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Recommended Specification
for
SPEED-GOVERNING OF STEAM TURBINES
INTENDED TO DRIVE ELECTRIC GENERATORS
RATED 500 KW AND UP

(Published for Trial Use)

Prepared by Joint AIEE and ASME Committee

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FOREWORD

The formation of a joint AIEE-ASME committee for the purpose of preparing a recommended specification covering the speed governing of prime movers intended to drive electric generators that may, if desired, be included in prime-mover purchase specifications, was approved by the AIEE Board of Directors on January 30, 1941 and by the ASME Council on June 15, 1941.

The personnel of this Joint Committee was appointed jointly by the Chairmen of the AIEE Power Generation Committee and the ASME Standing Committee on Power Test Codes under sponsorship of the ASME Power Division.

The need for a recommended specification arose from recognition that confusion existed in regard to values of desirable, possible and acceptable performance characteristics for the speed governing of prime movers and in nomenclature employed in connection therewith.

It was also recognized that the fundamental studies necessary for the writing of such a specification are identical with those for the preparation of the ASME Power Test Code on Speed, Temperature and Pressure Responsive Governors which has been assigned to the ASME Power Test Code Committee No. 20. Close collaboration between the Joint and Power Test Code Committees was essential for the successful completion of the respective assignments, and is the reason for appointment of personnel common to both committees.

Although the Joint Committee was appointed to prepare a recommended specification for the speed governing of all types of prime movers intended to drive electric generators, this specification is limited in its scope to steam turbine-generators rated 500 kw and larger. Specifications for other types of prime movers will be issued, upon completion, as separate publications.

The recommended specification does not cover emergency governors or other overspeed control devices, and in general, devices which are not responsive to speed. Exceptions to the latter were made for turbines designed to operate with controlled steam pressures, as in the case of turbines with initial and/or exhaust steam pressure control, automatic-extraction and mixed-pressure turbines, since the performance of the speed-governing system is affected by the performance of the steam pressure-regulating system.

It was the intention of the Joint Committee to limit the specification to a recommendation of minimum functional and performance characteristics which are generally recognized as being necessary for satisfactory and acceptable speed governing, which are capable of measurement by test, and which can be met by the manufacturers with available equipment of substantially standard design. Accordingly, it is not intended either to preclude a purchaser from specifying, and a manufacturer from agreeing to supply, additional functional requirements not recommended in this specification, or to preclude agreement for the modification of the numerical values recommended therein.

The recommended specification is applicable to steam turbines driving electric generators at constant speed when operated isolated or in parallel with other generators.

For the convenience of the user, the recommended specification has been divided into three parts. *Part A* is applicable to straight-condensing and non-condensing turbines, and non-automatic extraction turbines. With reference to these turbines, *Part A* is a complete and self-contained recommended specification. *Part B* includes additions to and modifications of *Part A* for the same types of turbines when speed-governing is combined with initial and/or exhaust steam pressure control. *Part C* includes additions to and modifications of *Part A* and *Part B* for mixed-pressure and automatic-extraction turbines intended for operation with compensated control systems.

To facilitate use of the recommended specification, a table has been included which indicates by number the paragraphs specifying the recommended equipment and performance for each type of turbine.

EQUIPMENT AND PERFORMANCE SPECIFICATIONS

TYPE OF TURBINE	CONTROL SYSTEM	SIZE	STANDARD EQUIPMENT	OP-TIONAL EQUIP-MENT	PERFORMANCE SPECIFICA-TIONS
Straight Condensing	Speed	Less than 10,000 kw	Par. 35-40	Par. 44-47	Par. 51-63
Straight Non-Condensing	Control	10,000 kw and larger	35-42	45-49	51-64
Non-Automatic Extraction	Only				
Straight Condensing	Speed Control With	Less than 10,000 kw	35-40; 66-68	44-47; 70	51-63; 72-77
Straight Non-Condensing	Initial and/or Exhaust	10,000 kw and larger	35-42; 66-68	45-49; 70	51-64; 72-77
Non-Automatic Extraction	Steam Pressure Control				
Automatic Extraction	Compensated	Less than 10,000 kw	34-40; 66-68; 79	44-47; 70	51-63; 72-77; 82-86
and		10,000 kw and larger	35-42; 66-68; 79	45-49; 70	51-64; 72-77; 82-86
Mixed Pressure	Control				

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on

A Recommended Specification for Prime-Mover Speed Governing

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Recommended Specifications for SPEED-GOVERNING OF STEAM TURBINES

SECTION I OBJECT AND SCOPE

1. The purpose of these specifications is to recommend minimum functional and performance characteristics relating to the speed-governing of steam turbines intended to drive electric generators that may, if desired, be included in prime-mover purchase specifications.
2. These specifications are limited in their scope to the following types of steam turbines, rated 500 kw and larger, and intended to drive electric generators at constant speed:
 - (a) Straight condensing, straight non-condensing and non-automatic extraction turbines without initial and/or exhaust steam pressure control.
 - (b) Straight condensing, straight non-condensing and non-automatic extraction turbines with initial and/or exhaust steam pressure control.
 - (c) Automatic extraction and mixed-pressure turbines.

SECTION II DEFINITION AND DESCRIPTION OF TERMS

Speed-Governing System

3. The speed-governing system includes the speed governor, the speed-control mechanism and the governor-controlled valves.

Speed Governor

4. The speed governor includes only those elements which are directly responsive to speed and which position or influence the action of other elements of the speed-governing system.

Speed-Control Mechanism

5. The speed-control mechanism includes all equipment such as relays, servomotors, pressure or power-amplifying devices, levers and linkages between the speed governor and the governor-controlled valves.

Governor-Controlled Valves

6. The governor-controlled valves include those valves which control the energy input to the turbine, and which are normally actuated by the speed governor through the medium of the speed-control mechanism.

Speed Changer

7. The speed changer is a device by means of which the speed-governing system may be adjusted to change

the speed or power output of the turbine while the turbine is in operation.

Load Limit

8. The load limit is a device which acts on the speed-governing system to prevent the governor-controlled valves from opening beyond the position for which the device is set.

Steady-State Speed Regulation

9. For straight condensing and non-condensing turbines and non-automatic extraction turbines the steady-state speed regulation is the change in sustained speed, expressed in percent of rated speed, when the power output of the turbine is gradually reduced from rated power output to zero power output with identical settings of all adjustments of the speed-governing system.

THUS:

$$R_s = \left\{ \frac{N_o - N}{N_r} \right\} \times 100$$

where R_s = steady-state speed regulation percent
 N_o = speed at zero power output rpm
 N = speed at rated power output rpm
 N_r = rated speed rpm

10. For automatic extraction turbines and mixed pressure turbines the steady-state speed regulation, expressed in percent of rated speed, is the change in sustained speed corresponding to the load change from rated load to no load with normal rated pressures in the controlled extraction stages, with zero extraction flows, and with identical settings of all adjustments of the speed governing and pressure regulating systems.

It is the speed change expressed in percent of rated speed when, with normal extraction pressures and zero extraction flows, the load is reduced from rated load to the minimum load at which these extraction conditions are permitted, times the ratio of rated load to this load change; THUS:

$$R_s = \frac{(N_m - N)}{(N_r)} \times \frac{(P_r)}{(P_r - P_m)} \times 100$$

where R_s = steady-state speed regulation percent
 N = speed at rated power output with rated extraction pressures and zero extraction flows rpm
 N_m = speed at minimum load at which rated extraction pressures with zero extraction flows can be obtained rpm