



SLOVENSKI STANDARD SIST IEC 60805:1999

01-april-1999

JcX]c`nUnU[cbg_YdfYg_i gYžcVfUrcj Ub^Y]b`j nXfÿYj Ub^YU_i a i `UW]g_] \ ` fdU_]b
fdU]b] `hi fV]bž_]cVfUhi ^c`_ch fdU_Y

Guide for commissioning, operation and maintenance of storage pumps and of pump-turbines operating as pumps

iTeh STANDARD PREVIEW

Guide pour la réception, l'exploitation et l'entretien des pompes d'accumulation et des pompes-turbines fonctionnant en pompe

[SIST IEC 60805:1999](https://standards.iteh.ai/catalog/standards/sist/39093099-f7b9-4610-9df7-158c80253da3/sist-iec-60805-1999)

Ta slovenski standard je istoveten z: **IEC 60805**

<https://standards.iteh.ai/catalog/standards/sist/39093099-f7b9-4610-9df7-158c80253da3/sist-iec-60805-1999>

ICS:

23.080 ;] æ\ ^ Pumps

SIST IEC 60805:1999 **en**

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST IEC 60805:1999

<https://standards.iteh.ai/catalog/standards/sist/39093099-f7b9-4610-9df7-158e86233da3/sist-iec-60805-1999>

**NORME
INTERNATIONALE
INTERNATIONAL
STANDARD**

**CEI
IEC**

60805

Première édition
First edition
1985-09

**Guide pour la réception, l'exploitation et
l'entretien des pompes d'accumulation et
des pompes-turbines fonctionnant en pompe**

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

SIST IEC 60805:1999

<https://standards.iteh.ai/catalog/standards/sist/39093099-f7b9-4610-9df7-158e86233da3/sist-iec-60805-1999>

© IEC 1985 Droits de reproduction réservés — Copyright - all rights reserved

Aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'éditeur.

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



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

CODE PRIX
PRICE CODE

T

*Pour prix, voir catalogue en vigueur
For price, see current catalogue*

CONTENTS

	Page
FOREWORD	5
PREFACE	5
Clause	
SECTION ONE – GENERAL	
1. Scope and object	7
2. Terms and definitions	7
3. Data on operating conditions	11
SECTION TWO – COMMISSIONING	
4. General	15
5. Test co-ordinator	15
6. Pre-start tests	15
7. Initial run	19
8. Test runs	19
SECTION THREE – OPERATION	
9. General	25
10. Test service period	27
11. Commercial service	29
SECTION FOUR – MAINTENANCE	
12. General	31
13. Basis for maintenance activities	33
14. Restoration to optimum condition	35
15. Re-starting	35
APPENDIX A – Measurements	37

iTeh STANDARD PREVIEW
(standards.iteh.ai)

<https://standards.iteh.ai/catalog/standards/sist/39093099-f7b9-4610-9df7-158e86233da3/sist-iec-60805-1999>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**GUIDE FOR COMMISSIONING, OPERATION AND
MAINTENANCE OF STORAGE PUMPS AND OF
PUMP-TURBINES OPERATING AS PUMPS**

FOREWORD

- 1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.
- 2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.
- 3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

iTeh STANDARD PREVIEW

PREFACE

This standard has been prepared by IEC Technical Committee No. 4: Hydraulic Turbines.

The text of this standard based on the following documents:

<https://standards.itih.ai/catalog/standards/sist/39093099-f7b9-4610-9df7-158c86233da3/sist-iec-60805-1999>

Six Months' Rule	Report on Voting
4(CO)41	4(CO)43

Further information can be found in the Report on Voting indicated in the table above.

The following IEC publications are quoted in this standard:

- Publications Nos. 198 (1966): International Code for the Field Acceptance Tests of Storage Pumps.
 497 (1976): International Code for Model Acceptance Tests of Storage Pumps.
 545 (1976): Guide for Commissioning, Operation and Maintenance of Hydraulic Turbines.
 609 (1978): Cavitation Pitting Evaluation in Hydraulic Turbines, Storage Pumps and Pump-turbines.

GUIDE FOR COMMISSIONING, OPERATION AND MAINTENANCE OF STORAGE PUMPS AND OF PUMP-TURBINES OPERATING AS PUMPS

SECTION ONE – GENERAL

1. Scope and object

The purpose of this guide is to establish, in a general way, suitable procedures for commissioning:

- a) non-reversible hydraulic machines without movable wicket-gates, i.e. storage pumps;
- b) reversible hydraulic machines with fixed blade impellers and without movable wicket-gates, operating as pumps;
- c) reversible hydraulic machines with fixed blade impellers and with movable wicket-gates, operating as pumps;
- d) reversible hydraulic machines with adjustable impeller blades and movable wicket-gates, operating as pumps.

and associated equipment.

This guide also indicates how such machines and equipment should be operated and maintained.

This guide applies to storage pumps and reversible pump-turbines of all types, especially to large units coupled to electrical motor-generators.

[SIST IEC 60805:1999](https://standards.iteh.ai/catalog/standards/sist/39093099-f7b9-4610-9df7-)

<https://standards.iteh.ai/catalog/standards/sist/39093099-f7b9-4610-9df7->

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

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

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

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 machine and its equipment.

It is assumed that the turbine of the set or the pump-turbine operating as turbine has been commissioned beforehand in accordance with IEC Publication 545: Guide for Commissioning, Operation and Maintenance of Hydraulic Turbines, where applicable. Where this is not possible, an individual commissioning procedure shall be established at an early stage of plan design.

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 convert energy, or state of readiness for such utilization.

2.3 Maintenance

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

2.4 Pre-start tests

Tests 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

Operating 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 runs for checking plant equipment, as well as pumping and energy supply interruption tests.

<https://standards.iteh.ai/catalog/standards/sist/39093099-f7b9-4610-9df7-158e86233da3/sist-iec-60805-1999>

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 convert energy, or state of readiness for such operation.

2.11 Commercial service period

Period starting after acceptance, 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 of his equipment in order to bring it into conformity with the contract. For this purpose, tests in accordance with 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 machine and its accessories by the purchaser's personnel.

The manufacturer(s) shall deliver to the purchaser's responsible representative 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 the supply, and tables of measurements as given in Appendix A;
- assembly and dismantling instructions and/or exploded views of assemblies as necessary;
- 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 representative as soon as required and in any case, before the initial run.

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

- 1) Diagram of the storage pump or pump-turbine operating as pump, relating head, discharge, input and suction head and indicating operation limits: in applicable cases, at different wicket-gate and runner blade openings.
- 2) Statement of similitude of model and prototype according to IEC Publication 497: International Code for Model Acceptance Tests of Storage Pumps, if appropriate.
- 3) Detailed sequential diagrams, illustrating ordinary changes from one mode of operation to another (pumping, generation, synchronous condenser operation, stand-by, stop for repair) as well as changes due to various electrical or mechanical faults.
- 4) Wicket-gate and impeller blade openings during the starting period and as a function of head and tailwater level, if applicable.

- 5) If applicable, description of the de-watering and refilling system of the pump impeller, data for pressure air tanks, compressors, valves, automatic control devices, maximum and minimum water level in the draft tube, etc.
- 6) If applicable, description of the coupling type between pump shaft and motor-generator shaft and of the synchronizing arrangement.
- 7) Control and servo systems.
Description of type and control system of the main valve, the distributor and the movable blade impeller (as applicable) as well as closing and opening laws for the main valve, the wicket-gates and impeller blades.
Characteristics of the fluids for the control system, filter specifications and information on purification frequency and method.
- 8) Speed and pressure variations at various operating heads under transient conditions. Maximum steady-state reversed runaway speed, maximum momentary reversed runaway speed.
- 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 time after shut-down for a re-start without operating the jacking system.
- 12) Speed limit 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 pressure oil or fluid 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 for 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.

Some of this information may be required already for other modes of operation of the hydraulic machine.

- 3.3 The manufacturer(s) shall give appropriate instruction to the purchaser's staff and provide the information stated in Sub-clause 3.2 on operating the equipment during the final stage of erection, initial run, test runs and test service particularly for all items not previously used by the purchaser.

During the final stage of erection, the start, the test runs and test service, the purchaser shall make his staff available to the manufacturer for instruction and training in order that they may be capable of operating properly the machinery and associated equipment.

- 3.4 During the guarantee period, the equipment shall not be operated outside the limits stated in the contract without agreement with the manufacturer.

SECTION TWO — COMMISSIONING

4. General

- 4.1 Commissioning occurs after first erection of a new unit. Similar procedures may be utilized with or without formal acceptance also after repair or overhaul.
- 4.2 Operating requirements given in Clause 3 shall be complied with during commissioning. If operating circumstances of the power station prevent commissioning within these requirements, the purchaser and manufacturer should agree on the commissioning procedure.
- 4.3 It will be advantageous for correct interpretation and determination of the causes of any unexpected phenomena, to make simultaneous recordings of significant parameters (such as pressure in spiral and draft tube, openings of control mechanisms, speed, displacement and vibration of shaft, wicket-gates and covers, and possibly power, forces on bearings, pressures in servo-motors, etc.) on recording instruments. These should be in operation during the initial run and onwards. Each recording shall have a time and date registration.
- 4.4 It is the purchaser's responsibility to obtain from all the authorities concerned, agreements on specified conditions (flow, grid, etc.) for test operation.

5. Test co-ordinator

Unless otherwise specified, a test co-ordinator shall be chosen by the purchaser, the main contractors, and the manufacturers. He shall be in charge of drawing up the programme of commissioning. His programme shall be checked and approved by the purchaser, the main manufacturers and contractors before and during the tests if changes appear to be necessary. He shall conduct the tests and check the results.

The test co-ordinator is responsible for the execution of all tests up to the beginning of the test service period. Operating and commissioning personnel shall report to the co-ordinator on all operations performed on the equipment.

6. Pre-start tests

The rigidity and resonance frequency of the supporting structures for reversible machines shall preferably be checked before erection of the unit, and later checked with the machine in place, if possible.

These test checks shall be carried out before the hydraulic machine is filled for the first time with water; they may be part of the turbine commissioning programme for pump-turbines. According to Sub-clause 6.1 of IEC Publication 545, at least the following items shall be checked and the results recorded by the test co-ordinator.

6.1 *Pre-tests check*

- 1) Inspection of all waterways of the hydraulic machine and removal of all foreign or loose objects (these might cause damage). If required, the measuring sections and pressure taps for future acceptance tests shall be checked and confirmed as satisfactory and dimensions recorded as appropriate.
- 2) Calibration of scales for control devices (such as wicket-gates and impeller blades), measurement of clearances, see Appendix A.

- 3) Operation of pressure oil units, hydraulic shut-off valves, pressure relief valves, control systems, automatic and manually-operated starting and stopping devices, and signalling devices.
 - 4) Oil levels and pressures in the control system; condition of all oil filters.
 - 5) All protective devices, such as oil level, pressure and temperature alarms and relays, with adjustment if needed.
 - 6) Times of opening and closing of control elements, and their function.
 - 7) Times of opening and closing of valves or gate (if possible), and their function.
 - 8) Bearing and seal clearances. In the case of pressure-lubricated bearings, the oil injection system should be checked.
 - 9) Operation of leakage and drainage pumps and separately-driven lubrication pumps.
 - 10) Oil, grease, and water supply to all bearings and seals requiring lubrication and cooling.
 - 11) Operation of the braking system of the unit.
 - 12) Proper fastening of all manhole covers.
- The following will also be checked, if applicable:
- 13) Runner blades set at starting position.
 - 14) Operation of the de-watering and refilling system and its control devices.
 - 15) Operation of the disengageable coupling mechanism.

After the above checks, the valves or gates shall be closed, the control devices on the machine shall be closed (and locked, if applicable), the brakes applied and the electrical board energized.

When satisfied, the test co-ordinator shall give instructions for the waterways to be filled.

6.2 Filling waterways

The suction side valve or gate shall be opened first. A check for leaks shall be made.

The waterway shall be filled slowly, and preferably manually either through a by-pass or a small opening of the gate or stop-logs. When the waterway has been sufficiently filled, the gate shall be opened or the stop-logs removed.

The casing of a machine with a distributor shall be pressurized through a by-pass and checked before the main valve is opened. The operation of automatic protection devices which actuate this valve shall then be checked, and the functioning of the valve itself tested.

The casings of hydraulic machines without a distributor, can be partially pressurized only with the tailwater pressure.

Automatic protection devices which actuate the intake or outlet gate or valve shall be checked, especially, the emergency gate. Also automatic locking devices shall be checked. If the protective devices and the emergency gate work satisfactorily and no unusual leakage or deformation has been observed; further tests, such as a de-watering and refilling test, shall be carried out and the control devices adjusted.