GENERAL DESIGN REQUIREMENTS

OF

MACHINERIES

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1. SCOPE

This Engineering specification gives general design requirements, specifications and guidance for rotating machineries (i.e compressors, pumps, fans, blowers, steam and gas turbines); for use in oil refineries, chemical plants, gas plants and where applicable, in exploration, production and new ventures.

The contractor shall determine by careful security which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safty, economic and legal aspects.

Compliance with the requirements of this specification and the Standards and codes referred to herein shall not relieve the contractor or manufacturer of their responsibility to follow safe engineering practice throughout.

2. REFERENCES

Throughout this Standard the following standards and codes are referred to. The editions of these standards and codes that are in effect at the time of publication of this Standard shall, to the extent specified herein, form a part of this Standard. The applicability of changes in standards and codes that occur after the date of this Standard shall be mutually agreed upon by the Company and the Vendor:

API (AMERICAN PETROLEUM INSTITUTE)

610	"Centrifugal Pumps for Refinery Services"
611	"General Purpose Steam Turbines for Refinery Services"
612	"Special Purpose Steam Turbines for Refinery Services"
614	"Lubrication, Shaft Sealing and Control Oil Systems for Special Purpose Application"
615	"Sound Control of Mechanical Equipment for Refinery Services"
616	"Combustion Gas Turbines for Refinery Services"
617	"Centrifugal Compressors for General Refinery Services"
618	"Reciprocating Compressors for General Refinery Services"
619	"Rotary-Type Positive Displacement Compressors for General Refinery Services"
671	"Special Purpose Couplings for Refinery Services"
672	"Packaged, Integrally Geared Centrifugal Air Compressors for General Refinery Services"
673	"Special, Purpose Centrifugal Fans for General Refinery Service"
674	"Positive Displacement Pumps-Reciprocating"
675	"Positive Displacement Pumps-Controlled Volume"
676	"Positive Displacement Pumps-Rotary"

IPS (IRANIAN PETROLEUM STANDARDS)

M-PM-105	"Centrifugal Pumps for Process Services"
M-PM-115	"Centrifugal Pumps for General Services"
M-PM-125	"Centrifugal Fire Water Pumps"
M-PM-130	"Positive Displacement Pumps - Reciprocating"
M-PM-140	"Positive Displacement Pumps - Rotary"
M-PM-150	"Positive Displacement Pumps - Controlled Volume"
M-PM-170	"Centrifugal Compressors for Process Services"
M-PM-180	"Packaged Integrally Geared Centrifugal Compressor for Utility and Instrument Air Services"

M-PM-190 "Axial Flow Centrifugal Compressors"
M-PM-200 "Reciprocating Compressors for Process Services"
M-PM-210 "Reciprocating Compressors for Utility and Instrument Air Services"
M-PM-220 "Positive Displacement Compressors - Rotary"
M-PM-230 "Centrifugal Fans for Special Services"
M-PM-235 "Centrifugal Fans for General Services"
M-PM-240 "General Purpose Steam Turbines"
M-PM-250 "Special Purpose Steam Turbines"
M-PM-260 "Combustion Gas Turbines"
M-PM-300 "Special Purpose Gear Units"
M-PM-310 "Special Purpose Couplings"
M-PM-320 "Lubrication, Shaft Sealing and Control Oil Systems for Special Purpose Applications"
M-PM-330 "Mixers"
E-SF-900 "Noise and Vibration Control"
E-EL-110 "Electrical Area Classification and Extent"
M-PM-220 "Shell and Tube Heat Exchangers"
E-PR-420 "Heat Tracing and Winterizing"

ASME (AMERICAN SOCIETY OF MECHANICAL ENGINEERS)

Boiler and Pressure Vessel Code Sec. VIII, Div. I

TEMA (TUBLAR EXCHANGER MANUFACTURER'S ASSOCIATION)

Class C

NFPA (NATIONAL FIRE PROTECTION ASSOCIATION)

No. 20

3. DEFINITIONS AND TERMINOLOGY

Vital duty

Vital duty is a duty where failure of an equipment to operate correctly results in an unsafe condition which puts the lives of personnel at risk or jeopardizes equipment.

Essential duty

Essential duty is a duty where failure of an equipment to operate correctly when required renders a plant or process unacceptable as a production unit.

Critical service

Critical service can be either a vital or an essential duty or service, according to the text and its intent.

Continuous operation

Continuous operation is an uninterrupted operation by an equipment and its auxiliaries, and its installed spare, for a period of at least 16,000 hours at the specified operating conditions.

Intermittent operation

Any operation which is not classed as continuous operation.

API STANDARDS

In the API Standards referred to in this specification several clauses are marked with a bullet(C) in the margin, indicating that a decision is required by the principal.

These decisions shall be indicated directly on the relevant data sheets when provision is made for them, otherwise they shall be stated in the purchase order.

4. UNITS

This standard is based on International System of Units, (SI) except where otherwise specified.

5. GENERAL REQUIREMENTS

5.1 Range and Variety of Equipment

Even effort shall be made consistent with sound engineering practice, to minimize the spares stocking of operating companies by rationalizing the variety of makes and types of equipment and auxiliaries selected for any particular project.

The rationalization shall be applied stringently so far as it does not interfere with the selection of an optimal equipment for the specified operating conditions.

5.2 Prototype Equipment

Selected equipment shall be, in all respects, well within the range of the manufacturer's proven experience, and shall not involve the use or application of any prototype design or components.

5.3 Special Operating Requirements

The data sheet shall indicate all particular operating requirements that the equipment may meet for example parallel operation, operating with fluids of different densities or at different operating temperatures, or being required to operate at minimum continuous thermal or stable flow.

5.4 Off-design Conditions

Manufacturers shall demonstrate that equipment shaft and bearing design takes into consideration the hydraulic forces occurring during operation away from the duty point anywhere within the range specified in data sheet.

5.5 Complete Unit Responsibility

The combined complete unit comprising driver, driven equipment, auxiliary equipment, lubrication, instrumentation and control system shall be ordered from the manufacturer of one of these components.

This manufacturer shall then become responsible for the satifactory performance of the complete unit under all operating conditions, including starting and acceleration. Further more, this manufacturer, shall warrant and guarantee all equipment and component parts as stipulated in the relevant specification and purchase order.

6. DESIGN REQUIREMENTS

6.1 General

6.1.1 Noise levels

As a general rule, the noise level of all equipment installed shall not exceed the limits specified in each equipment standard.

In the event that more stringent limits are required, then the sound power or sound pressure limit for equipment with its driver and auxiliaries shall be stated in data sheet, which shall always form part of the requisition. The supplier shall use this data sheet to submit the (guaranteed) sound power levels and/or sound pressure levels of the equipment.

Noise limits shall apply for all operating conditions, and shall have upper tolerance of +0 dB.

6.1.2 Material

Material selection shall be made based on relevant applicable specifications specified, preferably American code or standard materials. However, equivalent grade of materials produced in other recognized country CODES such as, DIN, JIS, BS, AFNOR, and UNI may also be used and each material on the drawings shall be identified by corresponding ASTM or AISI designation.

6.1.3 Electrical

All electrical components and installations shall be suitable for the specified area classification and grouping to be prepared separately and shall comply with the requirements of IPS-E-EL-110.

6.1.4 Pressure vessels

Pressure vessels as an auxiliary of rotary machinery, shall be designed in accordance with ASME Code Sec. VIII. ASME Code Stamp is not mandatory.

6.1.5 Lubricants and lubrication

Special type lubricants are not acceptable. Equivalent type lubricants shall be submitted.

Lubrication oil and seal oil systems shall comply with API Std. 614 as amended/supplemented by IPS-M-PM-320.

6.1.6 Couplings

Dry-flexible disk coupling with stainless steel disks shall be provided unless otherwise specified in data sheet.

Couplings shall comply with API Std. 671 as amended/supplemented by IPS-M-PM-310.

6.1.7 Gear units

Whenever specified or applicable the gear units shall comply with requirements of API Std. 613 as amended/supplemented by IPS-M-PM-300.

6.1.8 Instrumentation

For selection of instrumentation vendor Standard instrument may be employed, if they are installed within the confines of machinery skid and are well proven experientially. However, final selection of vendors of such instruments shall have approval of the Company prior to placement of order, with exception of special instruments to be selected by manufacturer.

Alarm and shutdown contacts for rotary machinery shall be normally closed (energized) and open (deenergized) to alarm and trip. The control and instrumentation system shall protect personnel and equipment against injury or loss under all conditions of operation or malfunction.

6.1.9 Winterization

Equipment shall be winterized and heat-conserved according to IPS-E-PR-420.

6.1.10 Valves

Pump casing vent and drains shall be provided with valves.

6.1.11 Heat exchangers

Heat exchangers shall comply with IPS-M-ME-220 and TEMA class C.

Unless otherwise specified, all water cooled heat exchangers shall have inhibited admiralty brass tubes with naval brass tubesheets.

Coolers on flushing lines of centrifugal pumps (MFR Std. construction) will have carbon steel or stainless steel body and duplex stainless steel or monel coil.

6.2 Pumps

6.2.1 Centrifugal pumps

Centrifugal pumps for process services shall meet minimum requirements of API Std. 610, Seventh Edition as amended/supplemented by IPS-M-PM-105.

Fire water pumps shall comply with IPS Std. M-PM-125 and NFPA No. 20, Latest Edition.

Centrifugal pumps for other general services shall meet requirements of IPS-M-PM-110.

Some additional requirements which should be considered when specify a pump are set out below.

6.2.1.1 Wear rings

Special wear-ring construction, including provision for clean fluid flushing, may be considered for pumps handling abrasive liquids. Where the pump manufacturer is able to demonstrate reliability of his design in comparable duties. For abrasive fluid services, wear rings with hard material shall be used.

6.2.1.2 Radial and thrust bearings

- Radial bearings shall be either anti-friction or hydrodynamic type.
- Thrust bearings shall be either anti-friction or hydrodynamic type.
- Pump bearings shall be oil-lubricated.

6.2.1.3 Mechanical seals

With certain exceptions, e.g. pumping sandy crude oil, when a clean flush is not available, mechanical seals shall be applied for all duties. Other exceptions are pumps in intermittent operation on less essential duties, in water service, in fire-fighting pumps and in cooling water pumps.

Normally, hydraulically-balanced seals with stainless steel seal end plates shall be applied. Shaft sleeves shall be provided with all mechanical seals.

Where seal face leakage of the pumped liquid to the atmosphere must be contained, use of tandem seals or double seal are recommended.

Provision shall be made to ensure optimal operating conditions for the mechanical seal. Means by which this is to be achieved shall be indicated in the data sheet by reference to the appropriate plan in Appendix D of API Std. 610. The pump and/or seal manufacturer shall confirm the suitability of the plan selected.

Only a fixed orifice shall be used to restrict the circulation of the flushing fluid.

Where the pumped liquid contains abrasives, a clean flushing medium from an external source compatible with the pumped fluid should be used.

Cyclones in flushing lines shall be used only for low concentrations of high-density solids, where there is a clearly marked difference in density between the liquid and the solids. Strainers are not acceptable in the recirculation line.

Cyclones integral with the pump casing are not permitted.

6.2.1.4 Quench fluid

A quench fluid shall be used under the following conditions:

- Where leakage of liquid to atmosphere could become a potential source of fire hazard.
- Where leakage of liquid to atmosphere could endanger personnel due to toxicity.
- Where the pumped liquid would crystallize on exposure to atmosphere.

6.2.1.5 Selection

Horizontal centrifugal pumps having top discharge nozzle on the shaft center shall not be selected except for multy stage pumps.

6.2.2 Rotary positive displacement pumps

Rotary pumps shall conform to the requirements of API Std. 676, as amended/supplemented by IPS-M-PM-140.

Pumps shall be selected well within the manufacturer's actual field experience of limits of operating temperature and maximum working pressure, available materials of construction, pumps speed and pumped liquid properties.

6.2.2.1 Bearings

In order to keep the number of shaft seals to a minimum, rotary pumps handling clean, abrasive-free non-corrosive liquids with lubricating properties shall be provided with internal bearings lubricated by the pumped liquid.

In all other cases, pumps shall be provided with oil-lubricated bearings and timing gears in separate housings. Constant level sight feed oilers shall be provided.

6.2.2.2 Pressure relief

A pressure relief valve shall be provided to protect the pump and its associated piping system. A relief valve integral with the pump is not permitted.

6.2.3 Positive displacement pumps-reciprocating

Reciprocating pumps shall conform to the requirements of API Std. 674 as amended/supplemented by IPS-M-PM-130.

Some additional requirements which should be considered when specifying reciprocating pumps are set out below.

6.2.3.3 Pressure relief

See 6.2.2.2.

6.2.4 Positive displacement pumps-controlled volume

Controlled volume pumps shall conform to the requirements of API Std. 675 as amended/supplemented by IPS-M-PM-150.

Pumps shall be selected well within the manufacturer's actual field experience of limits of operating temperature and maximum working pressure, pump speed and pumped liquid properties.

Diaphragm pumps with direct mechanical actuation shall not be selected.

Some additional requirements which should be considered when specifying controlled volume pumps are set below:

6.2.4.1 Distance pieces

Distance pieces shall be provided with gasketed solid covers.

6.2.4.2 Diaphragms

In the event that atmospheric release of product or contamination of product by hydraulic fluid is not permitted, double diaphragm pumps shall be specified and diaphragm failure indication shall be provided.

6.2.4.3 Pressure relief

See 6.2.2.2.

6.3 Compressors and Fans

6.3.1 Centrifugal compressors

Centrifugal compressors, except packaged integrally geared centrifugal compressors, shall meet the minimum requirements of API Std. 617 as amended/supplemented by IPS-M-PM-170 or IPS-M-PM-190 as specified.

6.3.1.1 Drivers

The required type of driver shall be specified together with the relevant specifications with which it shall comply.

For centrifugal compressors, the most economical method for capacity control (down to a certain minimum) is by means of speed variation, hence a variable-speed driver is favored such as may be provided by a steam turbine, an adjustable-speed electric motor or a two-shaft gas turbine. For constant speed drives, capacity control can be achieved by suction throttling or recycle systems. Variable inlet guide vanes may be considered for air and other clean gases.

6.3.1.2 Moisture separator

Where liquid may be present in the gas stream, installation of adequate moisture separators following intercoolers or at the inlet of process machines shall be required.

6.3.2 Reciprocating compressors

Reciprocating compressors shall conform to the minimum requirements of API Std. 618, as amended/supplemented by IPS-M-PM-200.

Some additional requirements which should be considered when specifying a reciprocating compressor and filling in data/sheets are set out below.

6.3.2.1 Type of compressors

Reciprocating compressors shall be horizontal and generally balanced opposed type .

For non-lubricated duties, an extra long distance piece is required to prevent carry-over of lurbricating oil into the cylinder.

For corrosive and toxic duties, a two compartment distance piece suitably purged and vented, is required to prevent the gases entering the crank case of the compressor along the piston rod.

For reciprocating compressors in air service (and those normally in hydrocarbon service, but where regeneration mode with air is required) a non-lubricated type shall be specified.

6.3.2.2 Pulsation damping equipment

As pressure pulsations can have a damaging effect even at moderate pressure levels, an analysis should be specified whenever there is concern, e.g. because of high operating pressure (above 70 bar) or because of the critical nature of the compressor operation.

A pulsation analysis of the suppression system may be profitable and the desirability of proceeding with such an analysis, including the piping, in accordance with Design Approach 3 in paragraph 3.3.5 of API Std. 618 should be considered jointly with the Company, as well as who should be appointed to carry out this analysis. The contractor would then be required to supply as soon as possible a lay-out of the suction and discharge piping systems.

To reduce pressure pulsations to levels in accordance with API Std. 618 para 3.3.4, volume bottles should be applied for pulsation damping.

Pulsation suppression devices for reciprocating compressors shall be evaluated by either analog study or digital computer.

6.3.2.3 Drivers

The type of driver required shall be specified together with the appropriate specification to which it shall conform.

Anticipated process variations, such as start-up and abnormal operating conditions, shall be specified in detail so that the compressor manufacturer can size the driver correctly.

6.3.2.4 Instrumentation for measurement and control

The type of capacity control shall be specified. Adjustable speed electric motor drivers can be considered for capacity control. The use of variable volume clearance pockets for capacity control is not favoured and its application requires the explicit approval of the company.

The use of reverse flow control by means of adjustable spring-loaded suction valves should only be used in clean gas service and at suction pressure where reliable operation has been demonstrated.

6.3.2.5 Alarm and shutdown

6.3.2.5.1 Alarm and shutdown devices for high vibration shall be provided with all reciprocating gas compressors.

6.3.2.5.2 Reciprocating gas compressors shall be provided with high or low cooling water temperature alarm for each cylinder outlet and high level alarm if moisture separators are provided.

6.3.3 Rotary-type positive displacement compressors

Rotary-type positive displacement compressors shall conform to the minimum requirements of API Std. 619 as amended/supplemented by IPS-M-PM-220.

Some additional requirements which should be considered when specifying a rotary-type compressor and filling in data/sheets are set out below.

6.3.3.1 Casings

In order to ensure comparable quotations from manufacturer, the number of stages, which is equivalent to the number of casings required, should be stated. Materials of construction for casings shall be specified, the material selected shall be compatible with the gas handled.

The orientation and flange rating of the suction and discharge connections shall be specified. Top suction with bottom discharge shall be specified for wet gas duties.

6.3.3.2 Shaft sealing

The preferred type of seal shall be specified. In general, the labyrinth-type seal shall be specified for non-toxic, non-flammable gases, and the liquid-film type for all other duties. Restrictive-ring type seals are not favored and their application is subject to the explicit approval of the Company.

6.3.4 Packaged integrally geared, centrifugal plant and instrument air compressors

Packaged integrally geared, centrifugal plant and instrument air compressors shall comply with the requirements of API Std. 672 as amended/supplemented by IPS-M-PM-180.

The operating data and conditions together with the additional requirements for the packaged unit shall be specified in the data sheets.

It should be realized that these package units are very much standard units so the manufacturer could be reluctant to incorporate special requirements.

6.3.5 Centrifugal fans

Centrifugal fans for special services shall conform to the requirements of API Std. 673, as amended/supplemented by IPS-M-PM-230 and for general services to the requirements of API Std. 673, as amended/supplemented by IPS-M-PM-235. Some additional requirements which should be considered when specifying a centrifugal fan and filling in data sheet are set out below.

6.3.5.1 Type of fan

The fan shall be of the overhung type, if the actual inlet flow is less than approximately 80-100 m^3/s. For larger flows a double inlet, in-between-bearings-type fan may be considered.

6.3.5.3 Shaft sealing

The required type of shaft seal shall be specified in the data sheet.

In general the labyrinth type seal is required for non-flammable, non-corrosive, non-toxic gases at ambient temperature. An inert gas sealing system may be considered if leakage (either air to inside or gas to outside) is not allowed for process reasons.

For high-temperature services (above 200°C) a restrictive ring or labyrinth type shaft seal, including a sealing gas system is preferred.

If a maximum sealing effect is required, mechanical contact type seals may be considered, however, this type of seal shall not be specified for high temperature services.

6.3.5.4 Bearings

In general hydro-dynamic bearings (radial and thrust) shall be specified for fans in the following services:

- Driver rating above 100 kW.
- High-temperature fans.
- Fans in vital or essential duties.

For fans in other services anti-friction bearings may be specified.

6.3.5.5 Lubrication

Grease lubrication for fan bearings may only be specified for fans on non-essential duties. When bearings are used which need to be relubricated, a minimum running period of 2000 hours is required before relubrication. Pressure lubrication systems are usually not necessary. Application of such systems should only be specified after consultation with the Company.

6.3.6 Reciprocating compressors for utility and instrument air services

Reciprocating compressors for utility and instrument air services shall meet the requirements of API Std. 680 "Packaged Reciprocating Plant and Instrument AIR compressors for General Refinery Service" as amended/supplemented by IPS-M-PM-210.

6.4 Turbines

6.4.1 Steam turbines

Steam turbines are divided into two categories according to their size and usage:

- General-purpose steam turbines, and
- special-purpose steam turbines.

Independently of the above two categories, steam turbines can be classified on the basis of their working principles:

- Impulse, or action turbines. where steam expansion occurs only in the nozzles or in the stationary blades, not both, and

- reaction turbines where steam expansion occurs in both the stationary and the rotating blades.

With the impulse-type turbine, close clearances at the blade tips are not essential. Interstage labyrinths over the diaphragms and shaft seal labyrinths are on relatively small diameters, so the leakage losses are correspondingly small, even with increased clearances. This makes this type of turbine especially suitable for quick starting from relatively cold stand-by conditions.

There is also a preference for this type of turbine wherever rapid changes in steam and/or load conditions can be expected.

Impulse turbines achieve higher efficiencies at low volumetric flow coefficients than can be obtained with reaction turbines, so are preferred when small volumetric flows must be combined with low speeds, for example to avoid the use of gearbox.

For high-speed special-purpose turbines, with speeds in excess of 8000 r/min and in back pressure or topping services, the reaction-type turbine is preferred because it is more efficient for these conditions.

The advantages and disadvantages of each type should be evaluated for every application.

6.4.1.1 General-purpose steam turbines

These turbines can be horizontal or vertical and are used to drive equipment that is usually spared, that is relatively small in size (power) or is in non-critical service. Examples are drivers for pumps, which are spared, and drivers for fan and small generators.

These turbines are intended for application where steam conditions will not exceed 42 bar absolute pressure or 400°C steam inlet temperature, or both, and where the speed will not exceed 6000 revolutions per minute.

General-purpose steam turbines shall comply with the requirements of API Std. 611, as amended/supplemented by IPS-M-PM-240.

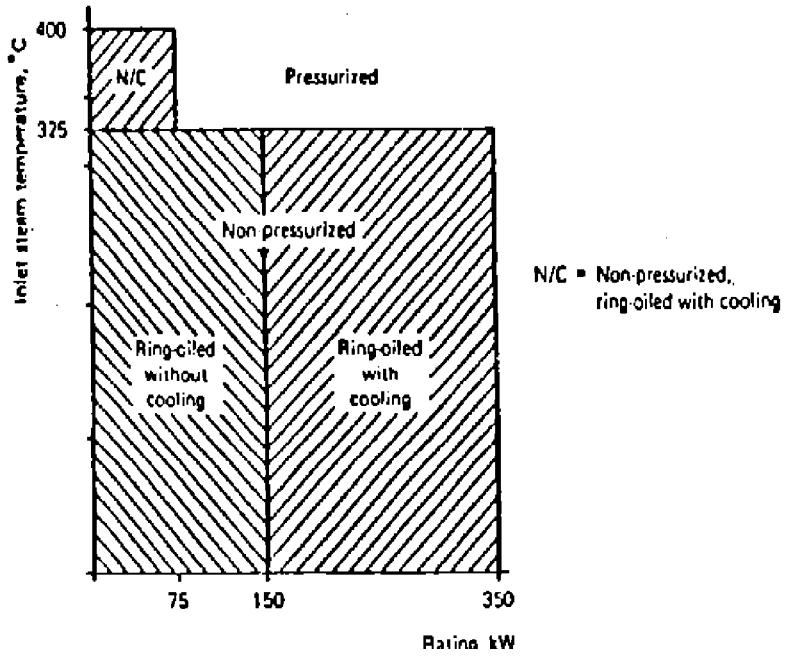
6.4.1.1.1 Vibration

Turbines equipped with sleeve bearings shall be provided with proximity probes to permit periodic on-stream checks on the vibration level of the rotor using portable vibration measuring equipment.

6.4.1.1.2 Lubrication

The lubrication may be pressurized, non-prssurized (ring-oiled) with cooling, or non-pressurized without cooling. In addition to the manufacturer's recommendations, the following guidelines shall be followed when making the selection.

- For turbines with speeds above 3600 r/min , pressureized lubrication shall be specified.
- For turbines with speeds of 3600 r/min and below, the choice of lubrication system depends mainly on the inlet steam temperature and the developed power, as indicated in the following diagram:



6.4.1.2 Special-purpose steam turbines

These are horizontal turbines and are used to drive equipment that is usually not spared, that is relatively large in size (power) or is in critical service. Examples are drivers for centrifugal compressors or generators.

The application of these turbines is not limited by steam conditions, nor by speed.

Special-purpose steam turbines shall comply with the requirements of API Std. 612, as amended/supplemented by IPS-M-PM-250.

When drawing up the requirements, special attention shall be given to off-design conditions which may occur during start-up or shutdown procedures associated with the driven equipment.

Unless otherwise specified, mechanical type trip device are not acceptable.

6.4.1.2.1 Dynamics

Calculated response curves of rotor deflection versus rotational speed for varying amounts of unbalance are required for special-purpose steam turbines.

A report of the sensitivity of the rotor-balancing machine system is required for turbine rotors running at speeds in excess of 15000 r/min; see paragraph 2.8.2.3 of API Std. 612.

6.4.1.2.2 Couplings

A flexible coupling between the turbine driver and the driven equipment shall be supplied by the manufacturer responsible for coordinating the turbine with the driven equipment.

6.4.1.2.3 Gear units

Gear transmissions should be avoided whenever possible.

6.4.1.2.4 Governor

Mechanical/hydraulic governors driven by a helical gear or worm drive are not recommended. In such cases, an electrical/hydraulic governor should be specified.

6.4.1.2.5 Vibration and position detectors

As a general rule, special-purpose steam turbines shall be provided with non-contacting radial vibration sensor probes and axial position probes, and the combined unit shall be provided with a phase-angle transducer.

6.4.1.2.6 Piping and appurtenances

If the turbine is driving a centrifugal compressor handling gases containing hydrogen sulphide, the turbine control oil and the lubricating oil for the turbine and compressor shall be separated from the compressor seal oil to avoid their contamination.

In such cases, a combined turbine control oil and lubricating oil system with a separate seal oil system shall be specified.

6.4.1.2.7 Lube oil reservoir

Stainless steel lube oil reservoirs are required for special purpose turbines.

6.4.2 Gas turbines

Gas turbines shall comply with the requirements of API Std. 616 as amended /supplemented by IPS-M-PM-260.

6.4.2.1 Site-rated power

The site conditions of elevation, humidity, and ambient temperature shall be taken into consideration together with the power requirements of the driven equipment in order to arrive at a realistic site-rated power (rating) of the gas turbine. This 'site rating' should be adequate to cover losses due to:

- Gas turbine air compressor fouling (estimate for a maximum of 4% on average 2%).
- Intake and exhaust systems.
- Exhaust heat exchanger.
- Main gearbox.

There shall be power output margin of at least 7% between the demand of the driven equipment and the power of the gas turbine at site when in new and clean condition. Note that the power extracted by the auxiliaries, directly driven from the gas turbine, is not always included in the vendor's standard information sheets.

Having established the site rating for the gas turbine, the ISO* rating of the gas turbine can be calculated to serve as a guide for comparing the available makes and models of the gas turbine type suitable for the application being considered.

*** The ISO rating of a gas turbine is its rating at 15°C ambient temperature, at 1013.25 mbar and 60% relative humidity, with zero inlet and exhaust pressure losses.**

6.4.2.2 Standard packages

Gas turbines are generally offered as standard packaged prime movers developing a rated power at a rated speed, and are not normally custom-built to the particular power requirements desired by the user. Improved overall efficiency will be obtained by matching process train size to the power available from a Standard packaged gas turbine prime mover.

6.4.2.3 Noise control

As gas turbines are known to be very noisy sources with high noise levels near casings, inlet and exhaust, remedial action in the form of silencers and enclosures are always required.

Hence, data sheets for silencer and acoustical enclosure , will also be part of the requisition.

6.4.2.4 Oil tank vents

Oil tank vapor should be led as far away from the gas turbine as possible, preferably in finned tube, to provide the maximum cooling effect before the vapor enters the coalescer, which should be a high-efficiency unit. Condensed oil shall be piped separately back to the oil tank, or to disposal.

Oil vapor from tanks containing synthetic fire-retardant lubricants shall be kept separate from mineral oil vapor.

Oil tank vents shall be led separately at atmosphere.

6.4.2.5 Controls and instrumentation

Gas turbine manufacturers supply a complete control and monitoring system with their gas turbines as an intrinsic part of the package. It is not possible to dispense with their control system because it contains such essential items as the governor control, fuel scheduling, combustion monitoring and gas turbine safety circuits. The process or driven equipment controls are frequently integrated with the gas turbine control panel.

The gas turbine control panel shall be capable of receiving signals from the plant control panel. The plant control system shall also be capable of receiving signals from the gas turbine control panel.

6.4.2.6 Air intake system

The location of the combustion air intake requires careful consideration if the life of the gas turbine is not to be curtailed, satisfactory access shall be provided and no undue hazard shall be created.

The air intakes for the combustion air should be as close to the gas turbine as possible. Long intake ductwork imposes a severe power penalty due to pressure loss.

It is essential to ensure that the entire air intake system is completely leak-free.

6.4.2.7 Exhaust system

The exhaust stack should terminate at a sufficient height to prevent recirculation of the hot gas plume into either the combustion air intake or the ventilation air intake.

The design of the exhaust stack shall prevent rain ingress into the gas turbine exhaust collector.

For offshore platforms, it is necessary to ensure that the hot gas plume cannot be recirculated into other areas of the platforms under any of the weather conditions likely to be experienced and that no hazard can be created to the helicopter flight paths. In most cases, model testing will be needed to ensure that these requirements are met.

6.4.2.8 Combustion air filtration

High-quality combustion air is essential if the gas turbine performance is to be maintained. Contaminants in the combustion air stream cause fouling, corrosion, premature blade and hot gas path failure in severe contamination conditions.

All air filters shall have upward air intakes fitted with a rain hood. This is most effective in reducing rain and snow ingress into the air filter.

6.5 Mixers

Mixers shall meet the requirements of IPS-M-PM-330.

Some additional requirements which should be considered when specifying a mixer and filling in data sheet are set below.

6.5.1 Tank mixers for crude oil tanks shall be of automatic variable angle type design.

6.5.2 Mounting flange for tank mixers shall be of such size where possible, that they may be mounted on nozzles of tanks provided.