Hydraulic machines - Guidelines for dealing with hydro-abrasive erosion in kaplan, francis and pelton turbines

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NATIONAL FOREWORD

See Eesti standard EVS-EN IEC 62364:2019 sisaldab Euroopa standardi EN IEC 62364:2019 ingliskeelset teksti.	This Estonian standard EVS-EN IEC 62364:2019 consists of the English text of the European standard EN IEC 62364:2019.
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.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 15.03.2019.	Date of Availability of the European standard is 15.03.2019.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

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

ICS 23.100.10, 27.140

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English Version

Hydraulic machines - Guidelines for dealing with hydro-abrasive erosion in kaplan, francis and pelton turbines (IEC 62364:2019)

Machines hydrauliques - Lignes directrices relatives au traitement de l'érosion hydro-abrasive des turbines kaplan, francis et pelton
(IEC 62364:2019)

Wasserturbinen - Leitfaden für den Umgang mit hydroabrasiver Erosion in Kaplan-, Francis und Pelton-Turbinen
(IEC 62364:2019)

This European Standard was approved by CENELEC on 2019-02-18. 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.

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

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Ref. No. EN IEC 62364:2019 E

European foreword

The text of document 4/351/FDIS, future edition 2 of IEC 62364, prepared by IEC TC 4 "Hydraulic turbines" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62364:2019.

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) 2019-11-18
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2022-02-18

This document supersedes EN 62364:2013.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 62364:2019 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 standards indicated:

IEC 60193:1999	NOTE	Harmonized as EN 60193:1999.
IEC 60609-2:1997	NOTE	Harmonized as EN 60609-2:1999.
IEC 60041	NOTE	Harmonized as EN 60041.
ISO 4288	NOTE	Harmonized as EN ISO 4288.
ISO 2178	NOTE	Harmonized as EN ISO 2178.
ISO 6507-1	NOTE	Harmonized as EN ISO 6507-1.
ISO 14916:2017	NOTE	Harmonized as EN ISO 14916:2017.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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International Standard IEC 62364 has been prepared by IEC technical committee 4: Hydraulic turbines.

This second edition cancels and replaces the first edition published in 2013. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) the formula for TBO in Pelton reference model has been modified;
b) the formula for calculating sampling interval has been modified;
c) the chapter in hydro-abrasive erosion resistant coatings has been substantially modified;
d) the annex with test data for hydro-abrasive erosion resistant materials has been removed;
e) a simplified hydro-abrasive erosion evaluation has been added.

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

FDIS	Report on voting
4/351/FDIS	4/366/RVD

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

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The number of hydro power plants with hydro-abrasive erosion is increasing worldwide.

An overall approach is needed to minimize the impact of this phenomenon. Already at the start of the planning phase an evaluation should be done to quantify the hydro-abrasive erosion and the impact on the operation. For this, the influencing parameters and their impact on the hydro-abrasive erosion have to be known. The necessary information for the evaluation comprises among others the future design, the particle parameters of the water, which will pass the turbine, the reservoir sedimentation and the power plant owner's framework for the future operation like availability or maximum allowable efficiency loss, before an overhaul needs to be done.

Based on this evaluation of the hydro-abrasive erosion, an optimised solution can then be found, by analysing all measures in relation to investments, energy production and maintenance costs as decision parameters. Often a more hydro-abrasive erosion-resistant design, instead of choosing the turbine design with the highest efficiency, will lead to higher revenue. This analysis is best performed by the overall plant designer.

With regards to the machines, owners should find the means to communicate to potential suppliers for their sites, their desire to have the particular attention of the designers at the turbine design phase, directed to the minimization of the severity and effects of hydro-abrasive erosion.

Limited consensus and very little quantitative data exists on the steps which the designer could and should take to extend the useful life before major overhaul of the turbine components when they are operated under severe hydro-abrasive erosion service. This has led some owners to write into their specifications, conditions which cannot be met with known methods and materials.

HYDRAULIC MACHINES – GUIDELINES FOR DEALING WITH HYDRO-ABRASIVE EROSION IN KAPLAN, FRANCIS, AND PELTON TURBINES

1 Scope

This document gives guidelines for:

a) presenting data on hydro-abrasive erosion rates on several combinations of water quality, operating conditions, component materials, and component properties collected from a variety of hydro sites;

b) developing guidelines for the methods of minimizing hydro-abrasive erosion by modifications to hydraulic design for clean water. These guidelines do not include details such as hydraulic profile shapes which are determined by the hydraulic design experts for a given site;

c) developing guidelines based on “experience data” concerning the relative resistance of materials faced with hydro-abrasive erosion problems;

d) developing guidelines concerning the maintainability of materials with high resistance to hydro-abrasive erosion and hardcoatings;

e) developing guidelines on a recommended approach, which owners could and should take to ensure that specifications communicate the need for particular attention to this aspect of hydraulic design at their sites without establishing criteria which cannot be satisfied because the means are beyond the control of the manufacturers;

f) developing guidelines concerning operation mode of the hydro turbines in water with particle materials to increase the operation life.

It is assumed in this document that the water is not chemically aggressive. Since chemical aggressiveness is dependent upon so many possible chemical compositions, and the materials of the machine, it is beyond the scope of this document to address these issues.

It is assumed in this document that cavitation is not present in the turbine. Cavitation and hydro-abrasive erosion can reinforce each other so that the resulting erosion is larger than the sum of cavitation erosion plus hydro-abrasive erosion. The quantitative relationship of the resulting hydro-abrasive erosion is not known and it is beyond the scope of this document to assess it, except to suggest that special efforts be made in the turbine design phase to minimize cavitation.

Large solids (e.g. stones, wood, ice, metal objects, etc.) traveling with the water can impact turbine components and produce damage. This damage can in turn increase the flow turbulence thereby accelerating wear by both cavitation and hydro-abrasive erosion. Hydro-abrasive erosion resistant coatings can also be damaged locally by impact of large solids. It is beyond the scope of this document to address these issues.

This document focuses mainly on hydroelectric powerplant equipment. Certain portions can also be applicable to other hydraulic machines.

2 Terms, definitions and symbols

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: