specify requirements for various generating set applications. The manufacturer shall certify that the generating set complies with the requirements given in ISO 8528-2 to ISO 8528-5, unless compliance is established by using the acceptance test in accordance with this part of ISO 8528. In particular, this applies to claiming compliance with the contractually agreed performance classes defined in ISO 8528-1 and ISO 8528-5, as well as to agreed requirements or variations in the performance classification for specific operating limits.

6.2 Contractual arrangements

The details of an acceptance test performed in accordance with the requirements of this part of ISO 8528 shall be agreed in writing between the manufacturer and customer at the time of purchase. The test equipment used shall be such that the measurements and checks agreed for the acceptance test can be verified within the agreed accuracy limits.

The validation of further requirements, the performance of additional measurements or the provision of further tests which go beyond the requirements of 6.6 shall be agreed in writing between the manufacturer and customer before any tests are performed. If the requirements of the tests specified in Clause 6 are changed during the acceptance test, an appropriate agreement shall be made.

The cost of a complete or partial repetition or extension of the agreed acceptance test programme shall be borne by the party responsible for the repetition or extension.

The acceptance test shall be performed within the agreed period following notification of readiness for the test to start.

The manufacturer of the generating set shall not be responsible for servicing any equipment provided by the customer.

By agreement between the manufacturer and the customer, the works test of the complete generating set with test certificates may be considered as substitutes for the acceptance test.

Separate acceptance tests performed on installed components (e.g. engine, generator, switchgear) shall not be considered suitable substitutes for the acceptance test carried out on the complete power station or generating set. In special cases and if agreed between the generating set manufacturer and customer, component test records supplied by the component manufacturer may be used for the verification of certain properties.

If computation documents are necessary to verify or as part of measurements and/or tests, it shall be specified which documents have to be made available, by which party and at what time.

Within the scope of the contractual arrangements, an independent inspector acceptable to both parties may be asked to witness the acceptance test performed at the manufacturer's works and/or at the site of installation. The acceptance test may be performed at the manufacturer's works and/or at the site of installation. The place where the test is to be carried out shall be agreed in writing.

6.3 Responsibility

The manufacturer shall be responsible for the acceptance test at his works.

The responsibilities of the customer and the manufacturer's agent shall be agreed before starting the acceptance test.