



NSAI
Standards

Irish Standard
I.S. EN 60193:2000

Hydraulic turbines, storage pumps and pump-turbines Model acceptance tests (IEC 60193:1999)

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I.S. EN 60193:2000

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EUROPEAN STANDARD

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NORME EUROPÉENNE

EUROPÄISCHE NORM

December 1999

ICS 27.140

Supersedes EN 60995:1994

English version

**Hydraulic turbines, storage pumps and pump-turbines
Model acceptance tests
(IEC 60193:1999)**

Turbines hydrauliques, pompes
d'accumulation et pompes-turbines
Essais de réception sur modèle
(CEI 60193:1999)

Hydraulische Turbinen,
Speicherpumpen und Pumpturbinen
Modellabnahmeprüfungen
(IEC 60193:1999)

This European Standard was approved by CENELEC on 1999-12-01. 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, Czech Republic, 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

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Foreword

The text of document 4/157/FDIS, future edition 2 of IEC 60193, prepared by IEC TC 4, Hydraulic turbines, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60193 on 1999-12-01.

This European Standard supersedes EN 60995:1994.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2000-09-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2002-12-01

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annexes B, F, G, K, L, M and ZA are normative and annexes A, C, D, E, H, J, N and P are informative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60193:1999 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)**Normative references to international publications
with their corresponding European publications**

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE: When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60041 (mod)	1991	Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump-turbines	EN 60041	1994
IEC 60609	1978	Cavitation pitting evaluation in hydraulic turbines, storage pumps and pump-turbines	-	-
IEC 60609-2	1997	Part 2: Evaluation in Pelton turbines	EN 60609-2	1999
IEC 60994	1991	Guide for field measurement of vibrations and pulsations in hydraulic machines (turbines, storage pumps and pump-turbines)	EN 60994	1992
IEC 61364	1999	Nomenclature for hydroelectric machinery	-	-
IEC 61366	series	Hydraulic turbines, storage pumps and pump-turbines - Tendering Documents	-	-
ISO 31-3	1992	Quantities and units Part 3: Mechanics	-	-
ISO 31-12	1992	Part 12: Characteristic numbers	-	-
ISO 468	1982	Surface roughness - Parameters, their values and general rules for specifying requirements	-	-
ISO 1438-1	1980	Water flow measurement in open channels using weirs and Venturi flumes Part 1: Thin-plate weirs	-	-
ISO 2186	1973	Fluid flow in closed conduits Connections for pressure signal transmissions between primary and secondary elements	-	-
ISO 2533	1975	Standard atmosphere	-	-
A1	1985		-	-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
ISO 4006	1991	Measurement of fluid flow in closed conduits - Vocabulary and symbols	EN 24006	1993
ISO 4185	1980	Measurement of liquid flow in closed conduits - Weighing method	EN 24185	1993
ISO 4373	1995	Measurement of liquid flow in open channels - Water-level measuring devices	-	-
ISO 5167-1	1991	Measurement of fluid flow by means of pressure differential devices - Part 1: Orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full	-	-
ISO 5168	1978	Measurement of fluid flow - Estimation of uncertainty of a flow-rate measurement	-	-
ISO 6817	1992	Measurement of conductive liquid flow in closed conduits - Method using electromagnetic flowmeters	EN ISO 6817	1995
ISO 7066-1	1997	Assessment of uncertainty in calibration and use of flow measurement devices Part 1: Linear calibration relationships	-	-
ISO 7066-2	1988	Part 2: Non-linear calibration relationships	-	-
ISO 8316	1987	Measurement of liquid flow in closed conduits - Method by collection of the liquid in a volumetric tank	EN ISO 8316	1995
ISO 9104	1991	Measurement of fluid flow in closed conduits - Methods of evaluating the performance of electromagnetic flow-meters for liquids	EN 29104	1993
VIM	1993	International vocabulary of basic and general terms in metrology (BIPM-IEC-ISO-OIML)	-	-

INTERNATIONAL STANDARD

**IEC
60193**

Second edition
1999-11

Hydraulic turbines, storage pumps and pump-turbines – Model acceptance tests

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*



Reference number
IEC 60193:1999(E)

I.S. EN 60193:2000

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

Further information on IEC publications

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology. Information relating to this publication, including its validity, is available in the IEC Catalogue of publications (see below) in addition to new editions, amendments and corrigenda. Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is also available from the following:

- **IEC Web Site** (www.iec.ch)

- **Catalogue of IEC publications**

The on-line catalogue on the IEC web site (www.iec.ch/searchpub) enables you to search by a variety of criteria including text searches, technical committees and date of publication. On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.

- **IEC Just Published**

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INTERNATIONAL STANDARD

**IEC
60193**

Second edition
1999-11

Hydraulic turbines, storage pumps and pump-turbines – Model acceptance tests

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INTERNATIONAL ELECTROTECHNICAL COMMISSION**HYDRAULIC TURBINES, STORAGE PUMPS
AND PUMP-TURBINES –
MODEL ACCEPTANCE TESTS****FOREWORD**

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
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- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60193 has been prepared by IEC technical committee 4: Hydraulic turbines.

This second edition of IEC 60193 cancels and replaces the first edition of IEC 60193 published in 1965, its amendment 1 (1977), IEC 60193A (1972), as well as IEC 60497 (1976) and IEC 60995 (1991).

Clauses 1 to 3 of this standard cover the scopes dealt with in the above-mentioned publications. Additional information is given in clause 4.

The text of this standard is based on the following documents:

FDIS	Report on voting
4/157/FDIS	4/162/RVD

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

Annexes B, F, G, K, L and M form an integral part of this standard.

Annexes A, C, D, E, H, J, N and P are for information only.

The committee has decided that this publication remains valid until 2004. At this date, in accordance with the committee's decision, the publication will be

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

HYDRAULIC TURBINES, STORAGE PUMPS AND PUMP-TURBINES – MODEL ACCEPTANCE TESTS

1 General rules

1.1 Scope and object

1.1.1 Scope

This International Standard applies to laboratory models of any type of impulse or reaction hydraulic turbine, storage pump or pump-turbine.

This standard applies to models of prototype machines either with unit power greater than 5 MW or with reference diameter greater than 3 m. Full application of the procedures herein prescribed is not generally justified for machines with smaller power and size. Nevertheless, this standard may be used for such machines by agreement between purchaser and supplier.

In this standard, the term "turbine" includes a pump-turbine operating as a turbine and the term "pump" includes a pump-turbine operating as a pump.

This standard excludes all matters of purely commercial interest, except those inextricably bound up with the conduct of the tests.

This standard is concerned with neither the structural details of the machines nor the mechanical properties of their components, so long as these do not affect model performance or the relationship between model and prototype performances.

1.1.2 Object

This International Standard covers the arrangements for model acceptance tests to be performed on hydraulic turbines, storage pumps and pump-turbines to determine if the main hydraulic performance contract guarantees (see 1.4.2) have been satisfied.

It contains the rules governing test conduct and prescribes measures to be taken if any phase of the tests is disputed.

The main objectives of this standard are:

- to define the terms and quantities used;
- to specify methods of testing and of measuring the quantities involved, in order to ascertain the hydraulic performance of the model;
- to specify the methods of computation of results and of comparison with guarantees;
- to determine if the contract guarantees, which fall within the scope of this standard, have been fulfilled;
- to define the extent, content and structure of the final report.

The guarantees can be given in one of the following ways:

- guarantees for prototype hydraulic performance, computed from model test results considering scale effects;
- guarantees for model hydraulic performance.

Moreover additional performance data (see 1.4.4) can be needed for the design or the operation of the prototype of the hydraulic machine. Contrary to the requirements of clauses 1 to 3 related to main hydraulic performance the information of these additional data given in clause 4 is considered only as recommendation or guidance to the user (see 4.1).

It is particularly recommended that model acceptance tests be performed if the expected field conditions for acceptance tests (see IEC 60041) would not allow the verification of guarantees given for the prototype machine.

This standard may also be applied to model tests for other purposes, i.e. comparative tests and research and development work.

If model acceptance tests have been performed, field tests can be limited to index tests (see IEC 60041, clause 15).

If a contradiction is found between this standard and any other standard, this standard shall prevail.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60041:1991, *Field acceptance test to determine the hydraulic performance of hydraulic turbines, storage pumps and pump-turbines*

IEC 60609:1978, *Cavitation pitting evaluation in hydraulic turbines, storage pumps and pump-turbines*

IEC 60609-2:1997, *Cavitation pitting evaluation in hydraulic turbines, storage pumps and pump-turbines – Part 2: Evaluation in Pelton turbines*

IEC 60994:1991, *Guide for field measurement of vibrations and pulsations in hydraulic machines (turbines, storage pumps and pump-turbines)*

IEC 61364:1999, *Nomenclature of hydraulic machinery*

IEC 61366 (all parts), *Hydraulic turbines storage pumps and pump-turbines – Tendering documents*

ISO 31-3:1992, *Quantities and units – Part 3: Mechanics*

ISO 31-12:1992, *Quantities and units – Part 12: Characteristic numbers*

ISO 468:1982, *Surface roughness – Parameters, their values and general rules for specifying requirements*

ISO 1438-1:1980, *Water flow measurement in open channels using weirs and Venturi flumes – Part 1: Thin-plate weirs*

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