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JAPANESE INDUSTRIAL STANDARD

General Specification
of Gas Turbines

JIS B 8042 —1981

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General Specification of Gas Turbines

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1. Scope

This Japanese Industrial Standard specifies the guidance to be used as the standard mainly about technical information which is necessary when a purchaser procures a gas turbine and its auxiliaries from a manufacturer⁽¹⁾.

Note (1): In this standard, "manufacturer" means a gas turbine manufacturer or a contractor responsible for supplying a gas turbine.

2. Field of Application

This standard applies to an open cycle gas turbine plant employing a normal combustion system, and can apply as practical to a gas turbine plant of closed cycle or semi-closed cycle.

Further, it may, with an appropriate modification, apply to a gas turbine employing a free piston gas generator or a special heat source (for example, chemical process, furnace for a super-charged boiler). However, it does not apply to a gas turbine used to propel aircraft, earth-moving machines, agricultural and industrial types of tractors and motor vehicles.

3. General Items

3.1 The essentials of contents of this standard are as follows:

- (1) The standard reference conditions are specified by taking that performances of gas turbine vary according to atmospheric conditions into consideration.
- (2) Because of the very widely varying operating modes for gas turbines in practice, distinct categories of operating modes are specified with which a standard rating can be associated.
- (3) Instruction referring to control and protection equipment including safety, fuel and environmental problems is specified.
- (4) Standard instruction for information to be supplied from both of the purchaser and the manufacturer is given.

3.2 This standard does not cover all the necessary information for a contract, and it is important to give consideration on each gas turbine plant and to have mutual agreement of the purchaser and the manufacturer by consultation.

3.3 Attention is drawn to the need for technical consultation between the manufacturer and the purchaser to ensure termination points of supply and compatibility of the equipment being supplied. This is especially important where responsibility for supplying equipment is divided.

3.4 If the content of this standard differs from the national or local regulation to which the installation is required to follow, precedence of such regulation is allowed.

Applicable Standard and Reference Standards: See page 28.

4. Definitions

No.	Term	Meaning
1	gas turbine	A machine which converts thermal energy into mechanical work; it consists of one or several rotating compressors, a thermal device which heats the working fluid, one or several turbines, a control system, and heat exchangers and other auxiliary equipment as needed. The examples of component arrangement of gas turbine are shown in Figures 1 to 6.
2	gas turbine plant	A power plant including gas turbine and all necessary auxiliary equipment.
3	open cycle	A thermodynamic cycle in which the working fluid enters the gas turbine from the atmosphere and discharges to the atmosphere.
4	closed cycle	A thermodynamic cycle having a recirculation working fluid independent of the atmosphere.
5	semi-closed cycle	A thermodynamic cycle utilizing a working fluid which is partially recirculated and partially exchanged by atmospheric air.
6	simple cycle	A thermodynamic cycle consisting only of successive compression, combustion and expansion.
7	regenerative cycle	A thermodynamic cycle employing exhaust heat recovery, consisting of successive compression, regenerative heating, combustion, expansion and regenerative cooling (heat transfer from the exhaust to the compressor discharge fluid) of the working fluid.
8	intercooled cycle	A thermodynamic cycle employing cooling of the working fluid between stages of successive compression.
9	reheat cycle	A thermodynamic cycle employing the reheating of the working fluid between stages of successive expansion.
10	single-shaft gas turbine	A gas turbine in which the compressor and turbine rotors are mechanically coupled and the power output is taken either directly or through gearing (refer to Figs. 1 and 2).
11	multi-shaft gas turbine	A gas turbine combination including at least two turbines working on independent shafts. The term includes cases of free turbine and compound turbine (refer to Figs. 3 and 4).

No.	Term	Meaning
12	bled gas turbine	A gas turbine which has, for external use, extraction of compressed air between compressor stages and/or at the discharge of compressor, or extraction of hot gas at the inlet of turbine and/or between turbine stages (refer to Fig. 5).
13	gas generator	An assembly of gas turbine components which produces heated pressurized gas to a process or to a power turbine. It consists of one or more rotating compressors, thermal device(s) associated with the working fluid, and one or more compressor driving turbines, a control system and essential auxiliary equipment.
14	compressor	That component of a gas turbine which increases the pressure of the working fluid.
15	turbine	That component of a gas turbine which produces power from expansion of the working fluid. This term, when used alone, means only turbine part.
16	power turbine	A turbine having a separate shaft from which output power is derived (refer to Fig. 3).
17	combustion chamber	A device in which the fuel is burnt to increase directly the temperature of working fluid up to the turbine inlet temperature. There is also a combustion chamber for reheating.
18	working fluid heater	A device in which the working fluid (air or gas) before expansion stage is heated indirectly up to the turbine inlet temperature.
19	regenerator/re-cuperator	A heat exchanger in which heat is transferred from the exhaust to the working fluid before it enters the combustion chamber (or working fluid heater). There are two types of regenerative and recuperative heat exchangers.
20	precooler	A heat exchanger or evaporative cooler which reduces the temperature of the working fluid before initial compression.
21	intercooler	A heat exchanger or evaporative cooler which reduces the temperature of the working fluid between stages of compression.

No.	Term	Meaning
22	control system	A system including all control, protection and monitoring devices necessary to operate the control system for orderly startup, stable operation and orderly shutdown (for example, startup control system, governor, fuel control system, etc.), protective system to perform alarm or shutdown at abnormal state (for example, overspeed protective device, fuel shut-off system, etc.), monitoring system and instrumentation for monitoring operation (for example, speed indicator, gas thermometer, etc.), and electrical power supply control system for this integrated system.
23	governing system	Control elements and devices for the control of critical parameters such as speed, temperature, pressure, power output.
24	speed governor	A device which detects turbine speed, sets the positions of components of the governing system and actuates the system. The variation in steady state speed when the output is varied from 0 to the rated value divided by the rated speed and expressed in percentage of the rated speed is called the steady state speed regulation of the speed governor.
25	fuel governor valve	A valve or any other device operating as a final fuel-metering element controlling the fuel input to the gas turbine. Remark: Other means of controlling the fuel flow to the gas turbine are possible.
26	protection device	A device which detects any abnormality in a turbine plant or in a system of the plant during the start-up and operation and performs a predetermined control or gives alarm to avoid the significant damage or injury caused by the abnormality.
27	overspeed protection device	A control element or trip element which actuates the overspeed protection system when a turbine rotor causes overspeed and reaches a preset speed. There are overspeed governor and overspeed tripping device.
28	fuel stop valve	A device which, when actuated, shuts off all fuel flow to the combustion system.

No.	Term	Meaning
29	gas overtemperature detector	The primary sensing element which is directly responsive to temperature and which actuates, through suitable amplifiers or converters, the overtemperature protection system when the gas temperature reaches the value for which the device is set.
30	fuel calorific value	The heat quantity released per unit mass of fuel burned. There are higher calorific value and lower calorific value; the higher calorific value is the total heat quantity released and the lower calorific value is the higher calorific value less the heat absorbed by the vapourized water formed during combustion. The both values are expressed in kJ/kg. The two calorific values can be obtained for constant volume or for constant pressure respectively, the difference being rather small. The higher calorific value for constant volume is obtained using a bomb calorimeter. The lower calorific value for constant pressure is used in the steady flow combustion process (refer to 5.3 of JIS B 8041).
31	heat rate	The heat consumption per unit of net power of the gas turbine based on the lower calorific value of the fuel including the sensible heat not less than 15°C (refer to 7.2.2 of JIS B 8041). This is expressed in kW of heat/kW of output power. This can also be expressed as the reciprocal of thermal efficiency.
32	specific fuel consumption	The mass rate of the fuel consumed per unit of output power. This is expressed in g/kW·h. Unless otherwise specified, the lower calorific value specified in 7.2 is used as the fuel calorific value.
33	thermal efficiency	The ratio of the net power output to the heat consumption based on the lower calorific value of the fuel (refer to 7.2.3 of JIS B 8041).
34	turbine inlet temperature	The mean temperature of the working fluid immediately upstream of the first stage stator vanes (refer to 7.6 of JIS B 8041).
35	self-sustaining speed	The minimum speed at which the gas turbine operates, without using the power of the starting device, under the most unfavourable ambient conditions.

No.	Term	Meaning
36	idling speed	The speed designated by the manufacturer at which the turbine will run in a stable condition and from which loading or shutdown may take place.
37	maximum continuous speed	The upper limit of the continuous operating speed of the gas turbine output shaft.
38	rated speed	The speed of the gas turbine output shaft at which the rated power is developed.
39	turbine trip speed	The speed at which the independent emergency overspeed device operates to shut off fuel to the gas turbine.
40	steam and/or water injection	Steam and/or water injection into the working fluid to increase the power output and/or to reduce the oxides of nitrogen (NO _x) content in the exhaust.
41	compressor surge	An unstable condition characterized by low-frequency fluctuation in mass flow of the working fluid in the compressor and in the successive connecting ducts.

Fig. 1. Example of Component Arrangement of Gas Turbine
Simple cycle, single-shaft gas turbine

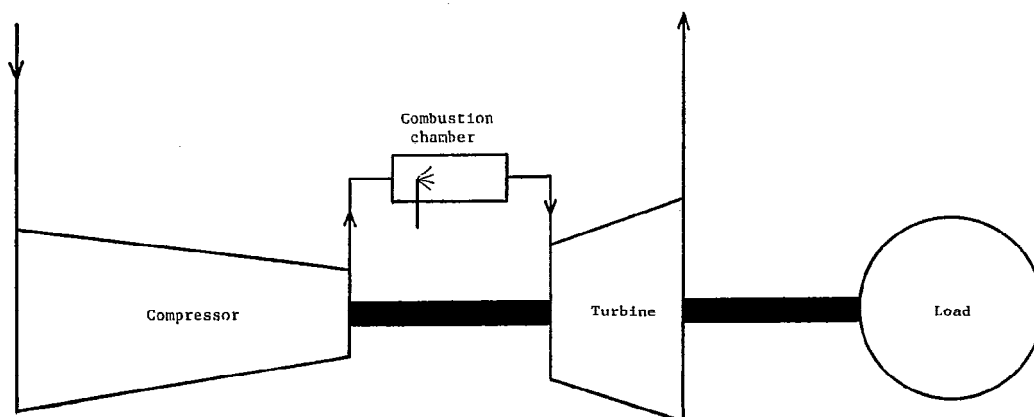


Fig. 2. Example of Component Arrangement of Gas Turbine
Regenerative cycle, single-shaft gas turbine

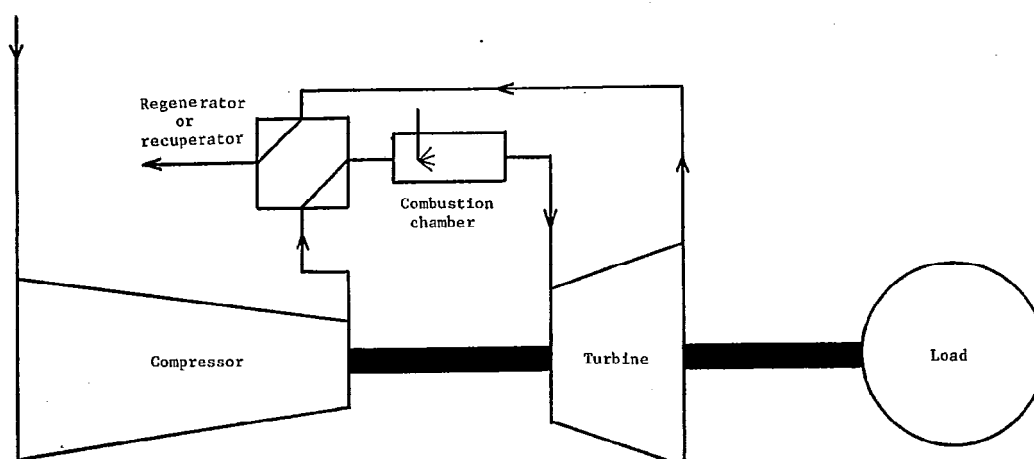


Fig. 3. Example of Component Arrangement of Gas Turbine
Simple cycle, split-shaft gas turbine
i.e. with separate power turbine (alternative twin spool arrangements
shown in dotted lines)

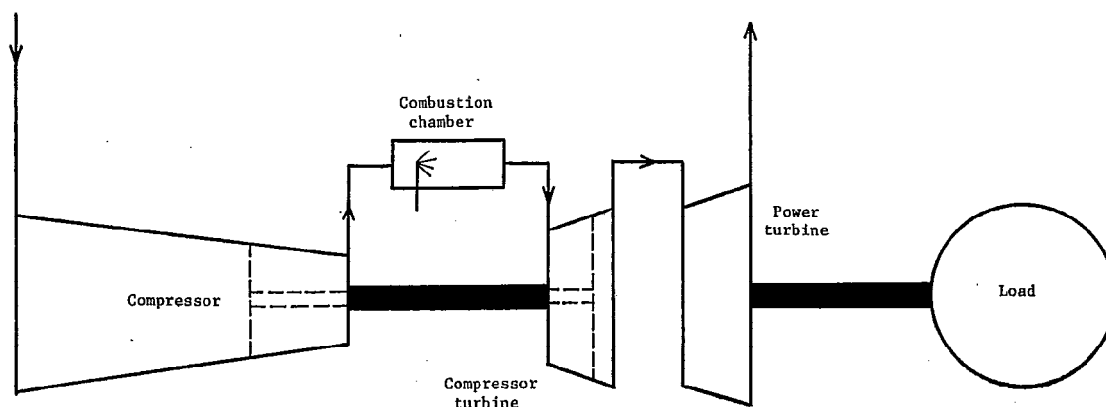


Fig. 4. Example of Component Arrangement of Gas Turbine
Intercooled and reheat cycle, compound type, multi-shaft gas turbine

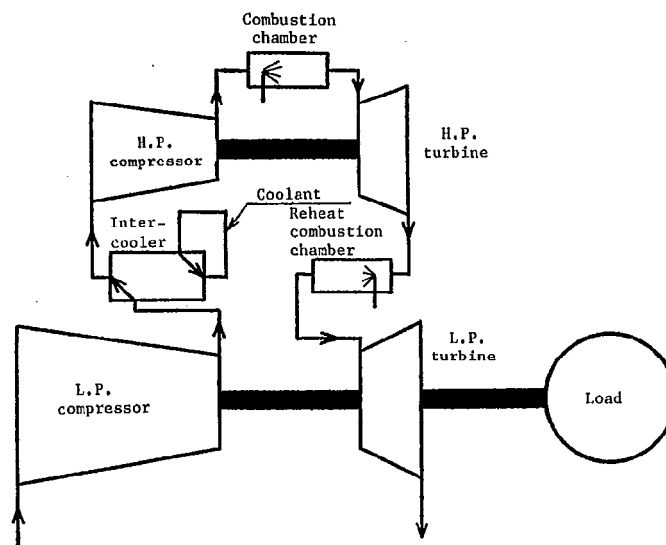


Fig. 5. Example of Component Arrangement of Gas Turbine
Bled gas turbine

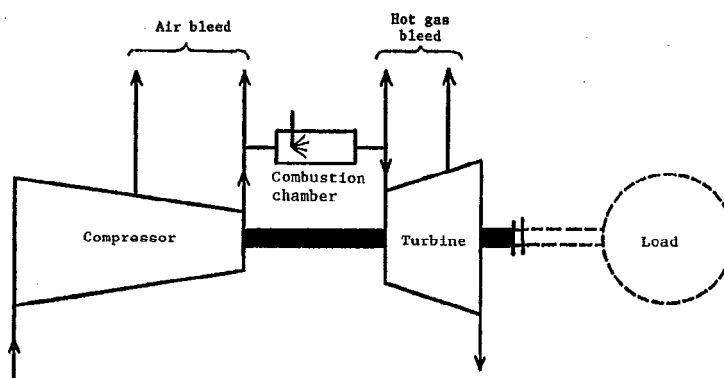


Fig. 6. Example of Component Arrangement of Gas Turbine
Closed cycle, single-shaft gas turbine

