SLOVENSKI STANDARD
SIST EN 60609-2:2001

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SIST IEC 60609-2:1999

Ovrednotenje kavitacijskih razjed vodnih turbin, akumulacijskih ļ rpalk in ļ rpalnih turbin ï 2. del: Ovrednotenje za Peltonove turbine (IEC 60609-2:1997)

Cavitation pitting evaluation in hydraulic turbines, storage pumps and pump-turbines -- Part 2: Evaluation in Pelton turbines

Bewertung des Kavitationsangriffs in Wasserturbinen, Speicherpumpen und Pumpenturbinen -- Teil 2: Bewertung in Peltonturbinen

Evaluation de l'érosion de cavitation dans les turbines, les pompes d'accumulation et les pompes-turbines hydrauliques -- Partie 2: Evaluation dans les turbines Pelton

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

Evaluation de l'érosion de cavitation dans les turbines, les pompes d'accumulation et les pompes-turbines hydrauliques
Partie 2: Evaluation dans les turbines Pelton
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(IEC 60609-2:1997)

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

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Foreword

The text of the International Standard IEC 60609-2:1997, prepared by IEC TC 4, Hydraulic turbines, was submitted to the formal vote and was approved by CENELEC as EN 60609-2 on 1999-05-01 without any modification.

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) 2000-08-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2002-08-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annexes A and ZA are normative and annex B is informative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60609-2:1997 was approved by CENELEC as a European Standard without any modification.

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

IEC 60041 NOTE: Harmonized as EN 60041:1994 (modified).

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.

Publication	Year	Title	EN/HD	Year
IEC 60609	1978	Cavitation pitting evaluation in hydraulic turbines, storage pumps and pump-turbines	-	-

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Evaluation de l'érosion de cavitation dans les turbines, les pompes d'accumulation et les pompes-turbines hydrauliques –

Partie 2: Evaluation dans les turbines Pelton

Cavitation pitting evaluation in hydraulic turbines, storage pumps and pump-turbines –

Part 2: Evaluation in Pelton turbines

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CAVITATION PITTING EVALUATION IN HYDRAULIC TURBINES, STORAGE PUMPS AND PUMP-TURBINES –

Part 2: Evaluation in Pelton turbines

FOREWORD

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International Standard IEC 60609-2 has been prepared by IEC technical committee 4: Hydraulic turbines.

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

FDIS	Report on voting
4/127/FDIS	4/139/RVD

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

Annex A forms an integral part of this standard.

Annex B is for information only.

INTRODUCTION

IEC 60609 (1978) treats cavitation pitting in reaction machines but does not refer to Pelton (impulse) turbines. Appendix A of IEC 60609 states that Pelton turbines "usually are not subjected to cavitation pitting".

However, experience shows that with increase of specific speed (especially of multijet turbines) and of specific hydraulic energy (head) the probability of cavitation pitting and drop erosion on Pelton turbines increases. Consequently weight loss guarantees on Pelton turbines may be required.

Various types of damage are observed, each the result of different flow phenomena, such as pitting due to:

– profile errors;
– unfavourable inflow conditions;
– erosion due to travelling droplets
(drop erosion, also called jet impingement);

and in some instances

– setting conditions
(e.g. setting of the runner referred to the tailwater level, or tailwater depression).

The causes of damage are often complex and have to be carefully investigated, taking into account also conditions which are excluded in the cavitation guarantee (see 1.2). However it is not the objective of this part of IEC 60609 to describe the requirements and measures needed for avoiding cavitation pitting due to

– hydraulic shape and surface roughness of turbine parts (buckets, nozzles, etc.), or
– installation requirements (setting, inflow conditions).

Those requirements are part of the know-how of the turbine contractor.

The damage (i.e. pitting respective weight loss) due to these various causes (cavitation pitting and drop erosion) is combined in the following clauses as the term "cavitation pitting".

CAVITATION PITTING EVALUATION IN HYDRAULIC TURBINES, STORAGE PUMPS AND PUMP-TURBINES –

Part 2: Evaluation in Pelton turbines

1 General

1.1 Scope and object

This part of IEC 60609 serves as a basis for the formulation of guarantees on cavitation pitting on Pelton turbine runners and also for the measurement and evaluation of the amount of cavitation pitting on Pelton turbine runners of a given turbine, which is defined in the contract by power, specific hydraulic energy of machine (head), rotational speed, material, operation, etc.

The sequence of clauses in this part of IEC 60609 is the same as in IEC 60609 (1978). The clauses on measurements and evaluation of the amount of cavitation pitting are practically identical to those of IEC 60609. Evaluation has to be based on the loss of material during a given time and under accurately defined operating conditions.

Guarantees which restrict the extent of cavitation pitting and drop erosion on Pelton turbines at the end of an operating period specified in the contract are necessary when cavitation pitting is expected in all or in some operating ranges. Such guarantees should include limits for operation which are consistent with specified operating conditions.

1.2 Excluded topics

It is assumed in this part of IEC 60609 that the water is not chemically aggressive to a significant degree and that it is essentially free from abrasive solids.

The cavitation guarantee shall, however, be given on the basis of an agreed water analysis. If it becomes apparent in the course of later analysis that the water is in fact more aggressive than the agreed analysis indicated, this shall be taken into consideration when judging whether the given guarantees have been met.

In case of a distorted inflow condition at the inlet of the turbine due to irregularities upstream of the turbine, hydraulic effects may be raised, which beyond the influence on hydraulic performance also may cause cavitation pitting. Therefore it is claimed for the basis of cavitation pitting guarantees that a satisfactorily uniform and vortex-free flow condition shall be provided. In case of damage, the influence of improper inflow condition shall be taken into account.

Abrasion due to water contaminated with solids (e.g. sand) cannot be considered as cavitation pitting. The solids content of the water and also – if relevant – the type of minerals and size and form of solid (sand) particles shall be stated in the water analysis and, if it reaches significant proportion, shall be the subject of a special agreement. Aspects of abrasive wear by sand erosion are dealt with in IEC 61366 (annex H).

Abrasion may cause a change of the geometry of the needle and/or the bucket and subsequently cavitation pitting as secondary damage. Such damage shall be excluded from the evaluation of cavitation.