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

**Part 1:  
General requirements**

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

*Partie 1: Exigences générales*

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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](http://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](http://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](http://www.iso.org/foreword)

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 10439-2, 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*

## Introduction

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

Users of this International Standard should be aware that further or differing requirements may 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 may be particularly appropriate where there is innovative or developing technology. Where an alternative is offered, the supplier should identify any variations from this International Standard 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 should be indicated on data sheets or stated in the enquiry or purchase order (see examples in ISO 10439-2:2015, Annex A, ISO 10439-3:2015, Annex A, and ISO 10439-4:2015, Annex A).

This International Standard includes the following annexes:

- [Annex A](#): Procedure for the determination of residual unbalance;
- [Annex B](#): Typical shaft end seals;
- [Annex C](#): Requirements for lateral analysis reports;
- [Annex D](#): Requirements for torsional analysis reports;
- [Annex E](#): Magnetic bearings;
- [Annex F](#): Dry gas seal testing at manufacturer's shop;
- [Annex G](#): Guidelines for anti-surge systems;
- [Annex H](#): Typical bid tab template.

[Annex A](#), [Annex C](#), [Annex D](#), [Annex E](#), and [Annex F](#) form a normative part of this part of ISO 10439. [Annex B](#), [Annex G](#), and [Annex H](#) 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 1: General requirements

### 1 Scope

This International Standard 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 general requirements applicable to all such machines.

This International Standard does not apply to fans (these are covered by API 673) or blowers that develop less than 34 kPa (5 psi) pressure rise above atmospheric pressure. This International Standard also does not apply to packaged, integrally geared centrifugal plant, and instrument air compressors, which are covered by API 672. Hot gas expanders over 300 °C (570 °F) are not covered by this International Standard.

This part of ISO 10439 contains information pertinent to all equipment covered by the other parts of ISO 10439. It shall be used in conjunction with the following parts of ISO 10439, as applicable to the specific equipment covered:

- ISO 10439-2; <https://standards.iteh.ai/catalog/standards/sist/5e587199-4e46-48e5-9900-b42d9777310c/iso-10439-1-2015>
- ISO 10439-3;
- ISO 10439-4.

### 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.

NOTE Typical documents submitted as a user inquiry or order are user specifications, industry specifications, (such as ISO and API specifications), data sheets, meeting notes, and supplemental agreements.

ISO 261, *ISO general purpose metric screw threads — General plan*

ISO 6708, *Pipework components — Definition and selection of DN (nominal size)*

ISO 7005-1, *Pipe flanges — Part 1: Steel flanges for industrial and general service piping systems*

ISO 7005-2, *Metallic flanges — Part 2: Cast iron flanges*

ISO 8068, *Lubricants, industrial oils and related products (class L) — Family T (Turbines) — Specification for lubricating oils for turbines*

ISO 21940-32, *Mechanical vibration — Rotor balancing — Part 32: Shaft and fitment key convention*

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

## ISO 10439-1:2015(E)

ISO 10441, *Petroleum, petrochemical and natural gas industries — Flexible couplings for mechanical power transmission — Special-purpose applications*

ISO 14839-3, *Mechanical vibration — Vibration of rotating machinery equipped with active magnetic bearings — Part 3: Evaluation of stability margin*

ISO 15156-3, *Petroleum and natural gas industries — Materials for use in H<sub>2</sub>S-containing environments in oil and gas production — Part 3: Cracking-resistant CRAs (corrosion-resistant alloys) and other alloys*

IEC 60079-10-1, *Explosive atmospheres — Part 10-1: Classification of areas — Explosive gas atmospheres*

EN 55011, *Industrial scientific and medical (ISM) radio-frequency equipment — Electromagnetic disturbance characteristics — Limits and methods of measurement*

EN 61000-6-2, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments*

API 613, *Special purpose gear units for petroleum, chemical, and gas industry services*

ASME B1.1, *Unified inch screw threads (UN and UNR thread form)*

ASME B16.1, *Grey iron pipe flanges and flanged fittings (Classes 25, 125, and 250)*

ASME B16.11, *Forged fittings, socket-welding and threaded*

ASME B16.42, *Ductile iron pipe flanges and flanged fittings (Classes 150 and 300)*

ASME B16.47, *Large diameter steel flanges NPS 26 through NPS 60 metric/inch standard*

ASME B16.5, *Pipe flanges and flanged fittings NPS ½ through NPS 24 metric/inch standard*

ASME B1.20.1, *Pipe threads, General purpose (Inch)*

ASTM A247, *Standard test method for evaluating the microstructure of graphite in iron castings*

ASTM A395, *Standard specification for ferritic ductile iron pressure-retaining castings for use at elevated temperatures*

ASTM E125, *Standard reference photographs for magnetic particle indications on ferrous castings*

ASTM E165, *Standard practice for liquid penetrant examination for general industry*

ASTM E709, *Standard guide for magnetic particle testing*

AWS D1.1, *Structural welding code*

NACE MR0103, *Standard material requirements — Material resistant to sulfide stress cracking in corrosive petroleum refining environments*

NACE SP0472, *Methods and controls to prevent in-service environmental cracking of carbon steel weldments in corrosive petroleum refining environments*

NFPA 70, *National electrical code*

SAE J518, *Hydraulic flanged tube, pipe, and hose connections, four-bolt split flange type*

## 3 Terms, abbreviated terms and definitions

### 3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

**3.1.1****anchor bolts**

bolts used to attach the mounting plates to the support structure (concrete foundation or steel structure)  
cf. *hold-down bolts* (3.1.11)

**3.1.2****axially split joint**

joint split with the principal face parallel to the shaft centreline

**3.1.3****cartridge bundle assembly**

<centrifugal> assembly consisting of the complete compressor assembly minus the casing

Note 1 to entry: It includes the inner barrel assembly, end heads, seals, bearing housings, and bearings. It also includes the rotor assembly. It is designed to be shop assembled, ready for insertion into the casing to minimize installation work in the field.

**3.1.4****certified point**

point to which the performance tolerances shall be applied

Note 1 to entry: This is usually the normal operating point and suppliers will normally require that this point is within their preferred selection range.

**3.1.5****complex stiffness**

notation for the total equivalent stiffness and damping expression, including the cross-coupled terms as required for the hydrodynamic bearing or squeeze damper oil film

**3.1.6****compliant seal**

seal design that allows rotor or rotor sleeve contact and possible stator element penetration without excessive loss of sealing performance

**3.1.7****compressor rated point**

intersection on the 100 % speed curve corresponding to the highest capacity of any specified operating point

**3.1.8****compressor section**

series of one or more impellers with defined external process conditions (i.e. side streams, bypassing, or injection)

Note 1 to entry: This is generally a derived point rather than an actual operating point (see Figure 1 in ISO 10439-2:2015 for a graphical representation).

**3.1.9****critical speed**

shaft rotational speed at which the rotor-bearing support system is in a state of resonance

**3.1.10****design**

manufacturers' calculated parameter

Note 1 to entry: This is a term used by the equipment manufacturer to describe various parameters such as design power, design pressure, design temperature, or design speed. It is not intended for the purchaser to use this term.

**3.1.11****bull gear****gear wheel**

lowest speed rotor in a gearbox cf. *pinion(s)* (3.1.34)

### 3.1.12

#### **gearing**

pinion(s) and gear wheel combination(s)

Note 1 to entry: A gear mesh is a pinion and gear wheel that operates together. A gear wheel may mesh with more than one pinion and, therefore, be part of more than one gear mesh.

### 3.1.13

#### **hold-down bolts**

bolts holding the equipment to the mounting plate cf. *anchor bolts* (3.1.1)

### 3.1.14

#### **hydrodynamic bearings**

bearings that use the principles of hydrodynamic lubrication

Note 1 to entry: The bearing surfaces are oriented so that relative motion forms an oil wedge, or wedges, to support the load without shaft-to-bearing contact.

### 3.1.15

#### **hysteresis damping**

<internal friction> causes a phase difference between the stress and strain in any material under cyclic loading; this phase difference produces the characteristic hysteric loop on a stress-strain diagram and, thus, a potentially destabilizing damping force

### 3.1.16

#### **inlet volumetric flow**

flow rate expressed in volume flow units at the conditions of pressure, temperature, compressibility, and gas composition, including moisture content, at the machine inlet flange

Note 1 to entry: Inlet volumetric flow is a specific example of actual volumetric flow. Actual volumetric flow is the volume flow at any particular location such as interstage impeller inlet or discharge or machine inlet or discharge. Actual volumetric flow should not be used interchangeably therefore with inlet volumetric flow.

### 3.1.17

#### **inner barrel assembly**

<centrigugal> assembly consisting of the internal stationary parts that make up the removable portion of the flowpath, including the inner barrel, the diaphragms, the impeller eye labyrinths, and the diaphragm labyrinths

### 3.1.18

#### **low temperature service**

service where the specified minimum design metal temperature is below  $-29\text{ °C}$  ( $-20\text{ °F}$ )

### 3.1.19

#### **maximum allowable temperature**

maximum continuous temperature for which the manufacturer has designed the equipment (or any part to which the term is referred)

Note 1 to entry: The maximum allowable temperature is usually set by material considerations.

### 3.1.20

#### **maximum allowable working pressure**

maximum continuous pressure for which the manufacturer has designed the equipment (or any part to which the term is referred)

Note 1 to entry: Normally expected operating conditions can be based on settling-out pressure, maximum suction pressure plus the maximum developed differential pressure at the maximum speed (trip speed) or may be limited by relief valve set pressure or other means.

**3.1.21****maximum continuous speed**

highest rotational speed (revolutions per minute) at which the machine, as-built and tested, is capable of continuous operation

**3.1.22****maximum inlet pressure**

highest specified inlet pressure the equipment shall be subject to

**3.1.23****maximum sealing pressure**

highest pressure the seals are required to seal during any specified static or operating conditions and during start-up and shutdown

**3.1.24****minimum allowable speed**

lowest speed (revolutions per minute) at which the manufacturer's design shall permit continuous operation

**3.1.25****minimum design metal temperature:**

lowest mean metal temperature (through the thickness) expected, including operation upsets, auto refrigeration, and temperature of the surrounding environment

**3.1.26****modular rotor**

rotor which is built up using stub shafts or similar devices and held together by one or more through bolts

**3.1.27****moment simulator**

auxiliary device intended to simulate the moment of the mass of a half coupling

Note 1 to entry: A moment simulator can also be designated to serve as an idling adapter (solo plate).

**3.1.28****mounting plate(s)**

device used to attach equipment to concrete foundations; this is either baseplate(s) or soleplates

**3.1.29****normal operating point**

point at which usual operation is expected and optimum efficiency is desired

Note 1 to entry: This point is usually the point at which the supplier certifies that performance is within the tolerances stated in this part of ISO 10439.

**3.1.30****normal speed**

speed corresponding to the requirements of the normal operating condition

**3.1.31****NPS****nominal pipe size**

dimensionless value approximately equal to the diameter in inches

EXAMPLE NPS 3/4

Note 1 to entry: Adapted from ASME B 31.3–2002, 300.2.

Note 2 to entry: The number following the letters NPS does not represent a measurable value.

Note 3 to entry: NPS is a designation of pipe size only. The pipe end may be threaded or prepared for a welded fitting.

**3.1.32  
observed**

<tests and inspections> inspection or test where the purchaser is notified of the timing of the inspection or test, and the inspection or test is performed as scheduled even if the purchaser or his representative is not present

**3.1.33  
overload**

highest flow point at which the predicted curve terminates on a speed line

**3.1.34  
pinion(s)**

high-speed rotor(s) in a gearbox cf. *bull gear* ([3.1.11](#))

**3.1.35  
PN  
nominal pressure**

numerical designation relating to pressure that is a convenient round number for reference purposes

EXAMPLE PN 100 [ISO 7268]

Note 1 to entry: The permissible working pressure associated with a PN designation depends upon the materials, design, and working temperature and has to be selected from the pressure/temperature rating tables in corresponding standards.

**3.1.36  
pressure casing**

composite of all stationary pressure-containing parts of the unit, including all nozzles and other attached parts that isolates process gas from the atmosphere

**3.1.37  
purchaser**

agency that issues the order and specification to the supplier

Note 1 to entry: The purchaser may be the owner of the plant in which equipment is to be installed or the owner's appointed agent.

**3.1.38  
radially split**

split with the joint perpendicular to the shaft centreline

**3.1.39  
rated speed  
100 % speed**

highest rotational speed (revolutions per minute) required to meet any of the specified operating conditions

**3.1.40  
relief valve set pressure**

pressure at which a relief valve starts to lift

Note 1 to entry: For information on relief valves, see API RP 520.

**3.1.41  
service factor**

<gear> factor that is applied to the tooth pitting index and the bending stress number, depending upon the characteristics of the driver and the driven equipment, to account for differences in potential overload, shock load, and/or continuous oscillatory torque characteristics

**3.1.42****settling-out pressure**

highest pressure which the compressor experiences when the compressor is not running and equilibrium has been reached

Note 1 to entry: Determination of settling-out pressure requires consideration of the trapped volume of gas throughout the compressor and its associated piping system. This includes all gas trapped between the downstream valve and the upstream valve after a compressor is shut down.

**3.1.43****shaft end seal**

process gas seal on the shaft which restricts leakage of process gas to the atmosphere

**3.1.44****slow roll**

speed less than 5 % of the normal operating speed or the minimum speed permitted by the speed control

**3.1.45****soleplate**

plate attached to the foundation, with a mounting surface for equipment or for a baseplate

**3.1.46****special purpose application**

application for which the equipment is designed for uninterrupted, continuous operation in critical service and for which there is usually no installed spare equipment

**3.1.47****special tool**

tool which is not a commercially available catalogue item

**3.1.48****stability analysis**

determination of the natural frequencies and the corresponding logarithmic decrements (log decs) of the damped rotor/support system using a complex value analysis

**3.1.49****standard volume flow**

flow rate expressed in volume flow units at standard conditions as follows:

ISO standard (normal) conditions

flow:	normal cubic meters per hour (Nm <sup>3</sup> /h)
	normal cubic meters per min (Nm <sup>3</sup> /min)
pressure:	1,013 bar absolute
temperature:	0 °C
humidity:	0 %

US customary standard conditions

flow:	standard cubic ft per min (scfm)
	million standard cubic ft per day (mmscfd)
pressure:	14,7 PSIA
temperature:	60 °F