INTERNATIONAL STANDARD

ISO 3977-2

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Gas turbines — Procurement —

Part 2:
Standard reference conditions and ratings

Turbines à gaz — Spécifications pour l'acquisition —

Partie 2: Conditions normales de référence et caracatéristiques

Reference number
ISO 3977-2:1997(E)

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.

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.

International Standard ISO 3977-2 was prepared by Technical Committee TC 192, *Gas turbines*.

This first edition of ISO 3977-2, together with the other parts, cancels and replaces ISO 3977:1991, which has been technically revised.

ISO 3977 consists of the following parts, under the general title: *Gas turbines – Procurement*

— *Part 1: General introduction and definitions*

— *Part 2: Standard reference conditions and ratings*

— *Part 3: Basic requirements for mechanical drive and electric drive*

— *Part 4: Packaging and auxiliary equipment*

— *Part 5: Controls and instrumentation*

Further parts are in preparation.

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Gas turbines — Procurement —

Part 2:
Standard reference conditions and ratings

1 Scope

This part of ISO 3977 specifies the standard reference conditions and ISO standard ratings for gas turbines.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 3977. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of ISO 3977 are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2314:1989, *Gas turbines — Acceptance tests.*

3 Standard reference conditions

The standard reference conditions on which ISO power, efficiency, heat rate and specific fuel consumption are based are as specified in 3.1 to 3.4.

3.1 Air intake conditions

For the intake air at the compressor flange (alternatively, the compressor intake flare), as described in ISO 2314:1989, 6.6.2, the conditions shall be

- a total pressure of 101,3 kPa;
- a total temperature of 15 °C;
- a relative humidity of 60 %.

3.2 Exhaust conditions

For the exhaust at the turbine exhaust flange (or regenerator outlet, if a regenerative cycle is used), the static pressure shall be 101,3 kPa.

3.3 Cooling water conditions (if applicable)

The inlet water temperature shall be 15 °C if cooling of the working fluid is used.

3.4 Working fluid heater or cooler

Where a heater or a cooler is used that uses ambient air, the standard reference conditions of the ambient air shall be 15 °C and 101,3 kPa.

4 Ratings

4.1 General

4.1.1 The output power of a given gas turbine at a given reference turbine inlet temperature is, in general, proportional to the absolute ambient pressure and is also greatly dependent on the air intake temperature (normally outside dry bulb temperature). Likewise, the output at a given air intake temperature is dependent on the reference turbine inlet temperature. To achieve a rating, it is necessary to adopt standard conditions of ambient temperature and pressure, but gas turbine ratings will nevertheless vary considerably owing to the differing operational modes demanded of them as well as the varying criteria used in the design of the basic elements. ISO standard ratings neglect pressure drop at the inlet and exhaust but site ratings allow for these losses.

NOTE — Steam or water injection may be used to increase the power output and to reduce the NO_x emissions.

4.1.2 The performance ratings of gas turbines shall be assessed on the net specific energy of the fuel used, as follows:

a) turbines intended for use on liquid fuel: 42 000 kJ/kg;

b) turbines intended for use on gaseous fuel (100 % methane): 50 000 kJ/kg.

The specific energy at constant pressure of the fuel, whether liquid, gaseous or solid, is based on a pressure of 101,3 kPa and a temperature of 15 °C.

4.1.3 If the fuel to be used for testing the gas turbine is different from that agreed between the purchaser and the manufacturer for service operation, a test fuel of a mutually agreed specification shall be used.

NOTE — Further information will be given in ISO 3977-9, now in course of preparation.

4.2 Operational modes

Unless specially agreed upon between the purchaser and the manufacturer, the net power rating of a gas turbine shall be specified under a combination of one of the classes specified in 4.2.1 together with one of the ranges of average number of starts per annum specified in 4.2.2.

EXAMPLE

B II (Class B, Range II) refers to operation of up to 2 000 h per annum associated with any number of starts up to 500 per annum.

The manufacturer shall state the type, frequency and degree of inspection and/or maintenance required for the relevant operational mode.

NOTE — Further information will be given in ISO 3977-9, now in course of preparation.

4.2.1 Classes

Class A: operation up to and including 500 h per annum at reserve peak power rating;

Class B: operation up to and including 2 000 h per annum at peak power rating;

Class C: operation up to and including 6 000 h per annum at semi-base power rating;

Class D: operation up to and including 8 760 h per annum at base power rating.

NOTE — It should be recognized that some gas turbine applications will operate with a combination of the classes given in 4.2.1. In such cases, the purchaser should specify the anticipated number of annual hours of operation at the specified net power ratings in each class. Operation outside these specified net power ratings/operational modes could materially affect the inspection intervals and maintenance required.

4.2.2 Ranges

Range I: over 500 starts per annum average;

Range II: up to 500 starts per annum average;

Range III: up to 100 starts per annum average;

Range IV: up to 25 starts per annum average;

Range V: continuous operation without planned shutdown for inspection and/or maintenance within a specified period.

4.3 ISO standard ratings

The manufacturer shall declare standard ratings, based on electrical power at the generator terminals or on turbine output shaft power under the standard reference conditions defined in clause 3, associated with the following operational modes:

a) ISO standard peak load rating (2 000 h and 500 starts per annum average) Class B: Range II;

b) ISO standard base load rating (8 760 h and 25 starts per annum average) Class D: Range IV.

In each case, the manufacturer shall state the type, frequency and degree of inspection and/or maintenance required.

4.4 Site ratings

The site power rating shall be specified by the manufacturer as follows.

a) Generating plant: the net electrical power at the generator terminals, with adjustment for auxiliary power as given in ISO 2314:1989, 8.1.2.

b) Mechanical drives: the net shaft power, adjusted for any auxiliaries not driven directly by the turbine (as defined in ISO 2314:1989, 8.1.1).

In either case, the site power rating shall relate to specified site conditions of the installation (such as ambient pressure and temperature, and pressure losses, steam and water injection, etc.) and operating modes under which the plant is intended to run in service.

When the gas generator is supplied separately, its site power shall be expressed as the gas power arising from the isentropic expansion of the gas generator exhaust flow (using total pressure and temperature) to the ambient atmospheric pressure when it is operated under the specified site conditions of the installation and operating modes under which the plant is intended to run in service (see ISO 2314:1989, 6.3.5).

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