SLOVENSKI STANDARD
SIST EN IEC 63230:2026

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Ocena utrujenosti tekačev hidravlične turbine: od načrtovanja do zagotavljanja kakovosti (IEC 63230:2026)

Fatigue assessment of hydraulic turbine runners: from design to quality assurance (IEC 63230:2026)

Lebensdauerbewertung von Laufrädern hydraulischer Turbinen: vom Design bis zur Qualitätssicherung (IEC 63230:2026)

Évaluation de la fatigue des roues de turbines hydrauliques: de la conception à l'assurance qualité (IEC 63230:2026)

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Fatigue assessment of hydraulic turbine runners: from design to quality assurance (IEC 63230:2026)

Évaluation de la fatigue des roues de turbines hydrauliques: de la conception à l'assurance qualité (IEC 63230:2026)

Lebensdauerbewertung von Laufrädern hydraulischer Turbinen: vom Design bis zur Qualitätssicherung(IEC 63230:2026)

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CENELEC

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 4/544/FDIS, future edition 1 of IEC 63230, prepared by TC 4 "Hydraulic turbines" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 63230:2026.

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)	2027-07-31
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2029-07-31

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The text of the International Standard IEC 63230:2026 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standard indicated:

ISO 80000-4:2019	NOTE	Approved as EN ISO 80000-4:2019 (not modified)
IEC 60994:1991	NOTE	Approved as EN 60994:1992 (not modified)
ISO 21920-2:2021	NOTE	Approved as EN ISO 21920-2:2022 (not modified)

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cencenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60193	2019	Hydraulic turbines, storage pumps and pump-turbines - Model acceptance tests	EN IEC 60193	2019
BS 7910	2019	Guide to methods for assessing the acceptability of flaws in metallic structures	-	-
CCH 70-4		Specification for Inspection of Steel Castings for Hydraulic Machines	-	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

Fatigue assessment of hydraulic turbine runners: from design to quality assurance

FOREWORD

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IEC 63230 has been prepared by IEC technical committee TC 4: Hydraulic turbines. It is an International Standard.

The text of this International Standard is based on the following documents:

Draft	Report on voting
4/544/FDIS	4/552/RVD

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

The language used for the development of this International 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/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated 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, or
– revised.

1 Scope

This International Standard applies to runners of reaction turbines, regardless of their size and capacity. These can include radial turbines such as Francis turbines, axial turbines such as Kaplan and propeller turbines, as well as diagonal turbines, in all possible configurations. In the case of turbine runners with adjustable blades, the internal mechanical components of the blades' adjustment mechanism are excluded from this document. Pelton turbines, storage pumps and pump-turbines are not covered in this first edition, even though several topics are applicable to these types of hydraulic machines. Specificities and applicability to Pelton turbine and pump-turbines will be discussed in a later revision of the standard

This document outlines the methodologies for conducting a fatigue assessment of turbine runners. It encompasses several key aspects, such as defining the load events to be considered during the assessment, determining stresses for each of these load events, as well as the detailed approaches for assessing fatigue of new and existing runners. Additionally, it includes manufacturing and quality assurance requirements to be complied with to achieve the desired material fatigue properties and effectively apply the proposed fatigue assessment methodologies. This document also contains best practices for performing and analysing on-site strain gauge measurements performed on existing runners to evaluate their fatigue life.

The purpose of this document is to provide guidelines to assess fatigue in new and existing turbine runners. It does not specify if a fatigue assessment should be performed or not for a given runner. However, Annex B provides guidance to evaluate the necessity of realizing a fatigue assessment or not for a given new runner. The methods described in this document can also be used for remaining life assessments of in-service runners. However, it is important to consider that the assessed runner materials' fatigue properties and quality level could differ from the prescriptions found in the manufacturing and quality assurance section of this document which have been defined for new runners. It is also important to mention that fatigue assessment alone is not sufficient for a complete validation of the mechanical integrity of a new runner design. Other mechanical validations not covered in this document are typically conducted.

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.

IEC 60193:2019, *Hydraulic turbines, storage pumps and pump-turbines - Model acceptance tests*

BS 7910:2019, *Guide to methods for assessing the acceptability of flaws in metallic structures*

CCH 70-4, *Specification for Inspection of Steel Castings for Hydraulic Machines*

3 Terms, definitions, symbols and units

3.1 General

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

NOTE Specialized terms are explained where they appear. Where terms are not explicitly defined in this document, the terms and definitions of IEC TR 61364[1] [1], as well as those of ASTM E1823-21[2] can be considered where applicable.

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

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

3.2 General terms and definitions

The terms below are defined specifically in the context of this document. The provided definitions may not be complete or coherent with definitions from other standards and codes.

3.2.1
continuous normal operating range
operating range of the turbine for unrestricted operating duration, typically delimited by minimum and maximum values of net head, minimum values of net positive suction energy, as well as minimum and maximum values of either or a combination of flow, turbine power output and guide vane opening

3.2.2
cycle counting method
method of counting the number of discrete stress (strain) cycles of different amplitude and mean from a history of varying stress (strain)

3.2.3
design fatigue life
the minimum period of time during which the runner is expected to function, according to its corresponding stress history

3.2.4
design S-N curve
S-N curve defined for design purposes of specific components

Note 1 to entry: It includes sufficient reduction coefficients to ensure conservative results and corresponds to what is considered a sufficient level of reliability for its related specific components. As the determination of this curve includes the return of experience on past runners, it cannot be associated with specific levels of probability of survival.

3.2.5
designer
entity responsible for analysing and translating technical specifications into design solutions that have the required reliability, safety, integrity and performance levels

3.2.6
dynamic stress
variation of stress over time around a mean stress

1 Numbers in square brackets refer to the Bibliography.

3.2.7
fatigue crack initiation
fatigue phase during which damage is accumulated in a runner under the action of stress cycles

Note 1 to entry: In the context of a fatigue crack initiation assessment as part of this document, the runner material is considered to be continuous, and stress is determined according to the principles of continuum mechanics.

3.2.8
fatigue crack propagation
fatigue phase during which a crack propagates in a runner under the action of stress cycles

Note 1 to entry: In the context of a fatigue crack propagation assessment as part this document, the runner material is considered to contain a discontinuity and stress is determined according to the principles of fracture mechanics.

3.2.9
hotspot
location on the runner with the highest fatigue damage sums for a given stress history

Note 1 to entry: This normally corresponds to the location of the highest dynamic stress during steady state conditions or the highest stress range of the start-stop sequence.

3.2.10
load event
loading applied to the runner during a specific steady state or transient condition (e.g. start-up, speed-no-load)

3.2.11
load rejection
transient operating condition characterized by an emergency automatic sequence where sudden decoupling from the grid and subsequent closing of the guide vanes result in a turbine-generator unit going from a given power output to transient overspeed and back to speed-no-load or standstill

3.2.12
load sequence
series of load events, which can include a combination of steady state and transient conditions, that are frequently repeated (e.g. start-stop load sequence: standstill – start-up - SNL- ramp-up - full load – stop – standstill)

3.2.13
manufacturer
entity responsible for carrying out the entire manufacturing process until completion of the hydraulic machine component

3.2.14
maximum power output
highest turbine or unit power output within the continuous normal operating range under a given net head

3.2.15
mean stress
constant average stress of a steady state condition or moving average stress of a transient stress history

Note 1 to entry: This term can also refer to the mean stress of a single fatigue cycle from a stress spectrum as obtained from a cycle counting algorithm.

3.2.16
owner
entity which is either the buyer or user, or both, of the hydraulic machine component, or its representative

3.2.17
periodic stress
dynamic stress of constant amplitude and frequency

3.2.18
rainflow algorithm
specific cycle counting method used in this document

Note 1 to entry: In this document, rainflow refers to the method named "simplified rainflow counting for repeating Histories" as per ASTM E1049-85.

3.2.19
residual stress
internal stress in static equilibrium that remains in the absence of any external loading

Note 1 to entry: In runners, such residual stresses most often stem from welding, casting, machining and forming.

3.2.20
rework
process of correcting defective, failed, or non-conforming features in a prototype runner after inspection

Note 1 to entry: In the context of this document, this process can include weld repair, machining, grinding and polishing.

3.2.21
runaway
no-load and non-excited steady state operating condition where a turbine-generator unit is rotating at its maximum runaway speed achieved with guide vanes fully open, under the maximum net head of the continuous operating range, or whichever condition results in the highest rotational speed

3.2.22
shutdown
transient operating condition characterized by a normal automatic sequence where a turbine-generator unit goes from a given power output to standstill

3.2.23
speed-no-load
no-load steady state operating condition where a turbine-generator unit is rotating at synchronous speed, ready to be synchronized with the grid with positive speed direction and zero power output

Note 1 to entry: The generator field winding can be excited or not.

3.2.24
start-up
transient operating condition characterized by a normal automatic sequence where a turbine-generator unit goes from standstill with guide vanes closed to speed-no-load

3.2.25
static stress
constant mean stress, linearized or not, calculated by static structural finite element analysis for a given steady state condition