



Hydraulic turbines, storage pumps and pump-turbines – Tendering Documents

Part 5: Guidelines for technical specifications for tubular turbines

[IEC TR 61366-5:1998](https://standards.iteh.ai/catalog/standards/sist/25afac5-9355-41c1-a661-3667494e330a)

[https://standards.iteh.ai/catalog/standards/sist/25afac5-9355-41c1-a661-](https://standards.iteh.ai/catalog/standards/sist/25afac5-9355-41c1-a661-3667494e330a)

*Turbines hydrauliques, pompes d'accumulation
et pompes-turbines –
Document d'appel d'offres –*

*Partie 5:
Guide des spécifications techniques pour
les turbines tubulaires*



Numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series.

Consolidated publications

Consolidated versions of some IEC publications including amendments are available. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

Validity of this publication

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology.

Information relating to the date of the reconfirmation of the publication is available in the IEC catalogue.

Information on the revision work, the issue of revised editions and amendments may be obtained from IEC National Committees and from the following IEC sources:

- **IEC Bulletin**
- **IEC Yearbook**
On-line access*
- **Catalogue of IEC publications**
Published yearly with regular updates
(On-line access)*

Terminology, graphical and letter symbols

For general terminology, readers are referred to IEC 60050: *International Electrotechnical Vocabulary (IEV)*.
<https://standards.iteh.ai/catalog/standards/sist/25afac5-9355-41c1-a661->

For graphical symbols, and letter symbols and signs approved by the IEC for general use, readers are referred to publications IEC 60027: *Letter symbols to be used in electrical technology*, IEC 60417: *Graphical symbols for use on equipment. Index, survey and compilation of the single sheets* and IEC 60617: *Graphical symbols for diagrams*.

IEC publications prepared by the same technical committee

The attention of readers is drawn to the end pages of this publication which list the IEC publications issued by the technical committee which has prepared the present publication.

* See web site address on title page.

TECHNICAL REPORT – TYPE 3

IEC 61366-5

First edition
1998-03

Hydraulic turbines, storage pumps and pump-turbines – Tendering Documents

Part 5: Guidelines for technical specifications for tubular turbines

IEC TR 61366-5:1998

<https://standards.iteh.ai/catalog/standards/sist/25afac5-9355-41c1-a661-366742019400/61366-5-1998>

*Turbines hydrauliques, pompes d'accumulation
et pompes-turbines –
Document d'appel d'offres –*

*Partie 5:
Guide des spécifications techniques pour
les turbines tubulaires*

© IEC 1998 — Copyright - all rights reserved

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Electrotechnical Commission
Telefax: +41 22 919 0300

3, rue de Varembe Geneva, Switzerland
e-mail: inmail@iec.ch IEC web site <http://www.iec.ch>



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE

V

For price, see current catalogue

CONTENTS

	Page
FOREWORD	4
Clause	
0 Introduction to technical specifications	
1 Scope	9
2 Reference documents	9
3 Technical requirements	9
3.1 Scope of work	9
3.2 Limits of the contract	10
3.3 Supply by Employer	10
3.4 Design conditions	11
3.5 Technical performance and other guarantees	13
3.6 Mechanical design criteria	16
3.7 Design documentation	17
3.8 Materials and construction	18
3.9 Shop inspection and testing	19
4 Technical specifications for fixed/embedded components	20
4.1 Bulb structure and hatch cover	20
4.2 Stay ring (if employed in design)	21
4.3 Discharge ring	21
4.4 Draft tube and draft tube liner	22
4.5 Upstream and downstream pressure taps and pipes	22
5 Technical specifications for stationary/removable components	22
5.1 Inner and outer rings	22
5.2 Guide vanes	22
6 Technical specifications for guide vane regulating apparatus	23
6.1 Servomotors	23
6.2 Connecting rods	23
6.3 Regulating ring	23
6.4 Guide vane linkage	23
6.5 Guide vane overload protection	23
6.6 Locking devices	24
6.7 Counter weight	24
7 Technical specifications for rotating parts, bearings, seals and gear box (if used)	24
7.1 Runner	24
7.2 Runner blade regulating apparatus	24
7.3 Main shaft	25

7.4	Turbine guide bearing	26
7.5	Main shaft seal	26
7.6	Standstill (maintenance) seal	26
7.7	Gearbox (if used)	26
8	Technical specifications for thrust and counter-thrust bearing	27
8.1	Design data	27
8.2	Bearing support	27
8.3	Bearing assembly	27
9	Technical specifications for miscellaneous components	27
9.1	Walkways, access platforms and stairs	27
9.2	Lifting fixtures	28
9.3	Special tools	28
9.4	Standard tools	28
9.5	Nameplate	28
10	Technical specifications for auxiliary systems	28
10.1	Bearing lubrication system	28
10.2	Turbine drainage	28
10.3	Lubrication – guide vane regulating system	28
11	Technical specifications for instrumentation	29
11.1	Controls	29
11.2	Indication	29
11.3	Protection	29
12	Spare parts	29
13	Model acceptance tests	29
14	Site installation and commissioning tests	30
14.1	General	30
14.2	Installation procedures	30
14.3	Tests during installation	31
14.4	Commissioning tests	31
15	Field acceptance tests	31
15.1	Scope and reports	31
15.2	Inspection of cavitating pitting	31

STANDARD PREVIEW

(standards.iteh.ai)

IEC TR 61366-5:1998

[https://standards.iteh.ai/catalog/standards/sis/25a1ac5b-9335-41c1-a661-](https://standards.iteh.ai/catalog/standards/sis/25a1ac5b-9335-41c1-a661-036c2c4af483/iec-tr-61366-5-1998)

[036c2c4af483/iec-tr-61366-5-1998](https://standards.iteh.ai/catalog/standards/sis/25a1ac5b-9335-41c1-a661-036c2c4af483/iec-tr-61366-5-1998)

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**HYDRAULIC TURBINES, STORAGE PUMPS AND PUMP-TURBINES –
TENDERING DOCUMENTS –**
**Part 5: Guidelines for technical specifications
for tubular turbines**

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
- 5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where for any other reason there is the future but no immediate possibility of an agreement on an International Standard;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

Technical reports of types 1 and 2 are subject to review within three years of publication to decide whether they can be transformed into International Standards. Technical reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

IEC 61366-5, which is a technical report of type 3, has been prepared by IEC technical committee 4: Hydraulic turbines.

The text of this technical report is based on the following documents:

Committee draft	Report on voting
4/110/CDV	4/122/RVC

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

Technical Report IEC 61366-5 is one of a series which deals with Tendering documents for hydraulic turbines, storage pumps and pump-turbines. The series consists of seven parts:

Part 1: General and annexes (IEC 61366-1)

Part 2: Guidelines for technical specification for Francis turbines (IEC 61366-2)

Part 3: Guidelines for technical specification for Pelton turbines (IEC 61366-3)

Part 4: Guidelines for technical specification for Kaplan and propeller turbines (IEC 61366-4)

Part 5: Guidelines for technical specification for tubular turbines (IEC 61366-5)

Part 6: Guidelines for technical specification for pump-turbines (IEC 61366-6)

Part 7: Guidelines for technical specification for storage pumps (IEC 61366-7)

Parts 2 to 7 are "stand-alone" publications which when used with Part 1 contain guidelines for a specific machine type (i.e. Parts 1 and 4 represent the combined guide for Kaplan and propeller turbines). A summary of the proposed contents for a typical set of Tendering documents is given in the following table 1 and annex A. Table 1 summarizes the arrangement of each part of this guide and serves as a reference for the various chapters and sections of the Tendering documents (see 3.2 of this part).

[IEC TR 61366-5:1998](https://standards.iteh.ai/catalog/standards/sist/25afac5-9355-41c1-a661-036c2c4af483/iec-tr-61366-5-1998)

<https://standards.iteh.ai/catalog/standards/sist/25afac5-9355-41c1-a661-036c2c4af483/iec-tr-61366-5-1998>

Table 1 – Summary of guide for the preparation of Tendering documents for hydraulic turbines, storage pumps and pump-turbines

CONTENTS OF GUIDE IEC 61366-1 TO IEC 61366-7		SAMPLE TABLE OF CONTENTS OF TENDERING DOCUMENTS (TD) (Example for the Francis turbines; see 61366-1, annex A)	
Part	Clause Title	Chapter	Title
1	General and annexes	1	Tendering requirements
1	1	2	Project information
1	1	3	General conditions
1	2	4	Special conditions
1	3	5	General requirements
1	4	6	Technical specifications
1	5	6.1	Technical requirements
1	6	6.1.1	Scope of work
		6.1.2	Limits of the contract
		6.1.3	Supply by Employer
		6.1.4	Design conditions
		6.1.5	Performance and other guarantees
		6.1.6	Mechanical design criteria
		6.1.7	Design documentation
		6.1.8	Materials and construction
		6.1.9	Shop inspection and testing
		6.2	Technical specifications for fixed/embedded components
		6.3	Technical specifications for stationary/removable components
		6.4	Technical specifications for guide vane regulating apparatus
		6.5	Technical specifications for rotating parts, bearings and seals
		6.6	Technical specifications for thrust bearings
		6.7	Technical specifications for miscellaneous components
		6.8	Technical specifications for auxiliary systems
		6.9	Technical specifications for instrumentation
		6.10	Spare parts
		6.11	Model tests
		6.12	Installation and commissioning
		6.13	Field acceptance tests
A	Sample table of contents of Tendering documents for Francis turbines		
B	Comments on factors for evaluation of tenders		
C	Check list for tender form		
D	Examples of technical data sheets		
E	Technical performance guarantees		
F	Example of cavitation pitting guarantees		
G	Check list for model test specifications		
H	Sand erosion considerations		
2 to 7	Technical specifications		
2	Francis turbines		
3	Pelton turbines		
4	Kaplan and propeller turbines		
5	Tubular turbines		
6	Pump-turbines		
7	Storage pumps		

HYDRAULIC TURBINES, STORAGE PUMPS AND PUMP-TURBINES – TENDERING DOCUMENTS –

Part 2: Guidelines for technical specifications for tubular turbines

0 Introduction to technical specifications

The main purpose of the technical specifications is to describe the specific technical requirements for the hydraulic machine for which the Tendering documents (TD) are being issued. To achieve clarity and to avoid confusion in contract administration, the Employer should not specify anything in the technical specifications which is of importance only to the preparation of the tender. Such information and instructions should be given only in the instructions to Tenderers (ITT). Accordingly, the ITT may refer to other chapters and sections of the Tendering documents but not vice versa. *As a general rule the word "Tenderer" should be confined in use only to TD Chapter 1 "Tendering requirements"; elsewhere the term "Contractor" should be used.*

Special attention should be given to items of a project specific nature such as materials, protective coating systems, mechanical piping systems, electrical systems and instrumentation. It is common for the Employer to use technical standards for such items which would apply to all contracts for a particular project or projects. In this event, detailed technical standards should be specified in TD Chapter 5 "General requirements".

Technical specifications for the various types of hydraulic machines included in this guide are provided in the following parts:

- Francis turbines (Part 2);
- Pelton turbines (Part 3);
- Propeller and Kaplan turbines (Part 4);
- Tubular turbines (Part 5);
- Pump-turbines (Part 6);
- Storage pumps (Part 7).

The guidelines for preparation of tubular turbine specifications include technical specifications for the following:

- Design conditions: Project arrangement, hydraulic conditions, mode of operation, generator characteristics, transient behaviour data, stability of the system, noise, vibration, pressure fluctuations and safety requirements.
- Technical performance and other guarantees:
 - power;
 - discharge;
 - efficiency;
 - maximum momentary pressure;
 - minimum momentary pressure;
 - maximum momentary overspeed;
 - maximum steady-state runaway speed;

- cavitation pitting;
 - hydraulic thrust;
 - maximum weights and dimensions for transportation, erection and maintenance.
- Mechanical design criteria: design standards, stresses and deflections and special design considerations.
 - Design documentation: Contractor's input needed for the Employer's design, the Contractor's drawings and data, Contractor's review of the Employer's design and technical reports by Contractor.
 - Materials and construction: material selection and standards, quality assurance procedures, shop methods and personnel, corrosion protection and painting.
 - Shop inspection and testing: general requirements and reports, material tests and certificates, dimensional checks, shop assembly and tests.
 - Fixed/embedded components: generator hatch cover or pit, stay ring, discharge ring (if any), draft tube, draft tube liner foundations anchorage, upstream and downstream pressure taps and pipes.
 - Stationary/removable components: bulb nose, generator access shaft inner and outer guide rings and guide vanes.
 - Regulating apparatus: servomotor, counterweight, connecting rods, regulating ring, guide vane linkage, system, guide vane overload protection and locking devices.
 - Rotating parts, bearings and seals: runner, main shaft, guide bearing, main shaft seal, oil head and runner blade regulation system with servomotor assembly with oil supply, linkage system, crosshead and oilhead.
 - Thrust and counter-thrust bearing: bearing support, thrust collar and counter-thrust bearing pads and rings, oil sump and instrumentation.
 - Gear box: gear box and related components.
 - Miscellaneous components: walkways, platforms, lifting fixtures, special tools, standard tools and nameplate.
 - Auxiliary systems: water supply to main shaft seal, turbine drainage, lubrication-guide vane regulating system, and oil supply to bearings.
 - Instrumentation: controls, indication and protection.
 - Spare parts: basic spare parts.
 - Model acceptance tests: test requirements.
 - Site installation and commissioning test: installation procedures and commissioning.
 - Field acceptance tests: scope of field test scope and reports and inspection of cavitation pitting.

An example of the proposed table of contents for Tendering documents for a Francis turbine is given in annex A of IEC 61366-1. The example does not include technical specifications for the control system, relief valves, or high and low pressure slide valves or gates which, at the Employer's option, may be included in the Tendering documents for the turbine or may be specified in separate documents.

Chapter 6 (technical specifications) of the Tendering documents should be arranged as follows:

- 6.1 Technical requirements;
- 6.2 Technical specifications for fixed/embedded components;
- 6.3 Technical specifications for stationary/removable components;
- 6.4 Technical specifications for guide vane regulating apparatus;
- 6.5 Technical specifications for rotating parts, guide bearings and seals;
- 6.6 Technical specifications for thrust bearing;
- 6.7 Technical specifications for gear box;

- 6.8 Technical specifications for miscellaneous components;
- 6.9 Technical specifications for auxiliary systems;
- 6.10 Technical specifications for instrumentation;
- 6.11 Spare parts;
- 6.12 Model acceptance tests
- 6.13 Site installation and commissioning
- 6.14 Field acceptance tests

1 Scope

This technical report, referred to herein as the Guide, is intended to assist in the preparation of Tendering documents and tendering proposals and in the evaluation of tenders for hydraulic machines. This part of IEC 61366 provides guidelines for tubular turbines.

2 Reference documents

IEC 60041:1992, *Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump-turbines*

IEC 60193:1965, *International code for model acceptance tests of hydraulic turbines*

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

IEC 60545:1976, *Guide for commissioning, operation and maintenance of hydraulic turbines*

IEC 60609:1978, *Cavitation pitting evaluation in hydraulic turbines, storage pumps and pump-turbines*

IEC 60994:1991, *Guide for field measurement of vibrations and pulsations in hydraulic machines (turbines, storage pumps and pump turbines)*

IEC 61362,— *Guide to specification of hydro-turbine control systems* ¹⁾

ISO 3740:1980, *Acoustics – Determination of sound power levels of noise sources – Guidelines for the use of basic standards and for the preparation of noise test codes*

3 Technical requirements

3.1 Scope of work

This subclause should describe the scope of work and the responsibilities which are to be conferred upon the Contractor. The general statement of scope of work presented in TD²⁾ subsection 2.1 (5.1 of IEC 61366-1) shall be consistent with what is presented here. In a similar manner, pay items in the tender form, TD section 1.2 (4.2 of IEC 61366-1) should be defined directly from TD subsection 6.1.1.

The scope of work should begin with a general statement which outlines the various elements of the work including (where applicable) the design, model testing, supply of materials and labour, fabrication, machining, quality assurance, quality control, shop assembly, shop testing, spare parts, transportation to site, site installation, commissioning, acceptance testing, warranty and other services specified or required for the items of work.

¹⁾ To be published.

²⁾ All references to Tendering documents (TD) apply to annex A of IEC 61366-1.

The general statement should be followed by a specific and detailed list of the major items which the Employer wishes to have as separate payment items in the tender form, for example:

Item	Description
1	Six (6) complete bulb type Kaplan turbines each with a specified power of not less than 10 200 kW at the shaft coupling under a specified hydraulic energy of 98 J/kg (specified head of 10 m);
2	Turbine model testing;
3	Tools, slings and handling devices required for maintenance of the turbines;
4	Transportation and delivery to site;
5	Site installation, commissioning, and acceptance testing of the turbines;
6	Preparation and submission of operation and maintenance manual and training of Employer's operating and maintenance staff in optimum use of these manuals; and
7	Spare parts required for operation and maintenance."

3.2 Limits of the contract

This subclause, making reference to the Employer's drawings and data, should describe the limits of the contract considering the following:

- details and location of the upstream high-pressure reference section;
- responsibility for connection of high-pressure reference section at site;
- details and location of the downstream low-pressure reference section;
- details and location of the upstream termination of the water passage liner;
- details and location of the downstream termination of the draft tube liner;
- orientation and location of the turbine/generator shaft flange interface;
- responsibility for flange coupling bolts, nuts and nut guards at generator/turbine coupling, including drilling jig;
- responsibility for bolts, nuts, gaskets at piping termination;
- termination of governor piping;
- termination of drainage piping;
- termination of bearings lubricating oil piping;
- termination of shaft seal piping (if any);
- termination points and junction boxes for wiring power, control, indication, protection, and lighting;
- compressed air for service and other functions.

NOTE – Contract limits will change considerably if other major items of equipment (such as speed governor system, turbine downstream gate, generators, excitation systems, control metering and relaying systems, switchgear, and power transformers) are included with the turbine equipment in a common set of Tendering documents.

3.3 Supply by Employer

This subclause should be complementary to 5.6 of IEC 61366-1 (TD 2.6) and should list the items and services which will be the responsibility of the Employer. The following should be considered:

- services during site installation and testing;
- temporary enclosures for site storage of turbine parts or for erection;
- installation in primary concrete of small items provided by the Contractor, such as anchors, sole plates, and piping provided by the Contractor;