

ICS 27.140
CCS K 55



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 10969-2008

**Specification for water passage components of hydraulic
turbines, storage pumps and pump-turbines
(English Translation)**

Issued on: June 30, 2008

Implemented on: April 1, 2009

**Issued by: General Administration for Quality Supervision, Inspection
and Quarantine**

Table of Contents

Foreword...	3
1 Scope...	4
2 Normative References...	4
3 Terms, Definitions, Symbols and Units...	5
3.1 Terms, Definitions and Symbols...	5
3.2 Unit...	8
4 Technical Requirements for Geometrical Similarity of Model and Prototype...	8
4.1 General Provisions...	8
4.2 Check Contents of Geometrical Similarity...	9
4.3 Evaluation of Uniformity and Geometrical Similarity...	9
4.4 Dimensional Check Procedures...	10
4.5 Dimensional Check Methods...	10
4.6 Multistage Machines, Seals and Thrust Balancing Provisions...	11
4.7 Dimensional Check Range of Water Passage Components...	11
4.8 Surface Roughness and Waviness of Water Passage Components...	28
4.9 Applicability to other Types of Machines...	30

1 Scope

This standard only specifies the control dimension accuracy of water passage components of hydraulic turbines, storage pumps and pump-turbines that are influential to the hydraulic performance as well as the surface quality of water passage components in the aspect of the requirements in prototype hydraulic turbine having geometrical similarity with the model.

This standard is applicable to the model and prototype hydraulic turbines, storage pumps and pump-turbines meeting one of the following conditions:

- a) Whose power is 10MW and the above;
- b) Radial flow machines, whose runner nominal diameter is 1.0m and the above;
- c) Axial flow, tubular and diagonal machines, whose runner nominal diameter is 3.3m and the above;
- d) Centrifugal storage pumps, whose runner nominal diameter is 1.0m and the above;
- e) Impulse turbines, whose runner nominal diameter is 1.0m and the above.

Prototype hydraulic turbines, storage pumps and pump-turbines whose dimension and capacity are less than the above conditions may refer to this standard.

2 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. For dated reference, subsequent amendments to (excluding correction to), or revisions of, any of these publications do not apply. However, the parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards. For undated references, the latest edition of the normative document referred to applies.

GB/T 2900.45 Electrotechnical terminology - Hydroelectric powerplant machinery (GB/T 2900.45-2006, IEC/TR 61364:1999, MOD)

GB/T 8564-2003 Specification installation of hydraulic turbine generator units

GB/T 15468-2006 Fundamental technical requirements for hydraulic turbines

Figure 2 -- Definition of waviness and surface roughness

3.1.10

Surface roughness

Surface roughness is the characteristic quality of the surface. Generally speaking, it is characterized by the arithmetical average tolerance of staggered profiles produced by the cutting action of tool edges, abrasive grains, feed of the machine, coating and painting or originally produced by the fabrication (welding) process, as shown in Figure 2.

Symbol: Ra

Unit: μm

3.1.11

Water passage components

As for the types of machines stated in this standard, they refer to the components with main water flow passing from diversion component inlet to drainage component outlet.

3.2 Unit

The international system of units (SI) and China statutory measurement units have been used throughout this standard.

4 Technical Requirements for Geometrical Similarity of

Model and Prototype

4.1 General Provisions

A basic requirement for determining prototype performance is to have geometrical similarity between model and prototype.

Where the dimension tolerance of model meets the requirements of this standard, the measured average values may be replaced by the theoretical values.

Where the prototype is heterogenic to the model, an agreement shall be reached between the supplier and the purchaser whether the model efficiency is to be corrected or not through technology demonstration or individual test.

Water passage surface control dimension of water passage components shall not only meet the permissible tolerance specified in this standard, but also meet the structural coordination tolerance and the relevant requirements of GB 8564-2003.

possible to determine if the uniformity requirement has been met. If the uniformity requirement is not fulfilled, the corresponding components shall be corrected or remanufactured. In the case where the tolerance between the average value and the theoretical value is outside the permissible uniformity tolerance, the theoretical values or the geometrical dimensions of the components shall be corrected. Where spot-checks are performed for the recurrent components, the individual values may be directly compared with the theoretical values.

4.3.2 Checking the geometrical similarity between prototype and model

By comparing the corresponding average values of model and prototype and considering the permissible similarity tolerances as given by this standard, it can be determined whether the geometrical similarity requirement has been met.

If the geometrical tolerances are greater than the similarity tolerances, further steps shall be agreed by both parties.

For some dimensions which are difficult to measure on the model and/or prototype, the average values of model and/or prototype may be replaced by the theoretical values, provided that the total manufacturing and/or installation permissible tolerances is less than the permissible similarity tolerance.

4.4.1 Geometrical similarity check for model and prototype generally starts from the model

to check the geometrical similarity of prototype. Where the model is manufactured

according to the existing prototype, the check starting point shall be the prototype.

4.4.2 Geometrical similarity check is composed of single check and post-assembly check.

As for the single check, the similarity of single component shall be checked. As for the post-assembly check, the similarity of the entire machine shall be checked. The runner axis and/or guide vane center line is usually used as the reference value for the relevant physical dimension of component assembly. Water passage formed by the transition between adjacent component, fixing and rotating parts shall be paid special attention to during the check.

Relevant permissible tolerances are not specified in this standard.

4.5 Dimensional Check Methods

To measure the shape (axial surface) of runner/impeller blades, guide vanes and stay vanes, several methods are suitable, including three dimensional co-ordinate measuring systems, optical measuring systems, templates, etc. Corresponding check for the blade shapes and geometrical positions of runner/impeller may be used for determining the blade setting angle.

Using three dimensional co-ordinate measuring systems or optical measuring systems, measurement can be made either by measuring points moving along curves or by measuring points on the surface. Where comparing the theoretical curve and the measuring results, the reference points may be adjusted so that the total measuring error is minimized.

Considering the manufacturing process of the runner/impeller, the supplier shall propose the most appropriate measuring method in agreement with the purchaser to demonstrate the geometrical similarity between prototype and model.

Figures 4 to 16 give examples showing schematically the location and extent of the dimensional check.

In some cases it is not possible to measure the relevant dimension directly (e.g. if a junction is covered by a round angle), the measurement shall be made in an agreed location.

In order to protect the confidentiality of the supplier's hydraulic design, the supplier need only submit the differences between the measured and the theoretical profile and not the actual values of the co-ordinates of the profile. For checking purposes, the absolute values and measured tolerances of inlet and outlet edge profiles may be provided by the supplier.

4.6.1 Multistage machines

Normally the model test should be performed with the same number of stages as the prototype.

For a prototype with four or more stages, in exceptional cases, the model may be tested