INTERNATIONAL STANDARD

ISO 10439-2

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Petroleum, petrochemical and natural gas industries — Axial and centrifugal compressors and expander-compressors —

Part 2: Non-integrally geared centrifugal and axial compressors

Industries du pétrole, de la pétrochimie et du gaz naturel — Compresseurs axiaux et centrifuges et compresseurs-détenteurs —

Partie 2: Compresseurs centrifuges et axiaux sans multiplicateur intégré

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 118, *Compressors and pneumatic tools, machines and equipment*, Subcommittee SC 1, *Process compressors*.

This first edition, together with ISO 10439-1, ISO 10439-3, and ISO 10439-4, cancels and replaces ISO 10439:2002.

ISO 10439 consists of the following parts, under the general title *Petroleum, petrochemical and natural gas industries — Axial and centrifugal compressors and expander-compressors*:

— *Part 1: General requirements*

— *Part 2: Non-integrally geared centrifugal and axial compressors*

— *Part 3: Integrally geared centrifugal compressors*

— *Part 4: Expander-compressors*

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Introduction

This International Standard is based on the 7th edition of the American Petroleum Institute standard API 617.

Further or differing requirements might be needed for individual applications. This International Standard is not intended to inhibit a supplier from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This can be particularly appropriate where there is innovative or developing technology. Where an alternative is offered, the supplier should identify any variations from this part of ISO 10439 and provide details.

An asterisk (*) at the beginning of the paragraph of a clause or subclause indicates that either a decision is required or further information is to be provided by the purchaser. This information is indicated on data sheets or stated in the enquiry or purchase order (see examples in Annex A in this part of ISO 10439, ISO 10439-3:2015, Annex A, and ISO 10439-4:2015, Annex A).

This International Standard includes the following annexes:

— Annex A: Datasheets;

— Annex B: Vendor (Supplier) data and drawing requirements (VDDR);

— Annex C: Centrifugal compressor nomenclature;

— Annex D: Typical materials;

— Annex E: Inspector's checklist;

— Annex F: Nozzle forces and moments;

— Annex G: Full load, full pressure, full speed testing;

Annex A forms a normative part of this part of ISO 10439. Annex B to Annex G are for information only.

In this International Standard, where practical, US Customary units are included in parentheses for information.

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Petroleum, petrochemical and natural gas industries — Axial and centrifugal compressors and expander-compressors —

Part 2: Non-integrally geared centrifugal and axial compressors

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1 Scope

This part of ISO 10439 specifies minimum requirements and gives recommendations for axial compressors, single-shaft, and integrally geared process centrifugal compressors and expander-compressors for special purpose applications that handle gas or process air in the petroleum, petrochemical, and natural gas industries. This part of ISO 10439 specifies requirements for non-integrally geared centrifugal and axial compressors, in addition to the general requirements specified in ISO 10439-1. These machines do not have gears integral with their casing but can have external gears.

NOTE See ISO 10439-3 for integrally geared process compressors, or API 672 for packaged plant instrument air compressors.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10439-1:2015, *Petroleum, petrochemical and natural gas industries — Axial and centrifugal compressors and expander-compressors — Part 1: General requirements*

ISO 10438 (all parts), *Petroleum, petrochemical and natural gas industries — Lubrication, shaft-sealing and control-oil systems and auxiliaries*

ISO 5389, *Turbocompressors — Performance test code*

API 670, *Machinery protection systems*

ASME PTC 10-1997, *Performance test code on compressors and exhausters*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10439-1 and the following apply.

NOTE Certain terms are depicted graphically in Figures 1 to 3.

4 General

4.1 Dimensions and units

The dimensional and unit requirements shall be in accordance with ISO 10439-1.

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4.2 Statutory requirements

The statutory requirements shall be in accordance with ISO 10439-1.

4.3 Unit responsibility

The unit responsibilities shall be in accordance with ISO 10439-1.

4.4 Basic design

4.4.1 Performance

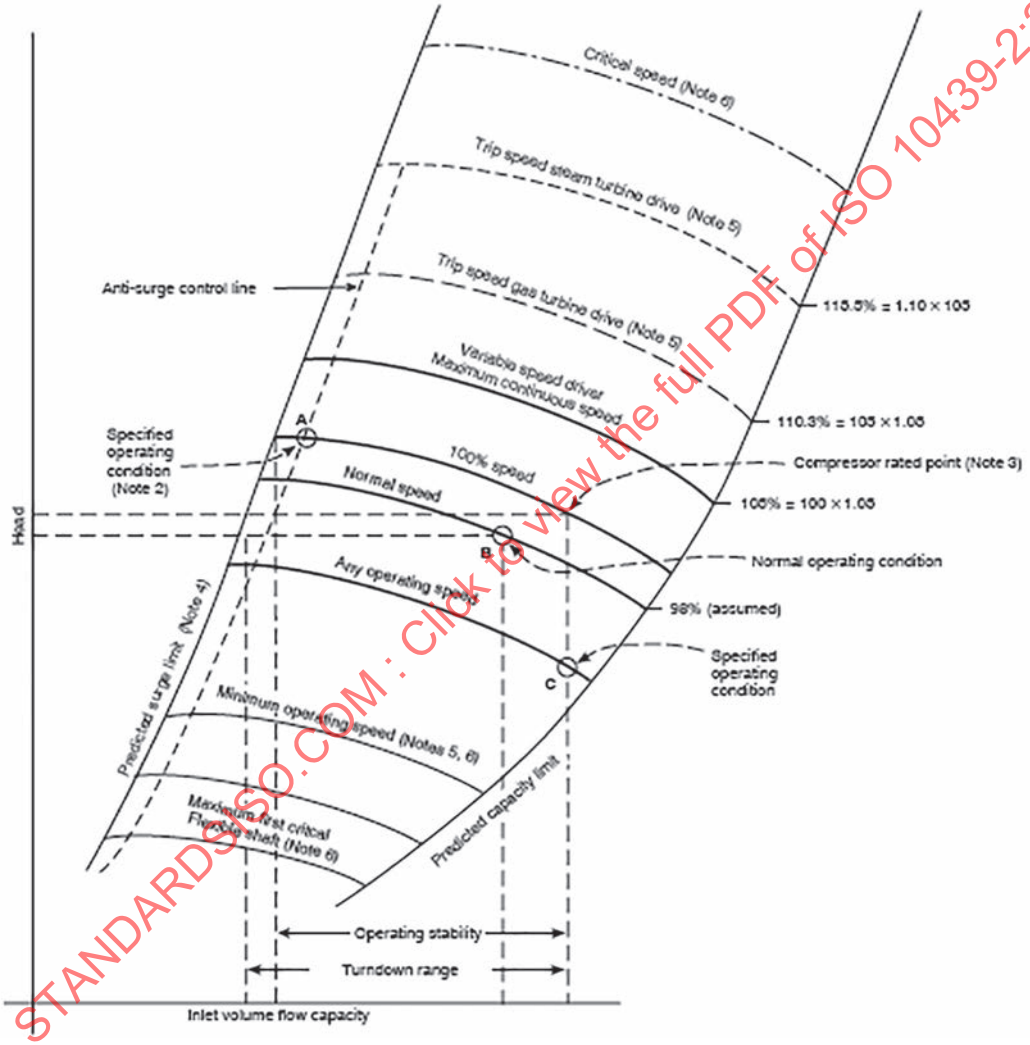

Figure 1 — Centrifugal compressor performance map — Illustration of terms

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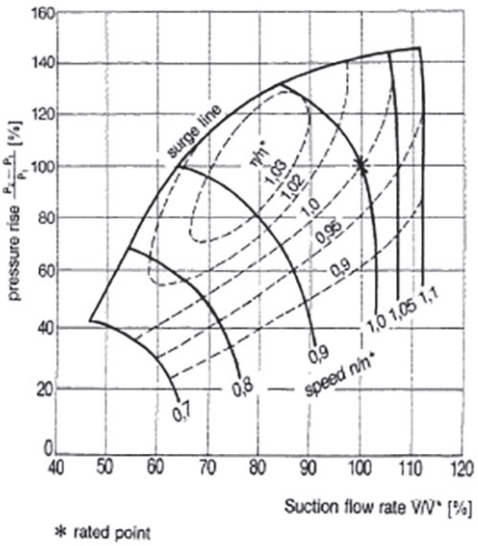

Figure 2 — Axial compressor performance map — variable speed

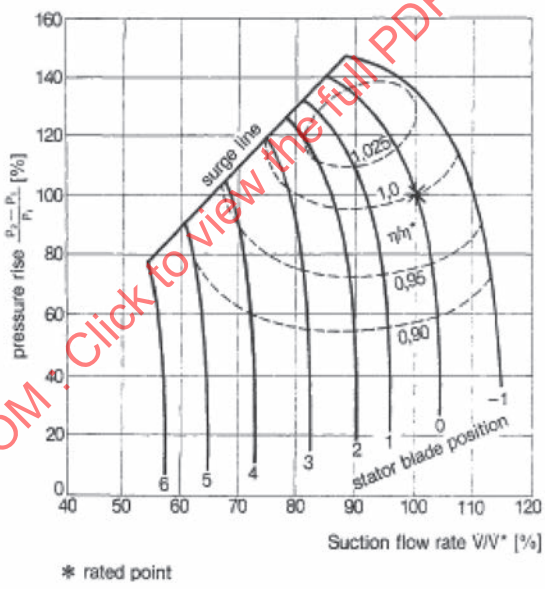

Figure 3 — Axial compressor performance map — variable stator vanes

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NOTE Figure 1 is a typical operating map for a centrifugal compressor. Figures 2 and 3 are typical operating maps for an axial compressor.

4.4.1.1 The sectional head-capacity characteristic curve shall rise continuously from the rated point to predicted surge. The compressor, without the use of a bypass, shall be suitable for continuous operation at any capacity at least 10 % greater than the predicted surge capacity shown in the proposal.

4.4.1.2 The supplier shall provide an overload limit for axial compressors to avoid damaging blade stresses.

4.5 Materials

Materials shall be in accordance with ISO 10439-1:2015, 4.5.

NOTE Refer to Annex D for typical materials.

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4.6 Casings

Casings shall be in accordance with ISO 10439-1:2015, 4.6 and 4.6.1 to 4.6.6 of this part of ISO 10439.

4.6.1 Pressure-containing casings

4.6.1.1 The purchaser should specify the relief valve set pressure. The maximum allowable working pressure of the casing shall be at least equal to the specified relief valve set pressure.

When a relief valve set pressure is not specified, the maximum allowable working pressure shall be at least 125 % of the maximum specified discharge pressure (gauge). System protection shall be furnished by the purchaser.

4.6.1.2 Casings designed for more than one maximum allowable pressure level (split pressure-level casings) are permitted only in process air service with an atmospheric pressure inlet. Split pressure-level casings are not permitted in other services unless specifically approved by the purchaser. If approved, the supplier shall define the physical limits and the maximum allowable working pressure of each section of the casing.

4.6.1.3 Unless otherwise specified, casings shall be radially split when the partial pressure of hydrogen (at maximum allowable working pressure) exceeds 1 380 kPa gauge (200 psi gauge). The partial pressure of hydrogen shall be calculated by multiplying the highest specified mole (volume) per cent of hydrogen by the maximum allowable working pressure.

4.6.1.4 Each axially split casing shall be sufficiently rigid to allow removal and replacement of its upper half without disturbing rotor-to-casing running clearances and bearing alignment.

4.6.1.5 Axially split casings shall use a metal-to-metal joint (with a suitable joint compound compatible with the process gas) that is tightly maintained by suitable bolting. Gaskets (including string type) shall not be used on the axial joint. "O" rings retained in grooves machined into the flange facing of an axially split casing joint can be used with purchaser's approval.

4.6.1.6 Radially split casings normally use "O" rings, gaskets, or other sealing devices between the end head(s) and cylinder. These devices shall be confined in machined grooves, and they shall be made of materials suitable for all specified service conditions.

4.6.1.7 Socket-head or spanner-type bolting shall not be used externally unless specifically approved by the purchaser.

4.6.2 Casing repair

Casings repairs shall be in accordance with ISO 10439-1:2015, 4.6.2.

4.6.3 Material inspection of pressure containing parts

Casings material inspection of pressure containing parts shall be in accordance with ISO 10439-1:2015, 4.6.3.

4.6.4 Pressure casing connections

Pressure casing connections shall be in accordance with ISO 10439-1:2015, 4.6.4 and 4.6.4.1 to 4.6.4.4 of this part of ISO 10439.

4.6.4.1 Main inlet and outlet connections for radially split machines shall be located in the outer casing, not in the end heads. On radially split overhung design machines, the process inlet connection can be in the end head.

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4.6.4.2 Auxiliary connections shall be at least DN 20 (3/4-in nominal pipe size).

NOTE See ISO 10439-1:2015, 4.6.4.1.3 for allowable connection sizes.

4.6.4.3 Threaded connections for pipe sizes DN 20 (NPS 3/4-in) to DN 40 (NPS 1-1/2-in) sizes are permissible with the approval of the purchaser.

NOTE See ISO 10439-1:2015, 4.6.4.1.3 for allowable connection sizes.

4.6.4.4 * If specified, connections for borescopic examination shall be supplied in agreed locations.

4.6.5 Casing support structures

The casing support structures shall be in accordance with ISO 10439-1:2015, 4.6.5.

4.6.6 External forces and moments

4.6.6.1 The compressor shall be designed to withstand external forces and moments on each nozzle calculated per Annex F. The supplier shall furnish the allowable forces and moments for each nozzle in tabular form.

4.6.6.2 Casing and supports shall be designed to have sufficient strength and rigidity to limit coupling movement caused by imposing allowable forces and moments to 50 µm (0.002 in).

4.6.7 Guide vanes, stators, and stationary internals

4.6.7.1 * If specified or required to meet specified operating conditions, adjustable inlet guide vanes (AIGVs) on centrifugal compressors shall be supplied.

4.6.7.2 * If specified or required to meet specified operating conditions, variable stators on axial compressors shall be supplied.

NOTE All or some of the stator blade rows can be adjustable.

4.6.7.3 The guide vane housing shall incorporate an external shell capable of providing an external purge of filtered air or inert gas.

4.6.7.4 A vane control system consisting of a positioner with direct driven local position indicator shall be provided that will be visible during operation of the machine.

4.6.7.5 Additional components to the vane control system in 4.6.7.4 shall be as specified.

4.6.7.6 Guide vanes shall be mounted in replaceable bushings. Vanes can be positioned in the housing by replaceable permanently sealed rolling element bearings if approved by the purchaser.

4.6.7.7 When inlet guide vanes or variable stators are used for toxic, flammable or explosive process gas, the linkage passing through the casing or enclosure shall be sealed to prevent leakage.

4.6.7.8 The inlet guide vanes shall be located sufficiently close to the eye of the impeller to be effective.

4.6.7.9 The vanes shall open on loss of the control signal.

4.6.7.10 When intermediate main suction or discharge process connections are used, the purchaser shall specify the maximum differential pressure between the connections if intermediate check valves

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are used. The supplier shall design the intermediate diaphragm between the process connections for the expected maximum differential including a suitable safety factor as agreed.

4.6.8 Internal joints

4.6.8.1 Internal joints shall be designed to minimize leakage and permit ease of disassembly.

4.6.9 Seal components

Seal components shall be separate parts and be renewable or replaceable in order to restore design clearances.

4.6.10 Diaphragms

4.6.10.1 Diaphragms shall be axially split unless otherwise approved by the purchaser. The diaphragms shall be furnished with threaded holes for eyebolts or with another means to facilitate removal.

4.6.10.2 Upper half diaphragms shall be fastened to the upper half casing or to each other in such a manner that they are lifted as a unit.

4.6.10.3 * If specified, the upper half diaphragms shall be attached to the lower half diaphragms.

NOTE For very large machines, this can have advantages in reducing the top half casing weight.

4.6.10.4 The internals of radially split multistage compressors shall be designed with an inner barrel assembly for withdrawal from the outer casing and disassembly for inspection or replacement of parts.

4.6.10.5 The supplier shall advise if a cartridge bundle assembly can be provided.

NOTE 1 This option can reduce maintenance time in the field.

NOTE 2 This feature is not available on all designs.

4.7 Rotating elements

4.7.1 General

4.7.1.1 Each assembled rotor shall be clearly marked with a unique identification number. This number shall be on the non-drive end of the shaft or in another accessible area that is not prone to maintenance damage.

4.7.1.2 Unless other shaft protection is approved by the purchaser, renewable components shall be furnished at interstage close-clearance points. Sleeves, spacers, or bushings shall be made of materials that are corrosion-resistant in the specified service.

4.7.1.3 Shaft sleeves shall be provided under shaft end seals. Sleeves shall be treated to resist wear and sealed to prevent gas leakage between the shaft and sleeve.

4.7.1.4 Shaft sleeves shall be provided under interstage seals. Closed impeller eye seals, which are stationary, do not require replaceable sleeves on the impeller.

4.7.2 Shafts

4.7.2.1 Shafts for non-through bolt rotors shall be made of one-piece, heat treated steel that is suitably machined. Shafts that have a finished diameter larger than 200 mm (8 in) shall be forged steel. Shafts that

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have a finished diameter of 200 mm (8 in) or less shall be forged steel or hot rolled barstock, providing such barstock meets all quality and heat treatment criteria established for shaft forgings.

4.7.2.2 When modular (through bolt) rotors are provided the stub-shafts shall meet all quality and heat treatment criteria for shaft forgings.

NOTE Refer to Annex C for rotor arrangements and nomenclature.

4.7.2.2.1 The studs or tie-bolts used to clamp a built-up rotor shall be made from bar or forgings. Threads shall be formed by rolling. Each tie-bolt shall be tested with a proof load corresponding to at least 110 % of maximum stretch that occurs during assembly or in operation.

4.7.2.2.2 Ferromagnetic material shall be DC wet magnetic particle inspected. Non-magnetic material shall be fluorescent penetrant inspected. These inspections shall be performed subsequent to proof-load test, and shall not reveal cracks, seams, or laps.

4.7.2.3 Proven methods of axial compressor rotor construction shall be offered. This includes solid (one-piece), disk-on-shaft, or stub shaft using through bolt, disk or drum construction, or other approved means.

4.7.3 Thrust balancing

4.7.3.1 A balance piston, balance line, and porting shall be provided if required to reduce axial loads on the thrust bearings. A separate pressure-tap connection or connections shall be provided to indicate the pressure in the balancing chamber, not in the balance line.

4.7.3.2 The balance line, if required, shall be flanged and sized to handle balance piston gas leakage at twice the initial design balance piston seal clearance without exceeding the load rating of the thrust bearings (see 4.9.3.3). If the balance line involves a connection to purchaser's piping, then the connection size and locations shall be indicated on the data sheets.

4.7.3.3 * If specified, a pressure tap connection shall be supplied in the downstream end of the balance line to allow measurement of differential pressure in the balance line.

NOTE This connection can be in the compressor supply or in the process piping.

4.7.3.4 * If specified, a differential pressure gage or transmitter shall be supplied to monitor differential balance line pressure.

4.7.4 Impellers

The impellers shall be in accordance with ISO 10439-1:2015, 4.7.10.

4.7.5 Axial compressor rotor blading

4.7.5.1 The blade natural frequencies shall not coincide with any source of excitation from 10 % below minimum allowable speed to 10 % above maximum continuous speed. If this is not feasible, blading shall be designed with stress levels low enough to allow unrestricted operation, at any specified operating speed for the minimum service life defined in ISO 10439-1:2015, 4.4.1.2. This shall be verified by Goodman diagrams or their equivalent. The supplier shall identify unacceptable speeds. Goodman diagrams for all blades shall be submitted to the purchaser for review.

NOTE Excitation sources include fundamental and first and second harmonic passing frequencies of rotating and stationary blades upstream and downstream of each blade row, gas passage splitters, irregularities in vane and periodic impulses caused by nozzle segment design at horizontal casing flanges, and the first 10 rotor speed harmonics.

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4.7.5.2 For each blade row, the supplier shall present bending and torsional blade natural frequencies under both operating and static conditions by Campbell diagrams or their equivalent.

NOTE Static frequencies can be used for comparison to "ring" testing on the blades installed in the rotor.

4.7.5.3 * If specified, or if blade natural frequencies are based on theoretical predictions, at least one blade from each stage shall be verified by ring testing.

4.7.5.4 All blades shall be peened. Peening intensity and media depend upon base material, compressive layer depth desired and material thickness. The compressive layer induced shall be checked by using Alnen strip.

4.7.5.5 Axial compressor rotor blading can be attached through axial dovetail, tangential fir tree, tangential, or T-slot. Other attachment methods are acceptable if approved by purchaser.

4.8 Dynamics

Dynamics requirements shall be in accordance with ISO 10439-1:2015.

4.9 Bearings and bearing housings

Bearing and bearing housing requirements shall be in accordance with ISO 10439-1:2015 and 4.9.1 to 4.9.4 of this part of ISO 10439.

4.9.1 General

4.9.1.1 Unless otherwise specified, hydrodynamic radial and thrust bearings shall be provided.

4.9.1.1.1 * If specified, active magnetic bearings shall be provided.

NOTE ISO 10439-1:2015, Annex E gives application considerations for use of active magnetic bearings.

4.9.1.2 Thrust bearings and radial bearings shall be fitted with bearing-metal temperature sensors installed in accordance with API 670.

4.9.1.3 As design criteria, bearing metal temperatures shall not exceed 100 °C (212 °F) at specified operating conditions with a maximum inlet oil temperature of 50 °C (120 °F). Suppliers shall provide bearing temperature alarm and shutdown limits.

In the event that the design criteria in 4.9.1.3 cannot be met, purchaser and supplier shall agree on acceptable bearing metal temperatures.

4.9.2 Hydrodynamic radial bearings

4.9.2.1 Unless otherwise specified, hydrodynamic bearings shall have flood lubrication. Directed lube can be used if agreed.

NOTE Directed lube has advantages in power losses, but has small passages with greater potential to plug. Radial bearings do not normally have significant power losses.

4.9.2.2 Sleeve or pad radial bearings shall be used and shall be split for ease of assembly. The use of non-split designs requires the purchaser's approval. The bearings shall be precision bored with steel or copper alloy backed babbitted replaceable liners, pads, or shells. The bearing design shall not require removal of the coupling hub to permit replacement of the bearing liners, pads, or shells unless approved by purchaser.

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4.9.2.3 * If specified, tilting pad bearings shoes shall be copper-alloy backed.

4.9.2.4 The removal of the top half of the casing of an axially split machine or the head of a radially split unit shall not be required for replacement of these elements. This might not be possible for overhung designs.

4.9.3 Hydrodynamic thrust bearings

4.9.3.1 Thrust bearings shall be steel-backed, babbitted multiple segments designed for equal thrust capacity in both axial directions and arranged for continuous pressurized lubrication to each side. Both sides shall be tilting pads, incorporating a self-levelling feature, which ensures that each pad carries an equal share of the thrust load even with minor variation in pad thickness.

NOTE Some low inlet pressure overhung compressors or axials will not need to meet the equal thrust load bi-directional criteria.

4.9.3.2 Hydrodynamic thrust bearings shall be selected at no more than 50 % of the bearing manufacturer's ultimate load rating. In sizing thrust bearings, consider the following for each specified application:

a) shaft speed;

b) temperature of the bearing babbitt;

c) deflection of the bearing pad;

d) minimum oil film thickness;

e) feed rate, viscosity, and supply conditions of the oil over the specified allowable oil supply condition range;

f) design configuration of the bearing;

g) babbitt or other bearing surface material alloy and pad material;

h) turbulence of the oil film;

i) load changes due to process changes over the specified operating range.

NOTE See ISO 10439-1:2015, 3.1.60 for a definition of ultimate load rating for hydrodynamic thrust bearings.

4.9.3.3 Thrust bearings shall be sized for continuous operation under the most adverse specified operating conditions. Calculations of the thrust forces shall include, but shall not be limited to the following factors:

a) seal maximum design internal clearances and twice the maximum design internal clearances;

b) pressurized rotor diameter step changes;

c) stage maximum differential pressures;

d) specified extreme variations in inlet, interstage, and discharge pressures;

e) the maximum thrust force that can be transmitted to the compressor thrust bearing by other equipment in the train (i.e. couplings, gears, or a motor without a thrust bearing);

f) the maximum thrust force from the sleeve bearing type drive if the motor or generator is directly connected.

4.9.3.4 The thrust bearing shall be arranged to allow both axial positioning of the rotor relative to the casing and setting the bearings' clearance.

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4.9.3.5 Each pad within one side of the thrust bearing, shall be designed and manufactured to tolerances to allow interchange or replacement of the individual pads.

NOTE Instrumented and offset pivot designs do not allow interchange side to side.

4.9.3.6 Unless otherwise specified, directed lube thrust bearings shall be used. Flooded lube can be used if agreed.

NOTE Directed lube has advantages in power losses, but has small passages with greater potential to plug.

4.9.3.7 * If specified, thrust bearings pads shall be copper-alloy backed.

4.9.4 Bearing housings

4.9.4.1 Rotor support system parts (bearings, bearing housings, bearing carriers, and bearing brackets) shall be separable from the casing, axially split, non-pressurized (vented to atmosphere), and furnished with plugged connections for dry air or inert gas purge to any atmospheric labyrinth seals.

4.9.4.2 Axially split-bearing housings shall have a metal-to-metal split joint whose halves are located by means of cylindrical dowels.

4.9.4.3 Shaft support structures bolted to casings shall be steel. Shaft support structures bolted to cast iron casings can be made from cast iron.

4.10 Shaft end seals

4.10.1 Shaft end seals shall be in accordance with ISO 10439-1:2015, 4.10 and 4.10.2 to 4.10.4 of this part of ISO 10439.

NOTE 1 Typical cross sections of various shaft seals are given in ISO 10439-1:2015, Annex C.

NOTE 2 Equipment covered in this part can be available with any of the shaft end seal types covered in ISO 10439-1:2015, or additional hybrid types can be available.

4.10.2 * Purchaser shall specify the type of shaft end seal(s) to be provided and all operating conditions including start-up, shutdown and settling-out conditions.

NOTE Axial compressors in process air service will generally be supplied with labyrinth shaft end seals. Process compressors can have any type of shaft end seal specified.

4.10.3 Shaft end seals shall be accessible for inspection and replacement without removing the top half of the casing for an axially split compressor or the heads of a radially split unit. This requirement is not applicable for overhung designs.

4.10.4 * If specified for non-cartridge seal types, shaft sleeves under shaft end seals shall be accessible for inspection and replacement without removing the top half of the casing for an axially split compressor or the heads of a radially split unit. This requirement is not applicable for overhung designs.

NOTE This is of benefit for seal types where the wearing component is in close proximity to the sleeve. Example seal types are labyrinth and carbon ring.

4.11 Integral gearing

Internal gearing is not applicable for equipment covered in this part. For external gearing, refer to API 613.

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4.12 Nameplates and rotation arrows

4.12.1 Nameplates and rotation arrows shall be in accordance with ISO 10439-1:2015, 4.12 and 4.12.2 and 4.12.3 of this part of ISO 10439.

4.12.2 The following data shall be clearly stamped or engraved on the nameplate:

a) supplier's name;

b) serial number;

c) size, type, and model;

d) rated capacity;

e) rated power;

f) lateral critical speeds up to and including the next lateral above maximum continuous speed;

g) purchaser item number or other reference;

h) maximum allowable working pressure;

i) minimum and maximum allowable working temperature;

j) minimum operating speed;

k) maximum continuous speed;

l) trip speed;

m) hydrostatic test pressure;

n) maximum sealing pressure.

4.12.3 Rotation arrows shall be cast-in or attached to each major item of rotating equipment at a readily visible location.

5 Accessories

5.1 General

Accessories shall be in accordance with ISO 10439-1:2015, Clause 5 and 5.2 to 5.8 of this part of ISO 10439.

5.2 Drivers and gearing

Drivers and external gearing shall be in accordance with ISO 10439-1:2015, 5.1.

5.3 Couplings and guards

Couplings and guards shall be in accordance with ISO 10439-1:2015, 5.2.

5.4 Lubrication and sealing systems

Lubrication and sealing systems shall be in accordance with ISO 10439-1:2015, 5.3.

5.5 Mounting plates

Mounting plates shall be in accordance with ISO 10439-1:2015, 5.4.

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5.6 Controls and instrumentation

5.6.1 Controls and instrumentation shall be in accordance with ISO 10439-1:2015, 5.5.

5.6.2 Control systems when supplied, shall be in accordance with ISO 10439-1:2015, 5.5.2 and 5.6.2.1 to 5.6.7.6 of this part of ISO 10439.

5.6.2.1 Axial compressors shall be supplied with a map of allowable operating range to permit the design of control logic to prevent operation in the region of choke (overload) and therefore avoid potentially dangerous blade stresses.

NOTE Figures 2 and 3 show typical performance maps for axial compressors.

5.6.2.2 When an anti-surge system as described in ISO 10439-1:2015, 5.5.2.2 is furnished for an axial compressor, the system shall also include overload protection.

5.6.2.3 * For constant-speed centrifugal compressors, when adjustable inlet guide vanes are required, the supplier shall also furnish a guide-vane positioner capable of supplying a compatible control signal as specified by the purchaser.

NOTE See ISO 10439-1:2015, 5.5.2.1.

5.6.2.4 For constant-speed axial compressors supplied with adjustable vanes, the supplier shall also furnish a vane positioner compatible with the type of control signal specified by the purchaser. A direct-driven local vane position indicator shall be provided that will be visible during operation of the machine.

5.6.3 Instrument and control panels, when supplied, shall be in accordance with ISO 10439-1:2015, 5.5.3.

5.6.4 Instrumentation, when supplied, shall be in accordance with ISO 10439-1:2015, 5.5.4.

5.6.5 Alarms, shutdowns, and control systems, when supplied, shall be in accordance with ISO 10439-1:2015, 5.5.5.

5.6.6 Electrical systems, when supplied, shall be in accordance with ISO 10439-1:2015, 5.5.6.

5.6.7 Vibration, position, and bearing temperature detectors

5.6.7.1 Radial shaft vibration and axial-position transducers and bearing temperature sensors shall be supplied, installed, and calibrated in accordance with API 670.

5.6.7.2 * If specified, radial shaft vibration and axial position monitors shall be supplied and calibrated in accordance with API 670.

5.6.7.3 * Purchaser shall specify the type of temperature detector to be supplied. Installation shall be per API 670.

5.6.7.4 * If specified, a bearing temperature monitor shall be supplied and calibrated in accordance with API 670.

5.6.7.5 * If specified, casing vibration transducers shall be supplied, installed, and calibrated in accordance with API 670.

5.6.7.6 * If specified, casing vibration monitors shall be supplied, installed and calibrated in accordance with API 670.

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5.7 Piping and appurtenances

5.7.1 General

Piping and appurtenances furnished shall be in accordance with ISO 10439-1:2015, 5.6 and 5.7.1.1 to 5.7.2 of this part of ISO 10439.

5.7.1.1 When a baseplate has been specified, the supplier shall furnish all piping systems, including mounted appurtenances, located within its confines. The piping shall terminate with flanged connections at the edge of the baseplate. When soleplates have been specified, the extent of the piping system supplied by the supplier shall be defined by the purchaser. The purchaser will furnish-interconnecting piping between equipment groupings and off base facilities.

5.7.1.2 * If specified, a liquid injection manifold shall be supplied. It shall include a throttle valve, an armored flow meter, a check valve, a pressure indicator, and a block valve for each injection point.

5.7.2 Process piping

Process piping, if furnished, shall be in accordance with ISO 10438-1:2007, 2.4.

5.8 Special tools

Special tools shall be in accordance with ISO 10439-1:2015, 5.7.

6 Inspection, testing, and preparation for shipment

6.1 General

General requirements for inspection, testing and preparation for shipment shall be in accordance with ISO 10439-1:2015, 6.1. Also refer to Annex E for the inspector's checklist.

6.2 Inspection

Requirements for inspection shall be in accordance with ISO 10439-1:2015, 6.2.

6.3 Testing

In addition to the requirements of ISO 10439-1:2015, 6.3, the compressor(s) shall be tested in accordance with 6.3.1 and 6.3.2. Optional tests that might be specified are described in 6.3.3. Immediately upon completion of each witnessed mechanical or performance test, copies of the data recorded during the test shall be given to the witnesses.

6.3.1 Mechanical running test

6.3.1.1 The requirements of 6.3.1.1.1 to 6.3.1.1.12 shall be met before the mechanical running test is performed.

6.3.1.1.1 The contract shaft seals and bearings shall be used in the machine for the mechanical running test, except that the atmospheric breakdown bushing(s) on oil seals can be replaced with a test bushing, if required.

NOTE Low-pressure mechanical testing can require increased clearance or fewer elements for proper heat removal.

6.3.1.1.2 Oil viscosity, pressures, and filtration shall be within the range of operating values recommended in the supplier's operating instructions for the unit being tested. Oil flow rates to each oil

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seal and bearing housing shall be measured. Oil inlet temperature can be varied for the mechanical test to match the design oil viscosity.

6.3.1.1.3 * If specified, oil temperatures and supply pressures shall be varied over the allowable operating range during test as agreed.

6.3.1.1.4 Oil system components downstream of the filters shall meet the cleanliness requirements of ISO 10438 before any test is started.

6.3.1.1.5 All joints and connections shall be checked for tightness, and any leaks shall be corrected.

6.3.1.1.6 All warning, protective, and control devices used during the test shall be checked, and adjusted as required.

6.3.1.1.7 Facilities shall be installed to prevent the entrance of oil into the process gas section of the compressor during the mechanical running test. These facilities shall be in operation throughout the test.

6.3.1.1.8 Testing with the contract coupling(s) is preferred. If this is not practical, the mechanical running test shall be performed with coupling(s) or simulators that have overhung moments within 10 % of the contract coupling(s).

6.3.1.1.9 The circumferential location of a hydraulically mounted coupling hub relative to the shaft shall be non-permanently marked before starting the test.

It can be required to ramp thru certain speed ranges to avoid resonant frequencies.

6.3.1.1.10 The equipment shall be operated at speed increments of approximately 10 % from zero to the maximum continuous speed and run at the maximum continuous speed until bearing metal temperatures and shaft vibrations have stabilized (see Figure 4).

NOTE Operating equipment at or near critical speeds is normally avoided. For axial compressors, other speeds at or near blade resonant frequencies are also avoided (see 4.7.5.1).

6.3.1.1.11 The speed shall be increased to trip speed and the equipment shall be run for a minimum of 15 min.

6.3.1.1.12 The speed shall be reduced to the maximum continuous speed, and the equipment shall be run for 4 h continuous operation.

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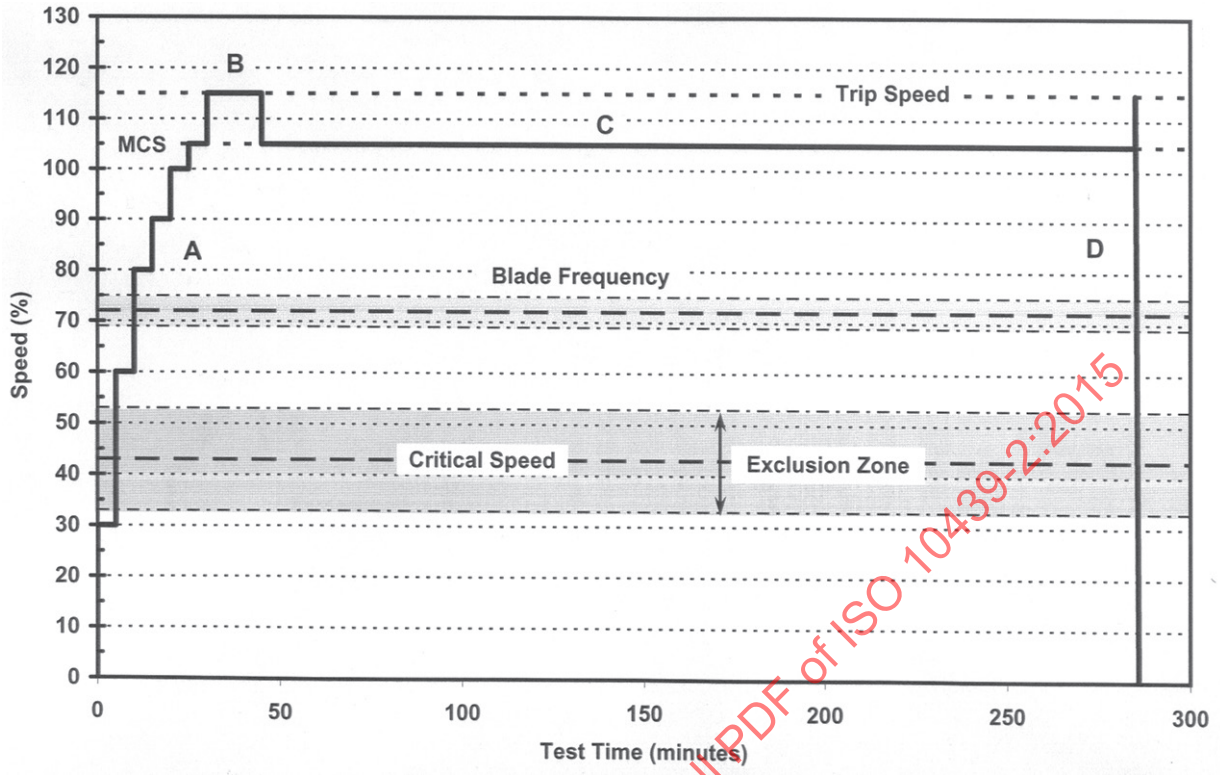

Key

A warm up phase
- speed increased multiple increments
- avoid critical speeds, blade frequencies, etc.

B trip speed operation
- 15 min

C maximum continuous speed 4 h test
- oil supply variations performed
- operating conditions recorded

D shutdown/ramp down
- momentary increase to trip speed
- transient operation recorded
- used as baseline for verification testing

Figure 4 — Mechanical test

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6.3.1.2 During the mechanical running test, the requirements of 6.3.1.2.1 to 6.3.1.2.9 shall be met.

6.3.1.2.1 During the mechanical running test, the mechanical operation of all equipment being tested and the operation of the test instrumentation shall be satisfactory. The measured unfiltered vibration shall not exceed the limits of ISO 10439-1:2015, 4.8.8.8 and shall be recorded throughout the operating speed range. Any other test acceptance criteria shall be agreed and stated in the test agenda.

6.3.1.2.2 While the equipment is operating at maximum continuous speed, or other speed required by the test agenda, vibration data shall be acquired to determine amplitudes at frequencies other than synchronous. This data shall cover a frequency range from 0,25 times to 8 times the maximum continuous speed. If the amplitude of any discrete, nonsynchronous vibration exceeds 20 % of the allowable vibration as defined in ISO 10439-1:2015, 4.8.8.8, the purchaser and the supplier shall agree on requirements for any additional testing and on the equipment's acceptability.

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6.3.1.2.3 The mechanical running test shall verify that lateral critical speeds conform to the requirements of ISO 10439-1:2015, 4.8.3.

6.3.1.2.4 Shop verification of the unbalanced response analysis shall be performed in accordance with ISO 10439-1:2015, 4.8.2.

6.3.1.2.5 When spare rotors are supplied to permit concurrent manufacture, each spare rotor shall also be given a mechanical running test in accordance with the requirements of this part of ISO 10439.

6.3.1.2.6 When spare inner barrel assemblies or cartridges bundle assemblies are supplied, the spare rotor shall be tested with the inner barrel assembly.

NOTE 1 Spare cartridge bundle assemblies can result in reduced turnaround time.

NOTE 2 See ISO 10439-1:2015, 3.1.3 and ISO 10439-1:2015, 3.1.15 for definitions of cartridge bundle assembly and inner barrel assembly.

6.3.1.2.7 When spare axial blade stator vane assemblies are supplied, the spare rotor shall be tested with the spare stator vanes.

6.3.1.2.8 The purchaser shall advise additional testing requirements for spare parts.

6.3.1.2.9 Axial compressors with variable stators shall be exercised throughout the entire range of movement using the contract linkage and linkage positioner during the mechanical test.

6.3.2 Assembled compressor gas leakage test

6.3.2.1 After the mechanical running test is completed, each completely assembled compressor casing intended for toxic, hazardous, or flammable service shall be tested as required in 6.3.2.2 and/or, when specified, 6.3.2.3.

NOTE These tests are intended to verify the integrity of the casing joint. Some shaft seal designs are not gas tight. Therefore, leakage from these seals is acceptable.

6.3.2.2 The assembled compressor (including end seals) shall be pressurized, with an inert gas, to the maximum sealing pressure or the maximum seal design pressure, as agreed by the purchaser and the supplier; held at no less than this pressure for a minimum of 30 min and subjected to a soap-bubble test, or alternate method, to check for gas leaks. The test shall be considered satisfactory when no casing or casing joint leaks are observed.

NOTE Test gas mole weight will approximate or be less than contract gas mole weight. Helium for low mole weight contract gas, and nitrogen or refrigerant gas for high mole weight can be considered.

6.3.2.3 * If specified, the assembled compressor (with or without end seals installed) shall be pressurized with an inert gas to the maximum specified discharge pressure, held at this pressure for a minimum of 30 min, and subjected to a soap bubble test, or alternate method, to check for gas leaks. The test shall be considered satisfactory when no casing or casing joint leaks are observed.

NOTE The requirements of 6.3.2.2 and 6.3.2.3 can necessitate two separate tests.

6.3.3 * Optional tests

The purchaser should specify whether any of the following shop tests shall be performed. Test details shall be agreed prior to the test.

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6.3.3.1 Factory performance test

6.3.3.1.1 The compressor shall be performance tested in accordance with ASME PTC 10-1997 or ISO 5389 as specified. A minimum of five points, including surge and overload, shall be taken at the speed equivalent to normal speed.

NOTE Refer to the applicable test code for general instructions. ASME PTC 10-1997 cannot apply to some low pressure ratio compressors. Refer to the scope, 1.2.2, of ASME PTC 10-1997 for the selection of the appropriate test code to be used.

6.3.3.1.2 * If specified, surge line testing or additional speed lines can be tested for variable speed machines.

6.3.3.1.3 For variable speed machines, head and capacity shall have zero negative tolerance at the certified point, and the power at this point shall not exceed 104 % of the supplier predicted shaft power value. This tolerance shall be inclusive of all test tolerances. Surge shall comply with provisions of 4.4.1.1.

NOTE Both of the performance test codes referred to have provision for calculating inaccuracy based on instrumentation and procedures. These test inaccuracies are already included in the above tolerance and, therefore, are not to be further additive.

6.3.3.1.4 For variable-speed compressors, a speed other than the normal speed can be used, if necessary, to achieve the specified conditions, provided that this adjusted speed meets the criteria specified in ISO 10439-1:2015, 4.8.

6.3.3.1.4.1 Variable speed compressors shall have maximum continuous speed increased if necessary after performance testing to maintain a minimum 5 % margin over adjusted rated speed based on test.

When a speed increase is necessary to achieve specified performance, all design margins such as separation margins, overspeed margins, maximum continuous margins, etc. shall be maintained.

NOTE This maintains a 5 % speed margin for future process changes.

6.3.3.1.5 For constant-speed compressors, the capacity shall be as specified in 6.3.3.1.2. The head shall be within the range of 100 % to 105 % of the normal head. The horsepower, based on measured head at certified capacity, shall not exceed 107 % of the value at the specified certified point. If the power required at this point exceeds 107 %, or head exceeds 105 % of the normal head, excess head can be removed by trimming impellers at the purchaser's option.

6.3.3.1.6 If hardware modifications are required to meet performance, the performance test shall be repeated.

6.3.3.1.7 The performance test shall be conducted using only one contract rotor, unless otherwise specified.

6.3.3.1.8 * If specified, purchaser shall state the intermediate pressures. Manufacturer shall state the pressure tolerance at each connection.

6.3.3.1.9 For trains with multiple compressors, intermediate pressures and individual power tolerances can be adjusted as agreed. Overall power tolerances shall be as stated in 6.3.3.1.

6.3.3.2 Complete unit test

The scope of this test shall be detailed by the purchaser. Such components as compressors, gears, drivers, and auxiliaries that make up a complete unit shall be tested together during the mechanical running test. A separate auxiliary test can be performed. The complete unit test can be performed in place of, or in addition to, separate tests of individual components.

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6.3.3.2.1 * If specified for the complete unit test, torsional vibration measurements shall be made to verify the supplier's analysis.

6.3.3.3 Tandem test

Compressor bodies arranged for tandem drive shall be tested as a unit during the mechanical running test, using the shop driver and oil systems as specified.

6.3.3.4 Gear test

For units with external gears, the contract gear shall be tested with the machine(s) during the mechanical running test.

6.4 Preparation for shipment

Equipment shall be prepared for shipment in accordance with ISO 10439-1:2015, 4.4 and 6.4.1 of this part of ISO 10439.

6.4.1 * If specified, dry gas seals shall be removed for shipment.

NOTE Seals will be reinstalled in the field or cover plates fabricated if the compressor is to be provided with a nitrogen blanket during construction.

7 Supplier's data

7.1 General

7.1.1 Supplier's data shall be in accordance with ISO 10439-1:2015, Clause 7 and 7.1 to 7.3 of this part of ISO 10439.

7.1.2 The information to be furnished by the supplier is specified in Annex B of this part of ISO 10439 and Clause 7 of ISO 10439-1. The supplier shall complete and forward the VDDR form in Annex B, to the address or addresses noted on the inquiry or order. This form shall detail the schedule for transmission of drawings, curves, and data as agreed to at the time of the order, as well as the number and type of copies required by the purchaser.

7.2 Proposals

Proposal data shall be in accordance with ISO 10439-1:2015, 7.2.

7.3 Contract data

Contract data shall be in accordance with ISO 10439-1:2015, 7.3.

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Annex A
(normative)

Datasheets

The datasheets are also available in electronic format via http://standards.iso.org/iso/.

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CENTRIFUGAL AND AXIAL COMPRESSOR
DATA SHEET (API 617-8TH Chapter 2)
SI UNITS (bar)

JOB NO. _____ ITEM NO. _____
PAGE 1 OF 7 REQ'N NO. _____

APPLICABLE TO: ○ PROPOSAL ○ PURCHASE ○ AS BUILT

FOR _____ UNIT _____
SITE _____ SERIAL NO. _____
SERVICE _____ NO. REQUIRED _____
MANUFACTURER _____ DRIVER TYPE (1-3.1.1) _____
MODEL _____ DRIVER ITEM NO. _____

APPLICABLE STANDARD: ○ US ○ ISO

INFORMATION TO BE COMPLETED: ○ BY PURCHASER ☐ BY MANUFACTURER △ MUTUAL AGREEMENT (PRIOR TO PURCHASE)

OPERATING CONDITIONS

(ALL DATA ON PER UNIT BASIS)

	NORMAL (1-2.1.1.2)	OTHER CONDITIONS (1-2.1.1.1) A	B	C	D	E
○ GAS HANDLED (ALSO SEE PAGE ____)						
△ GAS PROPERTIES (1-2.1.1.4)						
○ M³/H (1013 barA & 0°C DRY)						
○ WEIGHT FLOW, (kg/h) (WET) (DRY)						
INLET CONDITIONS						
○ PRESSURE (barA)						
○ TEMPERATURE (°C)						
○ RELATIVE HUMIDITY %						
○ MOLECULAR WEIGHT						
☐ Cp/Cv (K_1) OR (K_{AVG}) (NOTE 1)						
☐ COMPRESSIBILITY (Z_1) OR (Z_{AVG}) (NOTE 1)						
☐ INLET VOLUME, (m³/h) (WET / DRY)						
DISCHARGE CONDITIONS						
○ PRESSURE (barA)						
☐ TEMPERATURE (°C)						
☐ Cp/Cv (K_2) OR (K_{AVG}) (NOTE 1)						
☐ COMPRESSIBILITY (Z_2) OR (Z_{AVG}) (NOTE 1)						
☐ GAS POWER REQUIRED (kW)						
☐ TRAIN POWER REQUIRED (kW)						
☐ POWER REQ'D AT DRIVER INCL. EXT. LOSSES (kW)						
☐ SPEED (rpm)						
☐ TURNDOWN (%)						
☐ POLYTROPIC HEAD (N-m/kg)						
☐ POLYTROPIC EFFICIENCY (%)						
○ CERTIFIED POINT						
☐ PERFORMANCE CURVE NUMBER						

PROCESS CONTROL (1-3.4.2.1)

METHOD	○ SUCTION THROTTLING	○ VARIABLE INLET GUIDE VANES (2-2.4.1)	○ SPEED VARIATION	○ DISCHARGE BLOWOFF
	FROM ____ (barA)		FROM ____ %	TO ____
	TO ____ (barA)		TO ____ %	
SIGNAL	○ SOURCE (1-3.4.2.1)			○ COOLED BYPASS
	TYPE ○ ELECTRONIC ○ PNEUMATIC ○ OTHER			FROM ____
	RANGE ____ MA ____ (barG)			TO ____
START-UP	○ FROM SETTLING OUT CONDITION	○ NORMAL SUCTION PRESSURE	○ OTHER:	

REMARKS: Note 1 IF GAS ANALYSIS IS GIVEN, MANUFACTURER SHALL SUPPLY DATA, OTHERWHISE DATA SHALL BE SUPPLIED BY USER

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CENTRIFUGAL AND AXIAL COMPRESSOR
DATA SHEET (API 617-8TH Chapter 2)
SI UNITS (bar)

PAGE NO. ITEM NO.
PAGE 1 OF 7 REQ'N NO.

APPLICABLE TO: ○ PROPOSAL ○ PURCHASE ○ AS BUILT

FOR		UNIT	
SITE		SERIAL NO.	
SERVICE		NO. REQUIRED	
MANUFACTURER		DRIVER TYPE (1-3.1.1)	
MODEL		DRIVER ITEM NO.	

APPLICABLE STANDARD: ○ US ○ ISO

INFORMATION TO BE COMPLETED: ○ BY PURCHASER ☐ BY MANUFACTURER △ MUTUAL AGREEMENT (PRIOR TO PURCHASE)

OPERATING CONDITIONS (SINGLE-COOLED CONFIGURATION)

(ALL DATA ON PER UNIT BASIS)

	NORMAL (1-2.1.1.2)		OTHER CONDITIONS (1-2.1.1.1)			
	Section 1	Section 2	Section 1	Section 2	Section 1	Section 2
○ GAS HANDLED (ALSO SEE PAGE ____)						
△ GAS PROPERTIES (1-2.1.14)						
○ M³/H (1013 barA & 0°C DRY)						
○ WEIGHT FLOW, (kg/h) (WET) (DRY)						
INLET CONDITIONS						
○ PRESSURE (barA)						
○ TEMPERATURE (°C)						
○ RELATIVE HUMIDITY %						
○ MOLECULAR WEIGHT						
☐ Cp/Cv (K_1) OR (K_{AVG}) (NOTE 1)						
☐ COMPRESSIBILITY (Z_1) OR (Z_{AVG}) (NOTE 1)						
☐ INLET VOLUME, (m^3/h) (WET / DRY)						
DISCHARGE CONDITIONS						
○ PRESSURE (barA)						
☐ TEMPERATURE (°C)						
☐ Cp/Cv (K_2) OR (K_{AVG}) (NOTE 1)						
☐ COMPRESSIBILITY (Z_2) OR (Z_{AVG}) (NOTE 1)						
☐ GAS POWER REQUIRED (kW)						
☐ TRAIN POWER REQUIRED (kW)						
☐ POWER REQ'D AT DRIVER INCL. EXT. LOSSES (kW)						
☐ SPEED (rpm)						
☐ TURNDOWN (%)						
☐ POLYTROPIC HEAD (N-m/kg)						
☐ POLYTROPIC EFFICIENCY (%)						
○ CERTIFIED POINT						
☐ PERFORMANCE CURVE NUMBER						

PROCESS CONTROL (1-3.4.2.1)

METHOD	○ SUCTION THROTTLING	○ VARIABLE INLET GUIDE VANES (2-2.4.1)	○ SPEED VARIATION	○ DISCHARGE BLOWOFF	○ COOLED BYPASS
	FROM ____ (barA)		FROM ____ %		FROM ____
	TO ____ (barA)		TO ____ %	TO ____	TO ____
SIGNAL	○ SOURCE (1-3.4.2.1)				
	TYPE ○ ELECTRONIC	○ PNEUMATIC	○ OTHER		
	RANGE ____ MA	____ (barG)			

○ START-UP ○ FROM SETTLING OUT CONDITION ○ NORMAL SUCTION PARTS ○ OTHER:

REMARKS: Note 1: IF GAS ANALYSIS IS GIVEN, MANUFACTURER SHALL SUPPLY DATA, OTHERWHISE DATA SHALL BE SUPPLIED BY USER

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CENTRIFUGAL AND AXIAL COMPRESSOR
DATA SHEET (API 617-8TH Chapter 2)
SI UNITS (bar)

AGE NO. _____ ITEM NO. _____
PAGE 1 OF 7 REQ'N NO. _____

APPLICABLE TO: ○ PROPOSAL ○ PURCHASE ○ AS BUILT

FOR		UNIT	
SITE		SERIAL NO.	
SERVICE		NO. REQUIRED	
MANUFACTURER		DRIVER TYPE (1-3.1.1)	
MODEL		DRIVER ITEM NO.	

APPLICABLE STANDARD: ○ US ○ ISO

INFORMATION TO BE COMPLETED: ○ BY PURCHASER □ BY MANUFACTURER △ MUTUAL AGREEMENT (PRIOR TO PURCHASE)

OPERATING CONDITIONS (COMPRESSOR WITH TWO SIDESTREAMS)

EQUIP.FLNG COND. SHOWN IN DBL-WALLED CELLS
(ALL DATA ON PER UNIT BASIS)

	CONDITIONS (1-2.1.1.2)				
	Section1	SS 1	Section2	SS 2	Section3
○ GAS HANDLED (ALSO SEE PAGE ____)					
△ GAS PROPERTIES (1-2.1.14)					
○ M³/H (1013 barA & 0°C DRY)					
○ WEIGHT FLOW, (kg/h) (WET) (DRY)					
INLET CONDITIONS					
○ PRESSURE (barA)					
○ TEMPERATURE (°C)					
○ RELATIVE HUMIDITY %					
○ MOLECULAR WEIGHT					
□ Cp/Cv (K_1) OR (K_{AVG}) (NOTE 1)					
□ COMPRESSIBILITY (Z_1) OR (Z_{AVG}) (NOTE 1)					
□ INLET VOLUME, (m³/h) (WET / DRY)					
DISCHARGE CONDITIONS					
○ PRESSURE (barA)					
□ TEMPERATURE (°C)					
□ Cp/Cv (K_2) OR (K_{AVG}) (NOTE 1)					
□ COMPRESSIBILITY (Z_2) OR (Z_{AVG}) (NOTE 1)					
□ GAS POWER REQUIRED (kW)					
□ TRAIN POWER REQUIRED (kW)					
□ POWER REQ'D AT DRIVER INCL. EXT. LOSSES (kW)					
□ SPEED (rpm)					
□ TURNDOWN (%)					
□ POLYTROPIC HEAD (N-m/kg)					
□ POLYTROPIC EFFICIENCY (%)					
○ CERTIFIED POINT					
□ PERFORMANCE CURVE NUMBER					

PROCESS CONTROL (1-3.4.2.1)

METHOD	○ SUCTION THROTTLING	○ VARIABLE INLET	○ SPEED VARIATION	○ DISCHARGE	○ COOLED BYPASS
	FROM ____ (barA)	GUIDE VANES	FROM ____ %	BLOWOFF	FROM ____
	TO ____ (barA)	(2-2.4.1)	TO ____ %	TO ____	TO ____

SIGNAL ○ SOURCE (1-3.4.2.1) _____
TYPE ○ ELECTRONIC ○ PNEUMATIC ○ OTHER _____
RANGE ____ MA ____ (barG) _____

○ START-UP ○ FROM SETTLING OUT CONDITION ○ NORMAL SUCTION PARTS ○ OTHER: _____

REMARKS: Note 1 IF GAS ANALYSIS IS GIVEN, MANUFACTURER SHALL SUPPLY DATA, OTHERWHISE DATA SHALL BE SUPPLIED BY USER

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PAGE NO. ITEM NO.
PAGE 1 OF 7 REQ'N NO.

APPLICABLE TO: ○ PROPOSAL ○ PURCHASE ○ AS BUILT
FOR UNIT
SITE SERIAL NO.
SERVICE NO. REQUIRED
MANUFACTURER DRIVER TYPE (1-3.1.1)
MODEL DRIVER ITEM NO.
APPLICABLE STANDARD: ○ US ○ ISO
INFORMATION TO BE COMPLETED: ○ BY PURCHASER ☐ BY MANUFACTURER △ MUTUAL AGREEMENT (PRIOR TO PURCHASE)

OPERATING CONDITIONS (COMPRESSOR WITH TWO SIDESTREAMS)

EQUIP.FLNG COND. SHOWN IN DBL-WALLED CELLS
(ALL DATA ON PER UNIT BASIS)

CONDITIONS (1-2.1.1.2)

	Section1	SS 1	Section2	SS 2	Section3
○ GAS HANDLED (ALSO SEE PAGE)					
△ GAS PROPERTIES (1-2.1.14)					
○ M³/H (1013 barA & 0°C DRY)					
○ WEIGHT FLOW, (kg/h) (WET) (DRY)					
INLET CONDITIONS					
○ PRESSURE (barA)					
○ TEMPERATURE (°C)					
○ RELATIVE HUMIDITY %					
○ MOLECULAR WEIGHT					
☐ Cp/Cv (K_1) OR (K_{AVG}) (NOTE 1)					
☐ COMPRESSIBILITY (Z_1) OR (Z_{AVG}) (NOTE 1)					
☐ INLET VOLUME, (m³/h) (WET / DRY)					
DISCHARGE CONDITIONS					
○ PRESSURE (barA)					
☐ TEMPERATURE (°C)					
☐ Cp/Cv (K_2) OR (K_{AVG}) (NOTE 1)					
☐ COMPRESSIBILITY (Z_2) OR (Z_{AVG}) (NOTE 1)					
☐ GAS POWER REQUIRED (kW)					
☐ TRAIN POWER REQUIRED (kW)					
☐ POWER REQ'D AT DRIVER INCL. EXT. LOSSES (kW)					
☐ SPEED (rpm)					
☐ TURNDOWN (%)					
☐ POLYTROPIC HEAD (N-m/kg)					
☐ POLYTROPIC EFFICIENCY (%)					
○ CERTIFIED POINT					
☐ PERFORMANCE CURVE NUMBER					

PROCESS CONTROL (1-3.4.2.1)

METHOD	○ SUCTION THROTTLING	○ VARIABLE INLET	○ SPEED VARIATION	○ DISCHARGE	○ COOLED BYPASS
	FROM (barA)	GUIDE VANES	FROM %	BLOWOFF	FROM
	TO (barA)	(2-2.4.1)	TO %	TO	TO
SIGNAL	○ SOURCE (1-3.4.2.1)				
	TYPE	○ ELECTRONIC	○ PNEUMATIC	○ OTHER	
	RANGE MA	(barG)			

○ START-UP ○ FROM SETTLING OUT CONDITION ○ NORMAL SUCTION PARTS ○ OTHER:

REMARKS: Note 1: IF GAS ANALYSIS IS GIVEN, MANUFACTURER SHALL SUPPLY DATA, OTHERWHISE DATA SHALL BE SUPPLIED BY USER

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SI UNITS (bar)

JOB NO. _____ ITEM NO.
PAGE 1b OF 7 REQ'N NO. _____

		NORMAL (1-2.1.12)	OTHER CONDITIONS (1-2.1.1.1)				
	OPERATING CONDITIONS (ALL DATA ON PER UNIT BASIS)		A	B	C	D	E
○	GAS HANDLED (ALSO SEE PAGE ____)						
△	GAS PROPERTIES (1-2.1.14)						
○	M³/H (1013 barA & 0°C DRY)						
○	WEIGHT FLOW, (kg/h) (WET) (DRY)						
	INLET CONDITIONS						
○	PRESSURE (barA)						
○	TEMPERATURE (°C)						
○	RELATIVE HUMIDITY %						
○	MOLECULAR WEIGHT						
□	Cp/Cv (K_1) OR (K_{AVG}) (NOTE 1)						
□	COMPRESSIBILITY (Z_1) OR (Z_{AVG}) (NOTE 1)						
□	INLET VOLUME, (m³/h) (WET / DRY)						
	DISCHARGE CONDITIONS						
○	PRESSURE (barA)						
□	TEMPERATURE (°C)						
□	Cp/Cv (K_2) OR (K_{AVG}) (NOTE 1)						
□	COMPRESSIBILITY (Z_2) OR (Z_{AVG}) (NOTE 1)						
□	GAS POWER REQUIRED (kW)						
□	TRAIN POWER REQUIRED (kW)						
□	POWER REQ'D AT DRIVER INCL. EXT. LOSSES (kW)						
□	SPEED (rpm)						
□	TURNDOWN (%)						
□	POLYTROPIC HEAD (N-m/kg)						
□	POLYTROPIC EFFICIENCY (%)						
○	CERTIFIED POINT						
□	PERFORMANCE CURVE NUMBER						

REMARKS: Note 1: IF GAS ANALYSIS IS GIVEN, MANUFACTURER SHALL SUPPLY DATA, OTHERWHISE DATA SHALL BE SUPPLIED BY USER

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OPERATING CONDITIONS

(ALL DATA ON PER UNIT BASIS)

	NORMAL (12.1.12)	OTHER CONDITIONS (12.1.1.1)				
		A	B	C	D	E
○ GAS HANDLED (ALSO SEE PAGE ____)						
△ GAS PROPERTIES (12.1.14)						
○ M³/H (1013 barA & 0°C DRY)						
○ WEIGHT FLOW, (kg/h) (WET) (DRY)						
INLET CONDITIONS						
○ PRESSURE (barA)						
○ TEMPERATURE (°C)						
○ RELATIVE HUMIDITY %						
○ MOLECULAR WEIGHT						
□ Cp/Cv (K_1) OR (K_{AVG}) (NOTE 1) (NOTE 1)						
□ COMPRESSIBILITY (Z_1) OR (Z_{AVG}) (NOTE 1) (NOTE 1)						
□ INLET VOLUME, (m³/h) (WET / DRY)						
DISCHARGE CONDITIONS						
○ PRESSURE (barA)						
□ TEMPERATURE (°C)						
□ Cp/Cv (K_2) OR (K_{AVG}) (NOTE 1)						
□ COMPRESSIBILITY (Z_2) OR (Z_{AVG}) (NOTE 1)						
□ GAS POWER REQUIRED (kW)						
□ TRAIN POWER REQUIRED (kW)						
□ POWER REQ'D AT DRIVER INCL. EXT. LOSSES (kW)						
□ SPEED (rpm)						
□ TURNDOWN (%)						
□ POLYTROPIC HEAD (N-m/kg)						
□ POLYTROPIC EFFICIENCY (%)						
○ CERTIFIED POINT						
□ PERFORMANCE CURVE NUMBER						

REMARKS: Note 1: IF GAS ANALYSIS IS GIVEN, MANUFACTURER SHALL SUPPLY DATA, OTHERWHISE DATA SHALL BE SUPPLIED BY USER

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OPERATING CONDITIONS (Continued) (1-2.1.1.1) (1-3.1.2) (1-3.1.3)

GAS ANALYSIS: ○ MOL %	MW	NORMAL	OTHER CONDITIONS A	B	C	D	E	REMARKS:
AIR	28,966							
OXYGEN	32.000							
NITROGEN	28,016							
WATER VAPOR	18,016							
CARBON MONOXIDE	28.010							
CARBON DIOXIDE	44.010							
HYDROGEN SULFIDE	34,076							(1-2.2.16)
HYDROGEN	2,016							(1-2.2.19)
METHANE	16,042							
ETHYLENE	28,052							
ETHANE	30,068							
PROPYLENE	42,078							
PROPANE	44,094							
I-BUTANE	58.120							
n-BUTANE	58.120							
I-PENTANE	72,146							
n-PENTANE	72,146							
HEXANE PLUS								
CORROSIVE AGENTS								(1-2.2.13)
TOTAL								
AVG. MOL. WT.								

LOCATION: (1-2.1.8)
○ INDOOR ○ OUTDOOR ○ GRADE
○ HEATED ○ UNDER ROOF ○ MEZZANINE
○ UNHEATED ○ PARTIAL SIDES ○ _____

SITE DATA (1-2.1.8)
○ ELEVATION _____ (m) BAROMETER _____ (bar A)
○ RANGE OF AMBIENT TEMPS:

		DRY BULB	WET BULB
NORMAL	(°C)		
MAXIMUM	(°C)		
MINIMUM	(°C)		
_____	(°C)		

UNUSUAL CONDITIONS: ○ DUST ○ FUMES
○ OTHER (1-2.1.8) _____
○ COPPER AND COPPER ALLOYS PROHIBITED (1-2.2.1.14)

COATING: (1-2.2.1.16)
○ ROTATING COMPONENTS _____
○ STATIONARY COMPONENTS _____

REMARKS: _____

NOISE SPECIFICATIONS: (1-2.1.9)
○ APPLICABLE TO MACHINE:
SEE SPECIFICATION _____
○ APPLICABLE TO NEIGHBORHOOD:
SEE SPECIFICATION _____
ACOUSTIC HOUSING: ○ YES ○ NO

APPLICABLE SPECIFICATIONS:
API 617, 7TH CHAPTER 2
○ VENDOR HAVING UNIT RESPONSIBILITY (1-1.5.5.4) (1-1.8) (1-2.1.3)
_____
○ GOVERNING SPECIFICATION (IF DIFFERENT)
_____

○ ELEC. AREA CLASS. (1-2.1.1.4) ○ NEC ○ IEC
EQUIPMENT
CLASS _____ GROUP _____ DIV. _____
ZONE _____ GROUP _____ TEMP CLASS _____
CONTROL PANNELS
CLASS _____ GROUP _____ DIV. _____
ZONE _____ GROUP _____ TEMP CLASS _____

INSTRUMENT AND CONTROLS
STANDARD ○ NEMA ○ IEC

	INDOOR	OUTDOOR
CONTROL ENCLOSURE		
TERMINAL BOX		

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CONSTRUCTION FEATURES

☐ **SPEEDS:**
MAX. CONT. _____ (rpm) TRIP _____ (rpm)
MAX. TIP SPEEDS: _____ (m/s) @ 100% SPEED
_____ (m/s) @ MAX. CONT. SPEED

☐ **LATERAL CRITICAL SPEEDS (DAMPED)**
FIRST CRITICAL _____ (rpm) _____ MODE
SECOND CRITICAL _____ (rpm) _____ MODE
THIRD CRITICAL _____ (rpm) _____ MODE
FOURTH CRITICAL _____ (rpm) _____ MODE
○ LATERAL ANALYSIS ADDITIONAL REQUIREMENTS (1-2.6.2.14)
○ TRAIN LATERAL ANALYSIS REQUIRED (1-2.6.2.6)
○ TRAIN TORSIONAL ANALYSIS REQUIRED (1-2.6.6.1)

☐ **TORSIONAL CRITICAL SPEEDS:**
FIRST CRITICAL _____ (rpm)
SECOND CRITICAL _____ (rpm)
THIRD CRITICAL _____ (rpm)
FOURTH CRITICAL _____ (rpm)
○ LIST OF TRAIN UNDESIRABLE SPEEDS (1-2.6.14)
○ STABILITY ANALYSIS (1-2.6.5)

☐ **VIBRATION:**
ALLOWABLE TEST LEVEL _____ (μm)
(PEAK TO PEAK)

NAMEPLATE (2-2.11.2)
○ US CUSTOMARY ○ METRIC

☐ **ROTATION, VIEWED FROM DRIVEN END** ○ CW ○ CCW

○ **MATERIALS INSPECTION REQUIREMENTS (1-4.2.1.3)**
○ RADIOGRAPHY REQUIRED FOR _____
○ ULTRASONIC REQUIRED FOR _____
○ MAGNETIC PARTICLE REQUIRED FOR _____
○ LIQUID PENETRANT REQUIRED FOR _____
○ LOW TEMPERATURE (2-2.11.5.3) _____
MIN. DESIGN METAL TEMPERATURE (°C) _____
AT CONCURRENT PRESSURE (barG) _____
○ OTHER TRAIN COMPONENTS (2-2.11.5.2)

☐ **CASING:**
MODEL _____
CASING SPLIT _____
MATERIAL _____
THICKNESS (mm) _____ CORR. ALLOW. (mm) _____
MAX. ALLOWABLE PRESS (barG) _____
TEST PRESS. (barG) HELIUM _____ HYDRO _____
MAX. ALLOWABLE TEMPERATURE (°C) _____
MAX OPER. TEMP. _____ (°C) MIN. OPER. TEMP. _____ (°C)
MAX CASING CAPACITY (m³/h) _____
○ SYSTEM RELIEF VALVE SET PT. (2-2.3.11) _____ (barG)
○ Q.C. OF INACCESSIBLE WELDS (1-2.3.11.2)

☐ **DIAPHRAGMS:**
MATERIAL _____
AXIALLY SPLIT ☐ YES ☐ NO (2-2.4.7)
DIAPHRAGM MAX. Δ P (BAR)(kPa):

○ **INTERMEDIATE MAIN PROCESS CONNECTIONS (2-2.4.4)**
DISCH. PRESSURE: (barG) MAX _____ MIN _____
INLET PRESSURE: (barG) MAX _____ MIN _____

☐ **GUIDE VANES**
○ IGV EXTERNAL PURGE (2-2.4.2) _____
○ VANE CONTROL SYSTEM (2-2.4.3) _____
NUMBER OF AXIAL BLADE ROWS _____
NUMBER OF ADJUSTIBLE ROWS _____
NO. VANES GUIDE VANE _____ MATERIAL _____

☐ **IMPELLERS:**
NO. _____ DIAMETERS _____
NO. VANES EA. IMPELLER _____
TYPE (OPEN, ENCLOSED, ETC.) _____
TYPE FABRICATION _____ MATERIAL _____
MIN. YIELD STRENGTH (MPa) _____
HARDNESS: (Rc) (BRINNEL) MAX _____ MIN _____
SMALLEST TIP INTERNAL WIDTH (mm) _____
MAX. MACH. NO. @ IMPELLER EYE _____
MAX. IMPELLER HEAD @ 100% SPD (N-m/kg) _____

☐ **SHAFT:**
○ ONE PIECE ○ BUILT UP
MATERIAL _____
DIA @ IMPELLERS (mm) _____ DIA @ COUPLING (mm) _____
SHAFT END: ○ TAPERED ○ CYLINDRICAL
○ SPLINED ○ INTEGRAL FLANGE
MIN. YIELD STRENGTH (MPa) _____
SHAFT HARDNESS (BNH)(Rc) _____
MAX TORQUE CAPABILITY (N-m) _____

☐ **BALANCE PISTON:**
MATERIAL _____ AREA _____ (mm²)
FIXATION METHOD _____
NORMAL CLEARANCE (mm) _____
FLOW WITH NORMAL CLEARANCE (kg/h) _____
FLOW WITH 2x NORMAL CLEARANCE (kg/h) _____
○ PRESS. CONN. BAL LINE DOWNSTREAM (2-2.5.4.3)

☐ **SHAFT SLEEVES:**
AT INTERSTG. CLOSE MATL _____
CLEARANCE POINTS
AT SHAFT SEALS MATL _____
○ ACCESSIBLE (2-2.8.3)

ROTOR
○ DISASSEMBLY AND REASSEMBLY (1-2.6.8.2.11)
○ AT SPEED BALANCING (1-2.6.8.3)
○ SEQUENTIAL LOW SPEED BAL. PREC. AT SPEED BAL. (1-2.6.8.6)
○ RESIDUAL BALANCE CHECK (1-2.6.8.7)

☐ **LABYRINTHS:**
INTERSTAGE
TYPE _____ MATERIAL _____
BALANCE PISTON
TYPE _____ MATERIAL _____

REMARKS: _____

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LOW PRESSURE CASING CONSTRUCTION FEATURES (CONTINUED)

SHAFT SEALS:

- ○ SEAL TYPE (1-2.8.13) _____
- ○ SETTLING OUT PRESSURE (1-2.8.11) (barG) _____
- ○ MIN.SEALING PRESSURE (barG) _____
- ○ SUPPLEMENTAL DEVICE REQUIRED FOR CONTACT SEALS (1-2.8.3.4) TYPE _____
- ○ BUFFER GAS SYSTEM REQUIRED (2-2.8.15)
- ○ TYPE BUFFER GAS (1-2.8.15) _____
  - ☐ PRESSURE (1-2.8.16) _____ (barG)
  - ☐ FLOWRATE (1-2.8.16) _____ (kg/h)
  - ☐ FILTRATION (1-2.8.16) _____ (µm)
- ○ MANIFOLD (1-3.5.14)
- ○ METHOD OF CONTROL (1-2.8.15)

- ○ BUFFER GAS CONTROL SYSTEM SCHEMATIC BY VENDOR
- ○ PRESSURIZING GAS FOR SUBATMOSPHERIC SEALS (1-2.8.2.4)
  - ○ EDUCTOR ○ INJECTION (1-2.8.2.3)
- ☐ SEAL MANUFACTURER _____
- ☐ LEAKAGE TO PROCESS (l/day/seal) _____

BUFFER GAS REQUIRED FOR:

- ☐ AIR RUN-IN ☐ OTHER _____
- ☐ FLOW (PER SEAL):
  - NORM: _____ (kg/h) @ _____ (bar) ΔP _____
  - MAX. _____ (kg/h) @ _____ (bar) ΔP _____
- ☐ **BEARING HOUSING CONSTRUCTION:**
  - TYPE (SEPARATE, INTEGRAL) _____ SPLIT _____
  - MATERIAL _____

AXIAL COMPRESSOR

STAGE	1	2	3	4	5	6	7	8	9
ROTOR									
☐ BLADE MATERIAL									
☐ BLADE ROOT TYPE									
☐ CORD WIDTH (mm)									
☐ OUTER DIAMETER (mm)									
☐ BLADE HEIGHT (mm)									
☐ BLADE QUANTITY									
STATOR									
☐ BLADE MATERIAL									
☐ TYPE (MOVABLE, FIXED, ADJUSTABLE)									
☐ CORD WIDTH (mm)									
☐ BLADE QUANTITY									

STAGE	10	11	12	13	14	15	16	17	18
ROTOR									
☐ BLADE MATERIAL									
☐ BLADE ROOT TYPE									
☐ CORD WIDTH (mm)									
☐ OUTER DIAMETER (mm)									
☐ BLADE HEIGHT (mm)									
☐ BLADE QUANTITY									
STATOR									
☐ BLADE MATERIAL									
☐ TYPE (MOVABLE, FIXED, ADJUSTABLE)									
☐ CORD WIDTH (mm)									
☐ BLADE QUANTITY									

REMARKS: _____

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CONSTRUCTION FEATURES (CONTINUED)

BEARINGS AND BEARING HOUSINGS

○ MAGNETIC BEARINGS (2-2.7.1.12)

RADIAL	THRUST	NON-THRUST
☐ TYPE		
☐ MANUFACTURER		
☐ LENGTH (mm)		
☐ SHAFT DIA. (mm)		
☐ UNIT LOAD (ACT/ALLOW) (bar)		
☐ BASE MATERIAL		
☐ BABBIT THICKNESS (mm)		
☐ NO. PADS		
☐ LOAD: B'TWN/ON PAD		
☐ PIVOT: CTR/OFFSET, %		

PAD MATERIAL ○ (2-2.7.2.2) ○
☐ BEARING SPAN _____ (mm)

THRUST	ACTIVE	INACTIVE
☐ TYPE		
☐ MANUFACTURER		
☐ UNIT LOADING - MAX (bar)		
☐ UNIT LOAD - ULT. (bar)		
☐ AREA (mm²)		
☐ NO. PADS		
☐ PIVOT: CENTER / OFFSET, %		
☐ PAD BASE MATL		

○ COPPER BACKED (2-2.7.3.7)
LUBRICATION: ○ FLOODED ○ DIRECTED (2-2.7.3.6)
THRUST COLLAR: ○ INTEGRAL ○ REPLACEABLE
MATERIAL _____
☐ SIZING CRITERIUM (2-2.7.3.3)

BEARING TEMPERATURE DETECTORS (2-3.4.7.3)

○ SEE ATTACHED API-670 DATASHEET
○ THERMOCOUPLES TYPE _____
○ RESISTANCE TEMP DETECTORS
○ RESISTANCE MAT'L _____ ○ _____ OHMS
☐ ALARM TEMPERATURE (2-2.7.13) _____ (℃)
☐ SHUTDOWN TEMPERATURE (2-2.7.13) _____ (℃)
○ PROVISION FOR LOCAL DISCONNECT (1-2.7.4.6)
○ LOCATION-JOURNAL BRG
NO. ____ EA PAD _____ EVERY OTH PAD ____ PER BRG
OTHER _____
○ LOCATION-THRUST BRG
NO. ____ EA PAD _____ EVERY OTH PAD ____ PER BRG
OTHER _____
NO. (INACT) ____ EA PAD ____ EVERY OTH PAD ____ PER BRG
OTHER _____
○ LOCAL DISCONNECTION (1-2.7.4.6)
○ MONITOR SUPPLIED BY (2-3.4.7.4) _____
○ LOCATION _____ ENCLOSURE _____
○ MFR. _____ ☐ MODEL _____
☐ SCALE RGE _____ ○ ALARM ☐ SET @ _____ (℃)
○ SHTDWN ☐ SET @ _____ (℃) ○ TIME DELAY _____ SEC

KEY PHASOR REQUIRED

○ COMPRESSOR ○ GEAR H.S. ○ GEAR L.S.

VIBRATION DETECTORS: ○ SEE ATTACHED API-670 DATA SHEET

○ TYPE _____ ☐ MODEL _____
○ MFR _____
○ NO. AT EA SHAFT BEARING _____ TOTAL NO. _____
○ OSCILLATOR-DETECTORS SUPPLIED BY _____
○ MFR _____ ☐ MODEL _____
MONITOR SUPPLIED BY (2-3.4.7.2) _____
○ LOCATION _____ ENCLOSURE _____
○ MFR. _____ ☐ MODEL _____
☐ SCALE RGE _____ ○ ALARM ☐ SET @ _____ (μm)
○ SHTDWN: ☐ SET @ _____ (μm) ○ TIME DELAY _____ SEC
○ CASING VIBRATION TRANSDUCERS (2-3.4.7.5)
○ CASING VIBRATION MONITORS (2-3.4.7.6)

AXIAL POSITION DETECTOR: ○ SEE ATTACH. API-670 DATA SHEET

○ TYPE _____ ☐ MODEL _____
● MFR _____ ○ NO. REQUIRED _____
○ OSCILLATOR-DEMODULATOR SUPPLIED BY _____
○ MFR _____ ☐ MODEL _____
○ MONITOR SUPPLIED BY (2-3.4.7.2) _____
○ LOCATION _____ ENCLOSURE _____
○ MFR. _____ ☐ MODEL _____
☐ SCALE RGE _____ ○ ALARM ☐ SET @ _____ (μm)
○ SHTDWN: ☐ SET @ _____ (μm) ○ TIME DELAY _____ SEC

CASING CONNECTIONS (1-2.3.2.2)

CONNECTION	☐ ANSI/ASME (B16.1; B16.5; B16.42; B16.47 series A, B; ISO 7005-1, -2; OTHER	☐ FACING ☐ BORE	○ ORIENTATION	◯ FLANGED OR STUDDED (1-2.3.2.2.1)	○ MATING FLG & GASKET BY VENDOR (1-2.3.2.2.7)	☐ GAS VELOCITY (m/s)
INLET						
DISCHARGE						

○ BOROSCOPIC INSPECTION PORTS (2-2.3.2.4)

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☐ OTHER CONNECTIONS

SERVICE:	NO.	SIZE	TYPE		NO.	SIZE	TYPE
LUBE-OIL INLET				PRESSURE			
LUBE OIL OUTLET				TEMPERATURE			
SEAL-OIL INLET				SOLVENT INJECTION			
SEAL-OIL OUTLET				PURGE FOR:			
SEAL GAS INLET				BRG. HOUSING			
SEAL GAS OUTLET				BTWN BRG & SEAL			
CASING DRAINS				BTWN SEAL & GAS			
STAGE DRAINS							

○ INDIVIDUAL STAGE DRAINS REQUIRED (1-2.3.2.17)
○ VALVED & BLINDED
○ VALVED & BLINDED & MANIFOLD

LUBRICATION AND SEALING SYSTEMS (1-2.10) (1-3.5.1.2)

○ SEE ATTACHED API 614 DATASHEET
○ SEPARATE ○ COMBINED (2-2.10.1)
○ INTEGRAL OIL RESERVOIR (1-3.3.2.11)
○ OIL TYPE (2-2.10.2)

ACCESSORIES

COUPLING AND GUARDS (3.2)

NOTE: SEE ROTATING ELEMENTS - SHAFT ENDS

○ SEE ATTACHED API-671 DATA SHEET ○ KEYLESS HYDRAULIC ○ KEYED ○ FLANGED ○ OTHER
COUPLING FURNISHED BY MOUNTED BY
MANUFACTURER TYPE MODEL
COUPLING GUARD FURNISHED BY:
TYPE: ○ FULLY ENCLOSED ○ SEMI-OPEN ○ OTHER

COUPLING DETAILS

☐ MAX O.D. (mm)
☐ HUB WEIGHT (kg)
☐ SPACER LENGTH (mm)
☐ SPACER WEIGHT (kg)

○ PLUG AND RING GAUGES (1-3.2.5) ○ LAPPING TOOL
LUBRICATION REQUIREMENTS:
○ NON-LUBE ○ CONT. OIL LUBE ○ OTHER
QUANTITY PER HUB (kg) or (L/min)

MOUNTING PLATES (1-3.3)

○ BASEPLATES FURNISHED BY (1-3.3.2.1)
○ COMPRESSOR ONLY ○ DRIVER ○ GEAR
○ OTHER
○ NONSKID DECKING (1-3.3.2.4) ○ SLOPED DECK (1-3.3.2.4.1)
△ LEVELING PADS OR TARGETS (1-3.3.2.6)
△ COLUMN MOUNTING (1-3.3.2.5)
○ SUB-SOLE PLATES REQUIRED (1-3.3.2.10)
☐ STAINLESS STEEL SHIM THICKNESS (mm)
○ MACHINED MOUNTING PADS REQUIRED (1-3.3.2.9)

○ SOLEPLATES FURNISHED BY (1-3.3.3.1)
☐ THICKNESS (mm)
○ SUBSOLE PLATES REQUIRED (1-3.3.3.13)
○ EXTENT OF PIPING (2-3.5.1.1)
☐ STAINLESS STEEL SHIM THICKNESS (mm)
○ COMPRESSOR
○ COUNTER BORE ANCHOR BOLT HOLES (1-3.3.3.12)

ANTI-SURGE SYSTEM (1-3.4.2.2) FURNISHED BY ○ PURCHASER ☐ SUPPLIER

○ ☐ ANTI-SURGE VALVE ○ SIZING ONLY
PRESSURE UPSTREAM: (barG) DOWNSTREAM Δ P (barG)
☐ Δ P VALVE STROKE TIME OPEN - CLOSE (sec)
○ ☐ RECIRCULATION VALVE ○ SIZING ONLY
○ ☐ BLOWOFF VALVE ○ SIZING ONLY
○ ☐ CONTROL SYSTEM
○ ☐ PIPING
○ ☐ FLOW ELEMENT
○ ☐ ○ ☐
○ ☐ ○ ☐
○ ☐ ○ ☐
○ ☐ ○ ☐
○ ☐ ○ ☐
○ ☐ ○ ☐

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REVISION	0	1	2	3	4
DATE					

CENTRIFUGAL AND AXIAL COMPRESSOR
DATA SHEET (API 617-8TH Chapter 2)
SI UNITS (bar)

PAGE 7 OF 7 AGE NO. ITEM NO. REQ'N NO.

UTILITIES

○ **UTILITY CONDITIONS:**

	DRIVERS	
STEAM:		
INLET MIN	(barG)	(℃)
NORM	(barG)	(℃)
MAX	(barG)	(℃)
EXHAUST. MIN	(barG)	(℃)
NORM	(barG)	(℃)
MAX	(barG)	(℃)

ELECTRICITY:

	DRIVERS	CONTROL	SHUTDOWN
VOLTAGE			
HERTZ			
PHASE			

○ REDUCED VOLTAGE START (1-3.16)

△ NUMBER OF STARTS (1-2.6.7.6.4)

INSTRUMENT AIR:

MAX PRESS (barG) MIN PRESS (barG)

SHOP INSPECTION AND TESTS: (1-4.1.4)

○ (SEE INSPECTOR'S CHECKLIST)

	REQ'D	WIT/OBV
HYDROSTATIC (1-4.3.2)	●	
IMPELLER OVERSPEED (1-4.3.3)	●	
MECHANICAL RUN (1-4.3.6) (2-4.3.1)	●	
○ CONTRACT COUPLING ○ IDLING ADAPTOR(S)		
○ CONTRACT PROBES ○ SHOP PROBES		
○ PURCHASER VIB. EQUIPMENT (2-4.3.1.11.0)		
VARY LUBE & SEAL OIL PRESSURES		
AND TEMPERATURES (1-4.3.6.15)	○	
POLAR FORM VIB DATA (1-4.3.6.12)	○	
TAPE RECORD VIB DATA (1-4.3.6.13)	○	
SHAFT END SEAL INSP (1-4.3.6.2.2)	○	
GAS LEAK TEST AT DISCH PRESS (2-4.3.2.3)	○	
○ POST TEST INTERNAL INSP (1-4.3.8.5)		
○ BEFORE GAS LEAKAGE TEST		
○ AFTER GAS LEAKAGE TEST		
INTERMEDIATE HEAD/PRESSURE TOL (2-4.3.3.16)	○	
PERFORMANCE TEST (GAS) (AIR) (2-4.3.3.1.1)	○	
COMPLETE UNIT TEST (2-4.3.3.2)	○	
TANDEM TEST (2-4.3.3.3)	○	
GEAR TEST (2-4.3.3.4)	○	
HELIUM LEAK TEST (1-4.3.8.2)	○	
SOUND LEVEL TEST (1-4.3.8.3) (SURVEY ONLY)	○	
AUX. EQUIPMENT TEST (1-4.3.8.4)	○	
FULL LOAD SPEED / PRESS TEST (1-4.3.8.6)	○	
HYDRAULIC COUPLING INSP (1-4.3.8.7)	○	
SPARE PARTS TEST (1-4.3.8.8)	○	
INSPECTOR'S CHECKLIST COMPLIANCE (1-4.16)	○	
GAS SEAL TEST VENDOR SHOP (1-4.3.5)	○	
ADDITIONAL INSPECTION (1-4.2.12)	○	

MANUALS

○ DRAFT MANUAL FOR REVIEW (1-5.3.5.12)
○ TECHNICAL DATA MANUAL (1-5.3.5.4)

MISCELLANEOUS:

☐ RECOMMENDED STRAIGHT RUN OF PIPE DIAMETERS BEFORE SUCTION
○ COMPRESSOR TO BE SUITABLE FOR FIELD RUN-IN ON AIR (1-2.1.16)
○ PROVISION FOR LIQUID INJECTION (1-2.1.10)
○ INJECTION MANIFOLD (2-3.5.12)
○ VENDOR'S REVIEW & COMMENTS ON PURCHASER'S CONTROL SYSTEMS (1-3.4.11)
○ SHOP FITUP OF VENDOR PROCESS PIPING (1-4.4.3.11)
○ WELDING HARDNESS TESTING (1-4.2.15)
○ INSPECT CLEANLINESS (1-4.2.14)
○ DESIGN AUDIT (1-5.14)
○ BALANCE PISTON ΔP (1-5.3.2.15)
○ PROVIDE TAIL END SCHEDULES (1-5.3.3.2)

VENDOR'S REPRESENTATIVE SHALL (1-2.1.13)

○ OBSERVE FLANGE PARTING
○ CHECK ALIGNEMENT AT TEMPERATURE
○ BE PRESENT AT INITIAL ALIGNMENT

☐ **WEIGHTS:** (kg)

COMPR. GEAR DRIVER BASE
ROTORS: COMPR. DRIVER GEAR
COMPRESSOR UPPER CASE
MAX. FOR MAINTENANCE (IDENTIFY)
TOTAL SHIPPING WEIGHT

☐ **SPACE REQUIREMENTS:** (mm)

COMPLETE UNIT: L W H

SPECIAL TOOL PACKAGING
○ METAL STORAGE CONTAINER
○ OTHER:

PAINTING:

○ MANUFACTURER'S STD.
○ OTHER

SHIPMENT: (4.4)

○ DOMESTIC ○ EXPORT ○ EXPORT BOXING REQ'D.
○ OUTDOOR STORAGE MORE THAN 6 MONTHS (1-4.4.1) MONTH
SPARE ROTOR ASSEMBLY PACKAGE (1-4.4.3.10)
○ HORIZONTAL STORAGE ○ VERTICAL STORAGE
○ METAL STORAGE CONTAINER
○ N2 PURGE ○ OTHER:

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Annex B
(informative)

Vendor (Supplier) data and drawing requirements (VDDR)

B.1 VDDR for centrifugal and axial compressors

The vendor (supplier) data and drawing requirements (VDDR) for centrifugal and axial compressors are also available in electronic format via http://standards.iso.org/iso/. The text for details of the description is given in B.2.

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CENTRIFUGAL AND AXIAL COMPRESSOR SUPPLIER DRAWING AND DATA REQUIREMENTS	Job No. Purchase order No. Requisition No. Inquiry No. Revision ..... by For Site	Item No. Date Date Date Manufacturer Unit Service

Proposal [a] – Bidder shall furnish number of paper copies /number of electronic copies of data as indicated
Review – Supplier shall furnish number of paper copies /number of electronic copies of data as indicated
Final – Supplier shall furnish number of paper copies /number of electronic copies of data as indicated

				Description (see text)	**Distribution record**				
					Review due from supplier [b c]	Review received from supplier	Review returned to supplier	Final due from supplier [c]	Final received from supplier
	/	/	/	1. Certified dimensional outline drawing and list of connections					
	/	/	/	2. Cross-sectional drawings and part numbers					
	/	/	/	3. Rotor assembly drawings and part numbers					
	/	/	/	4. Thrust-bearing assembly drawings and part numbers					
	/	/	/	5. Journal-bearing assembly drawings and bill of materials					
	/	/	/	6. Coupling assembly drawings and bill of materials					
	/	/	/	7. Lube-oil schematic and bill of materials					
	/	/	/	8. Lube-oil arrangement drawing and list of connections					
	/	/	/	9. Lube-oil component drawings and data					
	/	/	/	10. Seal system schematic and bill of material					
	/	/	/	11. Seal system arrangement drawing and list of connections					
	/	/	/	12. Seal system component drawings and data					
	/	/	/	13. Seal assembly drawing and part numbers					
	/	/	/	14. Electrical and instrumentation schematics and bill of materials					
	/	/	/	15. Electrical and instrumentation arrangement drawing and list of connections					
	/	/	/	16. Buffer gas system schematic and bill of material					
	/	/	/	17. Buffer gas system arrangement drawing and list of connections					
	/	/	/	18. Buffer gas system component drawing and data					
	/	/	/	19. Data sheets (proposal/as-built)					

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| | | |

B.2 Descriptions

	/	/	/	51. Installation manual					
	/	/	/	52. Operating and maintenance manual					
	/	/	/	53. Technical data manual					
a Proposal drawings and data do not have to be certified. Typical data shall be clearly identified as such. b Purchase may indicate in the column the desired time frame for submission of data. c Bidder shall complete these two columns to reflect the actual distribution schedule and include this form with the proposal.									

NOTES:

1. Where necessary to meet the scheduled shipping date, the supplier shall proceed with manufacture upon receipt of the order and without awaiting the purchaser's approval of drawings.
2. The supplier shall send all drawings and data to the following:

_____

_____

_____

3. All drawings and data shall show project, purchase order, and item numbers as well as plant location and unit. One set of the drawings and instructions necessary for field installation, in addition to the copies specified above, shall be forwarded with shipment.
4. See the descriptions of required items that follow.
5. All of the information indicated on the distribution schedule shall be received before final payment is made.
6. If typical drawings, schematics, bills of material are used for proposals, they shall be marked-up to show the expected weight and dimensions to reflect the actual equipment and scope proposed.

Nomenclature:

S — number of weeks before shipment.

F — number of weeks after firm order.

D — number of weeks after receipt of approved drawings.

Supplier_____

Date_____ Supplier Reference _____

Signature_____

(Signature acknowledges receipt of all instructions

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1) Supplier certified dimensional outline drawing and list of connections, including the following:
   i) the size, rating, and location of all customer connections;
   ii) approximate overall and handling weights;
   iii) overall dimensions and maintenance and dismantling clearances;
   iv) shaft centreline height;
   v) dimensions of base plate (if furnished) for train or skid mounted package, complete with diameters, number and locations of bolt holes and thicknesses of sections through which the bolts shall pass;
   vi) grounding details;
   vii) forces and moments allowed for suction and discharge nozzles;
   viii) centre of gravity and lifting points;
   ix) shaft end separation and alignment data;
   x) direction of rotation;
   xi) winterization, tropicalization, and/or noise attenuation details, when required;
   xii) sketches to show lifting of assembled machine and major components and auxiliaries.
2) cross-sectional drawings and part numbers of major equipment;
3) rotor assembly drawings and part numbers;
4) thrust-bearing assembly drawings and part numbers;
5) journal-bearing assembly drawings and bill of materials;
6) coupling assembly drawing and bill of materials;
7) lube-oil schematic and bill of material including the following:
   i) oil flows, temperatures, and pressure at each point;
   ii) control alarm shutdown settings for pressure and temperature;
   iii) total heat loads;
   iv) utility requirements including electrical, water, air, and steam;
   v) pipe, valve, and orifice sizes;
   vi) instrumentation, safety devices, control schemes, and wiring diagrams.
8) lube-oil arrangement drawing and list of connections;
9) lube-oil component drawings and data, including the following:
   i) pumps and drivers;
   ii) coolers, filter, and reservoir;
   iii) instrumentation.
10) seal system schematic and bill of material, including the following:
   i) flows oil or gas, temperatures, and pressures at each point;

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ii) control, alarm, and shutdown settings for pressure, and temperatures;

iii) total heat load for coolers, if required;

iv) utility requirements including electrical, water, air, and steam;

v) pipe, valve, and orifice sizes;

vi) instrumentation, safety devises, control schemes, and wiring diagrams;

vii) filtration requirements;

viii) height of overhead tank above centreline of machine.

11) seal system arrangement drawing and list of connections;

12) seal system components drawing and data, including the following:

i) pumps and drivers;

ii) coolers, filter, and reservoirs;

iii) instrumentation.

13) seal assembly drawing and part numbers;

14) electrical and instrumentation arrangement drawing and list of connections:

i) vibration warning and shutdown limits;

ii) bearing temperature warning and shutdown limits;

iii) lube-oil temperature warning and shutdown limits;

iv) lube-oil pressure warning and shutdown limits;

v) lube-oil level warning and shutdown limits;

vi) machine discharge pressure and temperature warning and shutdown limits;

vii) seal, pressure, temperature, flow warning, and shutdown limits.

15) electrical and instrumentation arrangement drawing and list of connections;

16) buffer gas system schematic and bill of material;

17) buffer gas system schematic and bill of material;

18) buffer gas system component drawings and data, including the following:

i) control devices;

ii) pressure and filtration requirements.

19) data sheets provided with proposal as-built;

20) predicted noise level, sound pressure, and sound power level;

21) metallurgy of major components identified with ASTM, AISI, ASME, or SAE numbers stated in proposal;

22) lateral analysis report when specified shall also include a stability analysis;

23) torsional analysis report;

24) vibration analysis conducted on machines that require disassembly after balancing to allow machine assembly. The supplier shall also provide historic unbalance data for the machine size and type;

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25) performance data and curves, sufficient performance data to enable the purchaser to properly design a control system, and surge prevention;

26) dimensions taken from each impeller before and after overspeed testing shall be submitted for review;

27) mechanical running test report to include the following:

    i) unfiltered vibration;

    ii) plots showing synchronous vibration and phase angle, filtered and unfiltered;

    iii) when specified data shall be furnished in polar form;

    iv) when specified, tape recordings shall be made of all real time vibration data;

    v) electrical and mechanical runout at each probe.

Immediately upon completion of each witnessed mechanical or performance test, copies of the log and data recorded during the test shall be given to the witnesses.

28) coupling selection and rating;

29) list of spare parts recommended for start-up and normal maintenance purposes;

30) list of the special tools furnished for maintenance;

31) the supplier shall provide the purchaser with instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the job site and before start-up.

32) a description of any special weather protection required for start-up, operation, and period of idleness under the site conditions specified on the data sheets;

33) a complete list of utility requirements: quantity, filtration, and supply pressure of the following:

    i) steam;

    ii) water;

    iii) electricity;

    iv) air;

    v) gas;

    vi) lube oil and seal oil (quantity and supply pressure);

    vii) heat loads;

    viii) power ratings and operating power requirements for auxiliary drivers.

34) a list of machines similar to the proposed machines that have been installed and operating under conditions analogous to those specified in the inquiry;

35) any start-up, shutdown, or operating restrictions required to protect the integrity of the equipment, including any unacceptable speeds due to natural frequencies;

36) a list of any components that can be construed as being of alternative design, requiring purchaser's acceptance;

37) a summary of the materials of construction for the compressor, including hardness for materials exposed to H_2S;

38) the maximum seal gas rates (injection or eduction) and rated or expected inner seal-oil leakage rates, if applicable;

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When self-acting dry gas seals are supplied, expected seal gas consumption, minimum seal gas supply flow, and primary vent flow should be given at maximum sealing pressure and at conditions over the operating envelope of the machine.

39) when interstage coolers are furnished, the supplier shall provide the following:

    i) drawing showing cooling system details;

    ii) data for purchasers heat and material balances;

    iii) details of provisions for separating and withdrawing condensate;

    iv) supplier's recommendations regarding provision for support and piping expansion.

40) drawings, details, and descriptions of the operations of instrumentation and controls, as well as the makes, materials, and type of auxiliary equipment;

The supplier shall also include a complete description of the alarm and shutdown facilities to be provided.

41) the minimum length of straight pipe required for proper flow characteristics at the inlet and at any side inlet connection;

42) maximum and minimum allowable seal pressure for each compressor;

43) a statement of the manufacturers capability regarding testing (including performance testing) of the compressor and any other specified items on the train;

Details of each optional test specified shall be included.

44) performance curves shall be submitted for each section (between purchasers process nozzles) of each casing as well as an overall curve for the train. All curves submitted prior to complete performance testing shall be marked "predicted";

    Any set of curves resulting from a test shall be marked "tested";

    If a performance test is specified, the supplier shall provide test data and curves when the test has been completed. The surge points shall be shown on the performance curves;

45) for compressors that have a back-to-back impeller arrangement, the supplier shall furnish a curve showing the expected loading on the active or inactive side of the thrust bearing versus any combination of differential pressures across the low pressure and high pressure sections of the casing;

46) the supplier shall supply balance piston leakage based on design clearances and twice design clearances for the rated conditions;

47) if specified, the supplier shall supply curves of balance piston line differential pressure versus thrust load;

48) the supplier shall provide production and delivery schedules;

49) the supplier shall submit detailed procedures, including acceptance criteria for the mechanical running test and all optional tests, at least six weeks prior to the first running test;

50) the supplier shall submit progress reports;

51) all information required for the proper installation of the equipment shall be compiled in a manual that shall be issued no later than the time of final certified drawings;

52) a manual containing all required operating and maintenance instructions shall be supplied not later than two weeks after all specified test shall have been successfully completed;

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53) the supplier shall provide a “technical data manual within 30 days of completion” of shop testing including the following:

i) necessary certification of materials;

ii) purchase specification for all items on the bill of materials;

iii) test data to verify requirements of specifications have been met;

iv) heat treat records;

v) results of quality test and inspections;

vi) mechanical running test data log;

vii) final assembly maintenance and running clearances.

The supplier is also required to keep this data available for examination by the purchaser upon request, for at least five years.

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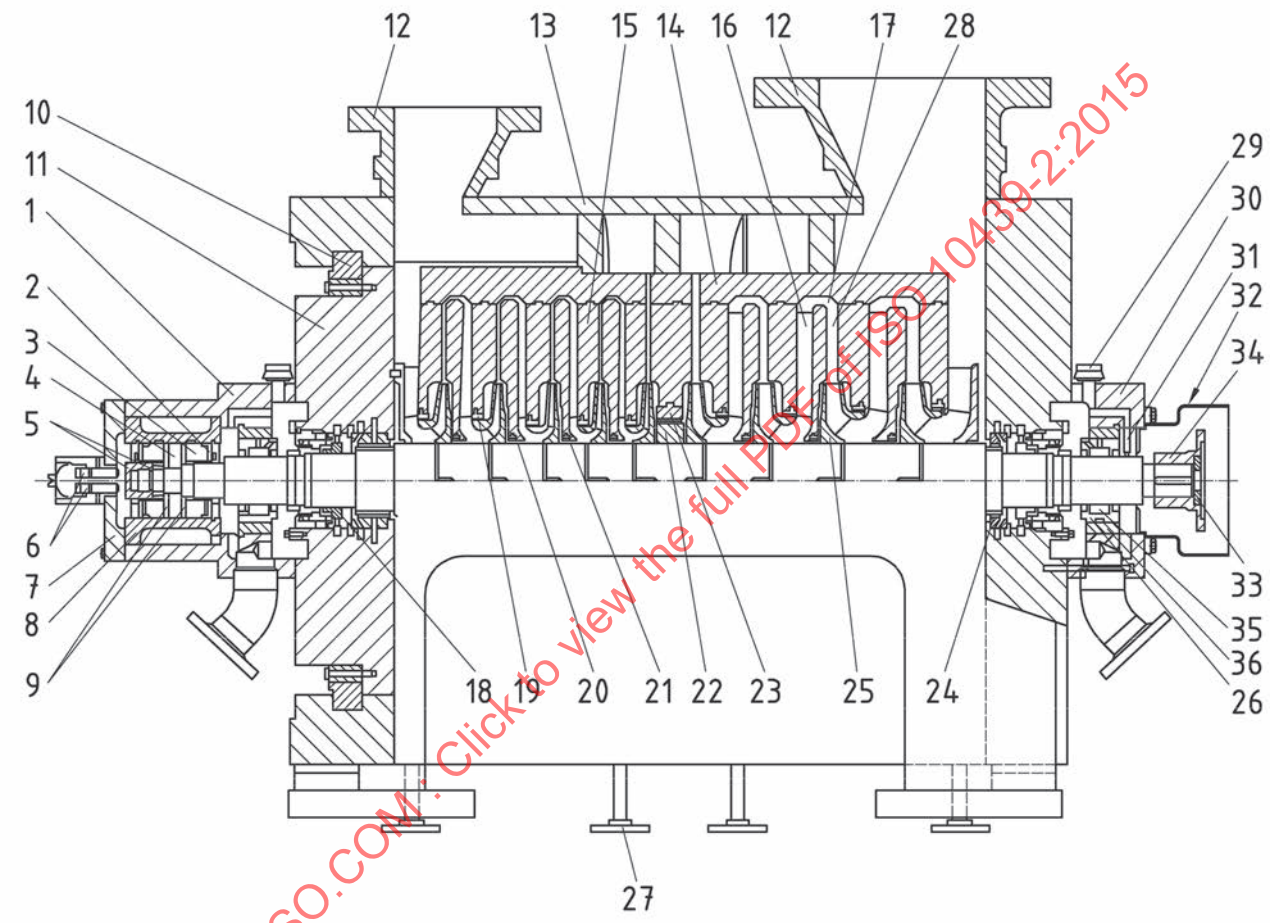
Annex C
(informative)

Centrifugal compressor nomenclature



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Key

1	bearing housing	10	shear ring	19	impeller-eye labyrinth	28	diffuser passage
2	thrust shims	11	end head	20	shaft sleeve	29	breather/vent
3	thrust base ring	12	main process connections	21	diaphragm labyrinth	30	bearing house
4	thrust collar	13	casing	22	balance piston	31	radial-vibration probe
5	thrust collar locknuts	14	inner barrel	23	balance piston labyrinth	32	coupling guard
6	axial-position probes	15	diaphragm	24	labyrinth seal	33	coupling locknut
7	end cover	16	return channel	25	impeller	34	coupling hub
8	thrust-bearing carrier	17	crossover	26	journal-bearing housing	35	journal-bearing shoes
9	thrust-bearing shoes	18	end seal	27	case drains	36	journal-bearing carrier

NOTE Some compressors use bolted-head construction.

Figure C.1 — Centrifugal compressor nomenclature

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Annex D
(informative)

Typical materials

The materials listed in this annex are considered equivalent as far as suitability for service. This does not imply that they are exactly equivalent. There can be significant differences in testing and other material requirements. The list of typical materials is also available in electronic format via http://standards.iso.org/iso/.

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Table D.1 — Typical centrifugal and axial compressor materials specifications for major component parts

Component[g]	Materials[a]	Specification[b,e]	Equivalent JIS Material	Equivalent EN Material		Form	Temperature limits[c]	
							Minimum °C (°F)	Maximum °C (°F)
Casing, Inlet Casing, Stator Housing, Discharge Casing								
Cast	Cast iron	ASTM A 278, Class 30	JIS G5501 FC200	EN 1561 EN-GJL-250	EN-JL1040	Cast	-45 (-50)	230 (450)
		ASTM A 278, Class 40	JIS G5501 FC300	EN 1561 EN-GJL-300	EN-JL1050	Cast	-28 (-20)	260 (500)
	Austenitic cast iron	ASTM A 436, Type 2	JIS G5510 FCA-NiCr202	NA		Cast	-45 (-50)	260 (500)
		ASTM A 571, Type D-2M Class 1 & 2	JIS G5510 FCDA-Ni22	NA		Cast	-195 (-320)	260 (500)
	Ductile iron	ASTM A 395	JIS G5502	EN 1563 EN-GJS-400-18U-RT	EN-JS1059	Cast	-28 (-20)	260 (500)
	Cast steel	ASTM A 216, Grade WCB[d]	JIS G5102 SCW450	EN 10213 GP240GH ISO 4991 G240 similar reference DIN 1681 GS-38	1.0619 1.0420	Cast	-28 (-20)	400 (750)
		ASTM A 352, Grade LCB	JIS G5152 SCPL1	GC24E	1.1156	Cast	-45 (-50)	345 (650)
		ASTM A 352, Grade LC2	JIS G5152 SCPL21	EN 10213 G9Ni10	1.5636	Cast	-75 (-100)	345 (650)
		ASTM A 352, Grade LC3	JIS G5152 SCPL31	EN 10213 G9Ni14	1.5638	Cast	-100 (-150)	345 (650)
		ASTM A 352, Grade LC4	similar reference JIS G5152 SCPL31	similar reference EN 10213 G9Ni14	1.5638	Cast	-115 (-175)	345 (650)
		ASTM A 352, Grade LC9	JIS G 5101 SC450 JIS G 5101 SC480			Cast	-195 (-320)	205 (400)

[a] The materials shown in this table are those commonly used by compressor manufacturers, but the list is not all inclusive. Other suitable materials may exist and may be used as indicated by specific design considerations.

[b] Descriptions of AISI Types (cross-referenced to UNS) can be found in SAE HS1086. Descriptions of UNS Types can also be found in ASTM DS 56J.

[c] The temperature limits shown in this table are those commonly observed by compressor manufacturers and are not necessarily the same as any temperature limits specified in the applicable material specifications.

[d] Normalized or normalized and tempered.

[e] AISI and UNS designations are only a description of chemical analyses of types of steels; they are not procurement specifications. All materials should be purchased to a specification that adequately defines the required properties and controls.

[f] TFE = tetrafluoroethylene

[g] See nomenclature in cross-sections of either the centrifugal or axial compressor for part names in Annex C

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Table D.1 *(continued)*

Component[g]	Materials[a]	Specification[b,e]	Equivalent JIS Material	Equivalent EN Material		Form	Temperature limits[c]	
							Minimum °C (°F)	Maximum °C (°F)
		ASTM A 352, Grade LCC	similar reference JIS G5152 SCPL1	EN 10213 G17Mn5 EN 10213 G20Mn5 similar reference SEW 685 G26CrMo4	1.1131 1.6220 1.7221	Cast	-45 (-50)	345 (650)
		ASTM A 217	JIS G5151	EN 10213		Cast	-28 (-20)	345 (650)
	Cast stainless steel	ASTM A 743/744 or A 351, Grade CF3, CF3M	CF3: JIS G5121 SCS19A CF3M: JIS G5121 SCS16A	CF3: EN 10213 GX2CrNi19-11 CF3M: EN 10213 GX2CrN-iMo19-11-2	1.4309 1.4409	Cast	-195 (-320)	345 (650)
		ASTM A 743/744 or A 351CF8 or CF8M	CF8: JIS G5121 SCS13A CF8M: JIS G5121 SCS14A	CF8: EN 10213 GX5CrNi19-10 or SEW 685 GX6CrNi18-10 CF8M: EN 10213 GX5CrN-iMo19-11-2	1.4308 1.6902 1.4408	Cast	-195 (-320)	345 (650)
		ASTM A 351, Grade CF3MA or CF8MA	JIS G5121 SCS19A	CF3MA: EN 10213 GX2CrN-iMo19-11-2 CF8MA: EN 10213 GX5CrN-iMo19-11-2	1.4409 1.4408	Cast	-195 (-320)	345 (650)
		ASTM A 487 Grade CA6NM Class A and B	JIS G 5121 SCS6	EN 10213 GX4CrNi13-4	1.4317	Cast	-45 (-50)	345 (650)
		ASTM A 757 Grade E3N	JIS G 5152 SCPL1	EN 10213 GX3CrNi13-4	1.6982	Cast	-75 (-100)	345 (650)
		ASTM A 757 Grade D1Q1	JIS G 5152 SCPL11 (Similar reference)	SEW 685 G15CrMo9-10	1.7377	Cast	-28 (-20)	345 (650)
	Cast aluminium	ASTM A 356 or A 357	JIS G5151	NA		Cast	-195 (-320)	150 (300)
	Cast titanium	ASTM B 367, Grade C3 or C4	C3: JIS H4600 2 C4: NA	NA		Cast	-45 (-50)	150 (300)

[a] The materials shown in this table are those commonly used by compressor manufacturers, but the list is not all inclusive. Other suitable materials may exist and may be used as indicated by specific design considerations.

[b] Descriptions of AISI Types (cross-referenced to UNS) can be found in SAE HS1086. Descriptions of UNS Types can also be found in ASTM DS 56J.

[c] The temperature limits shown in this table are those commonly observed by compressor manufacturers and are not necessarily the same as any temperature limits specified in the applicable material specifications.

[d] Normalized or normalized and tempered.

[e] AISI and UNS designations are only a description of chemical analyses of types of steels; they are not procurement specifications. All materials should be purchased to a specification that adequately defines the required properties and controls.

[f] TFE = tetrafluoroethylene

[g] See nomenclature in cross-sections of either the centrifugal or axial compressor for part names in Annex C

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Table D.1 *(continued)*

Component[g]	Materials[a]	Specification[b,e]	Equivalent JIS Material	Equivalent EN Material		Form	Temperature limits[c]	
							Minimum °C (°F)	Maximum °C (°F)
Casing, Inlet Casing, Stator Housing, Discharge Casing								
Fabricated	Steel	ASTM A 285, Grade C	JIS G3118 SGV450			Plate	-45 (-50)	345 (650)
		ASTM A 516, Grade 55, 60, 65, 70	55: JIS G3118 SGV410 60: JIS G3118 SGV410 65: JIS G3118 SGV450 70: JIS G3118 SGV480	55: EN 10028-2 P235GH 60: EN 10028-2 P265GH 65: EN 10028-2 P355GH EN 10025 S355J2+N 70: EN 10028-2 P355GH	1.0345 1.0425 1.0473 1.0577 1.0473	Plate	-45 (-50)	345 (650)
		ASTM A 203, Grade A or B	A: JIS G3127 SL2N255 B: NA	12Ni9	1.5635	Plate	-60 (-75)	345 (650)
		ASTM A 203, Grade D or E	D: JIS G3127 SL3N255 E: JIS G3127 SL3N275	EN 10028-4 12Ni14	1.5637	Plate	-105 (-160)	345 (650)
		ASTM A 537, Class 1 or 2	1: JIS G3115 SPV355 2: JIS G3115 SPV450	EN 10028-6 P355QH EN 10028-6 P460QH	1.8867 1.8871	Plate	-60 (-75)	345 (650)
		ASTM A 353	JIS G3127 SL9N520	EN 10028-3 X8Ni9	1.5662	Plate	-195 (-320)	345 (650)
		ASTM A 553, Type I	JIS G3127 SL9N590	EN 10028-3 X8Ni9	1.5662	Plate	-195 (-320)	345 (650)
		ASTM A 553, Type II	JIS G3127 SL9N590	EN 10028-3 X8Ni9	1.5662	Plate	-170 (-275)	345 (650)
		ASTM A 266, Class 1 or 4	JIS G3202 SFVC1	EN 10222-4 P355NH	1.0565	Forged	-28 (-20)	345 (650)
		ASTM A 336, Class F1	JIS G3202 SFVA F1	EN 10222-2 16Mo3	1.5415	Forged	-28 (-20)	345 (650)
		ASTM A 414	JIS G3116	EN 10120		Sheet	-28 (-20)	345 (650)

[a] The materials shown in this table are those commonly used by compressor manufacturers, but the list is not all inclusive. Other suitable materials may exist and may be used as indicated by specific design considerations.

[b] Descriptions of AISI Types (cross-referenced to UNS) can be found in SAE HS1086. Descriptions of UNS Types can also be found in ASTM DS 56J.

[c] The temperature limits shown in this table are those commonly observed by compressor manufacturers and are not necessarily the same as any temperature limits specified in the applicable material specifications.

[d] Normalized or normalized and tempered.

[e] AISI and UNS designations are only a description of chemical analyses of types of steels; they are not procurement specifications. All materials should be purchased to a specification that adequately defines the required properties and controls.

[f] TFE = tetrafluoroethylene

[g] See nomenclature in cross-sections of either the centrifugal or axial compressor for part names in Annex C

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Table D.1 *(continued)*

Component[g]	Materials[a]	Specification[b,e]	Equivalent JIS Material	Equivalent EN Material		Form	Temperature limits[c]	
							Minimum °C (°F)	Maximum °C (°F)
		ASTM A 508, Class 5a [now: Grade 5 Class 2]	JIS G3204 SFVQ3	20NiCrMo14-6	1.6742	Forged	-28 (-20)	345 (650)
		ASTM A 350, Grade LF2	JIS G3205 SFL2	EN 10222-3 12Ni14	1.5637	Forged	-45 (-50)	345 (650)
		ASTM A 350, Grade LF3	JIS G3205 SFL3	EN 10222-3 12Ni14	1.5637	Forged	-100 (-150)	345 (650)
		ASTM A266 CL.1	JIS G3202 SFVC1			Forged	-28 (-20)	345 (650)
		ASTM A662 Grade B	JIS G3205 SFL1	EN 10028-4 P355N EN 10028-4 P355NL2	1.0562 1.1106	Plate	-45 (-50)	345 (650)
		ASTM A 765 Grade IV	JIS G3201 SF490A	EN 10222-4 P355QH1	1.0571	Forged	-30 (-20)	345 (650)
		ASTM A 350 Grade LF6 Class 1	JIS G3201 SF340A	DIN 17103 TStE 355	1.0566	Forged	-50 (-60)	345 (650)
	Stainless steel	ASTM A 240, Type 304, 304L, 316, 316L	304: JIS G4304 SUS304, JIS G4305 SUS304 304L: JIS G4304 SUS304L, JIS G4305 SUS304L 316: JIS G4304 SUS316, JIS G4305 SUS316 316L: JIS G4304 SUS316L	304: EN 10028-7 X5CrNi18-10 304L: EN 10028-7 X2CrNi18-9 316: EN 10028-7 X5CrN-iMo17-12-2 316L: EN 10028-7	1.4301 1.4307 1.4401 1.4404 1.4571 1.4541	Plate	-195 (-320)	345 (650)
		ASTM A 240, Type 321	JIS G4305 SUS316L 321:JIS G4304 SUS321, JIS G4305 SUS321	X2CrNiMo17-12-2 or EN 10028-7 X5CrNiMoTi17-12-2 321: EN 10028-7 X5Cr-NiTi18-10		Plate	-195 (-320)	345 (650)

[a] The materials shown in this table are those commonly used by compressor manufacturers, but the list is not all inclusive. Other suitable materials may exist and may be used as indicated by specific design considerations.

[b] Descriptions of AISI Types (cross-referenced to UNS) can be found in SAE HS1086. Descriptions of UNS Types can also be found in ASTM DS 56J.

[c] The temperature limits shown in this table are those commonly observed by compressor manufacturers and are not necessarily the same as any temperature limits specified in the applicable material specifications.

[d] Normalized or normalized and tempered.

[e] AISI and UNS designations are only a description of chemical analyses of types of steels; they are not procurement specifications. All materials should be purchased to a specification that adequately defines the required properties and controls.

[f] TFE = tetrafluoroethylene

[g] See nomenclature in cross-sections of either the centrifugal or axial compressor for part names in Annex C

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Table D.1 *(continued)*

Component[g]	Materials[a]	Specification[b,e]	Equivalent JIS Material	Equivalent EN Material		Form	Temperature limits[c]	
							Minimum °C (°F)	Maximum °C (°F)
		ASTM A 182, Grade F304, F304L, F316	F304: JIS G3214 SUS F304 F304L: JIS G3214 SUS F304L F316: JIS G3214 SUS F316	F304: EN 10222-5 X5CrNi18-10 F304L: EN 10222-5 X2CrNi18-9 F316: EN 10222-5 X5CrNiMo17-12-2 or EN 10222-5 X5CrNiMoTi17-12-2 F321: EN 10222-5 X5CrNiTi18-10	1.4301 1.4307 1.4401 1.4571 1.4541	Forged	-195 (-320)	345 (650)
		ASTM A 182, Grade F321	F321: JIS G3214 SUS F321			Forged	-195 (-320)	345 (650)
		ASTM A 182, Grade F 6NM	JIS G3214 SUS F6 NM	EN 10222-5 X3CrNiMo13-4	1.4313	Forged	-45 (-50)	345 (650)
		AISI Type 304L	JIS G4304 SUS 304L, JIS G4305 SUS 304L			Plate	-195 (-320)	345 (650)
	Aluminium	ASTM B 209, Alloy 6061 or 7075	6061: JIS H4000 6061 7075: JIS H4000 7075			Plate	-195 (-320)	150 (300)
		ASTM B 211, Alloy 6061 or 7075	6061: JIS H4040 6061 7075: JIS H4040 7075			Bar	-195 (-320)	150 (300)
		ASTM B 247, Alloy 6061 or 7075	6061: JIS H4140 6061 7075: JIS H4140 7050			Forged	-195 (-320)	150 (300)
		AMS 4108, Alloy 7050	JIS H4140 7050			Forged	-195 (-320)	150 (300)
Diaphragms, guide vanes and inner casings								
	Cast iron	ASTM A 48 or A 278, Class 30	JIS G5501 FC250	EN 1561 EN-GJL-250	EN-JL1040	Cast	-195 (-320)	345 (650)

[a] The materials shown in this table are those commonly used by compressor manufacturers, but the list is not all inclusive. Other suitable materials may exist and may be used as indicated by specific design considerations.

[b] Descriptions of AISI Types (cross-referenced to UNS) can be found in SAE HS1086. Descriptions of UNS Types can also be found in ASTM DS 56J.

[c] The temperature limits shown in this table are those commonly observed by compressor manufacturers and are not necessarily the same as any temperature limits specified in the applicable material specifications.

[d] Normalized or normalized and tempered.

[e] AISI and UNS designations are only a description of chemical analyses of types of steels; they are not procurement specifications. All materials should be purchased to a specification that adequately defines the required properties and controls.

[f] TFE = tetrafluoroethylene

[g] See nomenclature in cross-sections of either the centrifugal or axial compressor for part names in Annex C

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Table D.1 *(continued)*

Component[g]	Materials[a]	Specification[b,e]	Equivalent JIS Material	Equivalent EN Material		Form	Temperature limits[c]	
							Minimum °C (°F)	Maximum °C (°F)
	Ductile iron	ASTM A 536	JIS G5502	EN 1563 EN-GJS-400-15U	EN-JS1072	Cast	-195 (-320)	345 (650)
	Cast steel	ASTM A 216, Grade WCB	JIS G5102 SCW450	EN 10213 GP240GH ISO 4991 G240 similar reference DIN 1681 GS-38	1.0619 1.0420	Cast	-195 (-320)	345 (650)
	Steel	ASTM A 283, A 284, A 285, A 516 or	JIS G3101 SS400	EN 10025 S235JR EN 10025 S355J2+N	1.0038 1.0577	Plate	-195 (-320)	345 (650)
		A 543				Plate	-195 (-320)	345 (650)
		ASTM A 36	JIS G3101 SS400	EN 10025 S235JR	1.0038	Plate	-195 (-320)	345 (650)
	Stainless steel	ASTM A 743/744 or A 351, Grade CA15,	JIS G5121 SCS13A, JIS G5121 SCS19A	CF8: EN 10213 GX5CrNi19-10 or SEW 685 GX6CrNi18-10 CF8M: EN 10213 GX5CrN-iMo19-11-2	1.4308 1.6902 1.4408	Cast	-195 (-320)	345 (650)
		CF3, CF3M, CF8 or CF8M				Cast	-195 (-320)	345 (650)
		ASTM A 240, Type 410	JIS G4304 SUS410, JIS G4305 SUS410	EN 10088-2 X12Cr13	1.4006	Plate	-195 (-320)	345 (650)
		ASTM A 276, Type 410	JIS G4303 SUS410	EN 10088-3 X12Cr13	1.4006	Bar	-195 (-320)	345 (650)
		AISI Type 304	JIS G4304 SUS304, JIS G4305 SUS 304			Plate	-195 (-320)	345 (650)
		AISI Type 304L	JIS G4304 SUS 304L, JIS G4305 SUS 304L	similar reference EN 10250 X6CrNiTi18-10	1.4541	Plate	-195 (-320)	345 (650)

[a] The materials shown in this table are those commonly used by compressor manufacturers, but the list is not all inclusive. Other suitable materials may exist and may be used as indicated by specific design considerations.

[b] Descriptions of AISI Types (cross-referenced to UNS) can be found in SAE HS1086. Descriptions of UNS Types can also be found in ASTM DS 56J.

[c] The temperature limits shown in this table are those commonly observed by compressor manufacturers and are not necessarily the same as any temperature limits specified in the applicable material specifications.

[d] Normalized or normalized and tempered.

[e] AISI and UNS designations are only a description of chemical analyses of types of steels; they are not procurement specifications. All materials should be purchased to a specification that adequately defines the required properties and controls.

[f] TFE = tetrafluoroethylene

[g] See nomenclature in cross-sections of either the centrifugal or axial compressor for part names in Annex C

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Table D.1 *(continued)*

Component[g]	Materials[a]	Specification[b,e]	Equivalent JIS Material	Equivalent EN Material		Form	Temperature limits[c]	
							Minimum °C (°F)	Maximum °C (°F)
		ASTM A 182, Grade F321, F316Ti	F321: JIS G 3214 SUS F 321 F316Ti:	F316 Ti: EN 10250 X6CrNi-MoTi17-12-2 F321: EN 10250 X6Cr-NiTi18-10	1.4571 1.4541	Forged	-195 (-320)	345 (650)
		ASTM A662 Grade B	JIS G3205 SFL1	EN 10028-4 P355N EN 10028-4 P355NL2	1.0562 1.1106	Plate	-195 (-320)	345 (650)
		ASTM A 350 Grade LF6 Class 1	JIS G3201 SF340A	DIN 17103 TStE 355	1.0566	Forged	-195 (-320)	345 (650)
		ASTM A 182, Grade F 6NM	JIS G3214 SUS F6NM	EN 10250 X3CrNiMo13-4	1.4313	Forged	-195 (-320)	345 (650)
		ASTM A 487 Grade CA6NM Class A and B	JIS G 5121 SCS6	EN 10213 GX4CrNi13-4	1.4317	Cast	-195 (-320)	345 (650)
		ASTM A 757 Grade E3N	JIS G5152 1991 SCPL1	EN 10213 GX3CrNi13-4	1.6982	Cast	-195 (-320)	345 (650)
	Aluminium	ASTM B 26, Alloy 355 or C355	JIS H5202 AC4D	n.a.		Cast	-195 (-320)	345 (650)
Fixed, Pre-whirl, De-whirl and Variable Stator Vanes								
	Stainless Steel	ASTM A478 Type 347				Bar	-195 (-320)	345 (650)
		ASTM A240 Type 304 or 304L				Plate	-195 (-320)	345 (650)
		ASTM A276 Type 316/316L				Bar	-195 (-320)	345 (650)

[a] The materials shown in this table are those commonly used by compressor manufacturers, but the list is not all inclusive. Other suitable materials may exist and may be used as indicated by specific design considerations.

[b] Descriptions of AISI Types (cross-referenced to UNS) can be found in SAE HS1086. Descriptions of UNS Types can also be found in ASTM DS 56J.

[c] The temperature limits shown in this table are those commonly observed by compressor manufacturers and are not necessarily the same as any temperature limits specified in the applicable material specifications.

[d] Normalized or normalized and tempered.

[e] AISI and UNS designations are only a description of chemical analyses of types of steels; they are not procurement specifications. All materials should be purchased to a specification that adequately defines the required properties and controls.

[f] TFE = tetrafluoroethylene

[g] See nomenclature in cross-sections of either the centrifugal or axial compressor for part names in Annex C

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Table D.1 *(continued)*

Component[g]	Materials[a]	Specification[b,e]	Equivalent JIS Material	Equivalent EN Material		Form	Temperature limits[c]	
							Minimum °C (°F)	Maximum °C (°F)
Shaft, Stub Shafts, Shaft Drums								
	Steel	ASTM A 470, Class 1	similar reference JIS G3201 SF540A			Forged	-28 (-20)	345 (650)
		ASTM A 470, Class 7	similar reference JIS G3204 SFVQ3(WH 社 10325UA-UE)	SEW 555 26NiCrMoV11-5 SEW 555 26NiCrMoV14-5	1.6948 1.6957	Forged	-115 (-175)	400 (750)
		AISI Type 4340	JIS G4053 SNCM439	EN 10083-3 30CrNiMo8	1.6580	Forged	-115 (-175)	345 (650)
		AISI Type 4140	JIS G4053 SCM440	EN 10083-3 42CrMo4	1.7225	Forged	-28 (-20)	400 (750)
		AISI Types 1040-1050[C]	JIS G4051 S40C	EN 10083-2 C45E	1.1191	Bar or Forged	-28 (-20)	345 (650)
		AISI Types 4140-4150[C]	JIS G4053 SCM440	EN 10083-3 42CrMo4	1.7225	Bar or Forged	-28 (-20)	400 (750)
		AISI Type 2320[C]	NA			Bar or Forged	-110 (-170)	345 (650)
		AISI Type 2330	NA			Bar or Forged	-110 (-170)	345 (650)
		ASTM A 522, Type 1	JIS G3127 SL9N520	EN 10222-3 X8Ni9	1.5662	Forged	-195 (-320)	345 (650)
		ASTM 4340-4345	ASTM may be replaced to AISI. JIS G4053 SNCM439	EN 10083-3 30CrNiMo8 ISO 4957 55NiCrMoV7	1.6580 1.2714	Forged	-115 (-175)	345 (650)
	Stainless steel	ASTM A 336, Grade F6	G3214 SUS F410-C	EN 10088-3 X12Cr13	1.4006	Forged	-60 (-75)	345 (650)
		ASTM A 473, Type 410	JIS G3214 SUS F410	EN 10088-3 X12Cr13	1.4006	Forged	-60 (-75)	345 (650)

[a] The materials shown in this table are those commonly used by compressor manufacturers, but the list is not all inclusive. Other suitable materials may exist and may be used as indicated by specific design considerations.

[b] Descriptions of AISI Types (cross-referenced to UNS) can be found in SAE HS1086. Descriptions of UNS Types can also be found in ASTM DS 56J.

[c] The temperature limits shown in this table are those commonly observed by compressor manufacturers and are not necessarily the same as any temperature limits specified in the applicable material specifications.

[d] Normalized or normalized and tempered.

[e] AISI and UNS designations are only a description of chemical analyses of types of steels; they are not procurement specifications. All materials should be purchased to a specification that adequately defines the required properties and controls.

[f] TFE = tetrafluoroethylene

[g] See nomenclature in cross-sections of either the centrifugal or axial compressor for part names in Annex C

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Table D.1 *(continued)*

Component[g]	Materials[a]	Specification[b,e]	Equivalent JIS Material	Equivalent EN Material		Form	Temperature limits[c]	
							Minimum °C (°F)	Maximum °C (°F)
		ASTM A1021, Grade D Class 2 (422)	NA			Forged	-60 (-75)	345 (650)
		ASTM A 182, Grade F 6NM	JIS G3214 SUS F6 NM	EN 10250 X3CrNiMo13-4	1.4313	Forged	-60 (-75)	345 (650)
	Precipitation hardening stainless steel	ASTM A 705, Types 630 or XM-12	JIS G3214 SUS F630	EN 10250 X5CrNiCuNb16-4	1.4542	Forged	-75 (-100)	345 (650)
		ASTM A 564, Type 630 or XM-12	JIS G4303 SUS630	EN 10250 X5CrNiCuNb16-4	1.4542	Bar	-270 (-454)	345 (650)
Thru-Bolts (Axial Rotor)								
	Stainless steel	UNS S45000	NA			Bar	-60 (-75)	345 (650)
		UNS S42200	JIS G4303 SUS410 (Similar reference)			Bar	-60 (-75)	345 (650)
Impellers								
Cast	Aluminium	ASTM B 26, Alloy C355	JIS H5202 AC4C			Cast	-195 (-320)	150 (300)
	Precipitation hardening stainless steel	ASTM A 747, Type CB7CU-1 or CB7CU-2	G5121 SCS 24			Cast	-75 (-100)	345 (650)
	Steel	ASTM A 148	JIS G5111			Cast	-28 (-20)	345 (650)
		ASTM A 487 Gs 4Q	JIS G5111 SCMnCrM2			Cast	-45 (-50)	345 (650)
	Stainless steel	ASTM A 743/744 or A 351, Grade CA15	JIS G5121 SCS1			Cast	-45 (-50)	345 (650)
		or CA6NM				Cast	-45 (-50)	345 (650)

[a] The materials shown in this table are those commonly used by compressor manufacturers, but the list is not all inclusive. Other suitable materials may exist and may be used as indicated by specific design considerations.

[b] Descriptions of AISI Types (cross-referenced to UNS) can be found in SAE HS1086. Descriptions of UNS Types can also be found in ASTM DS 56J.

[c] The temperature limits shown in this table are those commonly observed by compressor manufacturers and are not necessarily the same as any temperature limits specified in the applicable material specifications.

[d] Normalized or normalized and tempered.

[e] AISI and UNS designations are only a description of chemical analyses of types of steels; they are not procurement specifications. All materials should be purchased to a specification that adequately defines the required properties and controls.

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Table D.1 *(continued)*

Component[g]	Materials[a]	Specification[b,e]	Equivalent JIS Material	Equivalent EN Material		Form	Temperature limits[c]	
							Minimum °C (°F)	Maximum °C (°F)
		ASTM A 743/744 or A 351, Grade CF3, CF3M,	CF3: JIS G5121 SCS19A CF3M: JIS G5121 SCS16A			Cast	-195 (-320)	345 (650)
		CF8 or CF8M	CF8: JIS G5121 SCS13A CF8M: JIS G5121 SCS14A			Cast	-195 (-320)	345 (650)
	Aluminium	ASTM A 356 or A 357	JIS G5151			Cast	-195 (-320)	150 (300)
	Titanium	ASTM B 367, Grade C3 or C4	C3: JIS H4600 2 C4: NA			Cast	-45 (-50)	345 (650)
		ASTM B 367, Grade C5	JIS H4600 3 種。			Cast	-195 (-320)	345 (650)
Fabricated (covers, hubs, blades)	Aluminium	ASTM B 209, Alloy 6061 or 7075	6061: JIS H4000 6061 7075: JIS H4000 7075			Plate	-195 (-320)	150 (300)
		ASTM B 211, Alloy 6061 or 7075	6061: JIS H4040 6061 7075: JIS H4040 7075			Bar	-195 (-320)	150 (300)
		ASTM B 221, Alloy 6061 or 7075	6061: JIS H4040 6061 7075: JIS H4040 7075			Extruded	-195 (-320)	150 (300)
		ASTM B 247, Alloy 2618,	2618: JIS H4140 2618			Forged	-195 (-320)	150 (300)
		6061 or 7075	6061: JIS H4140 6061 7075: JIS H4140 7050			Forged	-195 (-320)	150 (300)
		AMS 4108, Alloy 7050	JIS H4140 7050			Forged	-195 (-320)	150 (300)
Impellers Fabricated	Steel	AISI Types 4130-4140[C]	JIS G4053 SCM430	EN 10083-3 42CrMo4	1.7225	Plate or Forged	-28 (-20)	400 (750)

[a] The materials shown in this table are those commonly used by compressor manufacturers, but the list is not all inclusive. Other suitable materials may exist and may be used as indicated by specific design considerations.

[b] Descriptions of AISI Types (cross-referenced to UNS) can be found in SAE HS1086. Descriptions of UNS Types can also be found in ASTM DS 56J.

[c] The temperature limits shown in this table are those commonly observed by compressor manufacturers and are not necessarily the same as any temperature limits specified in the applicable material specifications.

[d] Normalized or normalized and tempered.

[e] AISI and UNS designations are only a description of chemical analyses of types of steels; they are not procurement specifications. All materials should be purchased to a specification that adequately defines the required properties and controls.

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Table D.1 *(continued)*

Component[g]	Materials[a]	Specification[b,e]	Equivalent JIS Material	Equivalent EN Material		Form	Temperature limits[c]	
							Minimum °C (°F)	Maximum °C (°F)
		AISI Types 4320-4345[C]	JIS G4053 SNCM431	EN 10083-3 30CrNiMo8	1.6580	Plate or Forged	-115 (-175)	400 (750)
		ASTM A 470, Class 8	JIS G3221 SFCM 740S (Similar reference)	14CrMoV6-9	1.7735	Forged	-45 (-50)	400 (750)
		AISI Type 3140[C]	similar reference JIS G4102 SNC236			Forged	-45 (-50)	400 (750)
		ASTM A 543	JIS G3101 SS400			Plate	-115 (-175)	400 (750)
		ASTM A 522, Type I	JIS G3127 SL9N520	EN 10222-3 X8Ni9	1.5662	Forged	-145 (-230)	345 (650)
		ASTM A 522, Type II	JIS G3127 SL9N520	EN 10222-3 X8Ni9	1.5662	Forged	-170 (-275)	345 (650)
		ASTM A 353	JIS G3127 SL9N520	EN 10222-3 X8Ni9	1.5662	Plate	-195 (-320)	345 (650)
		AISI Type 403[C]	JIS G3214 SUS F403	EN 10088-3 X6Cr13	1.4000	Forged	-60 (-75)	345 (650)
		ASTM A 473, Type 410	JIS G3214 SUS F410	EN 10088-3 X12Cr13	1.4006	Forged	-60 (-75)	345 (650)
		ASTM A 240, Type 304, 304L, 316	304: JIS G4304 SUS304, JIS G4305 SUS304 304L: JIS G4304 SUS304L, JIS G4305 SUS304L 316: JIS G4304 SUS316, JIS G4305 SUS316 316L: JIS G4304 SUS316L, JIS G4305 SUS316L	304: EN 10028-7 X5CrNi18-10 304L: EN 10028-7 X2CrNi18-9 316: EN 10028-7 X5CrN-iMo17-12-2 316L: EN 10028-7 X2CrN-iMo17-12-2	1.4301 1.4307 1.4401 1.4404	Plate	-195 (-320)	345 (650)

[a] The materials shown in this table are those commonly used by compressor manufacturers, but the list is not all inclusive. Other suitable materials may exist and may be used as indicated by specific design considerations.

[b] Descriptions of AISI Types (cross-referenced to UNS) can be found in SAE HS1086. Descriptions of UNS Types can also be found in ASTM DS 56J.

[c] The temperature limits shown in this table are those commonly observed by compressor manufacturers and are not necessarily the same as any temperature limits specified in the applicable material specifications.

[d] Normalized or normalized and tempered.

[e] AISI and UNS designations are only a description of chemical analyses of types of steels; they are not procurement specifications. All materials should be purchased to a specification that adequately defines the required properties and controls.

[f] TFE = tetrafluoroethylene

[g] See nomenclature in cross-sections of either the centrifugal or axial compressor for part names in Annex C

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Table D.1 *(continued)*

Component[g]	Materials[a]	Specification[b,e]	Equivalent JIS Material	Equivalent EN Material		Form	Temperature limits[c]	
							Minimum °C (°F)	Maximum °C (°F)
		ASTM A 473, Type 304, 304L, 316, or 316L	304: JIS G3214 SUS F304 304L: JIS G3214 SUS F304L 316: JIS G3214 SUS F316 316L: JIS G3214 SUS F316L	F304: EN 10222-5 X5CrNi18-10 F304L: EN 10222-5 X2CrNi18-9 F316: EN 10222-5 X5CrN-iMo17-12-2 F316L: EN 10222-5 X2CrN-iMo17-12-2	1.4301 1.4307 1.4401 1.4404	Forged	-195 (-320)	345 (650)
		UNS S42400	NA	EN 10250 X3CrNiMo13-4	1.4313	Forged	-101 (-150)	345 (650)
		AISI Type 410	JIS G4303 SUS410	NA		Forged	-60 (-75)	345 (650)
		ASTM A 638 Grade 660 Type 2 (A286)	JIS G4311 SUH660	EN 10302 X6NiCrTi-MoVB25-15-2	1.4980			345 (650)
	Precipitation hard-ening stainless steel	ASTM A 705, Type 630 or XM-12	JIS G3214 SUS F630	EN 10250 X5CrNiCuNb16-4	1.4542	Forged	-75 (-100)	345 (650)
		AISI S17400	JIS G4303 SUS630				-75 (-100)	345 (650)
		ASTM A 693, Type 630 or XM-12	JIS G4304 SUS630, JIS G4305 SUS630	EN 10088-2 X5CrNiCuNb16-4	1.4542	Plate	-75 (-100)	345 (650)
	Ni-based	AMS 5662 Alloy 718	JIS G4902 NCF718			Forged	-110 (-170)	345 (650)
	Ni-Cu	SAE AMS 4646	NA			Forged	-115 (-175)	345 (650)
		ASTM B 127	JIS H4551			Plate	-115 (-175)	345 (650)
		QQ-N-286	JIS H4551 NW5500			Plate	-115 (-175)	345 (650)
		ASTM B 865 UNS N05500	JIS H4551 NW5500	DIN 17743 NiCu30Al ISO 9725 NiCu30Al3Ti	2.4375 NW5500	Forging	-115 (-175)	345 (650)

[a] The materials shown in this table are those commonly used by compressor manufacturers, but the list is not all inclusive. Other suitable materials may exist and may be used as indicated by specific design considerations.

[b] Descriptions of AISI Types (cross-referenced to UNS) can be found in SAE HS1086. Descriptions of UNS Types can also be found in ASTM DS 56J.

[c] The temperature limits shown in this table are those commonly observed by compressor manufacturers and are not necessarily the same as any temperature limits specified in the applicable material specifications.

[d] Normalized or normalized and tempered.

[e] AISI and UNS designations are only a description of chemical analyses of types of steels; they are not procurement specifications. All materials should be purchased to a specification that adequately defines the required properties and controls.

[f] TFE = tetrafluoroethylene

[g] See nomenclature in cross-sections of either the centrifugal or axial compressor for part names in Annex C

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Table D.1 *(continued)*

Component[g]	Materials[a]	Specification[b,e]	Equivalent JIS Material	Equivalent EN Material		Form	Temperature limits[c]	
							Minimum °C (°F)	Maximum °C (°F)
	Titanium	ASTM B 381 Grade F5	JIS H4657 TAF6400	DIN 17864 TiAl6V4	3.7165	Forging	-195 (-320)	345 (650)
Rotor Blades								
	Stainless Steel	UNS S45000				Forged or Bar	-60 (-75)	345 (650)
		UNS S42200	JIS G4303 SUS410 (Similar reference)			Forged or Bar	-60 (-75)	345 (650)
	Titanium	AMS 4928 Ti-6Al-4V	JIS H4600 TAP6400H			Forged or Bar	-60 (-75)	345 (650)
Labyrinths, impeller interstage, shaft seal, balance piston, thrust seal, inlet and discharge shaft seals								
	Aluminium	ASTM B 26, Alloy 443, 335, 850,	JIS H5202	EN 586		Cast	-195 (-320)	315 (600)
		AA -A850 or B850				Cast	-195 (-320)	315 (600)
		6061-T6 or 1100	6061: JIS H4000 6061 1100: JIS H4000 1100			Plate	-195 (-320)	315 (600)
		ASTM B 209 Grade 5083	JIS H4000 A 5083 P	EN 586 EN-AW-5083 [Al Mg4.5Mn0.7]	AW5083	Plate	-195 (-320)	315 (600)
	Babbit	ASTM B 23	JIS H5401			Cast	-195 (-320)	175 (350)

[a] The materials shown in this table are those commonly used by compressor manufacturers, but the list is not all inclusive. Other suitable materials may exist and may be used as indicated by specific design considerations.

[b] Descriptions of AISI Types (cross-referenced to UNS) can be found in SAE HS1086. Descriptions of UNS Types can also be found in ASTM DS 56J.

[c] The temperature limits shown in this table are those commonly observed by compressor manufacturers and are not necessarily the same as any temperature limits specified in the applicable material specifications.

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Table D.1 *(continued)*

Component[g]	Materials[a]	Specification[b,e]	Equivalent JIS Material	Equivalent EN Material		Form	Temperature limits[c]	
							Minimum °C (°F)	Maximum °C (°F)
	Brass	ASTM B 16 or B 21	JIS H3250	EN 12420		Rod, Bar	-195 (-320)	150 (300)
		ASTM B 36	JIS H3100	EN 1652		Plate, Bar	-195 (-320)	150 (300)
		ASTM B 171	JIS H3100	EN 1652		Plate	-195 (-320)	150 (300)
		ASTM B 564 UNS N04400	JIS H4551 NW4400	DIN 17743 NiCu30Fe ISO 9725 NiCu30	2.4360 NW4400		-195 (-320)	150 (300)
	Stainless steel	AISI Types 403, 410, 416,	403: JIS G3214 SUS F403 410: JIS G3214 SUS F410 416: JIS G3214 SUS F416	EN 10088-3 X6Cr13 EN 10088-3 X12Cr13 additional: X19CrMo12-1	1.4000 1.4006 1.4921	Wrought	-195 (-320)	345 (650)
		420,	420: JIS G4304 SUS 420J2 , JIS G4305 SUS 420J2	EN 10088-3 X20Cr13	1.4021	Wrought	-195 (-320)	345 (650)
		303, 304, or 316	403: JIS G3214 SUS F303 410: JIS G3214 SUS F304 416: JIS G3214 SUS F316	EN 10088-3 X6CrNiTi18-10 EN 10088-3 X6CrNi-MoTi17-12-2	1.4541 1.4571	Wrought	-195 (-320)	345 (650)
	Cr-Ni-Fe-Mo-Cu-Cb	ASTM B 462	JIS H4551 NW6007	EN 10088-3 X1NiCrMo-CuN25-20-7	1.4529	Wrought	-195 (-320)	345 (650)

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[b] Descriptions of AISI Types (cross-referenced to UNS) can be found in SAE HS1086. Descriptions of UNS Types can also be found in ASTM DS 56J.

[c] The temperature limits shown in this table are those commonly observed by compressor manufacturers and are not necessarily the same as any temperature limits specified in the applicable material specifications.

[d] Normalized or normalized and tempered.

[e] AISI and UNS designations are only a description of chemical analyses of types of steels; they are not procurement specifications. All materials should be purchased to a specification that adequately defines the required properties and controls.

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Table D.1 *(continued)*

Component[g]	Materials[a]	Specification[b,e]	Equivalent JIS Material	Equivalent EN Material		Form	Temperature limits[c]	
							Minimum °C (°F)	Maximum °C (°F)
	Stainless steel honeycomb	ASTM A 240, Type 304, 304L, 316 or 316L	304: JIS G4304 SUS304, JIS G4305 SUS304 304L: JIS G4304 SUS304L, JIS G4305 SUS304L 316: JIS G4304 SUS316, JIS G4305 SUS316 316L: JIS G4304 SUS316L, JIS G4305 SUS316L	304: EN 10028-7 X5CrNi18-10 304L: EN 10028-7 X2CrNi18-9 316: EN 10028-7 X5CrN-iMo17-12-2 316L: EN 10028-7 X2CrN-iMo17-12-2	1.4301 1.4307 1.4401 1.4404	Fabricated	-195 (-320)	345 (650)
	Ni-Cu alloy	ASTM B 164	JIS H4553	DIN 17743 NiCu30Fe ISO 9725 NiCu30	2.4360 NW4400	Wrought	-115 (-175)	345 (650)
	Nonmetallic TFE[f]					Molded	-195 (-320)	260 (500)
	Nonmetallic TFE[f]					Molded	-28 (-20)	260 (500)
	carbon-filled							
	Nonmetallic TFE[f]					Molded	-54 (-65)	260 (500)
	mica-filled							
	Polyamide-Imide (PAI)					Molded	-100 (-150)	300 (570)
	Polyetheretherketone (PEEK)					Molded	-100 (-150)	160 (320)
	Polyaryletherketone (PEK)					Molded	-100 (-150)	195 (380)
	Lead	ASTM B 29	H2105	NA		Cast	-101 (-150)	205 (400)

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[b] Descriptions of AISI Types (cross-referenced to UNS) can be found in SAE HS1086. Descriptions of UNS Types can also be found in ASTM DS 56J.

[c] The temperature limits shown in this table are those commonly observed by compressor manufacturers and are not necessarily the same as any temperature limits specified in the applicable material specifications.

[d] Normalized or normalized and tempered.

[e] AISI and UNS designations are only a description of chemical analyses of types of steels; they are not procurement specifications. All materials should be purchased to a specification that adequately defines the required properties and controls.

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Table D.1 *(continued)*

Component[g]	Materials[a]	Specification[b,e]	Equivalent JIS Material	Equivalent EN Material		Form	Temperature limits[c]	
							Minimum °C (°F)	Maximum °C (°F)
	Nickel-graphite					Coating	-101 (-150)	482 (900)
	Phenolic resin	Micarta, NEMA, Grade LE	NA			Sheet	-195 (-320)	65 (130)
	impregnated materials							
		Micarta, NEMA, Grade G10 or G9	NA			Sheet	-195 (-320)	110 (230)
Balance piston	Steel(new)	ASTM A 470, Class 1	similar reference JIS G3201 SF540A			Forged	-28 (-20)	345 (600)
		ASTM A 470, Class 7	similar reference JIS G3204 SFVQ3	SEW 555 26NiCrMoV11-5 SEW 555 26NiCrMoV14-5	1.6948 1.6957	Forged	-115 (-175)	400 (750)
		AISI Types, 1040-1050[c]	JIS G4051 S40C	EN 10083-2 C45E	1.1191	Forged	-28 (-20)	345 (650)
		AISI Types, 4130-4145[c]	JIS G4053 SCM440	EN 10083-3 42CrMo4	1.7225	Forged	-28 (-20)	400 (750)
		AISI Types, 4330, 4340, 4345[c]	JIS G4053 SNCM431	EN 10083-3 30CrNiMo8	1.6580	Forged	-115 (-175)	455 (850)
		AISI Type 2320[c]	NA			Forged	-112 (-170)	345 (650)
		ASTM A 522, Type I	JIS G3127 SL9N520	EN 10222-3 X8Ni9	1.5662	Forged	-195 (-320)	345 (650)
	Stainless steel(new)	ASTM A 336, Grade F6	G3214 SUS F410-C			Forged	-60 (-75)	345 (650)
		ASTM A 473, Type 410	JIS G3214 SUS F410	EN 10088-3 X12Cr13	1.4006	Forged	-60 (-75)	345 (650)
		AISI Type 403 or 410[c]	403: JIS G3214 SUS F403 410: JIS G3214 SUS F410	EN 10088-3 X6Cr13 EN 10088-3 X12Cr13	1.4000 1.4006	Forged	-28 (-20)	345 (650)

[a] The materials shown in this table are those commonly used by compressor manufacturers, but the list is not all inclusive. Other suitable materials may exist and may be used as indicated by specific design considerations.

[b] Descriptions of AISI Types (cross-referenced to UNS) can be found in SAE HS1086. Descriptions of UNS Types can also be found in ASTM DS 56J.

[c] The temperature limits shown in this table are those commonly observed by compressor manufacturers and are not necessarily the same as any temperature limits specified in the applicable material specifications.

[d] Normalized or normalized and tempered.

[e] AISI and UNS designations are only a description of chemical analyses of types of steels; they are not procurement specifications. All materials should be purchased to a specification that adequately defines the required properties and controls.

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Table D.1 *(continued)*

Component[g]	Materials[a]	Specification[b,e]	Equivalent JIS Material	Equivalent EN Material		Form	Temperature limits[c]	
							Minimum °C (°F)	Maximum °C (°F)
	Precipitation hardening stainless steel	ASTM A 705, Type 630 or XM-12	JIS G3214 SUS F630	EN 10250 X5CrNiCuNb16-4	1.4542	Forged	-75 (-100)	345 (650)
		ASTM A 470, Class 8	JIS G 3221 SFCM 740S (Similar reference)	14CrMoV6-9	1.7735	Forged	-45 (-50)	400 (750)
		UNS S42400	NA	EN 10250 X3CrNiMo13-4	1.4313	Forged	-101 (-150)	345 (650)
		ASTM A 638 Grade 660 Type 2 (A286)	JIS G4311 SUH660	EN 10302 X6NiCrTi-MoVB25-15-2	1.4980			
	Ni-Cu alloy	ASTM B 865 UNS N05500	JIS H4551 NW5500	DIN 17743 NiCu30Al ISO 9725 NiCu30Al3Ti	2.4375 NW5500	Forging	-115 (-175)	345 (650)
		SAE AMS 4676	NA			Forged	-115 (-175)	345 (650)
Shaft sleeves	Steel	AISI Types, 4130-4150[c]	JIS G4053 SCM440	EN 10083-3 42CrMo4	1.7225	Forged	-45 (-50)	345 (650)
		AISI Types, 4320, 4345[c]	JIS G4053 SNCM431	EN 10083-3 30CrNiMo8	1.6580	Forged	-115 (-175)	400 (750)
		AISI Type 4330[c]	JIS G4053 SNCM431			Forged	-115 (-175)	400 (750)
		ASTM A 470, Class 7	similar reference JIS G3201 SF540A	SEW 555 26NiCrMoV11-5 SEW 555 26NiCrMoV14-5	1.6948 1.6957	Forged	-115 (-175)	400 (750)
		ASTM A 522, Type I	JIS G3127 SL9N520	EN 10222-3 X8Ni9	1.5662	Forged	-195 (-320)	345 (650)
		ASTM A 106	JIS G3456	EN 10216		Pipe	-28 (-20)	345 (650)
		ASTM A 350	JIS G3205	EN 10250		Forged	-45 (-50)	345 (650)
		ASTM A 350, Grade LF-3	JIS G3205 SFL3	EN 10250 12Ni14	1.5637	Forged	-100 (-150)	345 (650)

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[b] Descriptions of AISI Types (cross-referenced to UNS) can be found in SAE HS1086. Descriptions of UNS Types can also be found in ASTM DS 56J.

[c] The temperature limits shown in this table are those commonly observed by compressor manufacturers and are not necessarily the same as any temperature limits specified in the applicable material specifications.

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