

IEEE Recommended Practice for Preparation of Equipment Specifications for Speed-Governing of Hydraulic Turbines Intended to Drive Electric Generators

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of the
Power Engineering Society

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Foreword

(This foreword is not part of IEEE Std 125-1977, Recommended Practice for Preparation of Equipment Specifications for Speed-Governing of Hydraulic Turbines Intended to Drive Electric Generators.)

The joint IEEE-ASME Working Group on Updating IEEE Specification No 125, Covering Speed Governing of Hydraulic Turbines Intended to Drive Electric Generators, was formed in December of 1971. The personnel of this Working Group were appointed by J. T. Madill, Chairman, Hydroelectric Power Subcommittee, IEEE, at the direction of W. S. Morgan, Chairman, Power Generation Committee, IEEE, in cooperation with ASME. The initial meeting was held in January 1972. The work was coordinated with approximately two meetings per year until final submission to the Power Generation Committee.

The recommended specification was updated to include the latest practices on the North American continent and the title was changed from a recommended specification to a "Recommended Practice for Preparation of Equipment Specifications. . . ."

Insofar as possible, the Practice has been made consistent with the ASME Performance Test Code PTC29-1965 and the draft of the corresponding IEC document.

As the title implies this document is a recommended practice and not a complete specification. It has been developed to be used by prospective purchasers of hydraulic turbine governors in preparing detailed procurement specifications for such equipment. In certain cases, performance criteria, such as temperature ranges or fluid velocity, representative of North American practice have been included; the specification writer may wish to verify their applicability to his job.

Section 2 defines terms, functions, and characteristics as commonly used. In order to adhere to more common North American usage, these definitions and associated nomenclatures may differ from these adopted by the International Electrotechnical Commission.

Section 3 describes specific components which may be included in a governor system. The purchaser should specify only those components he feels are required to interface with his equipment. The practice should not be incorporated verbatim, as it contains certain explanatory comments directed to the specification writer. When convenient, these explanatory comments have been enclosed in parentheses.

Section 4 defines the performance characteristics of a good governor system and adjustments and tests to obtain and confirm the desired performance. Prior to or concurrent with the writing of the specification, the purchaser should make studies to determine the required performance and the adjustments associated with that performance. He should also determine what tests are necessary to confirm that the desired performance has been obtained.

Section 5 is intended to make sufficient information available to the purchaser so that he can assure himself that the governor equipment will interface properly with other equipment. It is also intended to provide adequate information for maintenance purposes.

Section 6 deals with the criteria for acceptance tests.

Section 7 lists the data which will be furnished by the purchaser.

At the time of approval the personnel of the Joint IEEE-ASME Working Group on Updating IEEE Specification No 125 Covering Speed Governing of Hydraulic Turbines Intended to Drive Electric Generators was as follows:

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Acknowledgment

The Working Group wishes to acknowledge the ASME Performance Test Code PTC29-1965, Speed-Governing Systems for Hydraulic Turbine Generator Units, from which many of the terms and definitions have been extracted.

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IEEE Recommended Practice for Preparation of Equipment Specifications for Speed-Governing of Hydraulic Turbines Intended to Drive Electric Generators

1. Purpose and Scope

1.1 The purpose of this practice is to recommend minimum performance characteristics and equipment relating to governors for controlling hydraulic turbines intended to drive electric generators and to aid in preparation of procurement specifications.

1.2 This practice shall apply to mechanical-hydraulic or electric-hydraulic type governors for all types of hydraulic turbines including but not limited to the following types:

- (a) Impulse Turbine
- (b) Francis Turbine
- (c) Fixed Blade (Axial or Mixed-Flow) Turbines
- (d) Adjustable Blade (Axial or Mixed-Flow) Turbines
- (e) Inclined-Axis Turbines
- (f) Bulb Turbines
- (g) Pump Turbines

1.3 It is recommended that the issue in effect on the date of invitation to bid of ASME PTC29, "Speed-Governing Systems for Hydraulic Turbine Generator Units" be used with this Practice.

1.4 Only those paragraphs which apply to the specific equipment to be purchased should be used when preparing the procurement specifications.

2. Glossary of Terms, Functions, and Characteristics

2.1 Glossary of Terms

2.1.1 **governing system.** The combination of devices and mechanisms, which detect speed deviation and convert it into a change in servomotor position. It includes the speed sensing elements, the governor control actuator, the hydraulic pressure supply system, and the turbine control servomotor.

2.1.2 speed-sensing elements. The speed responsive elements which determine speed and influence the action of other elements of the governing system. Included are the means used to transmit a signal proportional to the speed of the turbine to the governor.

2.1.3 governor control actuator. The combination of devices and mechanisms which detects a speed error and develops a corresponding hydraulic control output to the turbine control servomotors but does not include the turbine control servomotors. Includes gate, blade, deflector, or needle control, or all equipment as appropriate.

2.1.4 fluid pressure supply system. The pumps, means for driving them, pressure and sump tanks, valves and piping connecting the various parts of the governing system and associated and accessory devices.

2.1.5 electric-hydraulic governor. A governor in which the control signal is proportional to speed error and the stabilizing and auxiliary signals are developed electrically, summed by appropriate electrical networks, and are then hydraulically amplified. Electrical signals may be analog or digitally derived.

2.1.6 mechanical-hydraulic governor. A governor in which the control signal proportional to speed error and necessary stabilizing and auxiliary signals are developed mechanically, summed by a mechanical system, and are then hydraulically amplified.

2.1.7 distributing valve. The element of the governor-control actuator which controls the flow of hydraulic fluid to the turbine-control servomotor(s).

2.1.8 speed changer. A device by means of which the governor system may be adjusted to change the speed or power output of the turbine while the turbine is operating.

2.1.9 speed regulation changer. A device by means of which the speed regulation may be adjusted while the turbine is operating.

2.1.10 speed-droop changer. A device by means of which the speed droop may be adjusted while the turbine is operating.

2.1.11 servomotor limit. A device which acts on the governor system to prevent the turbine-control servomotor from opening beyond the position for which the device is set.

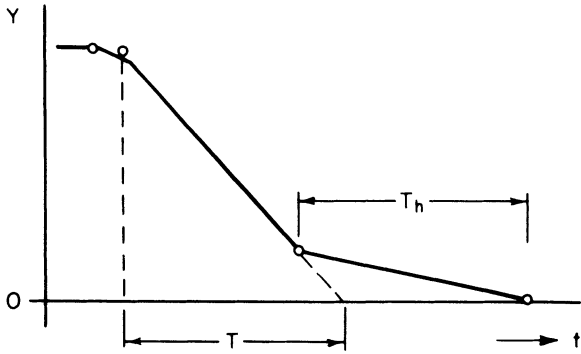
2.1.12 turbine-control servomotor. The actuating element which moves the turbine-control mechanism in response to the action of the governor control actuator. Turbine-control servomotors are designated as:

- (a) gate servomotor
- (b) blade servomotor
- (c) deflector servomotor
- (d) needle servomotor.

2.1.13 slow-closure device. A cushioning device which retards the closing velocity of servomotor travel from a predetermined servomotor position to zero servomotor position.

2.1.14 servomotor velocity limiter. A device which functions to limit the servomotor velocity in either the opening, closing, or both directions exclusive of the operation of the slow closure device (above).

2.1.15 governor control actuator rating. The governor actuator rating is the flow rate in volume per unit time which the governor actuator can deliver at a specified pressure drop. The pressure drop shall be measured across the terminating pipe connections to the turbine control servomotors at the actuator. This pressure drop is measured with the specified minimum normal working pressure of the fluid pressure supply system delivered to the supply port of the actuator distributing valve.

2.2 Functions and Characteristics	Unit	Symbol
2.2.1 Servomotor Stroke. Travel of the turbine control servomotor from zero to maximum without overtravel at the maximum position or “squeeze” at the minimum position. (Sometimes referred to as “effective servomotor stroke”.) For a gate servomotor this shall be established as the change in gate position from no discharge to maximum discharge. For a blade servomotor this shall be established as the change in blade position from “flat” to “steep.” For a deflector servomotor this shall be established as the change in deflector position from “no deflection” position to “full flow deflected” position with maximum discharge under maximum specified head including overpressure due to water hammer. 2.2.2 Servomotor Position. The instantaneous position of the turbine control servomotor expressed as a percent of the servomotor stroke. This is commonly referred to as gate position, needle position, blade position, or deflector position, although the relationship between servomotor stroke and the position of the controlled device may not always be linear. 2.2.3 Servomotor Time. The equivalent elapsed time for one servomotor stroke (either opening or closing) corresponding to maximum servomotor velocity. Servomotor time can be qualified as: (a) gate (b) blade (c) deflector (d) needle	inch or millimeter percent second second second second second	Y G T T_G T_B T_D T_N
 Fig 1		