SLOVENSKI STANDARD
SIST EN 60609-1:2005

01-september-2005

Vodne turbine, akumulacijske črpalke in črpalne turbine – Ovrednotenje kavitacijskih razjed – 1. del: Ovrednotenje za reakcijske turbine, akumulacijske črpalke in črpalne turbine (IEC 60609-1:2004)

Hydraulic turbines, storage pumps and pump-turbines - Cavitation pitting evaluation -- Part 1: Evaluation in reaction turbines, storage pumps and pump-turbines

Wasserturbinen, Speicherpumpen, Pumpenturbinen - Bewertung des Kavitationsangriffs -- Teil 1: Bewertung in Reaktionsturbinen, Speicherpumpen und Pumpenturbinen

Turbines hydrauliques, pompes d'accumulation et pompes-turbines - Evaluation de l'érosion de cavitation -- Partie 1: Evaluation dans les turbines à réaction, les pompes d'accumulation et les pompes-turbines hydrauliques

Ta slovenski standard je istoveten z: EN 60609-1:2005

ICS:

27.140	Vodna energija	Hydraulic energy engineering

SIST EN 60609-1:2005 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 60609-1

January 2005

ICS 23.100.10

English version

Hydraulic turbines, storage pumps and pump-turbines – Cavitation pitting evaluation Part 1: Evaluation in reaction turbines, storage pumps and pump-turbines
(IEC 60609-1:2004)

Turbines hydrauliques, pompes d'accumulation et pompes-turbines – Evaluation de l'érosion de cavitation Partie 1: Evaluation dans les turbines à réaction, les pompes d'accumulation et les pompes-turbines hydrauliques (CEI 60609-1:2004)

Wasserturbinen, Speicherpumpen, Pumpenturbinen – Bewertung des Kavitationsangriffs Teil 1: Bewertung in Reaktionsturbinen, Speicherpumpen und Pumpenturbinen (IEC 60609-1:2004)

This European Standard was approved by CENELEC on 2004-12-01. 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.

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CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 60609-1:2005 E

Foreword

The text of document 4/196/FDIS, future edition 1 of IEC 60609-1, prepared by IEC TC 4, Hydraulic turbines, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60609-1 on 2004-12-01.

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)	2005-09-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2007-12-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60609-1:2004 was approved by CENELEC as a European Standard without any modification.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application 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 Where an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60193	- [1]	Hydraulic turbines, storage pumps and pump-turbines - Model acceptance tests	EN 60193	1999 [2]
IEC/TR 61366-1	- [1]	Hydraulic turbines, storage pumps and pump-turbines - Tendering documents Part 1: General and annexes	-	-

1) Undated reference.

2) Valid edition at date of issue.

NORME INTERNATIONALE

INTERNATIONAL STANDARD

CEI IEC 60609-1

Première édition
First edition
2004-11

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

Partie 1: Evaluation dans les turbines à réaction, les pompes d'accumulation et les pompes-turbines hydrauliques

Hydraulic turbines, storage pumps and pump-turbines – Cavitation pitting evaluation –

Part 1: Evaluation in reaction turbines, storage pumps and pump-turbines

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International Electrotechnical Commission
Международная Электротехническая Комиссия

CODE PRIX
PRICE CODE S

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 1: Evaluation in reaction turbines, storage pumps and pump-turbines

FOREWORD

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International Standard IEC 60609-1 has been prepared by IEC technical committee 4: Hydraulic turbines.

This standard cancels and replaces IEC 60609, published in 1978, and constitutes a technical revision. The main changes with respect to IEC 60609 pertain to tighter controls on reduced permissible values of material loss. Modern technology with accumulated R&D has permitted the integration of improved hydraulic design, better controls from numerical machining and improved choice of materials.

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

FDIS	Report on voting
4/196/FDIS	4/200/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.

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

IEC 60609 consists of the following parts, under the general title *Cavitation pitting evaluation in hydraulic turbines, storage pumps and pump-turbines:*

Part 1: Evaluation in reaction turbines, storage pumps and pump-turbines

Part 2: Evaluation in Pelton turbines

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

INTRODUCTION

This part of IEC 60609 covers the subject of cavitation-pitting evaluation for reaction type hydraulic turbines, storage pumps and pump-turbines, while IEC 60609-2 covers the subject of cavitation-pitting evaluation for impulse (Pelton) type turbines.

Guarantees applied to cavitation pitting in hydraulic reaction turbines, storage pumps and pump-turbines are quite different from other performance guarantees stated in the contract documents representing inherent characteristics of the machine, such as efficiency. The extent of cavitation pitting depends essentially on five factors:

a) type and design of the machine;

b) material and surface condition of the parts subjected to cavitation;

c) setting of the machine, i.e. the cavitation factor sigma (σ) value at the plant;

d) duration of operation and type of operating conditions; and

e) water quality.

Items a) and b) describe the machine while items c), d) and e) depend on plant operating conditions. Therefore, the guarantee for cavitation pitting can be established only by mutual agreement between the employer and the contractor during the planning of the plant or during the contract negotiations. Under certain severe conditions such as plant upgrades with runner/impeller replacements or wide operating ranges, it may be to the advantage of the employer to request that tenderers submit a guarantee to cover cavitation pitting in their proposals.

A cavitation-pitting guarantee may be negotiated in two ways:

either the setting of the machine (and therefore the σ value of the plant) is given in the contract documents, and the amount of the cavitation pitting is agreed upon with due regard to the turbine or pump size, rotational speed, materials, surface conditions, operation, etc. (see Figure 1a);

or the maximum amount of the cavitation pitting is given and the setting of the machine is agreed upon (see Figure 1b).

In most cases, a machine can be operated normally without cavitation pitting or may be required to operate without cavitation pitting. In some cases, it may be more economical to accept a slight amount of cavitation pitting, which means using a higher setting than would be required for operation of the machine without cavitation pitting. Of course, in the case of underground power stations, the cost of additional submergence is usually relatively low.

It is not feasible to make general recommendations for an acceptable amount of cavitation pitting primarily because items a) through e) make each plant unique. Economic evaluations, therefore, are recommended for each case as conditions warrant. For example, a deeper setting of the machine (higher σ value for the plant requiring higher cost for civil work) and/or a more expensive runner/impeller (shape and/or material) can reduce the amount of cavitation pitting. The benefits of these higher purchase costs are a reduction in the operating cost and/or frequency of repair, as well as a reduction in lost energy production during the shut-down of the unit.

Examples of amounts of cavitation pitting expressed as depth and volume (see 2.2.26 and 2.2.27) as a function of runner/impeller diameter D are given in Annex A.