## 7.3.4 Optional tests

## 7.3.4.1 General

If specified, the shop tests described in 7.3.4.2 to 7.3.4.13 shall be performed. Test details shall be mutually agreed upon by the purchaser and the vendor.

## 7.3.4.2 Performance test

• The machine shall be tested in accordance with ISO 1217. See 5.1.15 a).

Vibration levels shall be measured and recorded during this test as specified in 7.3.3.1.9 to 7.3.3.1.11.

## 7.3.4.3 Complete-unit test

 Such components as compressors, gears, drivers and auxiliaries that make up a complete unit shall be tested together during the mechanical running test. If specified, torsional vibration measurements shall be made to verify the vendor's analysis. For a torsional test, it is necessary to include all main rotating components. The completeunit test may be performed in place of, or in addition to, separate tests of individual components specified.

#### 7.3.4.4 Deceleration test

 If proximity probes are specified, synchronous vibration amplitude and phase angle versus speed for deceleration during coastdown shall be plotted before and after the 4 h run. Both the filtered (one per revolution) and the unfiltered vibration levels shall also be plotted. If specified, these data shall also be furnished in polar form. The speed range covered by these plots shall be from 400 r/min to the specified driver trip speed.

#### 7.3.4.5 Tandem test

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

#### 7.3.4.6 Gear test

• If an external gearbox is provided in the drive train, it shall be tested with the machine unit during the mechanical running test.

#### 7.3.4.7 Helium test

Pressure-containing parts, such as compressor casings and cylinders, shall be tested for gas leakage with helium at the maximum allowable working pressure. The test shall be conducted with the casing submerged in water. The water shall be at a higher temperature than the nil-ductility transition temperature for the material from which the part is made. The maximum allowable working pressure shall be maintained for a minimum of 30 min, with no bubbles permitted. As an alternative, a non-submerged soap-bubble test or other approved method to check for gas leakage may be performed if approved by the purchaser. See ASTM E1003 for more information.

A helium test should be specified if the molar mass of the gas handled is less than 12, or if the gas contains more than 0,1 mol % hydrogen sulfide.

#### 7.3.4.8 Sound-level test

• The sound-level test shall be performed in accordance with ISO 3744 or another agreed standard.

NOTE A sound-level test on the test stand is not representative of the sound level in the field due to differences in operating conditions and piping system.

#### 7.3.4.9 Auxiliary-equipment test

Auxiliary equipment, such as oil systems, gears, and control systems, shall be tested in the vendor's shop. Details
of the auxiliary-equipment tests shall be developed jointly by the purchaser and the vendor.

#### 7.3.4.10 Post-test inspection

 If specified, the compressor, the gear and the driver shall be dismantled, inspected and reassembled after satisfactory completion of the mechanical running test. The purchaser should specify whether the gas test required by 7.3.3.4.3 shall be performed before or after the post-test inspection.

#### 7.3.4.11 Full-pressure/full-load/full-speed test

• The objectives and details of the full-pressure/full-load/full-speed test shall be developed jointly by the purchaser and the vendor. This test may be substituted for the mechanical running test.

#### 7.3.4.12 Inspection of hub/shaft fit for hydraulically mounted couplings

After the running tests, the shrink fit of hydraulically mounted couplings shall be inspected by comparing hub/shaft match marks to ensure that the coupling hub has not moved on the shaft during the tests.

#### 7.3.4.13 Spare-parts test

• Spare parts such as couplings, gears and seals shall be tested as specified.

NOTE A mechanical test of the spare rotor set is mandated in 7.3.3.4.2.

#### 7.3.5 Test data

Immediately upon completion of each witnessed mechanical, performance and optional test, copies of the data logged shall be given to the witness.

The purchaser and the vendor shall mutually agree that the test data have met the acceptance criteria shown in the test specification.

#### 7.3.6 Test report

If specified, the vendor shall provide test reports within the timetable identified on the VDDR (see example form in Annex I).

## 7.4 Preparation for shipment

**7.4.1** Equipment shall be prepared for the type of shipment specified, including blocking of the rotor when necessary. Blocked rotors shall be identified by means of corrosion-resistant tags attached with stainless steel wire. The preparation shall make the equipment suitable for six months of outdoor storage from the time of shipment, with no disassembly required before operation except for inspection of bearings and seals. If storage for a longer period is contemplated, the purchaser should consult with the vendor regarding the recommended procedures to be followed.

**7.4.2** The vendor shall provide the purchaser with the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the job site and before start-up, as described in API RP 686-96, Chapter 3.

**7.4.3** The equipment shall be prepared for shipment after all testing and inspection have been completed and the equipment has been released by the purchaser. The preparation shall include the following.

- a) Except for machined surfaces, all exterior surfaces that can corrode during shipment, storage or in service shall be given at least one coat of the manufacturer's standard paint. The paint shall not contain lead or chromates.
- NOTE 1 Austenitic stainless steels are typically not painted.
- b) Exterior machined surfaces except for corrosion-resistant material shall be coated with a rust preventive.
- c) The interior of the equipment shall be clean; free from scale, welding spatter and foreign objects; and sprayed or flushed with a rust preventive that can be removed with solvent. The rust preventive shall be applied through all openings while the rotor is rotated.
- d) Internal surfaces of bearing housings and carbon-steel oil-systems components shall be coated with an oilsoluble rust preventive that is compatible with the lubricating oil.
- e) Any paint exposed to lubricants shall be oil-resistant. If synthetic lubricants are used, special precautions shall be taken to assure compatibility with the paint.
- f) Permanent internal coating shall be compatible with process gases, cooling media and lubricants.
- g) If specified, flanged openings shall be provided with metal closures at least 5 mm (3/16 in) thick with elastomer gaskets and at least four full-diameter bolts. For studded openings, all nuts needed for the intended service shall be used to secure closures. Each opening shall be car-sealed so that the protective cover cannot be removed without the seal being broken.
  - h) Threaded openings shall be provided with steel caps or round-head steel plugs. In no case shall non-metallic (e.g. plastic) caps or plugs be used.

NOTE 2 These are shipping plugs; permanent plugs are covered in 5.3.11.

- i) Openings that have been beveled for welding shall be provided with closures designed to prevent entry of moisture and foreign materials and damage to the bevel.
- j) Lifting points and lifting lugs shall be clearly identified on the equipment or equipment package. The recommended lifting arrangement shall be as described in the installation manual.
- k) The equipment shall be identified with item and serial numbers. Material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number of the equipment for which it is intended. Crated equipment shall be shipped with duplicate packing lists, one inside and one on the outside of the shipping container.
- I) A spare rotor set, when purchased, shall be prepared for unheated indoor storage for a period of at least three years. It shall be treated with a rust preventive and shall be housed in a vapour-barrier envelope with a slow-release, volatile corrosion inhibitor. The rotor shall be crated for domestic or export shipment as specified. A purchaser-approved resilient material 3 mm (1/8 in) thick [not tetrafluoroethylene (TFE) or polytetrafluoroethylene (PTFE)] shall be used between the rotor and the cradle at the support areas. The probe-target area barriers shall be marked with the words "Probe area do not cut". If specified, the rotor shall be prepared for vertical storage. It shall be supported from its coupling end with a fixture designed to support 1,5 times the rotor's weight without damaging the shaft. Instructions on the use of the fixture shall be included in the installation, operation and maintenance manuals.

NOTE 3 TFE and PTFE are not recommended as cradle support liners since they cold flow and impregnate into the surface.

- m) Critical shaft areas such as journals, end-seal areas, probe-target areas and coupling-fit areas shall be protected with a corrosion barrier followed by a separate barrier material to protect against incidental mechanical damage.
- n) Loose components shall be dipped in wax or placed in plastic bags and contained by cardboard boxes. Loose boxes are to be securely blocked in the shipping container.

**7.4.4** Auxiliary piping connections furnished on the purchased equipment shall be impression stamped or permanently tagged to agree with the vendor's connection table or general arrangement drawing. Service and connection designations shall be indicated.

**7.4.5** Bearing assemblies shall be fully protected from the entry of moisture and dirt. If volatile corrosion-inhibitor crystals in bags are installed in large cavities to absorb moisture, the bags shall be attached in an accessible area for ease of removal. Where applicable, bags shall be installed in wire cages attached to flanged covers and bag locations shall be indicated by corrosion-resistant tags attached with stainless steel wire.

- 7.4.6 One copy of the manufacturer's installation instructions shall be packed and shipped with the equipment.
- 7.4.7 Connections on auxiliary piping, removed for shipment, shall be match-marked for ease of reassembly.
- **7.4.8** If specified, the fit-up and assembly of machine-mounted piping, intercoolers, etc. shall be completed in the vendor's shop prior to shipment.
- 7.4.9 If specified, the vendor shall provide lifting tools suitable for lifting the equipment or equipment package.

Lifting tools may include spreader bars, shackles and slings.

## 8 Vendor's data

#### 8.1 General

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**8.1.1** The information to be furnished by the vendor is specified in 8.2 and 8.3.

**8.1.2** The data shall be identified on transmittal (cover) letters, title pages and in title blocks or another prominent position on drawings, with the following information:

- a) purchaser's/owner's corporate name;
- b) job/project number;
- c) equipment item number and service name;
- d) inquiry or purchase order number;
- e) any other identification specified in the inquiry or purchase order;
- f) vendor's identifying proposal number, shop order number, serial number or other reference required to completely identify return correspondence.
- 8.1.3 A coordination meeting shall be held, preferably at the vendor's plant, 4 to 6 weeks after order commitment. Unless otherwise specified, the vendor shall prepare and distribute an agenda prior to this meeting, which, as a minimum, shall include a review of the following items:
  - a) purchase order, scope of supply, unit responsibility, sub-vendor items and lines of communication;
  - b) datasheets;
  - c) applicable specifications and previously agreed exceptions;
  - d) schedules for the transmission of data, production and testing;
  - e) quality assurance programme and procedures;
  - f) inspection, expediting and testing;
  - g) schematics and bills of materials for auxiliary systems;

- h) physical orientation of the equipment, piping and auxiliary systems, including access for operation and maintenance;
- i) coupling selection and rating;
- j) thrust- and journal-bearing sizing, estimated loadings and specific configurations;
- k) seal operation and controls;
- I) rotor dynamic analyses (lateral, torsional and transient torsional, as required);
- m) equipment performance, alternative operating conditions, start-up, shutdown and any operating limitations;
- n) scope and details of any pulsation or vibration analysis;
- o) instrumentation and controls;
- p) identification of items requiring design reviews;
- q) inspection, related acceptance criteria and testing;
- r) expediting;
- s) other technical items.

#### 8.2 Proposals

#### 8.2.1 General

The vendor shall forward the original proposal, with the specified number of copies, to the addressee specified in the inquiry documents. The proposal shall include, as a minimum, the data specified in 8.2.2 to 8.2.4, and a specific statement that the equipment and all its components and auxiliaries are in strict accordance with this part of ISO 10440. If the equipment or any of its components or auxiliaries is not in strict accordance, the vendor shall include a list that details and explains each deviation. The vendor shall provide sufficient detail to enable the purchaser to evaluate any proposed alternative designs. All correspondence shall be clearly identified in accordance with 8.1.2.

#### 8.2.2 Drawings

**8.2.2.1** The drawings indicated on the vendor drawing and data requirements (VDDR) form (see example in Annex I) shall be included in the proposal. As a minimum, the following shall be included:

- a) general arrangement or outline drawing for each machine train or skid-mounted package, showing overall dimensions, maintenance-clearance dimensions, overall masses, erection masses and the largest maintenance mass for each item; the direction of rotation and the size and location of major purchaser connections shall also be indicated;
- b) cross-sectional drawings showing the details of the proposed equipment;
- c) schematics of all auxiliary systems including fuel, lube-oil, control and electrical systems; bills of material shall be included;
- d) sketches that show methods of lifting the assembled machine or machines, packages and major components and auxiliaries. [This information may be included on the drawings specified in item a) above.]

**8.2.2.2** If "typical" drawings, schematics and bills of material are used, they shall be marked up to show the mass and dimension data to reflect the actual equipment and scope proposed.

#### 8.2.3 Technical data

The following data

- a) purchaser's datasheets with complete vendor's information entered thereon and literature to fully describe details of the offering;
- b) predicted noise data (5.1.19);
- c) vendor drawing and data requirements form (see Annex I) indicating the schedule according to which the vendor agrees to transmit all the data specified;
- d) schedule for shipment of the equipment, in weeks after receipt of an order;
- e) list of major wearing components, showing any interchangeability with the owner's existing machines;
- f) list of spare parts recommended for start-up and normal maintenance purposes;
- g) list of the special tools furnished for maintenance;
- h) description of any special weather protection and winterization required for start-up, operation and periods of idleness, under the site conditions specified on the datasheets; this description shall clearly indicate the protection to be furnished by the purchaser as well as that included in the vendor's scope of supply;
- complete tabulation of utility requirements, e.g. steam, water, electricity, air, gas, lube oil (including the quantity and supply pressure of the oil required and the heat load to be removed by the oil) and the nameplate power rating and operating power requirements of auxiliary drivers; approximate data shall be clearly indicated as such;
- j) description of any optional or additional tests and inspection procedures for materials as required by 5.11.1.4;
- k) description of any special requirements, whether specified in the purchaser's inquiry or required by this part of ISO 10440;
- list of machines similar to the proposed machine(s) that have been installed and operating under conditions analogous to those specified in the inquiry;
- m) any start-up, shutdown or operating restrictions required to protect the integrity of the equipment;
- n) list of any components that can be construed as being of alternative design, hence requiring the purchaser's acceptance;
- o) for constant-speed units, the vendor shall outline the procedure that can be followed to reduce power consumption in the event that excess pressure or flow is developed;
- p) vendor list of all required relief valves, clearly indicating those furnished by the vendor;
- q) for flooded screw compressors, the vendor shall state retention time, maximum and minimum liquid levels and capacity in the separator vessel.

## 8.2.4 Curves

The vendor shall provide complete performance curves to encompass the map of operations, with any limitations indicated thereon. For constant-speed equipment, refer to the operating point on the data sheet.

## 8.2.5 Optional tests

The vendor shall furnish an outline of the procedures to be used for each of the special or optional tests that have been specified by the purchaser or proposed by the vendor.

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## 8.3 Contract data

## 8.3.1 General

**8.3.1.1** Contract data shall be furnished by the vendor in accordance with the agreed VDDR form; see example in Annex I.

**8.3.1.2** Each drawing shall have a title block in the lower right-hand corner with the date of certification, the identification data specified in 8.1.2, revision number and date and title. Similar information shall be provided on all other documents including sub-vendor items.

**8.3.1.3** The purchaser shall promptly review the vendor's data upon receipt; however, this review shall not constitute permission to deviate from any requirements in the order unless specifically agreed upon in writing. After the data have been reviewed and accepted, the vendor shall furnish certified copies in the quantities specified.

**8.3.1.4** A complete list of vendor data shall be included with the first issue of major drawings. This list shall contain titles, drawing numbers, and a schedule for transmittal of each item listed. This list shall cross-reference data with respect to the VDDR form in Annex I.

## 8.3.2 Drawings and technical data

The drawings and data furnished by the vendor shall contain sufficient information so that, together with the manuals specified in 8.3.5, the purchaser can properly install, operate and maintain the equipment covered by the purchase order. All contract drawings and data shall be clearly legible (8-point minimum font size, even if reduced from a larger-size drawing), shall cover the scope of the agreed VDDR form (see example in Annex I), and shall satisfy the applicable detailed descriptions.

## 8.3.3 Progress reports

The vendor shall submit progress reports to the purchaser at the intervals specified.

NOTE Refer to I.2 oo) for content of these reports.

## 8.3.4 Parts lists and recommended spares

**8.3.4.1** The vendor shall submit complete parts lists for all equipment and accessories supplied. These lists shall include part names, manufacturers' unique part numbers, materials of construction (identified by applicable International Standards). Each part shall be completely identified and shown on appropriate cross-sectional, assembly-type cutaway or exploded-view isometric drawings. Interchangeable parts shall be identified as such. Parts that have been modified from the standard dimensions or finish to satisfy specific performance requirements shall be uniquely identified by part number. Standard purchased items shall be identified by the original manufacturer's name and part number.

**8.3.4.2** The vendor shall indicate on each of these complete parts lists all those parts that are recommended as start-up or maintenance spares, and the recommended stocking quantities of each. These should include spare parts recommendations of sub-suppliers that were not available for inclusion in the vendor's original proposal.

## 8.3.5 Installation, operation, maintenance and technical-data manuals

## 8.3.5.1 General

The vendor shall provide sufficient written instructions and all necessary drawings to enable the purchaser to install, operate, and maintain all of the equipment covered by the purchase order. This information shall be compiled in a manual or manuals with a cover sheet showing the information listed in 8.1.2, an index sheet and a complete list of the enclosed drawings by title and drawing number. The manual or manuals shall be prepared specifically for the purchase order the purchase order.

## 8.3.5.2 Installation manual

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 issue of the final certified drawings. For this reason, it may be separate from the operating and maintenance instructions. This manual shall contain information on alignment and grouting procedures, normal and maximum utility requirements, centres of mass, rigging provisions and procedures and all other installation data. All drawings and data specified in 8.2.2 and 8.2.3 that are pertinent to proper installation shall be included as part of this manual; see also description in 1.2 ll).

### 8.3.5.3 Operating and maintenance manual

A manual containing all required operating and maintenance instructions shall be supplied not later than 2 weeks after all specified tests have been successfully completed. In addition to covering operation at all specified process conditions, this manual shall also contain separate sections covering operation under any specified extreme environmental conditions; see also description in I.2 mm).

#### 8.3.5.4 Technical-data manual

 If specified, the vendor shall provide the purchaser with a technical data manual within 30 days of completion of shop testing; see description in I.2 ss).

# Annex A

(informative)

# **Typical datasheets**

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	JOB NO.			ITEM NO	ITEM NO.						
ROTARY-TYPE POSITIVE-	PURCHASE (	ORDER NO.			DATE						
DISPLACEMENT COMPRESSOR	REQUISITION NO.										
DATASHEET	INQUIRY NO.										
SI UNITS											
	DEVISION										
3 SITE											
4 SERVICE	NO. REQUIRED										
5 MANUFACTURER	RER MODEL DRIVER (6.1)										
6 NOTE: O INDICATES INFORMATION TO BE COMPLETED BY PURCHASER		BY MANU	FACTURER								
7 OPERATI	NG CONDITION	IS									
8	NORMAL	MAXIMUM		OTHER CON	DITIONS (5.1.4	.)					
9 ALL DATA ON PER UNIT BASIS	(3.28) (5.1.3)		A	В	C	D					
12 GAS HANDLED (ALSO SEE PAGE 2) 19 DECUIPED CARACITY $Nm^3/h$ (1.013 bar and 0.°C) (DRY) (3.40)											
14 O MASS ELOW ko/hr-(WET)(DBY)											
15 INLET CONDITIONS: O COMPRESSOR INLET FLANGE OCUS											
16 O PRESSURE - kPa [absolute (bar)]											
17 O TEMPERATURE (°C)											
18 O RELATIVE HUMIDITY (%)											
19 O RELATIVE MOLECULAR MASS (M)											
20 Cp/Cv (K <sub>1</sub> ) OR (K <sub>AVG</sub> ) (5.1.15 d)											
21 COMPRESSIBILITY (Z 1) OR (Z AVG) (5.1.15 e)											
22 INLET VOLUME FLOW (m <sup>3</sup> /h) (3.16)											
23 DISCHARGE CONDITIONS: OCOMPRESSOR DISCHARGE FL	ANGE 🔿 (	SUSTOMER CC	NNECTION								
24 O PRESSURE - kPa [absolute (bar)]											
25 TEMPERATURE (°C)											
26 $\Box C p/C v (K_2) OR (K_{AVG})$											
27 COMPRESSIBILITY ( $z_2$ ) OR ( $z_{AVG}$ )											
28 DEW POINT (°C)											
29 OIL CARRYOVER (mg/kg) <sup>1)</sup>											
30 KW REQUIRED (ALL LOSSES INCL.)											
31 SPEED (rev/min)											
32 PRESSURE RATIO (R)											
33 VOLUMETRIC EFFICIENCY (%)											
34 SILENCER ▲ P kPa [(bar)] (6.9.3)											
35 O SETTLE-OUT PRESSURE - kPa [absolute (bar)] (5.1.5)											
		TO									
42 O SPEED VARIATION FROM		то									
43 O OTHER											
44 SIGNAL: O SOURCE											
45 O TYPE											
46 O RANGE: FOR PNEUMATIC CONTROL	rev/min @	kPa (	bar) <u>&amp;</u>	rev/min (	2kPa(	bar)					
47 O OTHER		-			-						
48 SERVICE: O SPECIAL-PURPOSE (3.51) O GENERAL-PURPO	SE (3.13)		_								
49 O CONTINUOUS O INTERMITTENT O STANDBY (3.5	53) <b>O</b> DRN	( SCREW (3.8)		ODED SCREV	V (3.10)						
50 REMARKS: Unless otherwise noted, all pressures are GAUGE	pressures.										
51 (Example: bar refers to gauge pressure; bar abs. r	efers to abso	olute pressur	e)								
52											
53											

## ROTARY-TYPE POSITIVE-DISPLACEMENT COMPRESSOR DATASHEET SI UNITS

JOB NO.			ITEM NO.	_ ITEM NO			
REVISION NO.				DATE			
PAGE	2	OF	9	BY			

1	1 GAS ANALYSIS (5.1.15 d) 2 O MOL % O		NOR-	MAX-		OTHER CONDI				O REMARKS		
2			MAL IMUM A		В		C D					
3		M.W.										
4	AIR	28.966										
5	OXYGEN	32,000										
6	NITROGEN	28,016										
7	WATER VAPOR	18,016										
8	CARBON MONOXIDE	28,010										
9	CARBON DIOXIDE	44,010										
10	HYDROGEN SULFIDE	34,076								(5.11.1.10)		
11	HYDROGEN	2,016							1			
12	METHANE	16,042							1			
13	ETHYLENE	28,052										
14	ETHANE	30,068										
15	PROPYLENE	42,078										
16	PROPANE	44,094										
17	I-BUTANE	58,120										
18	n-BUTANE	58,120										
19	I-PENTANE	72,146										
20	n-PENTANE	72,146										
21	HEXANE PLUS				-							
22												
23												
24	O CORROSIVE									(5.11.1.7)		
25	O SOLID PARTICLE				2					(5.1.25)		
26	O LIQUID PARTICLE				3					(5.1.25)		
27	O NACE MATERIALS				6					(5.11.1.10)		
28	TOTAL											
29	RELATIVE MOLECULAR MA	ASS										
30	SITE DATA:						1	NOISE SPECIFICATIONS: (5.1.19)				
31	LOCATION:							O APPLICABLE TO MACHINE				
32	O INDOOR O	HEATED			ER ROO	F						
33	O OUTDOOR O	UNHEAT	ED		TIAL SID	ES		O APPLICABLE TO NEIGHBORHOOD				
34	O GRADE O	MEZZAN	INE	0								
35	O WINTERIZATION REQ'	O WINTERIZATION REQ'D. O TROPICALIZATION REQ'D.				1	ACOUSTIC HOUSING (5.1.20) O YES O NO					
36	O ELEVATION	m	BAROME	TER		kPa (bar	abs.) -	SOUND LEVELdB @m				
37	O RANGE OF AMBIENT TEMPS.: DRY BULB WET BULB					Γ BULB	3	dB RE: 20 MICRO PASCAL				
38	8 SITE RATED °C					APPLICABLE SPECIFICATIONS:						
39	NORMAL °C			2								
40	40 MAXIMUM °C											
41	41 MINIMUM °C											
42	42 ELECTRICAL AREA CLASSIFICATION: (5.1.18, IEC 60079)											
43	43 O ZONEGROUP CLASS					· —	-	HODIGI CHANN	ON ANY OTHER			
44												
45	45 UNUSUAL CONDITIONS: O DUST O FUMES											
46	46 U OTHER					-			THER			
47	47					3						
48	48											
49							_					
50							CLONG TERM STORAGE FOR MONTHS					
51												
52												

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