

TECHNICAL REPORT

IEC
61366-4

First edition
1998-03

**Hydraulic turbines, storage pumps
and pump-turbines –**

Tendering Documents –

Part 4:

**Guidelines for technical specifications
for Kaplan and propeller turbines**

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

Documents d'appel d'offres –

Partie 4:

*Guide des spécifications techniques pour les turbines Kaplan
et les turbines à hélice*



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

Part 4: Guidelines for technical specifications for Kaplan and propeller turbines

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et pompes-turbines –*

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Documents d'appel d'offres –

Partie 4:

*Guide des spécifications techniques pour les turbines Kaplan
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

**Part 4: Guidelines for technical specifications
for Kaplan and propeller 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.
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- 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 61366-4, 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 61366-4 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).

A bilingual edition of this technical report may be issued at a later date.

<https://standards.iteh.ai/catalog/standards/sist/2698a598-7c1f-47c7-a6da-57b87a62e2e4/iec-tr-61366-4-1998>

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		Technical requirements
1	6	6.1	Scope of work
		6.1.1	Limits of the contract
		6.1.2	Supply by Employer
		6.1.3	Design conditions
		6.1.4	Performance and other guarantees
		6.1.5	Mechanical design criteria
		6.1.6	Design documentation
		6.1.7	Materials and construction
		6.1.8	Shop inspection and testing
		6.1.9	Technical specifications for fixed/embedded components
		6.2	Technical specifications for stationary/removable components
		6.3	Technical specifications for guide vane regulating apparatus
		6.4	Technical specifications for rotating parts, bearings and seals
		6.5	Technical specifications for thrust bearings
		6.6	Technical specifications for miscellaneous components
		6.7	Technical specifications for auxiliary systems
		6.8	Technical specifications for instrumentation
		6.9	Spare parts
		6.10	Model tests
		6.11	Installation and commissioning
		6.12	Field acceptance tests
		6.13	
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 4: Guidelines for technical specifications for Kaplan and propeller 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);
- Kaplan and Propeller turbines (Part 4);
- Tubular turbines (Part 5);
- Pump-turbines (Part 6);
- Storage pumps (Part 7).

The guidelines for preparation of Kaplan and propeller turbine specifications include technical specifications for the following.

- Design conditions: project arrangement, hydraulic conditions, specified conditions, mode of operation, generator characteristics, synchronous condenser 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 (earthquake acceleration, etc.).
 - Design documentation: Contractor's input needed for the Employer's design, 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, 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: spiral case with compressible wrapping (if any), stay ring, foundation ring, discharge ring, draft tube, draft tube liner, pit liner, and foundation plates and anchorages.
 - Stationary/removable components: headcover, bottom ring (may be fixed), facing plates, stationary wearing ring, guide vanes.
 - Regulating apparatus for guide vanes: servomotor, connecting rods, regulating ring, guide vane linkage system, guide vane overload protection and locking devices, mechanical synchronizing device (if any).
 - Rotating parts, bearings and seals: runner, main shaft, intermediate shaft, guide bearing with oil supply, oil/water cooler, main shaft seal and standstill (maintenance) shaft seal.
 - Runner blade regulation: servomotor assembly with oil supply, linkage system, crosshead and oilhead.
 - Thrust bearing (when part of the hydraulic machine supply): bearing support, thrust block, rotating ring, thrust bearing pads and pivots, oil sump with oil supply (common with guide bearing, if any), oil/water coolers, instrumentation.
 - Miscellaneous components: walkways, lifting fixtures, special tools, standard tools, turbine pit hoist, nameplate, draft tube maintenance platform.
 - Auxiliary systems: turbine pit drainage and other drainage systems; lubrication, draft tube air admission, tailwater depression.
 - Instrumentation: controls, indication and protection.
 - Spare parts: basic spare parts.
 - Model tests: test requirements.
 - Site installation and commissioning tests: installation procedures and commissioning tests.
 - Field acceptance tests: scope of field tests, test measurement methods, 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. The example does not include technical specifications for the control system, relief valves, or high and low-pressure side valves or gates which, at the Employer's option, may be included in the Tendering Documents for the Kaplan and propeller 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 miscellaneous components;
- 6.8 Technical specifications for auxiliary systems;
- 6.9 Technical specifications for instrumentation;
- 6.10 Spare parts;
- 6.11 Model acceptance tests;
- 6.12 Site installation and commissioning;
- 6.13 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 Kaplan and propeller 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 TD ²⁾ section 2.1 (5.1) shall be consistent with what is presented here. In a similar manner, pay items in the tender form, TD subsection 1.2 (4.2), 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,

¹⁾ To be published.

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

spare parts, transportation to site, site installation, commissioning, acceptance testing, warranty and other services specified or required for the items of work. 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) vertical shaft Kaplan hydraulic turbines each with specified power of not less than 45 000 kW under a specified specific hydraulic energy of 294 J/kg (specified head of 30 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 the Employer's operating and maintenance staff in the 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 of the design and supply limits of the high and low-pressure sides of the machine;
- details and location of gate(s) or valve on high-pressure side and responsibility for field connection of spiral case to penstock or valve (if any) on high-pressure side;
- details and location of the downstream termination of the draft tube liner;
- details and location of gate(s) or valve(s) on low-pressure side;
- orientation and location of turbine/generator shaft flange interface;
- responsibility for supply and installation of flange coupling bolts, nuts and guards at generator/turbine coupling, including drilling jig;
- responsibility for supply and installation of bolts, nuts, gaskets at piping termination;
- termination of governor piping;
- termination of (semi-) spiral case and draft tube dewatering piping;
- termination of spiral case air exhaust piping (if any);
- termination of pit drainage piping;
- termination of bearing lubricating oil piping;
- termination of shaft seal piping (if any);
- termination of cooling water piping for bearings;
- turbine headcover mounted thrust bearing (if desired);
- termination points and junction boxes for power, control, indication, protection, and lighting;
- compressed air for service and other functions.

NOTE – Contract limits will change if other major items of equipment (such as hydro-turbine control system, valves, gates, 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 section 2.6) and should list the items of work and services which will be the responsibility of the Employer. The following items should be considered: