

MATERIAL AND EQUIPMENT STANDARD
FOR
COMBUSTION GAS TURBINES

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0. INTRODUCTION

This Standard specification gives the amendments and supplements to API Standard 616, Third Edition, January 1992, "Combustion Gas Turbines for Refinery Services".

For ease of reference, the clause and (paragraph) numbering of API Standard have been used throughout this Standard.

Clauses and (paragraphs) in API Standard, not mentioned here, are remained unchanged.

For the purpose of this Standard, the following definitions shall hold:

Sub. : The API Standard clause or (paragraph) is deleted and substituted by a new clause or (paragraph).

Add. : A new clause or (paragraph) with a new number is added.

Mod. : Part of the API Standard clause or (paragraph) is modified and/or a new statement or comment is added.

Del. : The API Standard Clause is deleted without any replacement.

1. GENERAL

1.1 Scope

This Standard Specification covers the minimum requirements for combustion gas turbines for mechanical drives and electric power generator drives to be used in pipeline transmission services, oil refineries, chemical plants, gas plants and in explorations, productions and new ventures, where applicable.

Compliance by the gas turbine manufacturer with the provisions of this Standard does not relieve him of the responsibility of furnishing gas turbine and accessories of proper design, mechanically suited to meet guarantees at the specified service conditions.

No deviations or exceptions from this Standard shall be permitted without the written prior approval of the purchaser.

Intended deviations shall be separately listed by the vendor and supported by reasons thereof for purchaser consideration. (Mod.)

1.2 Alternative Designs

Unless otherwise specified SI unit system and measurements shall be used. (Mod.)

1.3 Conflicting Requirements

In the case of conflict between documents relating to the inquiry or order, the following priority of documents (whichever more stringent realized by Company) shall apply:

- **First priority** : Purchase order and variations thereto.
- **Second priority** : Data sheets and drawings.
- **Third priority** : This standard specification.

All conflicting requirements shall be referred to the purchaser in writing. The purchaser will issue confirmation document if needed for clarification. (Sub.)

1.4 Definition of Terms

1.4.43 DIAMETER NOMINAL-written as DN 15, 25, 32, 40, etc., has been used for pipe sizes in accordance with ISO 6708 (1980) and Appendix F in this Standard Specification. (Add.)

1.4.44 PRESSURE NOMINAL-written as PN 20, 50, 68, 100, etc., has been used for flange ratings in accordance with ANSI-ASME B16.5 (1981), ISO 7268 (1983) and Appendix G in this Standard Specification. (Add.)

1.5 Referenced Publication

1.5.1 The latest edition of the following standards, codes, and specifications shall to the extent specified herein be applied in addition to those stated in API Standard 616 Third Edition 1992.

IPS (IRANIAN PETROLEUM STANDARDS)

| | |
|----------|--|
| E-EL-110 | "Electrical Area Classification & Extent" |
| E-SF-900 | "Noise and Vibration Control" |
| M-EL-132 | "Induction Motors" |
| M-PM-240 | "General Purpose Steam Turbines" |
| M-PM-250 | "Special Purpose Steam Turbines" |
| M-PM-280 | "Internal Combustion Diesel Engines" |
| M-PM-300 | "Special Purpose Gear Units" |
| M-PM-310 | "Special Purpose Couplings" |
| M-PM-320 | "Lubrication, Shaft-Sealing, and Control Oil System for Special Purpose Application" |

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

| | |
|------|--|
| 6708 | "Pipe Components-Definition of Nominal Size" |
| 7268 | "Pipe Components-Definition of Nominal Pressure" |

NACE (NATIONAL ASSOCIATION OF CORROSION ENGINEERS)

| | |
|-------------|--|
| MR-01-75-88 | "Sulfide Stress Cracking Resistant Metallic Material for Oil Field Equipment" (Mod.) |
|-------------|--|

2. BASIC DESIGN

2.1 General Service Conditions

2.1.1 Turbine ratings shall not exceed the limits of the Vendor’s design, but shall be well within the range of the manufacturer’s actual experience. Only equipment which has proven its reliability in service is acceptable.

Manufacturer shall prepare and submit in his proposal the lists showing gas turbines of the same frame size or model previously manufactured and operating under similar conditions of service, speed and power and location of such installation. (Mod.)

2.1.4 Delete "3 weeks" and substitute "2 months".

Turbine vendor shall submit special provisions necessary to be carried out for longer period of idleness in the proposal. (Mod.)

2.1.9 Control of sound level of all equipment furnished shall comply with the requirement of IPS-E-SF-900 "Noise and Vibration Control". (Mod.)

2.1.12 Unless otherwise specified, the arrangement of the equipment including piping and auxiliaries shall be developed by the Vendor and approved by the Company. (Mod.)

2.1.13 Motors, electrical components, and electrical installation shall also meet the requirements of IPS-E-EL-110 and M-EL-132. (Mod.)

2.1.16 The combined performance of the turbine and its driven equipment after installation shall be the responsibility of the vendor, who has been nominated to have unit responsibility. (Mod.)

2.1.18 Unless otherwise specified, the gas turbine and its auxiliaries shall operate outdoor in the climate condition specified in data sheet.

Any winterizing, enclosures, weather or sun protection required by the manufacturer shall be included in the package. (Mod.)

2.1.20 The site rated power of the turbine shall be at least 115% of the maximum horsepower required for the driven equipment (plus auxiliary loads, and gear, coupling, and other applicable losses) under the most severe site conditions as detailed in the Data Sheets. (Mod.)

2.2 Pressure Casings

2.2.7 Suitable inspection ports shall be provided in the casing to allow internal visual inspection of the compressor, combustion chambers, nozzles and blading in the hot gas path, using flexible or rigid fiber optic inspection devices. Adapters and guide tubes for fiber optic inspection shall be provided by the manufacturer.

Inspection ports shall be readily accessible without the need to dismantle any component or accessory, and their location shall be shown on the manufacturer's drawings. The internal area which may be viewed from each port shall also be shown on the drawings. (Mod.)

2.3 Combustors and Fuel Nozzles

2.3.7 An automatic combustor drain valve shall be furnished to drain any trapped liquid. (Mod.)

2.4 Casing Connections

2.4.6.4 For nozzle connections over DN 600 (24 inches), vendor shall furnish mating flanges per the following:

- a) Flanges shall be welding neck type with bolt hole spacing and bolt circle diameter exactly matching the machine flanges.
- b) Each flange shall be furnished with at least 3 dowel pins, each machined with a close fit tolerance to the diameter of the bolt hole bore.
- c) The turbine shall be shipped with flanges bolted in place and with dowel pins installed. Each flange (turbine and pipe), dowel pin and bolt replacement for the dowel pin shall be positively identified. (Mod.)

2.4.9 Drain connections shall be provided appropriately positioned for the removal of any accumulated liquid.

Drains shall be DN 40 (1½ inches) flanged minimum. (Add.)

2.5 Rotating Elements

2.5.2 Rotors

2.5.2.1 On gas turbines for generator drives, rotors shall be mechanically designed to withstand safely and without failure the transient torques produced in the event of a generator short circuit. The transient torques considered shall not be less than 200% of full-load torque.

Out-of-phase synchronization and full-load rejection shall also be considered in the design of the rotating components. (Mod.)

2.5.2.4 In the event of an order for a number of gas turbines, all of the same rating, all rotors shall be interchangeable. (Add.)

2.5.2.5 Gas turbines specified in the data sheets for operation in a hostile environment shall have the turbine air compressor rotor and stator blades of non-corroding material or shall have non-corrodible coating. The manufacturer shall furnish full details of rotor, stator blading and coating materials. (Add.)

2.6 Seals

2.6.5 Air-cooled seals shall be provided wherever there is a risk that hot combustion products may enter bearings or other components containing lubricants which are likely to char when exposed to the combustion product temperature. Sealing air shall be extracted from an appropriate stage of the combustion air compressor. The manufacturer shall include in his supply any coolers that may be required for the sealing air. Placing the coolers in the combustion air intake may be done only with the purchaser's approval.

Losses incurred by the extraction of air for sealing or cooling purposes shall be taken into account when calculating the overall cycle efficiency.

The manufacturer shall assure the purchaser that the sealing air extraction position in the turbine air compressor does not create unacceptable aerodynamic disturbance of the air compressor blades. (Add.)

2.7 Dynamics

2.7.1 Critical speed

2.7.1.7 Main Vendor shall be responsible for the satisfactory performance of the entire system and shall perform a lateral and torsional critical speed analysis of the driver and driven equipment system. (Mod.)

2.7.2 Lateral analysis

2.7.2.3 Delete "when specified" from this clause. (Mod.)

2.7.2.4.e Delete "when specified" from this paragraph. (Mod.)

2.7.4.5 Delete "when specified" from this clause. (Mod.)

2.8 Bearings and Bearing Housings

2.8.1 If the Vendor has made provisions for undersize bearings. The size range of bearings shall be submitted in his proposal. (Mod.)

2.8.4.2.2 Vendor shall submit the type of locking in his proposal, in case of using replaceable collars. (Mod.)

2.8.5.5 Two thermocouples or RTD's shall be installed in each journal bearing. The temperature sensors shall be embedded in the steel backing, close to the babbit interface in the area of minimum oil film thickness. In addition, the individual bearing drains, shall be fitted with temperature indicators. (Mod.)

2.9 Lube Oil System

2.9.7 Pressurized lubrication systems shall comply with the requirements of API Standard 614 as amended/supplemented by IPS-M-PM-320. (Sub.)

2.9.9 The special type lubricating oil is not acceptable. Vendor shall submit equivalent lubricating oil types in his proposal. (Add.)

2.9.10 Lubricating oil tanks may be accommodated within the base plate framework, if the arrangement complies with this Section (2.9) and the rise in oil temperature does not create misalignment. (Add.)

2.10 Materials

2.10.1 General

2.10.1.1 Materials for components in contact with gas containing hydrogen sulphite shall conform to the requirements of NACE Standard MR-01-75-88. (Mod.)

2.10.1.2 When vendor's quoted material specification is DIN, JIS or other standards, the proposal shall indicate the nearest above named American specification equivalent along with exact and specific deviations (chemical properties, physical properties, tests, type of heat treatment, etc.) if such exists, for purchaser's evaluation of equivalent for service intended. (Mod.)

2.10.2 Castings

2.10.2.3.1 Approval of the Company shall be obtained before any major weld repair is carried out. A major weld repair is either removal of more than 50% of the wall thickness, or a length of more than 150 mm in one or more directions, or the total surface area of all repairs exceeding 20% of the casting.

Castings subject to a major repair shall be inspected by the purchaser's representative, who shall be notified in accordance with paragraph 4.1 of API Std. 616. All repairs shall meet the inspection requirements and acceptance standards for the original material.

After weld repair, castings shall be suitably heat-treated, if specified in the material specification. A major weld repair shall always be followed by a suitable heat treatment. Details of all major weld repairs and the heat treatment shall be recorded and reported to the Company. (Mod.)

2.10.4 Welding

2.10.4.5.1 a) Butt welded joints of pressure casing shall be 100% radiographed. Inspection procedure for other pressure casing welds shall be approved by inspector. Examination method and acceptance criteria shall be per ASME Code Section VIII, Paragraph UW-51, except that fluorescent intensifying screens such as calcium tungstate shall not be used.

b) Support leg attachment welds, and welds in end covers of vertically split casings shall be examined by the magnetic particle method, or if non-magnetic materials, examination shall be by the dye penetrant method. (Mod.)

2.10.4.5.3 All piping welded joints shall be full penetration. (Mod.)

2.10.4.6.2 All welds in auxiliary piping, including seal welds and pipe to case welds, shall be heat treated, hardness tested in accordance with ASME B 31.3 and examined by magnetic particle or dye penetrant. (Mod.)

2.10.5 Low temperature

Delete "when specified" from this clause and add the following:

- For materials and thicknesses not covered by the code, the vendor shall indicate in the proposal, the recommended inspection and testing level. For materials, other than Austenitic stainless steel, in service below -29°C Vendor shall require a Charpy V-notch impact test of the base metal and of the weld joint. (Mod.)

2.11 Nameplates and Rotation Arrows

2.11.3 The text on nameplates shall be in English language unless otherwise specified the data in SI Units. The information on nameplates shall include the year of manufacture. (Mod.)

3. ACCESSORIES

3.1 Starting and Helper Drivers

3.1.1 General

3.1.1.4 Starting steam turbines shall be general-purpose steam turbines conforming to API Standard 611 as amended or supplemented by IPS-M-PM-240. (Sub.)

3.1.1.5 Unless otherwise specified helper steam turbines shall be special-purpose steam turbines conforming to API Standard 612 as amended or supplemented by IPS-M-PM-250. (Sub.)

3.1.1.6 If a diesel engine is specified for starting, it shall be per IPS-M-PM-280. (Mod.)

3.1.1.7 Starter drives shall be declutched when the gas turbine is running and re-engagement shall be prevented before, the gas turbine rotor is completely stationary. (Mod.)

3.1.1.9 The gas for the starter shall not be extracted from the fuel system. The vendor shall furnish a separate connection and piping system from the starter to his limit of supply.

Exhaust from a gas expansion starter shall not be connected to any common vent system. (Mod.)

3.1.1.10 Lubrication for gas expansion starters shall be taken from the common lubricating oil supply system for the gas turbine. Systems requiring operator attention for starter lubricant oil levels are not permitted. (Add.)

3.1.1.11 Starting equipment located within the air intake plenum shall have all bolts and fastenings wire-locked to prevent inadvertent loosening or detachment. (Add.)

3.1.2 Ratings

3.1.2.2 Gas turbine vendor shall specify helper driver rating whenever it is not specified by the purchaser. as a minimum it shall satisfy the requirements of 3.1.2.1. (Mod.)

3.1.3 Turning equipment

3.1.3.1 Means shall be provided for manually turning all rotor's for maintenance and alignment checks. (Mod.)

3.2 Gears, Couplings and Guards

3.2.1 Gears

3.2.1.2 Add to the end of this clause, "as amended/supplemented by IPS-M-PM-300". (Mod.)

3.2.2 Couplings and guards

3.2.2.3 Dry flexible disk coupling with restrained spacer shall be used unless approved otherwise by Company. Flexible disc material shall be stainless-steel. Non-sparking guards are required.

Unless otherwise specified, all couplings and guards shall conform to the requirements of AP I Standard 671 as amended or supplemented by IPS-M-PM-310. (Sub.)

3.3 Mounting Plates

3.3.1 General

3.3.1.1 The gas turbine unit with starting equipment, lubrication system and other auxiliaries shall be supported by a single rigid steel base plate, unless otherwise specified. The base plate shall be a continuous structural member designed to support the driven equipment. (Sub.)

3.3.1.2.5 Base plates shall be provided for epoxy grout unless otherwise specified. (Mod.)

3.3.1.2.10 Anchor bolts shall be provided by the Vendor, unless otherwise specified (Sub.)

3.3.2 Base plate

3.3.2.2 Delete "when specified" from this clause. (Mod.)

3.3.2.6 For parts requiring maintenance or operation access that are installed at elevation 70 cm or higher from grade level, the vendor shall provide decking, walkaways and platforms, unless otherwise specified. (Mod.)

3.3.2.8 Pedestals requiring either heating or cooling for controlling the effects of thermal expansion, require the approval of the Company. (Add.)

3.4 Control and Instrumentation

3.4.1 General

3.4.1.1 Add to the end of this clause "as amended/supplemented by IPS-M-PM-320". (Mod.)

3.4.1.4 The control and instrumentation system shall protect personnel and plant against injury or loss under all conditions of operation or malfunction. The monitoring and supervisory instruments shall provide information for the diagnosis of the gas turbine health during operation and for warning of deterioration of its condition. (Mod.)

3.4.1.5 The gas turbine shall have a fully self-contained control system including:

- A fully automatic start-up, which may be initiated from a single push button or by a remote signal.
- Automatic acceptance of load, including adjustment of speed as necessary.
- Adjustments to speed or load in response to a remote signal.
- Manual adjustments of speed or load from the control panel.

The control system shall not permit a turbine inlet temperature in excess of the maximum allowable temperature with increasing ambient temperature.

Whenever hydraulic type governors are specified, a separate hydraulic oil system shall be furnished for them. (Mod.)

3.4.1.7 All monitoring instruments, sensors and pick-ups shall be suitable for field checking and calibration during operation of the gas turbine or shall be duplicated to enable individual items to be removed for checking and calibration without affecting the integrity of the monitoring system. Duplicates shall be installed alongside the corresponding items. (Add.)

3.4.2 Starting control system

3.4.2.2 The purge period shall be active irrespective of the mode of starting. (Mod.)

3.4.2.6 The starting sequence shall be monitored by an annunciator panel which shall indicate each stage of the start-up in sequence. If there is a failure in starting the gas turbine, the controls shall initiate a normal shutdown procedure for the gas turbine and its driven equipment, and shall lock the train out of service. The sequence annunciator shall hold at the state at which failure occurred. (Add.)

3.4.3 Load control

3.4.3.6 An over speed trip device shall operate at a minimum of 105 percent of maximum continuous speed. Multiple shaft turbine shall have individual over speed trip device for each shaft. (Add.)

3.4.3.7 Control-signal actuation or failure of the signal or actuator shall not prevent the governor from limiting over-speed to a minimum of 105 percent of maximum continuous speed. (Add.)

3.4.4 Alarms and shutdowns

3.4.4.2 a) The normal shutdown procedure shall not use the Emergency Shutdown (ESD), but shall allow the gas turbine to shut down in accordance with a controlled program. The program shall provide for any necessary post-shutdown lubrication, and where applicable, shall maintain the ventilating system of the acoustic enclosure in operation.

All electricity supplies shall remain alive after normal shutdown of the gas turbine. (Mod.)

3.4.4.3 Delete "when specified" from this clause. (Mod.)

3.4.4.4 The vent from this valve shall not be connected to any other venting or blowdown system. (Mod.)

3.4.4.8 annunciated alarm and shutdown conditions shall include as minimum those listed in Table 2, plus the following alarms and/or shutdowns.

TABLE 2

| CONDITION | ALARM | ANNUNCIATED SHUTDOWN | ESD |
|---|--------------|-----------------------------|------------|
| ATOMIZING AIR LOW PRESSURE | × | | |
| INSTRUMENT AIR LOW PRESSURE | × | | |
| INSTRUMENT AIR UNACCEPTABLE LOW PRESSURE | | × | |
| HIGH LUBE OIL TEMPERATURE AFTER COOLER | × | | |
| UNACCEPTABLE HIGH LUBE OIL TEMPERATURE AFTER COOLER | | × | |
| FIRE DETECTION | × | | ×* |
| GAS DETECTION | × | × | |
| COMBUSTOR STAGE FLAME OUT | × | | |

* The emergency lube oil pump shall remain in operation.

(Mod.)

3.4.5 Instrument and control panel

3.4.5.1 Delete "when specified" from this clause.

The control panel will be installed in a control room designated as a safe area, unless the purchaser specifies otherwise.

3.4.6 Electrical system

3.4.6.1 If equipment for the gas turbine requires other voltages than specified by the purchaser, the vendor shall provide appropriate transformer-rectifier systems, batteries and circuit breakers. Electrical motors used as auxiliary drivers shall be per IPS-M-EL-132. (Mod.)

3.4.6.6 Delete "When specified" from this Clause. (Mod.)

3.4.6.7 Power cabling to motors and heaters will be run directly from the motor control center to the motor or heater terminal boxes without intermediate junction boxes. The vendor shall provide routes and supports for the purchaser’s site-run cabling.

All other site-run cabling shall terminate at junction boxes located at the edge of the base plate, at a location agreed with the purchaser. The size of junction box cable gland for the purchaser’s cable shall be agreed with the purchaser. (Mod.)

3.4.7 Instrumentation

3.4.7.8 Vibration and position detectors

3.4.7.8.2 Delete "when specified" from this clause. (Mod.)

3.4.7.8.4 Delete "when specified" from this clause. (Mod.)

3.4.7.8.5 All vibration detection devices mounted on the gas turbine shall be suitable for the prevailing temperatures. Equipment mounted on the gas turbine shall be suitable for the prevailing temperatures. Equipment mounted on the hot parts of the turbine shall have an operating temperature of not less than 250°C. Field amplifiers, proximitors, etc., shall be installed in steel or cast aluminum boxes, according to the requirements of the area classification, to protect them against mechanical damage. (Add.)

3.4.7.8.6 Vibration read-out instrumentation shall be mounted on the control panel. It shall provide for a continuous analogue read-out of the rms velocity of vibration and for preset alarm and shutdown signals. (Add.)

3.5 Piping and Appurtenances

3.5.1.6 Connections for flammable or toxic fluids shall be flanged. (Mod.)

3.5.1.15 For the selection of materials below -28.9°C (-20°F) the vendor shall require a charpy V-notch impact test of the base metal and of the weld joint. (Add.)

3.5.2 Oil piping

3.5.2.3 Lubricating oil, control oil and fuel oil piping around the gas turbine shall be arranged to prevent a hazardous situation developing from oil leaking or spraying onto hot turbine insulation in the event of a pipe or pipe joint failure.

Where this requirement cannot be met by selected routing of the pipe-work, appropriate baffle plates shall be installed to prevent a hazard as described from occurring. (Add.)

3.5.5 Inlet and exhaust systems

3.5.5.5 Lifting davits, platforms, access ladders and airtight doors shall be furnished for maintenance of the inlet air filter media.

Air intake plenums shall be fitted with wired glass windows and interior lighting to allow for on-stream inspection of the gas turbine air inlet. (Mod.)

3.5.5.9 Provision shall be made to prevent exhaust gases escaping into the turbine room, or acoustic enclosure. (Add.)

3.5.6 Filters

3.5.6.1 The air filter shall be guaranteed to remove 95% of all particles 2 µm and larger, and 99% of all particles 10 µm and larger in the atmospheric air intake. The vendor shall state the allowable air approach velocity on the active face of the filter intake, and the respective velocities in all stages of the air filtration system. The pressure drop in the as new, clean condition shall be guaranteed. (Mod.)

3.5.6.5 The air filter and its housing shall be an integral unit designed and supplied by the air filter vendor. The air filter house shall have a single-piece roof, fabricated from either a single piece of plate, or continuous fillet welding. The roof shall be sloped to shed rain water. Roofs comprising bolted or similarly fastened sections with mastic sealant are prohibited. Joints between the air filter and filter house shall be fully airtight. Joints requiring greater than 2 mm thickness of sealant are not acceptable. The air filter shall be installed at highest possible elevation. (Mod.)

3.5.6.9 Unless otherwise specified, all internal cladding downstream of the air filter shall be fabricated in AISI 316L stainless steel. (Add.)

3.5.6.10 The complete air filter assembly within the filter house shall be erected for inspection in the Vendor's works. Where specified by the purchaser, a smoke test for air leaks shall be conducted. (Add.)

3.5.7 Silencers

3.5.7.2 Unless otherwise specified, air intake silencers installed downstream of the intake filters shall be fabricated from AISI type 316L stainless steel. (Mod.)

3.5.7.3 The baffle packing material shall not contain asbestos. (Mod.)

3.5.9 Expansion joints

3.5.9.1 The exhaust expansion shall permit movement of at least 50 mm in the axial and 19 mm in the lateral directions.

Internal liners shall allow for offset or rotational movements required. (Mod.)

3.5.9.2 Delete "may" from this clause and substitute "shall". (Mod.)

3.6 Insulation, Weather Proofing, Fire Protection and Acoustical Treatment

3.6.1 Insulation

3.6.1.1 Ceramic tile insulation shall be provided for turbine casings. (Mod.)

3.7 Fuel System

3.7.1 General

3.7.1.1 The manufacturer shall state in his proposal if any treatment is considered necessary for the intended fuels. (Mod.)

3.7.1.3 Delete "when specified" from this clause. (Mod.)

3.7.1.5 Delete "when specified by the purchaser" from the end of this clause. For viscous liquid fuels, air atomization is preferred. (Mod.)

3.7.2 Gaseous fuel

3.7.2.1 The manufacturer shall state the maximum variation which can be accepted in composition, heating value, wobble index, hydrocarbon and water dew points, and in pressure and temperature for the fuel intended. (Mod.)

3.8 Special Tools

3.8.1 Delete "when specified" from this clause. (Mod.)

3.8.2 Delete "when specified" from this clause. (Mod.)

4. INSPECTION AND TESTS

4.1 General

4.1.1 The purchaser or his representative shall have the right to reject the equipment or any parts of equipment that do not conform to purchase order. (Mod.)

4.1.3 Vendor shall notice the purchaser at least 15 working days before conducting any inspection or test that is specified to be witnessed or observed. (Mod.)

4.2 Inspection

4.2.1 General

4.2.1.1 e) Delete "when specified" from this paragraph.

f) The manufacturer shall provide certificates to verify that the materials of construction meet the requirements of the material specifications and are in accordance with the approved proposal of the Vendor.

g) The different types of certificate which shall be used are distinguished as follows:

- Type A

Certificates by which the manufacturer confirms that the product supplied corresponds to the specification, on the basis of test results taken from the in-production testing of products of the same material and same manufacturing method as the delivery concerned.

- Type B

Certificates by which the manufacturer's inspector confirms that the product supplied corresponds to the specification, on the basis of tests carried out on purchaser's equipment itself or on standard-specified test specimens related to that equipment.

The necessary testing shall have been carried out by a testing center which is independent of production in the manufacturing works and which has the necessary facilities at its disposal. When the independence of the testing center cannot be established, a Type C certificate shall be submitted.

- Type C

Certificates as described under Type B with the additional requirement that the tests shall be witnessed by an independent inspector who shall be approved by the Company

Certificates shall be valid only when stamped and signed by this independent inspector.

h) All certificates shall contain the following information:

- Name of manufacturer.
- Purchase order number and date.
- Manufacturer's order number.

- Identification number of certificate and its date of issue.
- Material specification (s).
- Dimensions in SI units, unless otherwise specified or applicable.
- Mechanical properties recorded from tests results.
- Chemical composition recorded from chemical analyses.
- NDT methods and results, where applicable.
- Heat treatment procedures, furnace charge number and heat treatment records, where applicable.
- Such supplementary or additional information as may be required.

All Type C certificates shall contain the following additional information:

- Name of the independent inspector who has witnessed the tests.
- The independent inspector's identification symbol.

Unless otherwise specified, materials covered by Type C certificates shall be hard-die stamped with a symbol identical with the identification symbol of the independent inspector, using low-stress dies.

- i)** As a minimum, materials certificates in accordance with Type A are required for carbon steel pressure-containing parts with a design temperature below 400°C.
- j)** As a minimum, material certificates in accordance with Type B are required for carbon steel pressure-containing parts with a design temperature of 400°C and above, for rotor shafts, discs and blading, for stationary blading and nozzle rings, and for the main nuts and bolts.
- k)** Material certificates in accordance with Type C are required for pressure-containing parts of low and high alloy steels. (Mod.)

4.2.1.3 a) All gas turbine combustion chambers and rotor parts (shaft, wheel, and blades) shall be examined by means of radiographic, magnetic practice, dye penetrant, or ultrasonic methods for surface and sub surface defects as specified by the purchaser.

b) Shaft and wheel forgings shall be ultrasonically tested and inspected. Vendor shall identify blading inspection method (s) in proposal. (Mod.)

4.2.3 Mechanical inspection

4.2.3.2 Add to the end of this clause "as amended/supplemented by IPS-M-PM-320". (Mod.)

4.2.3.4 Delete "when specified" from this clause. (Mod.)

4.3 Tests

4.3.1 General

4.3.1.3 Change "5 working days" into "15 working days" in first and second sentences of this Clause. (Mod.)

4.3.2 Hydrostatic test

4.3.2.6 Test shall be maintained for a period of minimum four hours. Use of any type of gaskets in axially split joints, including string or tape, is not permitted during hydrostatic testing.

Postweld heat treatment shall be done prior to hydrotesting. (Add.)

4.3.3 Mechanical running test

4.3.3.1.8 Add after API Standard 614. "as amended/supplemented by IPS-M-PM-320" in this paragraph. (Mod.)

4.3.3.3.1 Reading shall be logged, as a minimum, every 20 minutes during the 4 hours run at maximum continuous speed. (Mod.)

4.3.4 Optional tests

4.3.4.1 Performance test

Delete the bullet (0) from this clause. (Mod.)

4.3.4.2 Complete-unit test

A complete unit test of the gas turbine complete with the driven equipment and all control auxiliary and accessory equipment under control of the contract control panel shall be carried out. All functions of the complete package shall be demonstrated to the satisfaction of the purchaser.

The intake air filter, waste heat recovery equipment and exhaust silencer may be omitted from this test with the agreement of the purchaser.

The complete unit test shall be undertaken prior to delivery. The site of the complete unit test shall be by agreement with the purchaser. The vendor shall remain responsible for the equipment through out the complete unit test, and afterwards until the purchaser agrees to accept delivery.

The complete unit test shall be performed for all operating speeds upto one percent below trip speed.

The test shall include a continuous run at maximum operating speed for a period of not less than 4 hours, following stabilization of temperatures and pressures.

All protection devices shall be demonstrated, including release of fire extinguishant. The capability of the acoustic enclosure in containing the extinguishant shall be demonstrated. Carbon dioxide may be substituted for the contract extinguishant for this test. (Mod.)

4.3.4.3 Delete the bullet (0) from this clause. (Mod.)

4.3.4.4 Sound-level test

The sound-level test shall be performed in accordance with IPS-E-SF-900.

4.3.4.8 Governor response and emergency over speed trip system tests

4.3.4.8.3 For gas turbines driving alternators, tests shall be carried out to demonstrate the governor response at acceptance and rejection of load in 25, 50, 70 and 100% load steps. (Add.)

4.3.4.11 Other tests and inspection

4.3.4.11.1 Overspeed test

Unless otherwise specified an over speed test of at least 115% of the maximum continuous speed shall be undertaken for a minimum period of 3 minutes upon all rotor discs, complete with blading.

After the over speed test, rotor discs shall be checked for cracks and defects by magnetic particle inspection. (Add.)

4.3.4.11.2 Air filter tests

When specified, the air filter and intake duct assembly shall be erected as a complete unit in the manufacturer's works. All normal openings shall be sealed, and a smoke test shall be carried out at 1.2 kPa gage internal pressure. There shall be no visible leakage from any joints.

The mechanical and electrical operation of the air filter cleaning mechanism, if fitted, shall be demonstrated to the satisfaction of the purchaser. (Add.)

4.4 Preparation for Shipment

4.4.1 The equipment shall be prepared suitable for 12 months of outdoor storage from the time of shipment. (Mod.)

4.4.3.9 No material shall be shipped separately. Miscellaneous parts shall be properly tagged or marked with the item number for which they are intended. All such parts shall be suitably boxed, firmly attached to the base plate, and shipped with the unit. (Mod.)

5. VENDOR'S DATA

5.2 Contract Data

5.2.3 Technical data

The vendor shall furnish a complete illustrated part list for all equipment supplied. (Mod.)

5.2.6 Installation, operation, and maintenance manuals

5.2.6.3 Operating and maintenance manual

The manual shall contain information regarding acceptance/rejection criteria for wear and tear inside the turbine, e.g. acceptable crack length in blades, combustors, transmission pieces and other critical parts, unacceptable excessive clearances, etc. (Mod.)

5.3 Proposals

5.3.1 General

Vendor shall specifically state in his proposal that the system and all components are in strict accordance with API Std. 616 as amended or supplemented by this standard. (Mod.)

5.3.3 Technical data

- f) A list of spare parts for two years of continuous operation including spare rotor and price list shall also be submitted. (Mod.)

6. GUARANTEE AND WARRANTY

6.1 Mechanical

Unless exception is recorded by the vendor in his proposal, it shall be understood that the vendor agrees to the guarantees and warranties described in 6.1.1 and 6.1.2.

6.1.1 All turbine and component parts shall be warranted by the vendor against defective materials, design, and workmanship when operated under normal usage for 1 year after being placed in specified service but not exceeding 18 months (30 months for export) after date of shipment.

6.1.2 If any malperformance or defects occur during the guarantee and warranty period, the vendor shall make available repaired, altered, or replacement parts free of charge, free on board the purchaser's job site.

6.1.2.1 The vendor shall make available, free of cost to the purchaser, qualified representatives as the vendor deems necessary to supervise the removal, repair, and replacement of defective parts in such manner that the warranty is maintained.

6.1.2.2 The warranty period for repaired or replaced parts shall be 12 months after start-up of the repaired equipment but not more than 18 months after the equipment repairs are completed.

6.1.2.3 The warranty period for the remaining equipment shall be extended by the number of days, or fraction thereof, that the equipment was inoperable because of warranty defects.

6.1.2.4 Field labor charges for warranty work shall be subject to negotiation between the purchaser and the Vendor.

6.2 Performance

The turbine shall be guaranteed for satisfactory performance at all operating conditions specified on the data sheet and the range between those points. The performance guarantee point shall be site rated power with no negative tolerance and site rated speed at the fuel rate quoted or some other point (such as load guarantee point) as mutually agreed upon by the purchaser and the Vendor.

APPENDICES**APPENDIX A
TYPICAL DATA SHEETS**

Unless otherwise specified SI Unit data sheets shall be used.

**APPENDIX F
PIPE COMPONENTS NOMINAL SIZE (Add.)**

The purpose of this appendix is to establish an equivalent identity for the piping components nominal sizes in Imperial System and SI System.

TABLE 1

| NOMINAL SIZE | | NOMINAL SIZE | | NOMINAL SIZE | | NOMINAL SIZE | |
|--------------|---------|--------------|-----|--------------|-----|--------------|-----|
| DN (1) | NPS (2) | DN | NPS | DN | NPS | DN | NPS |
| 15 | ½ | 100 | 4 | 500 | 20 | 1000 | 40 |
| 20 | ¾ | 125 | 5 | 600 | 24 | 1050 | 42 |
| 25 | 1 | 150 | 6 | 650 | 26 | 1100 | 44 |
| 32 | 1¼ | 200 | 8 | 700 | 28 | 1150 | 46 |
| 40 | 1½ | 250 | 10 | 750 | 30 | 1200 | 48 |
| 50 | 2 | 300 | 12 | 800 | 32 | 1300 | 52 |
| 65 | 2½ | 350 | 14 | 850 | 34 | 1400 | 56 |
| 80 | 3 | 400 | 16 | 900 | 36 | 1500 | 60 |
| 90 | 3½ | 450 | 18 | 950 | 38 | 1800 | 72 |

1) Diameter nominal, mm

2) Nominal pipe size, inch.

**APPENDIX G
PIPE FLANGES PRESSURE TEMPERATURE RATING**

The purpose of this Appendix is to establish an equivalent identity for the pipe flange nominal pressure temperature ratings in Imperial System and SI System.

TABLE DI

| PN (1) | ANSI RATING CLASS |
|---------------|--------------------------|
| 20 | 150 |
| 50 | 300 |
| 68 | 400 |
| 100 | 600 |
| 250 | 1500 |
| 420 | 2500 |

1) Pressure Nominal, bar.