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Hydraulic machines – Acceptance tests of small hydroelectric installations

Machines hydrauliques – Essais de réception des petits aménagements hydroélectriques



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Switzerland
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**HYDRAULIC MACHINES – ACCEPTANCE TESTS
OF SMALL HYDROELECTRIC INSTALLATIONS**

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FDIS	Report on voting
4/254/FDIS	4/257/RVD

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HYDRAULIC MACHINES – ACCEPTANCE TESTS OF SMALL HYDROELECTRIC INSTALLATIONS

1 Scope

This International Standard defines the test, the measuring methods and the contractual guarantee conditions for field acceptance tests of the generating machinery in small hydroelectric power installations. It applies to installations containing impulse or reaction turbines with unit power up to about 15 MW and reference diameter of about 3 m. The driven generator can be of synchronous or asynchronous type.

This International Standard contains information about most of the tests required for acceptance of the hydraulic turbine such as safety approval tests, trial operating and reliability tests, as well for verification of cavitation, noise and vibration conditions, if required.

This standard represents the typical methods used on smaller hydroelectric installations, and is divided into three classes as follows (see Table 1 for more detail):

Class A	Normal test program (panel measurement) To determine the maximum power output of the installation.	Default
Class B	Extended test program To determine the performance characteristics of the installation.	Recommended
Class C	Comprehensive test program To determine the absolute efficiency of the installation.	Optional

NOTE All classes contain safety tests, trial operating tests, and reliability tests.

This standard gives all necessary references for the contract in order to execute the test, evaluate, calculate and compare the result to the guarantee for all the classes A, B and C.

The manufacturer or consulting engineer is responsible for ensuring that standardized connections are installed for performing these tests. This standard does not cover the structural details of a hydroelectric installation or its component parts.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60041:1991, *Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump turbines*

IEC 60193, *Hydraulic turbines, storage pumps and pump-turbines – Model acceptance tests*

IEC 60308, *Hydraulic turbines – Testing of control systems*

IEC 60609 (all parts), *Hydraulic turbines, storage pumps and pump-turbines – Cavitation pitting evaluation*

IEC 60651, *Specification for sound level meters*

IEC 61362, *Guide to specification of hydraulic turbine control systems*

ISO 1680 *Acoustics – Test code for the measurement of airborne noise emitted by rotating electrical machinery*

ISO 1940-1:2003, *Mechanical vibration – Balance quality requirements for rotors in a constant (rigid) state – Part 1: Specification and verification of balance tolerances*

ISO 3746, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Survey method using an enveloping measurement surface over a reflecting plane*

ISO 4412 (all parts), *Hydraulic fluid power – Test code for determination of airborne noise levels*

ISO 5168, *Measurement of fluid flow – Procedures for the evaluation of uncertainties*

ISO 7919-5, *Mechanical vibration – Evaluation of machine vibration by measurements on rotating shafts – Part 5: Machine sets in hydraulic power generating and pumping plants*

ISO 10816-3, *Mechanical vibration – Evaluation of machine vibration by measurements on non-rotating parts – Part 3: Industrial machines with nominal power above 15 kW and nominal speeds between 120 r/min and 15 000 r/min when measured in situ*

ANSI/IEEE 810, *Hydraulic Turbine and Generator Integrally Forged Shaft Couplings and Shaft Runout Tolerances*

3 Terms, definitions and schematic layout

3.1 Terms and definitions

A complete list of terms and definitions is given in Annex A.

3.2 Schematic layout of a hydroelectric installation

In general, there are three connected hydraulic regimes in a hydroelectric installation as shown in Figure 1 below. These are the upstream water passage, the turbine guarantee domain, and the downstream water passage.