

Guide to

# Acceptance tests for steam turbine speed control systems

The European Standard EN 61064:1993 has the status of a  
British Standard

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# Contents

|                                                        | Page               |
|--------------------------------------------------------|--------------------|
| Cooperating organizations                              | Inside front cover |
| National foreword                                      | ii                 |
| Foreword                                               | 2                  |
| Text of EN 61064                                       | 5                  |
| National annex NA (informative) Committees responsible | Inside back cover  |
| National annex NB (informative) Cross-references       | Inside back cover  |

## National foreword

This British Standard has been prepared under the direction of the Machinery and Components Standards Policy Committee and is the English language version of EN 61064:1993 *Acceptance tests for steam turbine speed control systems* published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 1064:1991 published by the International Electrotechnical Commission (IEC).

For graphical symbols, and letter symbols and signs approved by the IEC for general use, readers are referred to:

- IEC Publication 27: *Letter symbols to be used in electrical technology*;
- IEC Publication 617: *Graphical symbols for diagrams*

The symbols and signs contained in the present publication have either been taken from IEC Publications 27 or 617, or have been specifically approved for the purpose of this publication.

For general terminology, readers are referred to IEC Publication 50: *International Electrotechnical Vocabulary (IEV)*, which is issued in the form of separate chapters each dealing with a specific field, the General Index being published as a separate booklet. Full details of the IEV will be supplied on request.

The terms and definitions contained in the present publication have either been taken from the IEV or have been specifically approved for the purpose of this publication.

EN 61064 was produced as a result of international discussion in which the United Kingdom took an active part.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

**Compliance with a British Standard does not of itself confer immunity from legal obligations.**

### Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 30, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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Descriptors: Steam turbine, control system, speed, overspeed protection, acceptance test

English version

## Acceptance tests for steam turbine speed control systems

(IEC 1064:1991)

Essais de réception des systèmes de régulation  
de vitesse des turbines à vapeur  
(CEI 1064:1991)

Abnahmeprüfungen für  
Dampfturbinen-Regelsysteme  
(IEC 1064:1991)

This European Standard was approved by CENELEC on 1992-12-09. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

## CENELEC

European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**Central Secretariat: rue de Stassart 35, B-1050 Brussels**

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## Foreword

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 1064:1991 could be accepted without textual changes, has shown that no common modifications were necessary for the acceptance as European Standard.

The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as EN 61064 on 9 December 1992.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1993-12-01
- latest date of withdrawal of conflicting national standards (dow) 1993-12-01

For products which have complied with the relevant national standard before 1993-12-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 1998-12-01.

Annexes designated “normative” are part of the body of the standard. In this standard, Annex A and Annex ZA are normative.

## Contents

|                                                                                     | Page | Page                                                                                                                                       |
|-------------------------------------------------------------------------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Foreword                                                                            | 2    |                                                                                                                                            |
| 1 Scope and object                                                                  | 5    | 6.1 Turbine at standstill 15                                                                                                               |
| 2 Normative reference                                                               | 5    | 6.2 Turbine at no-load 15                                                                                                                  |
| 3 Terms, symbols, definitions and units                                             | 5    | 6.3 Turbine on load 15                                                                                                                     |
| 4 Guiding principles                                                                | 7    | 6.4 Dynamic testing of overspeed protection system by turbine trip from maximum load 15                                                    |
| 4.1 Matters on which agreement shall be reached                                     | 7    | 6.4.1 Overview 15                                                                                                                          |
| 4.2 Time of carrying out tests                                                      | 8    | 6.4.2 Operating conditions 15                                                                                                              |
| 4.3 Preparation for acceptance tests                                                | 8    | 6.4.3 Test procedure 15                                                                                                                    |
| 4.4 Instruments                                                                     | 8    | 6.4.4 Test results 15                                                                                                                      |
| 4.5 Test report                                                                     | 9    | Annex A (normative) General guidance 17                                                                                                    |
| 5 Speed governing system tests                                                      | 9    | Annex ZA (normative) Other international publications quoted in this standard with the references of the relevant European publications 29 |
| 5.1 Turbine at standstill                                                           | 9    | Figure 1 — Diagram of condensing reheat steam turbine set 19                                                                               |
| 5.2 Turbine at no-load                                                              | 9    | Figure 2 — Static characteristics at no-load 21                                                                                            |
| 5.2.1 Overview                                                                      | 9    | Figure 3 — Speed-speed changer setting relationship 22                                                                                     |
| 5.2.2 Test procedure for determination of static characteristics                    | 10   | Figure 4 — Static characteristics on load 23                                                                                               |
| 5.2.3 Determination of dead band                                                    | 10   | Figure 5 — Cylinder fluid pressure versus servomotor stroke 24                                                                             |
| 5.2.4 Speed range determination                                                     | 10   | Figure 6 — Servomotor stiffness characteristic 25                                                                                          |
| 5.2.5 Stability                                                                     | 10   | Figure 7 — Network frequency-load relationship 26                                                                                          |
| 5.3 Turbine on load                                                                 | 11   | Figure 8 — Static characteristic of the speed governing system for one setting of the speed changer 27                                     |
| 5.3.1 Overview                                                                      | 11   | Figure 9 — Block-diagram of a typical speed governing system 28                                                                            |
| 5.3.2 Test conditions                                                               | 11   | Table 1 5                                                                                                                                  |
| 5.3.3 Load-steam flow demand relationship                                           | 11   | Table 2 6                                                                                                                                  |
| 5.3.4 Dead band determination — Overview                                            | 11   | Table 3 14                                                                                                                                 |
| 5.3.5 Dead band determination — Method 1                                            | 12   |                                                                                                                                            |
| 5.3.6 Dead band determination — Method 2                                            | 12   |                                                                                                                                            |
| 5.3.7 Determination of steady-state speed regulation — Method 1                     | 12   |                                                                                                                                            |
| 5.3.8 Determination of steady-state speed regulation — Method 2                     | 13   |                                                                                                                                            |
| 5.3.9 Determination of incremental speed regulation — Method 1                      | 13   |                                                                                                                                            |
| 5.3.10 Determination of incremental speed regulation — Method 2                     | 13   |                                                                                                                                            |
| 5.3.11 Stability                                                                    | 13   |                                                                                                                                            |
| 5.4 Dynamic tests of the speed governing system by sudden load rejection to no-load | 13   |                                                                                                                                            |
| 5.4.1 Overview                                                                      | 13   |                                                                                                                                            |
| 5.4.2 Operating conditions                                                          | 13   |                                                                                                                                            |
| 5.4.3 Test procedure                                                                | 14   |                                                                                                                                            |
| 5.4.4 Test results                                                                  | 15   |                                                                                                                                            |
| 5.4.5 Stability                                                                     | 15   |                                                                                                                                            |
| 6 Overspeed protection system tests                                                 | 15   |                                                                                                                                            |



## 1 Scope and object

This International Standard applies primarily to constant-speed steam turbines driving a.c. generators at power stations, for testing speed control systems consisting of speed governing and overspeed protection systems. It may also be used, where appropriate, for other types of steam turbines.

The purpose of acceptance tests of steam-turbine speed governing and overspeed protection systems is to verify any criteria quoted in the manufacturer's guarantees. Such tests will generally be carried out to check compliance with IEC 45-1. The criteria may include:

- a) steady-state speed regulation (speed governing droop);
- b) steady-state incremental speed regulation (incremental speed governing droop);
- c) range of speed at no-load corresponding to the extreme settings of the speed changer;
- d) dead band of the speed governing system;
- e) stability of the speed governing system;
- f) maximum transient increase of speed following full load rejection and any partial load rejections, with the speed governing system in operation;
- g) overspeed trip setting;
- h) maximum transient overspeed following full load rejection on the failure of the speed governing system.

Selection of the tests to be carried out and procedures for other tests not covered by this specification shall be agreed upon between the manufacturer and the purchaser.

## 2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard 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.

IEC 45:1991, *Steam turbines — Part 1: Specifications*.

## 3 Terms, symbols, definitions and units

Using these rules it is recommended to employ the symbols, definitions and units that are given in Table 1 and Table 2 and in Figure 1. Table 1 lists basic terms, symbols, and units, while Table 2 presents terms, symbols, definitions, and units of parameters specific to this standard. IEC 45-1 definitions are also applicable.

Table 1

| No. | Term                                          | Symbol   | Unit                   |
|-----|-----------------------------------------------|----------|------------------------|
| 1   | Power or load                                 | $L$      | MW or kW               |
| 2   | Pressure                                      | $p$      | MPa or bar             |
| 3   | Temperature                                   | $e$      | K or °C                |
| 4   | Angular speed                                 | $\omega$ | rad/s                  |
| 5   | Rotational speed                              | $n$      | Hz, rev/s<br>(rev/min) |
| 6   | Voltage                                       | $U$      | V                      |
| 7   | Current                                       | $I$      | A                      |
| 8   | Position or stroke of servomotors             | $s$      | mm, rad or (°)         |
| 9   | Position or stroke of valves                  | $h$      | mm, rad or (°)         |
| 10  | Position or stroke of pilots                  | $x$      | mm, rad or (°)         |
| 11  | Time constant, characteristic time of element | $T$      | s                      |
| 12  | Time as independent variable                  | $t$      | s                      |
| 13  | Speed or load setting point                   | $y$      | % or other             |

Table 2

| No. | Term                                                        | Symbol    | Definition                                                                                                                                                                                                                                                                                                                                                                                         | Unit                   |
|-----|-------------------------------------------------------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| 1   | Rated speed                                                 | $n_o$     | The speed at which the turbine is specified to operate at its rated output                                                                                                                                                                                                                                                                                                                         | Hz<br>rev/s<br>rev/min |
| 2   | Minimum controlled speed at no-load                         | $n_1$     | The speed at no-load corresponding to the lower setting of the speed changer                                                                                                                                                                                                                                                                                                                       | Hz<br>rev/s<br>rev/min |
| 3   | Maximum controlled speed at no-load                         | $n_2$     | The speed at no-load corresponding to the upper setting of the speed changer                                                                                                                                                                                                                                                                                                                       | Hz<br>rev/s<br>rev/min |
| 4   | Temporary speed rise                                        |           | The transient increase in turbine speed following a load rejection, with the speed governing system in operation. The rated temporary speed rise applies if the rated output is rejected at rated speed                                                                                                                                                                                            | Hz<br>rev/s<br>rev/min |
| 5   | Maximum speed rise                                          |           | The maximum transient increase in turbine speed following a load rejection, with the speed governing system inoperative. The rated maximum speed rise applies if the rated output is rejected at rated speed                                                                                                                                                                                       | Hz<br>rev/s<br>rev/min |
| 6   | Maximum transient speed                                     | $n_m$     | The maximum transient increase in turbine speed following rejection of maximum capability by disconnecting the generator from the electrical system (with auxiliary supplies previously disconnected) and the speed governing system in operation                                                                                                                                                  | Hz<br>rev/s<br>rev/min |
| 7   | Maximum transient overspeed                                 | $n_{ops}$ | The maximum rotational speed following rejection of maximum capability by disconnecting the generator from the electrical system (with auxiliary supplies previously disconnected) and the speed governing system inoperative                                                                                                                                                                      | Hz<br>rev/s<br>rev/min |
| 8   | Overspeed trip setting                                      | $n_s$     | The speed at which the overspeed trip is set to operate                                                                                                                                                                                                                                                                                                                                            | Hz<br>rev/s<br>rev/min |
| 9   | Maximum continuous rating (MCR) (electrical generating set) | $L_o$     | The power output assigned to the turbine-generator by the supplier, at which the unit may be operated for an unlimited time, not exceeding the specified life, at the specified terminal conditions. This is the rating which will normally carry a guarantee of heat rate. The governing valves will not necessarily be fully open. (Also referred to as rated output, rated power or rated load) | MW<br>or<br>kW         |
| 10  | Maximum capability                                          | $L_{max}$ | The maximum power output that the turbine can produce with the governing valves fully open and at the specified initial steam conditions. (Also referred to as valves-wide-open capability or maximum load)                                                                                                                                                                                        | MW<br>or<br>kW         |

Table 2

| No. | Term                                                                | Symbol        | Definition                                                                                                                                                                                                                                         | Unit                  |
|-----|---------------------------------------------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| 11  | Maximum overload capability                                         | $L_{ol}$      | The maximum power output that the unit can produce with the governing valves fully open, and with the terminal conditions specified for overload, e.g. with final feed water heater bypassed or with increased initial steam pressure              | MW<br>or<br>kW        |
| 12  | Dead band of the speed governing system                             | $\varepsilon$ | The total magnitude of the change in steady-state speed (expressed as a percentage of rated speed), within which there is no resultant change in the position of the governing valves. The dead band is a measure of the sensitivity of the system | %<br>(Dimension-less) |
| 13  | Steady-state speed regulation (speed governing droop)               | $\delta$      | The steady-state speed change, expressed as a percentage of rated speed, when the load of an isolated unit is changed between rated load and zero load, with identical setting of the speed governing system, assuming a zero dead band            | %<br>(Dimension-less) |
| 14  | Steady-state incremental speed regulation (incremental speed droop) | $\delta_1$    | The rate of change of the steady-state speed with respect to load at a given steady-state speed and load, assuming a zero dead band. The value is the slope of the tangent to the steady-state speed/load curve at the load under consideration    | %<br>(Dimension-less) |
| 15  | Steam flow demand                                                   | $d_c$         | The signal generated in the speed governing system which represents the required steam flow to the turbine                                                                                                                                         | MPa<br>V<br>or<br>A   |
| 16  | Fluid pressure in control system                                    | $p_c$         | Fluid pressure at different points of the hydraulic control system                                                                                                                                                                                 | MPa                   |
| 17  | Stability                                                           |               | The capability of the speed governing system to reduce oscillations of the speed or load resulting from the action of the governing system to amplitudes within acceptable limits                                                                  |                       |

## 4 Guiding principles

### 4.1 Matters on which agreement shall be reached

a) The parties to the test shall, prior to the tests, reach agreement on the object of the tests and on the interpretation of the guarantees. Unless otherwise stated in the contract, the control system functions shall be verified in accordance with 1.2.

b) Agreement shall be reached on the method of operation and on such matters as the means of maintaining constant steam conditions and output. If the test conditions differ from those specified in the test program, agreement shall be reached on the methods of conversion of experimental values.