



NSAI
Standards

Irish Standard
I.S. EN 61362:2012

Guide to specification of hydraulic turbine governing systems (IEC 61362:2012 (EQV))

I.S. EN 61362:2012

Incorporating amendments/corrigenda issued since publication:

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard – national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation - recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

<i>This document replaces:</i> EN 61362:1998	<i>This document is based on:</i> EN 61362:2012 EN 61362:1998	<i>Published:</i> 31 August, 2012 27 April, 1998
This document was published under the authority of the NSAI and comes into effect on: 24 September, 2012		ICS number: 27.140
NSAI 1 Swift Square, Northwood, Santry Dublin 9	T +353 1 807 3800 F +353 1 807 3838 E standards@nsai.ie W NSAI.ie	Sales: T +353 1 857 6730 F +353 1 857 6729 W standards.ie
Údarás um Chaighdeáin Náisiúnta na hÉireann		

English version

**Guide to specification of hydraulic turbine governing systems
(IEC 61362:2012)**

Guide pour la spécification des systèmes
de régulation des turbines hydrauliques
(CEI 61362:2012)

Leitfaden zur Spezifikation der
Regeleinrichtung von Wasserturbinen
(IEC 61362:2012)

This European Standard was approved by CENELEC on 2012-05-25. 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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

CENELEC

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

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Foreword

The text of document 4/270/FDIS, future edition 2 of IEC 61362, prepared by IEC/TC 4 "Hydraulic turbines" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61362:2012.

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) 2013-02-28
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2015-05-25

This document supersedes EN 61362:1998.

EN 61362:2012 includes the following significant technical changes with respect to EN 61362:1998:

This technical revision takes into account the experience with the guide during the last decade as well as the progress in the state of the art of the underlying technologies.

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

Endorsement notice

The text of the International Standard IEC 61362:2012 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 documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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 60050-351	2006	International Electrotechnical Vocabulary (IEV) - Part 351: Control technology	-	-
IEC 60068-2-6	2007	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	2008
IEC 60068-2-27	2008	Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock	EN 60068-2-27	2009
IEC 60308	2005	Hydraulic turbines - Testing of control systems	EN 60308	2005
IEC 61000-4-1	2006	Electromagnetic compatibility (EMC) - Part 4-1: Testing and measurement techniques - Overview of IEC 61000-4 series	EN 61000-4-1	2007
CISPR 11 (mod)	2009	Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement	EN 55011	2009
ISO 3448	1992	Industrial liquid lubricants - ISO viscosity classification	-	-

This page is intentionally left BLANK.

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references.....	8
3 Terms, definitions, symbols and units.....	9
3.1 General terms and definitions.....	9
3.2 Terms and definitions related to control levels and control modes.....	9
3.3 Terms and definitions from control theory.....	9
3.4 Subscripts and prefixes.....	10
3.5 Terms and definitions related to the plant and the machines.....	10
3.6 Terms and definitions relating to the governing system.....	11
4 Control structure.....	18
4.1 General.....	18
4.2 Main control functions.....	18
4.2.1 General.....	18
4.2.2 Speed control.....	19
4.2.3 Power output control.....	19
4.2.4 Opening control.....	19
4.2.5 Water level control.....	19
4.2.6 Flow control.....	20
4.3 Configurations of combined control systems.....	20
4.3.1 General.....	20
4.3.2 Parallel structure.....	20
4.3.3 Series structures.....	21
4.3.4 Other configurations.....	22
4.4 Configurations of servo-positioners.....	23
4.5 Multiple control.....	23
4.5.1 General.....	23
4.5.2 Parallel structure.....	24
4.5.3 Series structure.....	24
5 Performance and components of governing systems.....	24
5.1 General.....	24
5.2 Modeling and digital simulation.....	25
5.3 Characteristic parameters for PID-controllers.....	26
5.3.1 General.....	26
5.3.2 Permanent droop b_p	27
5.3.3 Proportional action coefficient K_p , integral action time T_I , and derivative action time T_D	27
5.4 Other parameters of the governing systems.....	28
5.4.1 Command signal adjustments for controlled variables (speed, power output, etc.) and load limiter.....	28
5.4.2 Governor insensitivity $i_x/2$	28
5.4.3 Parameters of servo-positioner.....	29
5.5 Functional relationship between servo-positioners.....	30
5.5.1 Dual regulation of turbines with controllable guide vane and runner blade angles.....	30

5.5.2	Dual control of turbines with needles and deflectors	31
5.5.3	Multiple control	31
5.5.4	Other relationships.....	31
5.6	Actual signal measurement.....	31
5.6.1	General	31
5.6.2	Rotational speed.....	32
5.6.3	Power output	32
5.6.4	Water level	32
5.6.5	Actuator position (stroke).....	32
5.6.6	Signal transmission from electronic transmitters.....	32
5.7	Manual control.....	33
5.8	Linearization	33
5.9	Follow-up controls	34
5.10	Optimization control.....	34
5.11	Monitoring parallel positioning of amplifiers	34
5.12	Provision of actuating energy	34
5.12.1	General	34
5.12.2	System with an accumulator.....	35
5.12.3	Systems without accumulator	38
5.12.4	Direct electric positioner	39
5.12.5	Recommendation for hydraulic fluid selection	40
5.13	Power supply for electronic control systems	40
5.14	Operational transitions.....	40
5.14.1	Start-up and synchronization.....	40
5.14.2	Normal shutdown	41
5.14.3	Sudden load rejection	41
5.14.4	Other operational transitions	42
5.15	Safety devices/circuits	42
5.15.1	General	42
5.15.2	Quick shutdown and emergency shutdown	42
5.15.3	Overspeed protection device.....	43
5.15.4	Interlocks.....	43
5.16	Supplementary equipment	43
5.16.1	Measures to reduce pressure variations	43
5.16.2	Surge control	43
5.16.3	Equipment and measures to lower the speed rise.....	44
5.16.4	Central flow rate control in river power station systems.....	44
5.16.5	Brakes.....	44
5.16.6	Synchronous condenser mode of operation	45
5.17	Environmental suitability of governor components	45
5.17.1	Vibration and shock resistance.....	45
5.17.2	Temperature and humidity	45
5.18	Electromagnetic compatibility.....	45
6	How to apply the recommendations.....	45
Annex A (normative) Simplified differential equations and transfer functions of idealized PID-controllers.....		58
Annex B (informative) Grid frequency control.....		60
Annex C (informative) Quick shutdown and emergency shutdown		63

Figure 1 – Controlled variable range	12
Figure 2 – Permanent droop	12
Figure 3 – Proportional action coefficient and integral action time	13
Figure 4 – Derivative time constant	14
Figure 5 – Dead band	15
Figure 6 – Minimum servomotor opening/closing time	16
Figure 7 – Time constant of the servo-positioner	16
Figure 8 – Servo-positioner inaccuracy	17
Figure 9 – Control system dead time	17
Figure 10 – Control system with speed and power output controllers in parallel	21
Figure 11 – Control system with speed controller and power command signal in parallel	21
Figure 12 – Control system with speed controller and water level controller in parallel	21
Figure 13 – Governing system with power output and speed controller in series	22
Figure 14 – Governing system with water level controller and speed controller in series	22
Figure 15 – Power output control via the speed controller	22
Figure 16 – Water level controller without speed controller	23
Figure 17 – Parallel structure with defined functional relation and an additional signal superimposition	24
Figure 18 – Series structure with defined functional relation and additional signal superimposition	24
Figure 19 – Time step response and frequency response of the amplifier output Y/Y_{\max} to a displacement input s_v	30
Figure 20 – Pressure tank content and pressure ranges	35
Figure 21 – Open-circuit system	39
Figure 22 – Start-up speed curve up to synchronization	41
Figure 23 – Load rejection	42
Figure A.1 – Idealized PID in pure parallel structure	59
Figure A.2 – Idealized PID alternative representation	59
Figure B.1 – Example of principle schematic functional diagram of a unit with a turbine governing system using an idealized PID controller with a power droop	61
Figure B.2 – Behaviour of two units with different governor permanent droop values	62
Table C.1 – Alternative I – Summary of cases for quick shut-down and emergency shut-down	65
Table C.2 – Alternative II – Summary of cases for quick shut-down and emergency shut-down	66

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**GUIDE TO SPECIFICATION OF HYDRAULIC TURBINE
GOVERNING SYSTEMS**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61362 has been prepared by IEC technical committee 4: Hydraulic turbines.

This second edition cancels and replaces the first edition published in 1998. It is a technical revision. It takes into account the experience with the guide during the last decade as well as the progress in the state of the art of the underlying technologies.

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

FDIS	Report on voting
4/270/FDIS	4/272/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.

The committee has decided that the contents of this publication will remain unchanged until the stability 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

While a standard for the testing of hydraulic turbine governing systems had been existing for a very long time (IEC 60308 published in 1970)¹, a guide for the specification of hydraulic turbine governing systems was missing until 1998. The need for such a guide became more and more urgent with the fast development and the new possibilities especially of the digital components of the governor.

The current second edition of the guide takes into account the experience with the guide during the last decade as well as the progress in the state of the art of the underlying technologies.

While the first edition was written more or less as a supplement to the already existing guide for testing, the objective of the second edition is to be the leading guide with respect to turbine governing systems.

¹ IEC 60308:1970, *International code for testing of speed governing systems for hydraulic turbines*. This publication was withdrawn and replaced by IEC 60308:2005.

GUIDE TO SPECIFICATION OF HYDRAULIC TURBINE GOVERNING SYSTEMS

1 Scope

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

The scope of this standard is restricted to the turbine governing level. Additionally some remarks about the control loops of the plant level and about primary and secondary frequency control (see also Annex B) are made for better understanding without making a claim to be complete.

Important topics covered by the guide are:

- speed, power, water level, opening and flow (discharge) control for reaction and impulse-type turbines including double regulated machines;
- means of providing actuating energy;
- safety devices for emergency shutdown, etc.

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

Acceptance tests, specific test procedures and guarantees are outside the scope of the guide; those topics are covered by IEC 60308.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-351:2006, *International Electrotechnical Vocabulary – Part 351: Control technology*

IEC 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60308:2005, *Hydraulic turbines – Testing of control systems*

IEC 61000-4-1:2006, *Electromagnetic compatibility (EMC) – Part 4-1: Testing and measurement techniques – Overview of IEC 61000-4 series*

CISPR 11:2009, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*

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

This is a free preview. Purchase the entire publication at the link below:

[Product Page](#)

-
- [Looking for additional Standards? Visit Intertek Inform Infostore](#)
 - [Learn about LexConnect, All Jurisdictions, Standards referenced in Australian legislation](#)
-