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Vattenturbiner – Vägledning vid beskrivning och specificering av reglersystem

Guide to specification of hydraulic turbine control systems

Som svensk standard gäller europastandarden EN 61362:1998. Den svenska standarden innehåller den officiella engelska språkversionen av EN 61362:1998.

Nationellt förord

Europastandarden EN 61362:1998^{*)}

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 61362, First edition, 1998^{**)} - Guide to specification of hydraulic turbine control systems**

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^{*)} EN 61362:1998 ikraftsattes 1998-08-28 som SS-EN 61362 genom offentliggörande, d v s utan utgivning av något svenskt dokument.

^{**)} Corrigendum, March 2000 till IEC 61362:1998 är inarbetat i standarden.

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Det finns många fördelar med att ha gemensamma tekniska regler för bl a säkerhet, prestanda, dokumentation, utförande och skötsel av elprodukter, elanläggningar och metoder. Genom att utforma sådana standarder blir säkerhetskraven tydliga och utvecklingskostnaderna rimliga samtidigt som marknadens acceptans för produkten eller tjänsten ökar.

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English version

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

Guide pour la spécification des
régulateurs des turbines hydrauliques
(CEI 61362:1998)

Leitfaden zur Spezifikation der
Regelungssysteme für hydraulische
Turbinen
(IEC 61362:1998)

This European Standard was approved by CENELEC on 1998-01-01. 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.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

Foreword

The text of document 4/119/FDIS, future edition 1 of IEC 61362, prepared by IEC TC 4, Hydraulic turbines, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61362 on 1998-01-01.

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) 1998-12-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 1998-12-01

Annexes designated "normative" are part of the body of the standard.
In this standard, annexes A and ZA are normative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61362:1998 was approved by CENELEC as a European Standard without any modification.

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.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60068-2-6 + corr. March	1995 1995	Environmental testing Part 2: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	1995
IEC 60308	1970	International code for testing of speed governing systems for hydraulic turbines	-	-
IEC 61000-3-2	1995	Electromagnetic compatibility (EMC) Part 3: Limits Section 2: Limits for harmonic current emissions (equipment input current up to and including 16 A per phase)	EN 61000-3-2 + corr. July	1995 1997
IEC 61000-3-3	1994	Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current up to and including 16 A	EN 61000-3-3 + corr. July	1995 1997
IEC 61000-4-1	1992	Part 4: Testing and measurement techniques Section 1: Overview of immunity tests	EN 61000-4-1	1994
CISPR 11 (mod)	1990	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment	EN 55011	1991
ISO 3448	1992	Industrial liquid lubricants ISO viscosity classification	-	-

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INTRODUCTION

Recent developments have led to more stringent control system requirements with respect to power frequency regulation and to isolated network operation. These requirements essentially concern the primary control, which due to the use of modern, mostly electronic components, can be tasked with some additional control functions. Also the primary control responds to a superimposed large network control system (secondary control).

This guide mainly deals with primary control specifications; additional tasks are covered but the guide does not elaborate on specific details.

Specifically the primary control can include some or all of the following functions:

- unit start-up and shut-down;
- idling before synchronizing and after separation from the network and synchronizing;
- isolated network operation;
- parallel operation on large networks in speed control and power output control mode;
- head water level and/or flow control;
- operating mode transitions;
- monitoring and safety functions.

The guide also deals with aspects of the actuating energy supply.

The controlled system in a hydroturbine control loop, i.e., the respective transfer function, is characterized by:

- the unit(s), i.e. turbine(s) and generator(s);
- the water passage system;
- the network to which the unit(s) is (are) connected;
- the modes of operation as mentioned above.

The parameters of the primary control system (speed governor, power output governor, etc.) are to be carefully matched to the prevailing system conditions in order to:

- achieve adequate stability;
- satisfy performance requirements with respect to damping, response and accuracy;
- provide safety with respect to limitations in hydraulic transients, etc.

To achieve the above, in many cases modeling and simulations are valuable. The guide refers to some important aspects in this respect.

Since the governors have to be able to cope with a range of conditions, it is suitable practice to specify that a certain range for the setting of parameters is available in the governors. The guide follows this practice in the relevant part.

Specifically, in this guide, the performance-relevant definitions refer to the PID-controller, which can be implemented by analog or digital means. With appropriate microcomputer technology, higher control algorithms also can be implemented. Although it is deemed difficult to set up specific rules at the time of the issue of this guide, the general criteria for the adequate performance of a control system are essentially independent of the control strategy used. This means that they remain applicable as described in this guide and that the PID-controller can be regarded and used as a reference governor to gauge the control performance of a system.

The guide makes reference to IEC 60308 on hydraulic turbine control systems. It relies on it for the methods of system identification and verification of performance, etc. It is the intention of this guide to supplement IEC 60308 by recommending performance criteria and ranges for the setting of parameters.

To facilitate the setting up of specifications, this guide also includes data sheets, which are to be filled out by the customer and the vendor in the various stages of the project and the contract.

GUIDE TO SPECIFICATION OF HYDRAULIC TURBINE CONTROL SYSTEMS

1 General

1.1 Scope and object

This guide includes relevant technical data necessary to describe hydraulic turbine control systems and define their performance. It is aimed at unifying and thus facilitating the bidding specifications and technical bids. It will also serve as a basis for setting up technical guarantees.

In case of separate vendors for different segments of a system, the interface between them is especially important.

The guide is not confined to the control loop functions proper but includes all important functions of a control system, i.e., it also treats sequencing functions, etc. Hydraulic turbine control is thus understood to include:

- speed, power, water level and discharge control for reaction and impulse-type turbines including double regulated machines;
- means of providing actuating energy;
- safety devices for emergency shut-down, etc.;
- environmental performance criteria.

The guide aids the selection of some important parameters to be specified and checked in relation to the different types of installations.

Excluded topics are acceptance tests, specific test procedures and guarantees.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreement based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60068-2-6:1995, *Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60308:1970, *International code for testing of speed governing systems for hydraulic turbines*

IEC 61000-3-2:1995, *Electromagnetic compatibility (EMC) – Part 3: Limits – Section 2: Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*

IEC 61000-3-3:1994, *Electromagnetic compatibility (EMC) – Part 3: Limits – Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A*

IEC 61000-4-1:1992, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 1: Overview of immunity tests*

CISPR 11:1990, *Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment*

ISO 3448:1992, *Industrial liquid lubricants – ISO viscosity classification*