

Guide for

Commissioning, operation and maintenance of hydraulic turbines

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Association of Hydraulic Equipment Manufacturers	Electricity Supply Industry in England and Wales*
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British Compressed Air Society	Federation of Manufacturers of Construction Equipment and Cranes
British Electrical and Allied Manufacturers' Association (BEAMA)	Health and Safety Executive
British Gas Corporation	Institution of Gas Engineers
British Gear Manufacturers' Association	Institution of Mechanical Engineers
British Internal Combustion Engine Manufacturers' Association	Institution of Plant Engineers
British Pump Manufacturers' Association	Institution of Production Engineers
British Steel Corporation	Lloyd's Register of Shipping*
British Steel Industry	London Transport Executive
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The organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

Institution of Civil Engineers	North of Scotland Hydro-electric Board
Institution of Electrical Engineers	Power Generation Association (BEAMA)

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National foreword

This British Standard was prepared under the direction of the Mechanical Engineering Standards Committee and is identical with IEC Publication 545:1976 “*Guide for commissioning, operation and maintenance of hydraulic turbines*”.

Terminology and conventions. The text of the International Standard has been approved as suitable for publication, without deviation, as a British Standard. Some terminology and certain conventions are not identical with those used in British Standards; attention is especially drawn to the following.

The comma has been used as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

Wherever page numbers are quoted in connection with references to figures in this publication they are IEC page numbers (shown in brackets at the foot of each page).

Cross-references. At present there are no corresponding British Standards for the International Standards referred to.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 14 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Chapter I. General

1 Scope and object

The purpose of this guide is to establish, in a general way, suitable procedures for commissioning hydraulic turbines and associated equipment, and to indicate how such turbines and equipment should be operated and maintained.

It is understood that a publication of this type will be binding only if, and to the extent that, both contracting parties have agreed upon it.

The guide excludes matters of purely commercial interest, except those inextricably bound up with the conduct of commissioning, operation and maintenance.

The guide applies to impulse and reaction turbines of all types, and especially to large turbines directly coupled to electric generators. It applies also to pump-turbines when operating as turbines.

The guide is not concerned with water conduits, gates, valves, drainage pumps, cooling-water equipment, generators, etc., except where they cannot be separated from the turbine and its equipment.

Wherever the guide specifies that documents, drawings or information shall be supplied by a manufacturer (or by manufacturers), each individual manufacturer shall be required to furnish the appropriate information for his own supply only.

2 Terms and definitions

2.1

commissioning

testing of new equipment to check its conformity with contractual specifications, as well as operation of the equipment until formally accepted by the purchaser

2.2

operation

utilization of the equipment to produce energy, or a state of readiness for such production

2.3

maintenance

activity on the equipment directed to its conservation in a state of optimum operating condition

2.4

pre-start tests

test between completion of erection of the equipment and initial run

2.5

initial run

first movement of rotating parts after erection

2.6

test run

operation to obtain one set of data for a specific test

2.7

test operation

utilization of the equipment for testing purposes

2.8

test operation period

test period following initial run and followed by test service. It includes no-load runs for checking power plant equipment, as well as load runs and load rejection tests

2.9

test service

operation of the equipment for an agreed period, during which the manufacturer is generally responsible for the way in which it is operated

2.10

commercial service

operation of the equipment, under the purchaser's responsibility, to produce energy, or a state of readiness for such operation

2.11

commercial service period

period starting after acceptance and including service periods, as well as periods when the equipment may be out of operation for maintenance, inspection, repairs, etc.

2.12

guarantee period

time, extending through an agreed part of the commercial service period, during which the manufacturer has commercial obligations to correct defects in his equipment in order to bring it into conformity with the contract. For this purpose, tests in accordance with the appropriate parts of Sub-clause 11.1.4, shall be performed

2.13

inspection

check on the condition of equipment

2.14

maintenance inspection

inspection at regular intervals, often combined with incidental repairs

2.15

repair

restoration after wear or damage

2.16 modification

change intended to improve performance

2.17 overhaul

complete inspection with necessary repairs and/or modifications intended to bring the unit or part of it to, or nearly to, the optimum functioning condition

3 Data on operating conditions

3.1 A fundamental requirement for proper operation and maintenance is a satisfactory knowledge of the turbine and its accessories by the purchaser's personnel.

The manufacturer (manufacturers) shall deliver to the purchaser's responsible representatives all necessary documents, instructions and information. They shall include:

- general drawings and data;
- material lists, descriptions and test certificates for main parts;
- function diagrams;
- instructions for operation, inspection and maintenance of his supply and tables of measurements as given in the Appendix;
- assembly and dismantling instructions and/or exploded view of the parts;
- safety instructions;
- list of original spare parts, as stated in the contract.

These documents, even in a preliminary form, shall be given to the purchaser's representatives as soon as required and, in any case, before the initial run.

3.2 The documents submitted by the manufacturer (manufacturers) shall include the following data, some of which may be amended according to experience gathered during commissioning.

- 1) Diagram (such as a hill diagram) relating heads, tailwater elevations, flow and output, wicket-gate openings and operating limits; also, where applicable, runner blade or deflector position.
- 2) Statement of similitude of model and prototype, according to IEC Publication 193, International Code for Model Acceptance Tests of Hydraulic Turbines, if appropriate;
- 3) Information on turbine inlet and outlet gates, valves and pressure relief valves.

4) Wicket-gate opening (or needle opening of impulse turbines) for no-load, starting and cavitation limits, as functions of head and tailwater levels also, where appropriate, runner blade or deflector position.

5) Turbine governor and servomotor characteristics.

6) Adjustment of overspeed protection device.

7) Characteristics of the fluids for the governing system. Filter specifications and information on purification frequency and method.

8) Maximum steady-state runaway speed and maximum momentary speed and pressure variations at various operating heads.

9) Minimum continuous operating speed for initial run (depending on design of thrust bearing and other bearings).

10) Description of lubrication systems, stating amount and characteristics of lubricants and frequency of replacement.

11) If applicable, data on jacking system for rotating parts and maximum time after shut-down before re-start without operating the jacking system.

12) Speed limits below which operation of the thrust bearing oil injection system is necessary.

13) If applicable, maximum and minimum speeds for brake operation.

14) Intermediate oil levels and pressures at which pumps and compressors should be started or alarms given; also data for automatic signalling and emergency devices.

15) Maximum and minimum temperatures in bearings, seals and in the oil or fluid pressure circuits (alarm and shut-down values).

16) Maximum and minimum pressures, flows and levels in oil or fluid pressure systems and bearings, according to control system (alarm and shut-down values).

17) Maximum and minimum pressures and flows in coolers (alarm and shut-down values).

18) Maximum water levels in drainage pits (alarm and shut-down values).

19) Data on electric motors, pumps and other accessories.

20) Safety instructions for test and operating staff.

21) Other data of importance which are considered necessary by either purchaser or manufacturer for safe operation of the equipment or for instruction of personnel.