TECHNICAL REPORT – TYPE 3

IEC 61366-6

First edition
1998-03

Hydraulic turbines, storage pumps and pump-turbines –

Tendering Documents –

Part 6: Guidelines for technical specifications for pump-turbines

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

Documents d'appel d'offres –

Partie 6: Guide des spécifications techniques pour les pompes-turbines

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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 7
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 11
3.4 Design conditions 11
3.5 Technical performance and other guarantees 15
3.6 Mechanical design criteria 18
3.7 Design documentation 19
3.8 Materials and construction 20
3.9 Shop inspection and testing 21
4 Technical specifications for fixed/embedded components 22
4.1 Spiral case 23
4.2 Stay ring 23
4.3 Foundation ring 24
4.4 Draft tube and draft tube liner 24
4.5 Pit liner 24
5 Technical specifications for stationary/removable components 25
5.1 Headcover and bottom ring 25
5.2 Guide vanes 26
6 Technical specifications for guide vane regulating apparatus 26
6.1 Servomotors 26
6.2 Connecting rods 26
6.3 Regulating ring 27
6.4 Guide vane linkage 27
6.5 Guide vane overload protection 27
6.6 Locking devices 27
6.7 Synchronizing device (optional) 27
7 Technical specifications for rotating parts, bearings and seals 27
7.1 Runner 27
7.2 Main shaft 28
7.3 Pump-turbine guide bearing 28
7.4 Main shaft seal 29
7.5 Standstill (maintenance) seal 29

8 Technical specifications for thrust bearing 29
8.1 Design data 29
8.2 Bearing support 29
8.3 Bearing assembly 29
8.4 Oil injection pressure lift system 30
9 Technical specifications for miscellaneous components 30
9.1 Walkways, access platforms and stairs 30
9.2 Lifting fixtures 30
9.3 Special tools 30
9.4 Standard tools 31
9.5 Pump-turbine pit hoist 31
9.6 Nameplate 31
10 Technical specifications for auxiliary systems 31
10.1 Bearing lubrication system 31
10.2 Runner pressure balancing and pressure relief limes 31
10.3 Pump-turbine pit drainage 31
10.4 Lubrication of guide vane regulating system 31
10.5 Draft tube air admission system 31
10.6 Tailwater depression system (if applicable) 32
11 Technical specifications for instrumentation 32
11.1 Controls 32
11.2 Indication 32
11.3 Protection 32
12 Spare parts 32
13 Model acceptance tests 33
14 Site installation and commissioning tests 33
14.1 General 33
14.2 Installation procedures 34
14.3 Tests during installation 34
14.4 Commissioning tests 34
15 Field acceptance tests 34
15.1 Scope and reports 34
15.2 Inspection of cavitating pitting 35

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 6: Guidelines for technical specifications for pump-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 61366-6, 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 61366-6 is one of a series which deals with Tendering Documents for hydraulic turbines, storage pumps and pump-turbines. The series consists of seven parts:

IEC 61366-1: 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 IEC 61366-1 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.

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	–		2	Project information
1	1	Object and scope of this guide	3	General conditions
1	2	Reference documents and definitions	4	Special conditions
1	3	Arrangement of Tendering Documents	5	General requirements
1	4	Guidelines for tendering requirements	6	Technical specifications
1	5	Guidelines for project information	6.1	Technical requirements
1	6	Guidelines for general conditions, special conditions and general requirements	6.1.1	Scope of work
			6.1.2	Limits of the contract
			6.1.3	Supply by Employer
1		Annexes	6.1.4	Design conditions
			6.1.5	Performance and other guarantees
A		Sample table of contents of Tendering Documents for Francis turbines	6.1.6	Mechanical design criteria
B		Comments on factors for evaluation of tenders	6.1.7	Design documentation
C		Check list for tender form	6.1.8	Materials and construction
D		Examples of technical data sheets	6.1.9	Shop inspection and testing
E		Technical performance guarantees	6.2	Technical specifications for fixed/embedded components
F		Example of cavitation pitting guarantees	6.3	Technical specifications for stationary/removable components
G		Check list for model test specifications	6.4	Technical specifications for guide vane regulating apparatus
H		Sand erosion considerations	6.5	Technical specifications for rotating parts, bearings and seals
			6.6	Technical specifications for thrust bearings
2 to 7		Technical specifications	6.7	Technical specifications for miscellaneous components
			6.8	Technical specifications for auxiliary systems
2		Francis turbines	6.9	Technical specifications for instrumentation
3		Pelton turbines	6.10	Spare parts
4		Kaplan and propeller turbines	6.11	Model tests
5		Tubular turbines	6.12	Installation and commissioning
6		Pump-turbines	6.13	Field acceptance tests
7		Storage pumps		

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

Part 6: Guidelines for technical specifications for pump-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 pump-turbine specifications include technical specifications for the following:

– Design conditions: Project arrangement, hydraulic conditions, specified conditions, modes of operation conditions, generator characteristics, motor characteristics, synchronous condenser characteristics, speed-up procedure for pump mode, transient behaviour data, change-over times and characteristics, stability of the system, noise, vibration, pressure fluctuations and safety requirements.
– Technical performance and other guarantees:
  • power
  • discharge
  • specific hydraulic energy (head)
  • efficiency
  • maximum momentary pressure
  • minimum momentary pressure
  • maximum momentary overspeed
  • maximum steady-state runaway speed
  • cavitation pitting
  • hydraulic thrust

  - change-over times
  - 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 the 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, facing plates, stationary wearing ring, guide vanes.

– Regulating apparatus for guide vanes: servomotor, connecting rods, regulating ring (if any), guide vane linkage system, guide vane overload protection and locking devices and mechanical synchronizing device (if any).

– Rotating parts, bearings and seals: runner (impeller), main shaft, intermediate shaft (if any), guide bearing with oil supply, oil/water cooler, main shaft seal, standstill (maintenance) seal.

– Thrust bearing (if 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: runner pressure balancing and pressure relief lines, turbine pit drainage and other drainage systems; lubrication, draft tube air admission, tailwater depression, cooling water supply for runner seal for blow-down operation.

– Instrumentation: controls, indication and protection.

– Spare parts: basic spare parts.

– Model acceptance tests: test requirements.

– Site installation and commissioning tests: installation procedures and commissioning tests.

– Field acceptance tests: scope of field tests, 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 of the control system, shut-off valves, gates motor-generator, pony motor, frequency converter for starting into pump-mode, excitation system which may, at the Employer's option, be included in the Tendering Documents for the pump-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 pump-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 60609:1978, *Cavitation pitting evaluation in hydraulic turbines, storage pumps and pump-turbines*

IEC 60805:1985, *Guide for commissioning operation and maintenance of storage pumps and of pump-turbines operating as pumps*

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*

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1) To be published.