SLOVENSKI STANDARD

SIST EN 60308:2005

september 2005

Vodne turbine – Preskušanje krmilnih sistemov (IEC 60308:2005)

Hydraulic turbines – Testing of control systems (IEC 60308:2005)

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EUROPEAN STANDARD **EN 60308**

NORME EUROPÉENNE

EUROPÄISCHE NORM June 2005

ICS 27.140

English version

Hydraulic turbines – Testing of control systems
(IEC 60308:2005)

Turbines hydrauliques – Essais des systèmes de régulation (CEI 60308:2005)

Wasserturbinen – Prüfung von Regelsystemen (IEC 60308:2005)

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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

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Ref. No. EN 60308:2005 E

Foreword

The text of document 4/199/FDIS, future edition 2 of IEC 60308, prepared by IEC TC 4, Hydraulic turbines, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60308 on 2005-05-01.

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)	2006-02-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2008-05-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60308:2005 was approved by CENELEC as a European Standard without any modification.

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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 60041 (mod)	1991	Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump-turbines	EN 60041	1994
IEC 60193	1999	Hydraulic turbines, storage pumps and pump-turbines - Model acceptance tests	EN 60193	1999
IEC 60545	- [1)]	Guide for commissioning, operation and maintenance of hydraulic turbines	-	-
IEC 61362	1998	Guide to specification of hydraulic turbine control systems	EN 61362	1998
IEC 61000-4-2	- [1)]	Electromagnetic compatibility (EMC) Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	1995 [2)]
IEC 61000-4-3	- [1)]	Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3	2002 [2)]
IEC 61000-4-6	- [1)]	Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	-	-
ISO 4406	1999	Hydraulic fluid power - Fluids - Method for coding the level of contamination by solid particles	-	-

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1) Undated reference.

2) Valid edition at date of issue.

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NORME INTERNATIONALE

INTERNATIONAL STANDARD

CEI
IEC
60308

Deuxième édition
Second edition
2005-01

Turbines hydrauliques – Essais des systèmes de régulation

Hydraulic turbines – Testing of control systems

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Международная Электротехническая Комиссия

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HYDRAULIC TURBINES – TESTING OF CONTROL SYSTEMS

FOREWORD

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International Standard IEC 60308 has been prepared by IEC technical committee 4: Hydraulic turbines.

This second edition cancels and replaces the first edition published in 1970. This second edition constitutes a technical revision.

The following is an explanation of the reasons for issuing a new edition.

For the testing of control systems, only the first edition of this standard (IEC 60308:1970, International code for testing of speed governing systems for hydraulic turbines) was available up till now. It was limited – as the name suggests – to speed governing. It is, therefore, the intention of this second edition to expand the scope to include further functions of the overall control system of hydro turbines. The scope of acceptance tests of such a system depends on the guarantees stipulated in the specifications of a contract.

Since new control concepts/algorithms are becoming more and more important besides and beyond the PID principle, the following clauses do not refer to a specific algorithm (as did the first edition of this standard).

It is noted that the testing of specific properties and the drawing-up of the corresponding documentation involves costs which rise with increasing scope and the accuracy of the work to be done. Therefore, a test should be limited to parameters, components and characteristics which are indispensable for reliable and safe operation. Also the prescribed accuracy of measurements should correspond to the requirements of operation. The code therefore distinguishes in certain clauses the specific requirements for certain applications (for example, peak load, base load, frequency control operation, etc.).

This standard is closely related to the IEC 61362.

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

FDIS	Report on voting
4/199/FDIS	4/209/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.

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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

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

INTRODUCTION

The control functions of water turbines have undergone far-reaching changes and at the same time gained in importance during the last few decades. This is shown in the fact that a new standard has been developed: i.e. IEC 61362.

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HYDRAULIC TURBINES – TESTING OF CONTROL SYSTEMS

1 Scope and object

This International Standard deals with the definition and the characteristics of control systems and is the basis for tender documents and technical tenders. It is not limited to the actual controller tasks but also include other tasks which may be assigned to a control system, such as for instance sequence control tasks, safety, provision for the actuating energy.

The testing of control systems for hydro turbines can generally fulfil the following tasks:

– verification of system characteristics as per contract specification;
– verification of general proper functioning in the workshop and/or on site;
– tests to prove the fulfilment of guarantees;
– assessment of the actual state of an existing control system with regard to the question of repair or replacement.

This standard covers the following systems:

– speed, power, opening, water level and flow control for all turbine types;
– electronic, electrical and fluid power devices;
– safety devices;
– start-up, shutdown devices etc.

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2 Normative references

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.

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

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

IEC 60545, *Guide for commissioning, operation and maintenance of hydraulic turbines*

IEC 61362: 1998, *Guide to specification of hydraulic turbine control systems*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

ISO 4406: 1999, *Hydraulic fluid power – Fluids – Method for coding the level of contamination by solid particles*

3 Terms and definitions, symbols and units

For the purposes of this document, the following terms and definitions, symbols and units, as well as the terms and definitions, symbols and units given in IEC 61362, apply.

Sub-clause	Term	Definition	Quantity	Unit	Relative quantity
3.1	General definitions				
3.1.1	speed deviation	at a considered instant, the difference between the actual speed of rotation and a reference speed	Δn $\Delta\omega$ Δf	rev/min rad/s Hz	x_n
3.2	Performance under major disturbances				
3.2.1	servomotor cushioning time	elapsed time during which the rate of servomotor travel is retarded beginning at a specified servomotor position to full closed position (see Figure 1)	T_h	s	
3.2.2	servomotor force	net opening and/or closing force generated by the servomotor when supplied with oil at the minimum specified pressure NOTE When penstock water pressure is used to provide the closing force, the head at which the servomotor shall be rated should be stated. For spring operated servomotors it is the net force exerted by the servomotor when the spring is at its maximum extended position	F	N	
3.2.3	servomotor capacity	product of the maximum servomotor stroke and the force as described under 3.2.2	$F \times Y_M$	J = N·m	

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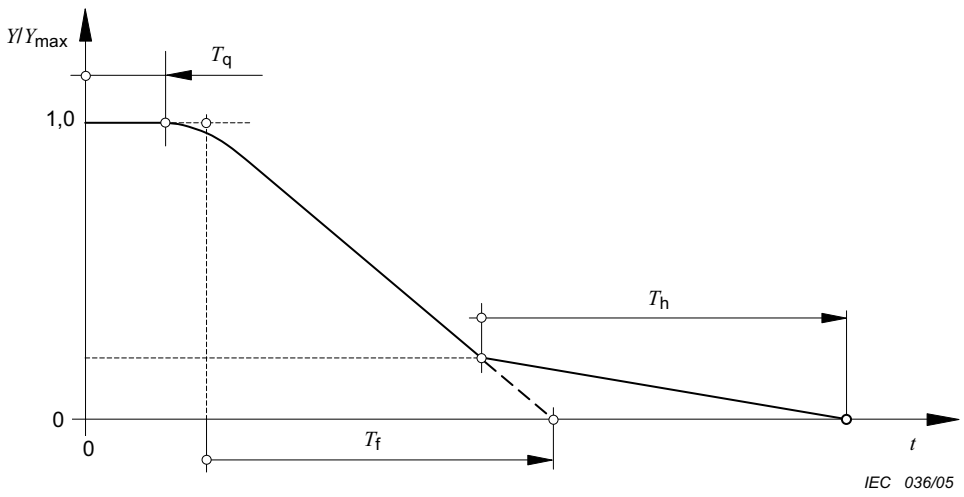

Figure 1 – Servomotor cushioning time T_h

Sub-clause	Term	Definition	Quantity	Unit	Relative quantity
3.3	Terms relating to the controlled system				
3.3.1	controlled system	system controlled by the governing system consisting of the hydraulic turbine, its water supply and discharge passages, the generator with voltage regulator and the electric power network to which it is connected			
3.3.2	torque deviation	power output deviation divided by instantaneous angular speed	ΔM	N·m	m
3.3.3	unit acceleration constant	ratio of the angular momentum of the unit to the guarantee torque	T_a	s	
3.3.4	load acceleration constant	ratio of the angular momentum, caused by the network referred to the guaranteed torque of the unit	T_b	s	
3.3.5	turbine control transmission ratio	At a considered servomotor position, the slope of the graph relating to the turbine torque m_t at constant speed and head to servomotor movement y (see Figure 2) $e_y = \frac{d(M_t/M_r)}{dy} = \frac{dm_t}{dy}$			e_y
3.3.6	speed regulation graph	graph showing the relative speed as a function of the relative power $p = \frac{P}{P_r}$, when the controller is in equilibrium and the command signal is constant			

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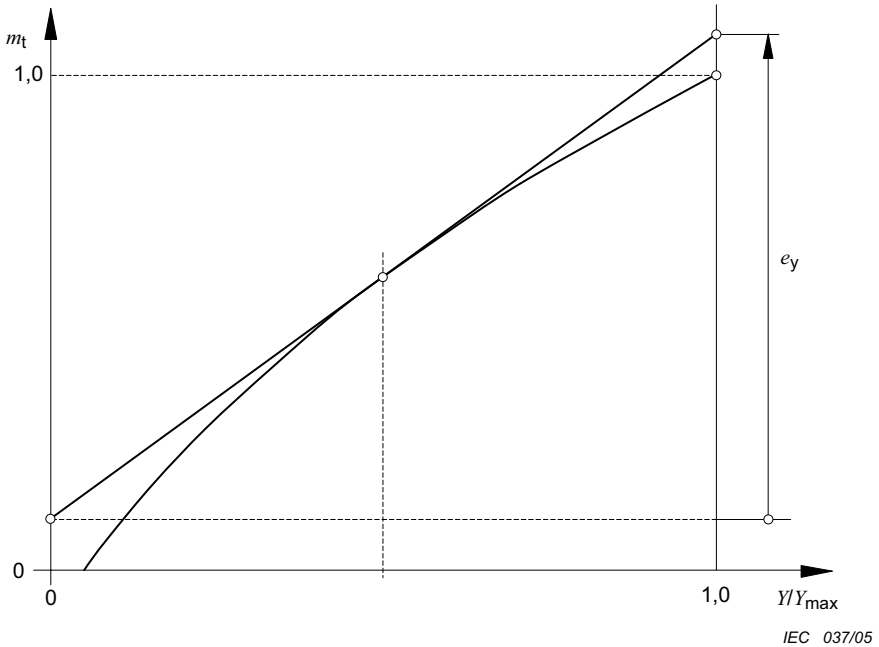

Figure 2 – Turbine control transmission ratio