Rules for steam turbine thermal acceptance tests - Part 0: Wide range of accuracy for various types and sizes of turbines

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN IEC 60953-0:2022 sisaldab Euroopa standardi EN IEC 60953-0:2022 ingliskeelset teksti.	This Estonian standard EVS-EN IEC 60953-0:2022 consists of the English text of the European standard EN IEC 60953-0:2022.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 08.07.2022.	Date of Availability of the European standard is 08.07.2022.
Standard on kättesaadav Eesti Standardimis-ja Akrediteerimiskeskusest.	The standard is available from the Estonian Centre for Standardisation and Accreditation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

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EUROPEAN STANDARD

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English Version

Rules for steam turbine thermal acceptance tests - Part 0: Wide range of accuracy for various types and sizes of turbines (IEC 60953-0:2022)

Règles pour les essais thermiques de réception des turbines à vapeur - Partie 0: Plage de précision étendue pour différents types et dimensions de turbines (IEC 60953-0:2022)

Regeln für wärmetechnische Abnahmemessung an Dampfturbinen - Teil 0: Weiter Genauigkeitsbereich für unterschiedliche Bauarten und Baugrößen von Dampfturbinen (IEC 60953-0:2022)

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

The text of document 5/248/FDIS, future edition 1 of IEC 60953-0, prepared by IEC/TC 5 "Steam turbines" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60953-0:2022.

The following dates are fixed:

•	latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop) 2023-04-04
•	latest date by which the national standards conflicting with the document have to be withdrawn	(dow) 2025-07-04

This document supersedes EN 60953-2:1995 and all of its amendments and corrigenda (if any).

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The text of the International Standard IEC 60953-0:2022 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 60034-2 (series) NOTE Harmonized as EN IEC 60034-2 (series)

IEC 60953-0

Edition 1.0 2022-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Rules for steam turbine thermal acceptance tests – Part 0: Wide range of accuracy for various types and sizes of turbines

Règles pour les essais thermiques de réception des turbines à vapeur – Partie 0: Plage de précision étendue pour différents types et dimensions de turbines

IEC 60953-0:2022-05(en-fr)

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Edition 1.0 2022-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Rules for steam turbine thermal acceptance tests – Part 0: Wide range of accuracy for various types and sizes of turbines

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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RULES FOR STEAM TURBINE THERMAL ACCEPTANCE TESTS –

Part 0: Wide range of accuracy for various types and sizes of turbines

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 60953-0 has been prepared by subcommittee WG 11/MT 14: Thermal Acceptance Test, of IEC technical committee 5: Steam Turbines. It is an International Standard.

This first edition cancels and replaces IEC 60953-2, published in 1990. This edition constitutes a technical revision.This edition includes the following significant technical changes with respect to the previous edition:

a) IEC 60953-2:1990 has been used as the basis to develop IEC 60953-0;
b) Outdated measuring techniques have been updated and the corresponding reduction of the expected test result measuring uncertainty indicated;
c) Guarantee of power output at specified steam flow has been included;
d) A proposal for assignment of unaccounted for leakages has been included;
e) Correction methods and guarantee comparisons are updated;
f) Various appendices deleted:
   – Appendix B (flow nozzle)
   – Appendix E (generalized correction curves)
   – Appendix G (power measurement uncertainty)

g) Annex added:

– Annex E (Temperature variation method) taken over from IEC 60953-3:2002,Annex L

The text of thisInternational Standard is based on the following documents:

Draft	Report on voting
5/248/FDIS	5/250/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

A list of all parts in the IEC 60953 series, published under the general title *Rules for steam turbine thermal acceptance tests*, can be found on the IEC website.

The language used for the development of thisInternational Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement,available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The committee has decided that the contents of this document will remain unchanged until the stability dateindicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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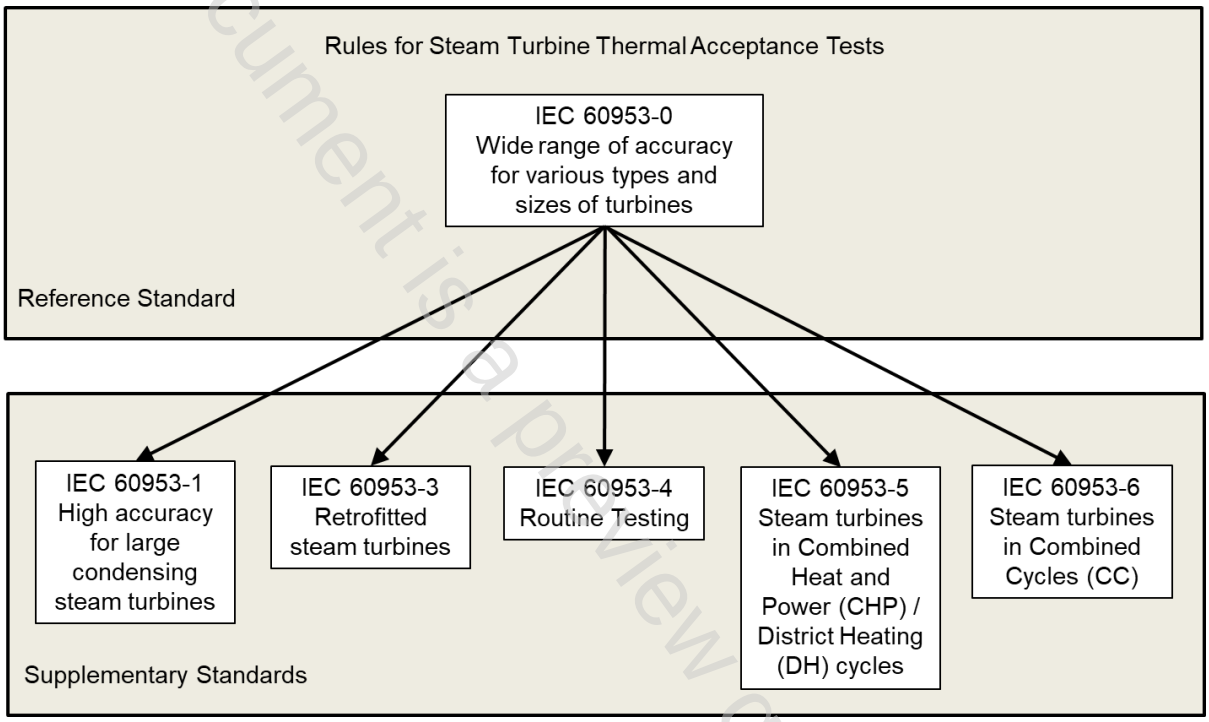
INTRODUCTION

The continuing development of measuring techniques, the increasing capacity of steam turbines and increasing variety of steam turbine configurations has necessitated a revision of IEC 60953:1990.

Since all the needs of the power industry could not be satisfied by one single performance test standard covering the requirements for all of the steam turbine configurations and accuracy, the revision to this standard is based upon one reference standard and various supplementary parts as indicated below:



1) Basic philosophy and figures on uncertainty

   IEC 60953-0 provides for acceptance tests of steam turbines of various types and capacities with corresponding measuring uncertainty, it is based upon the Method B of IEC 60953-2:1990. Additional and alternative guidance will be given for specific steam turbine applications in the supplementary standards where it is required.

   Instrumentation and measuring procedures are chosen accordingly from a scope specified in the standard series which is centred mainly on standardized instrumentation and procedures, but may extend up to high accuracy provisions requiring calibration of flow measuring devices. The resulting measuring uncertainty of the test result is then determined by calculating methods presented in the standard series and normally, if not stated otherwise in the contract, taken into account in the comparison between test result and guarantee value. The total cost of an acceptance test can therefore be maintained in relationship with the economic value of the guarantee values to be ascertained.

   When good-standardized instrumentation and procedures are applied in a test, the measuring uncertainty given in Table 6 can be achieved. The parties to the test should reach agreement on the measuring uncertainty desired for the acceptance tests.

2) Guiding principles

   The requirements concerning the preparation and conditions of the test and especially such conditions of the test as duration, deviations and constancy of test conditions are defined.

The test should be conducted preferably within eight weeks after first synchronisation. It is the intent during this period to minimize performance deterioration and risk of damage to the turbine.

Enthalpy drop tests should be made during this period to monitor HP and IP turbine section performance. However, these tests do not provide LP section performance and for this reason it is imperative to conduct the acceptance tests as soon as practicable.

Adjustment of the heat rate and power output test results for the effects of aging preferably by use of start-up enthalpy drop efficiency tests or by application of a standard allowance according to 7.9 is to be applied unless otherwise agreed in the contract.

3) Instruments and methods of measurement

   a) Measurement instruments (for electrical power, pressure, temperature)
   The measuring instruments used should be individually calibrated shortly before the test.

   b) Flow measurement devices
   For the measurement of main flows, uncalibrated or calibrated standardized flow measuring devices may be used.
   Typically uncalibrated standardized flow measuring devices are used, however calibration is recommended where a reduction of overall measuring uncertainty is desirable. Double or multiple measurement of primary flow is recommended for the reduction of measuring uncertainty and a method for checking the compatibility is described.

4) Evaluation of tests

   The preparatory work for the evaluation and calculation of the test results is covered.

   Detailed methods for calculation of measuring uncertainty values of measured variables and tests results are given.

5) Correction of test results and comparison with guarantees

   The correction of test results to guarantee conditions is covered. The measuring uncertainty of the result is taken into account in the guarantee comparison.

6) Proposals for application

   Since the acceptance test method to be applied has to be considered in the details of the plant design, it should be stated as early as possible, preferably in the turbine contract, which method will be used.

   This standard series can be applied to steam turbines of any type and any power. The desired measuring uncertainty should be decided upon sufficiently early, so that the necessary provisions can be included in the plant.

   If the guarantee includes the complete power plant or large parts thereof, the relevant parts of this standard series can be applied for an acceptance test in accordance with the definition of the guarantee value.

RULES FOR STEAM TURBINE THERMAL ACCEPTANCE TESTS –

Part 0: Wide range of accuracy for various types and sizes of turbines

1 Scope

1.1 General

The rules given in this document are applicable to thermal acceptance tests covering a wide range of accuracy on steam turbines of every type, rating and application. Only the relevant portion of these rules will apply to any individual case.

The rules provide for the testing of turbines, whether operating with either superheated or saturated steam. They include measurements and procedures required to determine specific enthalpy within the moisture region and describe precautions necessary to permit testing while respecting radiological safety rules in nuclear plants.

Uniform rules for the preparation, carrying out, evaluation, comparison with guarantee and calculation of measuring uncertainty of acceptance tests are defined in this standard. Details of the conditions under which the acceptance test can take place are included.

Should any complex or special case arise which is not covered by these rules, appropriate agreement is to be reached by manufacturer and purchaser before the contract is signed.

1.2 Object

The purpose of the thermal acceptance tests of steam turbines and turbine cycles described in this document is to verify guarantees given by the manufacturer of the equipment concerning:

Efficiency guarantees

a) Thermal efficiency;
b) Heat rate;
c) Thermodynamic efficiency;
d) Steam rate;
e) Power output.

Capacity guarantees

a) Main steam flow capacity;
b) Maximum power output at specified steam conditions according to IEC 60045-1 (other than steam flow);
c) Nuclear: thermal load capacity of the steam turbine under defined conditions.

The guarantees with their provisions are formulated completely and without contradictions (see 3.4). The acceptance tests may also include such measurements as are necessary for corrections according to the conditions of the guarantee and checking of the results.

1.3 Matters to be considered in the contract

Some matters in these rules are to be considered at an early stage. Such matters are dealt with in the following subclauses:

Subclause	
1.1	(paragraph 4)
1.2	(paragraph 2)
4.1	(paragraph 3 and 4)
4.3.2	(paragraph 1)
7.6	
7.8	
7.9	(paragraph 1)

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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/IEC Guide 98, *Uncertainty of measurement*

IEC 60045-1, *Steam turbines – Part 1: Specifications*

ISO 5167 (all parts), *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full.*

ISO 12242, *Measurement of fluid flow in conduits – ultrasonic transit-time meters for liquids*

ISO 18888, *Gas turbine combined cycle power plants – Thermal performance tests*

ANSI/IEEE C57.13, *IEEE Standard requirements for instrument transformers*

3 Units, symbols, terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 General

The International System of Units (SI) is used in these rules; all conversion factors can therefore be avoided.

The coherent units for all relevant quantities are given in the Table in 3.2. Some conversion factors are given as well for specific heat rates based on units other than W/W.