

### 8.3.3 Mechanical Running Test

**8.3.3.1** The requirements of 8.3.3.1.1 through 8.3.3.1.4 shall be met before the mechanical running test is performed.

**8.3.3.1.1** All oil pressures, viscosities and temperatures shall be within the range of operating values recommended in the vendor's operating instructions for the specific unit being tested.

**8.3.3.1.2** Bearings intended to be lubricated by an oil mist systems shall be pre-lubricated.

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

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

**8.3.3.2** The contract shaft seals and bearings shall be used in the machine for the mechanical running test.

**8.3.3.3** Shop coupling may be used when testing with shop motors.

**8.3.3.4** All purchased vibration probes, transducers, and accelerometers shall be in use during the test. If vibration probes are not furnished by the equipment vendor or if the purchased probes are not compatible with shop readout facilities, then shop probes and readouts that meet the accuracy requirements of API Standard 670 shall be used.

**8.3.3.4.1** Shop test facilities shall include instrumentation with the capability of continuously monitoring and plotting revolutions per minute, and vibration spectra.

**8.3.3.4.2** The vibration characteristics determined by the use of the instrumentation specified in 8.3.3.4 shall serve as the basis for acceptance or rejection of the machine.

**8.3.3.4.3** <sup>Vibration data shall</sup> be recorded in horizontal and vertical directions, at radial planes transverse to each bearing centerline and also in the axial direction as shown in Figure 5.

**8.3.3.5** All instrumentation used for the tests shall have valid calibration at the time of the test.

**8.3.3.6** The mechanical running test of the equipment shall be conducted as specified in 8.3.3.6.1 through 8.3.3.6.4.

**8.3.3.6.1** The mechanical running test shall verify that the operating speed range is free of critical speeds.

**8.3.3.6.2** A mechanical run test may be performed either before or following the performance test.

**8.3.3.6.3** The mechanical run test shall be one hour or until bearing temperatures have stabilized; that is, when temperature rise relative to ambient temperature is not more than 2 °F (1 °C) over a 10 minute period. Correct operation of the control system shall be demonstrated, when applicable.

- [•] a) If specified, the LRC/VP shall be mechanically run for four hours. This test shall be performed at the rated flow.
- b) Mechanical run test shall be conducted with ring liquid present.

**NOTE** The mechanical run test is typically done at either the normal point or rated point for the equipment, as agreed by the vendor and purchaser.

**8.3.3.6.4** In the case of adjustable speed units, the test program shall be agreed upon by the purchaser and the vendor, and it shall include a period of operation at maximum continuous speed.

**8.3.3.7** The requirements of 8.3.3.7.1 to 8.3.3.7.3 shall be met during the mechanical running test.

**8.3.3.7.1** The measured unfiltered vibration shall not exceed the limits of 6.8.2.1 and shall be recorded throughout the operating speed range.

NOTE Typically, the instrumentation is verified for proper operation before and after the mechanical running test.

**8.3.3.7.2** While the equipment is operating at maximum continuous speed, and at any other speeds or load, or both, that may have been specified in the test agenda, vibration data shall be acquired to determine amplitudes at frequencies other than synchronous.

**8.3.3.7.2.1** As a minimum, this data shall cover a frequency range from 10 Hz to 1000 Hz. Equipment operating at shaft speeds from 750 rpm down to 300 rpm should be monitored in a frequency range from 5 Hz to 250 Hz.

**8.3.3.7.2.2** If the amplitude of any discrete, nonsynchronous vibration exceeds 20 percent of the allowable vibration as defined in 6.8.2.1 the purchaser and the vendor shall agree on requirements for further investigation which may include additional testing and on the equipment's acceptability.

[•] **8.3.3.7.3** If specified, all real-time vibration data as agreed by the purchaser and vendor shall be recorded and a copy provided to the purchaser.

**8.3.3.8** If replacement or modification of bearings or seals or dismantling of the case to replace or modify other parts or assembly is required to correct mechanical or performance deficiencies, the initial test will not be acceptable, and the final shop tests shall be run after these deficiencies are corrected.

**8.3.3.9** When spare rotors are ordered, each spare rotor shall be manufactured and balanced, in accordance with the requirements of this standard.

[•] **8.3.3.10** If specified, spare rotors shall be given a mechanical run test or performance test, or both.

**8.3.3.11** The purchaser shall advise additional testing requirements for spare parts.

#### **8.3.4 Gas Leak Test**

**8.3.4.1** Each completely assembled LRC/VP casing shall be tested as specified in 8.3.4.2.

**8.3.4.2** The casing (with the end seals installed) shall be pressurized to the rated discharge pressure, or in the case of vacuum pumps to 1 bar (15 psi), held at this pressure for a minimum of 30 minutes, and subjected to a soap-bubble test or another approved test to check for gas leaks.

#### **8.3.5 Performance Test**

**8.3.5.1** LRC/VP shall be tested in accordance with HEI *Performance Standards for Liquid Ring Vacuum Pumps*. PNEUROP 6612 may be used for a testing standard if agreed.

[•] **8.3.5.2** The LRC/VP shall be performance tested together with its ring liquid system. The extent of the test, and the applicable test methods, shall be agreed.

**8.3.5.3** The machine shall be tested on air and water.

**8.3.5.4** For vacuum pumps, test data shall be recorded at one speed at five suction pressures varying from atmospheric pressures to maximum vacuum.

**8.3.5.4.1** For compressors, test data shall be recorded at one speed from minimum discharge pressure to maximum discharge pressure.

**8.3.5.4.2** The points are subject to negotiation between purchaser and vendor.

**8.3.5.5** The dry air and water performance shall be within the tolerances given in Table 11.

**Table 11—Performance Tolerances**

Variable	Tolerance (%)
Rated inlet volume flow	–0
Rated power	+4
Ring liquid flow rate	±10

**8.3.5.6** Performance at the certified point shall be calculated from test data in accordance with the vendor's standard procedures, or as otherwise specified. Where the test is to be performed under different conditions or with different fluids from those specified, the method of converting the test results to the specified conditions shall also be agreed upon (see Annex F).

**8.3.5.7** If it is necessary to dismantle an LRC/VP for a correction, such as improvement of efficiency, the initial test will not be acceptable, and the final hydrostatic test, gas leak test, and performance test shall be repeated after the correction is made.

**8.3.5.8** The performance test shall be conducted using only one contract rotor.

**8.3.5.9** The vendor shall maintain a complete, detailed log of all final tests and shall prepare the required number of copies, including test curves and data, certified for correctness. All preliminary tests and mechanical checks shall be completed by the vendor before the purchaser's witnessed performance test.

**8.3.5.10** The requirements of 8.3.5.10.1 through 8.3.5.10.5 shall be met before the performance test is performed.

**8.3.5.10.1** The contract shaft seals and bearings shall be used in the machine for the performance test.

- a) The vendor may propose substitute seals for reasons such as incompatibility of the job seals with the test fluid.
- b) Use of substitute seals requires purchaser approval.
- c) The acceptable level of leakage during testing shall be agreed upon by the purchaser and the vendor.

**8.3.5.10.2** All lubricating-oil and liquid-sealant pressures, viscosities, and temperatures shall be within the range of operating values recommended in the vendor's operating instructions for the specified unit being tested.

**8.3.5.10.3** Bearings used in oil mist lubrication systems shall be pre-lubricated.

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

**8.3.5.10.5** All warning, protective, and control devices used during the test shall be checked, and adjustments shall be made as required.

### **8.3.6 Optional Tests**

If specified, the shop tests described in 8.3.6.1 through 8.3.6.7 shall be performed. Test details shall be agreed upon by the purchaser and the vendor.

#### **8.3.6.1 Complete Unit Test**

Such components as LRC/VP, couplings, gears, drivers, and auxiliaries that make up a complete unit shall be tested together during the mechanical running test. If agreed by the Purchaser, the complete unit test may be performed in place of separate tests of individual components.

### 8.3.6.2 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.

### 8.3.6.3 Helium Test

**8.3.6.3.1** Pressure containing parts, such as casings, shall be tested for gas leakage with helium at the maximum allowable working pressure.

**8.3.6.3.2** If the test is conducted with the casing submerged in water, the water shall be at a higher temperature than the nil ductility transition temperature for the material of which the part is made.

**8.3.6.3.3** The maximum allowable working pressure shall be maintained for a minimum of 30 minutes, with no bubbles permitted.

**8.3.6.3.4** 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.

**NOTE** A helium test can be appropriate when the molar mass of the gas to be handled is less than 12 or if the gas contains more than 0.1 mole percent hydrogen sulfide.

### 8.3.6.4 Sound-level Test

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

**NOTE** This test usually does not reflect field sound levels due to shop test environment.

### 8.3.6.5 Ring Stability Test

For adjustable speed machines a test agreed to between the purchaser and the vendor shall be conducted to establish the operating limits of liquid ring stability.

### 8.3.6.6 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.

### 8.3.6.7 Spare Parts Test

Spare parts such as couplings, gears, diaphragms, bearings, and seals shall be tested.

## 8.4 Preparation for Shipment

[●] **8.4.1** Equipment shall be suitably prepared for the type of shipment specified.

**8.4.1.1** Blocked rotors shall be identified by means of corrosion-resistant tags attached with stainless steel wire.

**8.4.1.2** The preparation shall make the equipment capable of withstanding six months of outdoor storage from the time of shipment, with no disassembly required before operation, except for inspection of bearings and seals.

**8.4.1.3** If storage for a longer period is contemplated, the purchaser will consult with the vendor regarding the recommended procedures to be followed.

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

**8.4.3** Except for machined surfaces, all exterior surfaces that may 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 Austenitic stainless steels are typically not painted.

**8.4.4** Exposed shafts and shaft couplings shall be wrapped with waterproof, moldable waxed cloth, or vapor-phase-inhibitor paper. The seams shall be sealed with oil-proof adhesive tape.

**8.4.5** Bearing assemblies shall be fully protected from the entry of moisture and dirt.

**8.4.5.1** If vapor-phase-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.

**8.4.5.2** 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.

**8.4.6** The interior of the equipment shall be clean; free from scale, welding spatter, and foreign objects; and sprayed or flushed with a suitable rust preventative that is water soluble or can be removed with solvent. The rust preventative shall be applied through all openings while the machine is slow-rolled.

**8.4.7** Flanged openings shall be provided with metal closures at least 5 mm ( $\frac{3}{16}$  in.) thick, with elastomer gaskets, and at least four full-diameter bolts. For studed openings, all nuts needed for the intended service shall be used to secure closures.

**8.4.8** Threaded openings shall be provided with steel caps or round-head steel plugs. In no case shall nonmetallic (such as plastic) caps or plugs be used.

NOTE These are shipping plugs; permanent plugs are covered in 6.3.14.

**8.4.9** Openings that have been beveled for welding shall be provided with closures designed to prevent entrance of foreign materials and damage to the bevel.

**8.4.10** If a spare rotor is purchased, it shall be prepared for unheated indoor storage for a period of at least three years.

**8.4.10.1** The rotor shall be treated with a rust preventative and shall be housed in a vapor-barrier envelope with a slow-release volatile-corrosion inhibitor.

[•] **8.4.10.2** The rotor shall be crated for domestic or export shipment, as specified.

**8.4.10.3** A purchaser approved resilient material 3.0 mm ( $\frac{1}{8}$  in.) thick [not tetrafluoroethylene (TFE) or polytetrafluoroethylene (PTFE)] shall be used between the rotor and the cradle at the support areas.

**8.4.10.4** The rotor shall not be supported at journals.

**8.4.11** Internal steel areas of bearing housings and carbon steel oil systems' auxiliary equipment such as reservoirs, vessels, and piping shall be coated with suitable oil-soluble rust preventive.

**8.4.12** Lifting points and lifting lugs shall be clearly identified on the equipment or equipment package.

**8.4.12.1** The recommended lifting arrangement shall be as described in the installation manual.

**8.4.12.2** The recommended lifting arrangement shall be identified on boxed equipment.

**8.4.13** 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.

**8.4.14** 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 startup, as described API RP 686, Chapter 3, "Recommended Practices for Machinery Installation and Installation Design".

**8.4.15** 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.

**8.4.16** The fit-up and assembly of machine-mounted piping, intercoolers etc. shall be completed in the vendor's shop prior to shipment.

**8.4.17** Wood used in export shipping shall comply with the requirements of ISPM Publication No.15 <sup>[2]</sup>.

**8.4.18** Composition wood product such as Particleboard, Medium Density Fiberboard (MDF), and Oriented Strand Board (OSB) shall not be used.

#### **8.4.19 Package Markings and Shipping Documentation**

[●] **8.4.19.1** All markings shall be in English and other specified language.

**8.4.19.2** Package markings shall be stenciled on two opposite sides of the shipping unit. A shipping unit may be a box, carton, bundle, crate, drum, loose self-supported piece of equipment etc.

**8.4.19.3** Lettering shall be between 76 mm to 125 mm (3 in. to 5 in.) high in weatherproof black ink to ensure visibility.

**8.4.19.4** Shipping packages that cannot be stenciled directly shall have attached corrosion resistant metal tags with raised markings.

**8.4.19.5** Shipping packages shall be marked with industry standard cautionary symbols indicating center of gravity, sling or lifting points, top heavy packages, fragile and liquid contents, moisture sensitive contents etc. per ASTM D5445-05, *Standard Practice for Pictorial Markings for Handling of Goods*.

**8.4.19.6** Package markings shall include:

- a) purchaser's purchase order number and tag number
- b) shipping unit piece number
- c) gross weight
- d) dimensions
- e) purchaser's project name

**8.4.19.7** Packaged equipment shall be shipped with duplicate packing lists—one inside and the other on the outside of the shipping container. Also, a paper copy of package markings shall be inside each container.

**8.4.19.8** One copy of the manufacturer's installation instructions shall be packed and shipped with the equipment.

**8.4.19.9** Equipment or materials that contain or are coated with chemical substances shall be prominently tagged at openings to indicate the nature of contents and precautions for shipping, storage, and handling.

**NOTE** Some examples include oils, corrosion inhibitors, antifreeze solutions, desiccants, hydrocarbon substances, and unused paint.

**8.4.19.9.1** Substances that are supplied with the shipment shall have a Safety Data Sheet (SDS).

**8.4.19.9.2** If a substance is exempt from regulation, a statement to that effect shall be included.

**8.4.19.9.3** At least two weeks before shipment, SDSs shall be forwarded to the receiving facility, to allow planning for handling of any regulated substances.

**8.4.19.9.4** SDSs in protective envelopes shall be affixed to the outside of the shipping package.

## **9 Vendor's Data**

**9.1** The purchaser may specify the content of proposals, meeting frequency and vendor data content/format identified in Annex B. Annex B provides a general outline of information that potentially may be requested by the purchaser.

[•] **9.2** If specified, the information specified in Annex B shall be provided.

# Annex A (informative)

## Data Sheets

LIQUID RING COMPRESSOR AND VACUUM PUMP SYSTEMS (API 681-2nd) DATA SHEETS SI UNITS (kPa)		JOB NO. _____ ITEM NO. _____ PURCHASE ORDER NO. _____ SPECIFICATION NO. _____ REVISION NO. _____ DATE _____ PAGE 1 OF 13 BY _____						
1	APPLICABLE TO: <input type="radio"/> PROPOSAL <input type="radio"/> PURCHASE <input type="radio"/> AS BUILT							
2	FOR _____	UNIT _____						
3	SITE _____	DRIVEN EQUIP. NO. REQUIRED _____						
4	SERVICE _____	SIZE AND TYPE _____						
5	MANUFACTURER _____	SERIAL NO. _____						
6								
7	NOTE: <input type="radio"/> INDICATES INFORMATION TO BE COMPLETED BY PURCHASER <input type="checkbox"/> BY MANUFACTURER <input checked="" type="checkbox"/> BY MANUFACTURER OR PURCHASER							
8	GENERAL							
9	NO. MOTOR DRIVEN _____ OTHER DRIVER TYPE _____							
10	DRIVEN EQUIP. ITEM NO'S _____	DRIVEN EQUIP. ITEM NO'S _____						
11	MOTOR ITEM NO'S _____	DRIVER ITEM NO'S _____ GEAR ITEM NO'S _____						
12	MOTOR PROVIDED BY _____	DRIVER PROVIDED BY _____ GEAR PROVIDED BY _____						
13	MOTOR MOUNTED BY _____	DRIVER MOUNTED BY _____ GEAR MOUNTED BY _____						
14	MOTOR DATA SHEET NO. _____	DRIVER DATA SHEET NO. _____ GEAR DATA SHEET NO. _____						
15								
16	SYSTEM DESCRIPTION							
17	DRIVEN EQUIPMENT TYPE	SYSTEM TYPE (ANNEX E)						
18	<input type="radio"/> LIQUID RING VACUUM PUMP (3.21) <input type="radio"/> LIQUID RING COMPRESSOR (3.20)	<input checked="" type="checkbox"/> ONCE-THROUGH (FIGURE E.1)						
19	SERVICE (6.1.1)	<input checked="" type="checkbox"/> PARTIAL RECIRCULATION (FIGURE E.2)						
20	<input type="radio"/> CONTINUOUS <input type="radio"/> INTERMITTENT (STARTS/DAY): _____	<input checked="" type="checkbox"/> TOTAL RECIRCULATION - VERTICAL SEPARATOR (FIGURE E.3)						
21	<input type="radio"/> TRIL LEVEL (6.1.1.1): _____ <input type="radio"/> OTHER _____	<input checked="" type="checkbox"/> TOTAL RECIRCULATION - HORIZONTAL SEPARATOR (FIGURE E.4)						
22	<input type="radio"/> VENDOR TO PROVIDE FIELD PROVEN DOCUMENTATION (6.1.1.2)							
23	PROCESS OPERATING CONDITIONS (6.1.2)							
24								
25								
26	ALL DATA ON PER UNIT BASIS	START-UP	NORMAL	RATED	OTHER CONDITIONS			
27	<input type="radio"/> PROCESS CONDITION				A	B	C	D
28	<input type="radio"/> GAS HANDLED (ALSO SEE PAGE 2)							
29	<input type="radio"/> SM <sup>3</sup> /H (101.325 kPaA & 15°C DRY)							
30	<input type="radio"/> MASS FLOW (kg/h) <input type="radio"/> WET <input type="radio"/> DRY							
31	SUCTION CONDITIONS:							
32	<input type="radio"/> PRESSURE (kPaA)							
33	<input type="radio"/> TEMPERATURE (°C)							
34	<input type="radio"/> RELATIVE HUMIDITY (%)							
35	<input type="radio"/> MOLECULAR WEIGHT							
36	<input checked="" type="checkbox"/> Cp/Cv <input checked="" type="checkbox"/> K <sub>1</sub> <input checked="" type="checkbox"/> K <sub>AVG</sub>							
37	<input checked="" type="checkbox"/> COMPRESSIBILITY <input checked="" type="checkbox"/> Z <sub>1</sub> <input checked="" type="checkbox"/> Z <sub>AVG</sub>							
38	<input checked="" type="checkbox"/> INLET VOLUME FLOW (m <sup>3</sup> /h) <input checked="" type="checkbox"/> WET <input checked="" type="checkbox"/> DRY							
39	DISCHARGE CONDITIONS:							
40	<input checked="" type="checkbox"/> PRESSURE (kPaA)							
41	<input type="checkbox"/> TEMPERATURE (°C)							
42	<input checked="" type="checkbox"/> Cp/Cv <input checked="" type="checkbox"/> K <sub>2</sub> <input checked="" type="checkbox"/> K <sub>AVG</sub>							
43	<input checked="" type="checkbox"/> COMPRESSIBILITY <input checked="" type="checkbox"/> Z <sub>2</sub> <input checked="" type="checkbox"/> Z <sub>AVG</sub>							
44	PACKAGE DISCHARGE CONDITIONS:							
45	<input type="radio"/> PRESSURE (kPaA)							
46	<input type="checkbox"/> TEMPERATURE (°C)							
47	<input type="checkbox"/> MASS FLOW OF NON-CONDENSIBLES (kg/h)							
48	<input type="checkbox"/> MASS FLOW OF SAT LIQUID (AFTER SEPARATOR) (kg/h)							
49	<input type="radio"/> SYSTEM SETTLE OUT PRESSURE (kPaA)							
50								
51	<input type="checkbox"/> POWER REQUIRED (ALL LOSSES INCL) (kW)							
52	<input type="checkbox"/> SPEED (RPM)							
53	<input type="checkbox"/> VOLUMETRIC EFFICIENCY (%)							
54	<input type="radio"/> CERTIFIED POINT (3.5)							
55								
56	<input type="checkbox"/> PERFORMANCE CURVE NO.							
57								



<b>LIQUID RING COMPRESSOR AND VACUUM PUMP SYSTEMS (API 681-2nd) DATA SHEETS SI UNITS (kPa)</b>										JOB NO. _____ ITEM NO. _____ PURCHASE ORDER NO. _____ SPECIFICATION NO. _____ REVISION NO. _____ DATE _____ PAGE 2 OF 13 BY _____		
1	<b>PROCESS OPERATING CONDITIONS (CONTINUED)</b>											
2	GAS ANALYSIS (6.1.3)		START UP	NOR- MAL	RATED	OTHER CONDITIONS				REMARKS		
3	<input type="radio"/> MOL % <input type="radio"/> _____					A	B	C	D			
4												
5		M.W.										
6	AIR	28.966										
7	OXYGEN	32.000										
8	NITROGEN	28.016										
9	WATER VAPOR	18.016										
10	CARBON MONOXIDE	28.010										
11	CARBON DIOXIDE	44.010										
12	HYDROGEN SULFIDE	34.076								(6.10.1.11)		
13	HYDROGEN	2.016								(6.10.1.8)		
14	METHANE	16.042										
15	ETHYLENE	28.052										
16	ETHANE	30.068										
17	PROPYLENE	42.078										
18	PROPANE	44.094										
19	I-BUTANE	58.120										
20	n-BUTANE	58.120										
21	I-PENTANE	72.146										
22	n-PENTANE	72.146										
23	HEXANE PLUS											
24												
25												
26												
27												
28												
29												
30	TOTAL											
31	AVG. MOL. WT.											
32												
33	<b>LRC/VP OUTLET MATERIALS BALANCE</b>											
34												
35												
36	<b>AT CERTIFIED POINT:</b>											
37	<input type="checkbox"/> HYDROCARBONS AND NON-CONDENSIBLES											
38	<input type="checkbox"/> CONDENSED LIQUID:											
39	<input type="checkbox"/> CONDENSED HYDROCARBONS											
40	<input type="checkbox"/> CONDENSED WATER											
41												
42	<b>RING LIQUID OPERATING CONDITIONS (6.1.4)</b>											
43	<input checked="" type="checkbox"/> LIQUID TYPE											
44												
45	<input checked="" type="checkbox"/> SUPPLY PRESSURE (kPaG)											
46	<input checked="" type="checkbox"/> SUPPLY TEMPERATURE (°C)											
47	<input checked="" type="checkbox"/> VAPOR PRESSURE (kPaA)											
48	<input checked="" type="checkbox"/> VISCOSITY (mPa-s)											
49	<input checked="" type="checkbox"/> SPECIFIC HEAT (kJ/kg °C)											
50	<input checked="" type="checkbox"/> SPECIFIC GRAVITY											
51	<input type="checkbox"/> MINIMUM CONTINUOUS RING LIQUID FLOW (3.34) (m³/h)											
52	<input type="checkbox"/> MIN. CONT. NON-CONDENSABLE GAS FLOW (3.33) (kg/h)											
53												
54												
55	<b>REMARKS:</b>											
56												
57												

<b>LIQUID RING COMPRESSOR AND VACUUM PUMP SYSTEMS (API 681-2nd) DATA SHEETS SI UNITS (kPa)</b>		JOB NO. _____ ITEM NO. _____ PURCHASE ORDER NO. _____ SPECIFICATION NO. _____ REVISION NO. _____ DATE _____ PAGE 3 OF 13 BY _____
REV	1	<b>LIQUID RING MACHINE CONSTRUCTION FEATURES</b>
	2	<div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p style="text-align: center;"><b>SPEEDS</b></p> <p><input type="checkbox"/> ROTATION, VIEWED FROM COMP. DRIVEN END: <input type="checkbox"/> CW <input type="checkbox"/> CCW</p> <p><input type="checkbox"/> MAXIMUM CONTINUOUS SPEED (3.28) _____ RPM</p> <p><input type="checkbox"/> TRIP (3.64) _____ RPM</p> <p><input type="checkbox"/> MAX. TIP SPEEDS: _____ (m/s) @ MAX. CONT. SPEED</p> <p><input type="checkbox"/> MINIMUM CONTINUOUS SPEED (3.32) _____ RPM</p> <p><input type="checkbox"/> LATERAL CRITICAL SPEEDS: (6.8.1.1)</p> <p><input type="checkbox"/> FIRST CRITICAL (DRY) _____ RPM</p> <p><input type="checkbox"/> SECOND CRITICAL (DRY) _____ RPM</p> <p><input type="checkbox"/> LATERAL CRITICAL SPEED - BASIS:</p> <p><input type="checkbox"/> TYPICAL LATERAL ANALYSIS REQUIRED (6.8.1.5)</p> <p><input type="checkbox"/> UNDAMPED STIFFNESS MAP REQUIRED</p> <p><input type="checkbox"/> OTHER TYPE ANALYSIS: _____</p> <p><input type="checkbox"/> TORSIONAL CRITICAL SPEEDS: (6.8.1.7)</p> <p><input type="checkbox"/> FIRST CRITICAL _____ RPM</p> <p><input type="checkbox"/> SECOND CRITICAL _____ RPM</p> <p><input type="checkbox"/> TRAIN TORSIONAL ANALYSIS REQUIRED (6.8.1.9)</p> <p><input type="checkbox"/> OTHER TYPE ANALYSIS: _____</p> </div> <div style="width: 48%;"> <p style="text-align: center;"><b>ROTORS</b></p> <p><input type="checkbox"/> NO. _____ <input checked="" type="checkbox"/> SOLID <input type="checkbox"/> HOLLOW</p> <p><input type="checkbox"/> DIAMETERS _____</p> <p><input type="checkbox"/> NO. VANES PER ROTOR _____</p> <p><input type="checkbox"/> TYPE <input type="checkbox"/> OPEN <input type="checkbox"/> CLOSED <input type="checkbox"/> OTHER _____</p> <p><input type="checkbox"/> FABRICATION METHOD _____</p> <p><input checked="" type="checkbox"/> MATERIAL _____</p> <p><input type="checkbox"/> MAX YIELD STRENGTH _____</p> <p><input type="checkbox"/> BRINNEL HARDNESS MAX _____ MIN _____</p> <p><input type="checkbox"/> DYNAMIC ROTOR BALANCING (6.6.5)</p> <p><input checked="" type="checkbox"/> ISO 21940-11 G2.5 (6.6.5) <input type="checkbox"/> ISO 21940-11 G1 (6W/n) (6.6.6)</p> </div> </div>
	3	
	4	
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	11	
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	21	<b>CASING</b>
	22	<p><input type="checkbox"/> MODEL _____</p> <p><input checked="" type="checkbox"/> CASING SPLIT</p> <p><input type="checkbox"/> MATERIAL (6.10.1.2) <input checked="" type="checkbox"/> CLADDING _____</p> <p><input type="checkbox"/> THICKNESS (mm) _____ CORR. ALLOW (mm) _____</p> <p><input checked="" type="checkbox"/> MANIFOLD MATERIAL _____</p> <p><input checked="" type="checkbox"/> PORT PLATE/CONE MATERIAL _____</p> <p><input type="checkbox"/> MAX. ALLOWABLE WORKING PRESS. (3.27) _____ (kPaG)</p> <p><input type="checkbox"/> MAX. DESIGN PRESS. (3.9) _____ (kPaG)</p> <p><input type="checkbox"/> TEST PRESSURE: HELIUM (8.3.6.3) _____ (kPaG)</p> <p style="padding-left: 40px;">HYDRO (8.3.2) _____ (kPaG)</p> <p><input type="checkbox"/> MAX. ALLOWABLE TEMPERATURE (3.26) _____ (°C)</p> <p><input type="checkbox"/> MINIMUM OPERATING TEMPERATURE _____ (°C)</p> <p><input type="checkbox"/> RELIEF VALVE SETTING (6.2.3) _____ (kPaG)</p> <p><input type="checkbox"/> MARGIN FOR ACCUMULATION _____ (kPaG)</p> <p><input checked="" type="checkbox"/> HEXAGONAL CAP SCREWS REQ'D FOR ASSEMBLY (6.2.7)</p> <p><input type="checkbox"/> CASING VERTICAL JACKSCREWS AND DOWEL PILOT HOLES</p> <p><input checked="" type="checkbox"/> RADIOGRAPH QUALITY _____</p> <p><input checked="" type="checkbox"/> THREADED OPENINGS FOR TAPERED PIPE PER ISO 7-1 (6.3.10)</p>
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	53	<b>REMARKS:</b>
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REV	LIQUID RING COMPRESSOR AND VACUUM PUMP SYSTEMS (API 681-2nd) DATA SHEETS SI UNITS (kPa)										JOB NO. _____ ITEM NO. _____ PURCHASE ORDER NO. _____ SPECIFICATION NO. _____ REVISION NO. _____ DATE _____ PAGE 4 OF 13 BY _____																														
1	CONNECTIONS																																								
2																																									
3	CONNECTION	NO.	SIZE	FACING	RATING	POSITION	FLANGED STUDDED OR THREADED (6.3.2)		MATING RING & GASKET BY VENDOR																																
4	SYSTEM	SYSTEM INLET																																							
5		SYSTEM DISCHARGE																																							
6		SYSTEM FILL																																							
7		SYSTEM MAKE-UP																																							
8		SYSTEM DRAIN																																							
9		CW INLET																																							
10	CW OUTLET																																								
11	VENTS																																								
12	MACHINE	MACHINE SUCTION																																							
13		MACHINE DISCHARGE																																							
14		RING LIQUID INLET																																							
15		DRAINS																																							
16	ALLOWED FORCES AND MOMENT ON SYSTEM AND LIQUID RING MACHINE (6.5)																																								
17	SYSTEM	POSITION	SYSTEM INLET		SYSTEM DISCH.		SYSTEM FILL		SYS. MAKE-UP		SYSTEM DRAIN		CW INLET		CW OUTLET		VENTS																								
18		LOAD	FORCE	MOMENT	FORCE	MOMENT	FORCE	MOMENT	FORCE	MOMENT	FORCE	MOMENT	FORCE	MOMENT	FORCE	MOMENT	FORCE	MOMENT																							
19		AXIAL																																							
20		VERTICAL																																							
21	HORIZONTAL 90°																																								
22	MACHINE	POSITION	CASING SUCT. 1		CASING SUCT. 2		DISCHARGE 1		DISCHARGE 2		RING LIQ. INLET		DRAINS		UNITS																										
23		AXIAL														FORCE (kN)																									
24		VERTICAL														MOMENT (N-m)																									
25		HORIZONTAL 90°																																							
26	COUPLING (7.2) AND GUARDS (7.3)																																								
27	<input type="checkbox"/> COUPLING TYPE: <input type="checkbox"/> KEYED <input type="checkbox"/> TAPERED <input type="checkbox"/> STRAIGHT <input type="checkbox"/> DIRECT COUPLED (SEALLESS CONSTRUCTION) <input type="checkbox"/> MFR/MODEL _____ <input type="checkbox"/> FURNISHED BY: _____ <input type="checkbox"/> SPACER LENGTH _____ <input type="checkbox"/> RATING: _____ <input type="checkbox"/> LIMITED END FLOAT REQUIRED GUARD TYPE: <input type="checkbox"/> FULLY ENCLOSED <input type="checkbox"/> SEMI-OPEN <input type="checkbox"/> NON-SPARKING (7.3.7) <input type="checkbox"/> FURNISHED BY: _____ <input type="checkbox"/> VENDOR MOUNT HALF COUPLING (7.2.12)										BALANCE TO: <input type="checkbox"/> AGMA 9000 CL. 9 (7.2.2) <input type="checkbox"/> ISO 21940-11 G6.3 (7.2.2 f) <input type="checkbox"/> AGMA 9000 CL. 10 (7.2.3) <input type="checkbox"/> SEE ATTACHED API 671 DATA SHEET <input type="checkbox"/> LUBRICATING REQUIREMENTS <input type="checkbox"/> NON-LUBE <input type="checkbox"/> GREASE <input type="checkbox"/> OTHER <input type="checkbox"/> BELT DRIVE (7.4) <input type="checkbox"/> BELT TYPE (7.4.1.3) _____ <input type="checkbox"/> BELT MANUFACTURER _____ <input type="checkbox"/> BELT SERVICE FACTOR (7.4.1.4) _____ <input type="checkbox"/> ISO 21940-11 GRADE 6.3 SHEAVE BALANCE (7.4.5.7)																														
28	BASEPLATE (7.5)																																								
29	<input type="checkbox"/> BASEPLATE FURNISHED BY (7.5.1): _____ <input type="checkbox"/> COLUMN MOUNTING (7.5.20) MOUNTED EQUIPMENT (7.5.16): <input type="checkbox"/> MACHINE <input type="checkbox"/> DRIVER <input type="checkbox"/> COMPLETE SYSTEM <input type="checkbox"/> NON-SKID DECKING (7.5.26) <input type="checkbox"/> EPOXY GROUT TYPE FOR FIELD INSTALL. (7.5.7): _____ <input type="checkbox"/> STAINLESS STEEL SHIM THICKNESS: _____ QTY: _____ <input type="checkbox"/> LEVELING PADS (7.5.18) <input type="checkbox"/> MACHINED PADS (7.5.10) <input type="checkbox"/> SPACER PLATE INSTALLED UNDER EQUIPMENT FEET (7.5.10.6)																																								
30	WEIGHTS (kg)										SPACE REQUIREMENTS																														
31	<input type="checkbox"/> LIQUID RING MACHINE <input type="checkbox"/> DRIVER <input type="checkbox"/> GEARBOX <input type="checkbox"/> SEPARATOR <input type="checkbox"/> COMPLETE UNIT <input type="checkbox"/> CRANE FOR MAINTENANCE <input type="checkbox"/> ADDITIONAL AUX EQUIP. <input type="checkbox"/> TOTAL SHIPPING										<input type="checkbox"/> LIQUID RING MACHINE <input type="checkbox"/> DRIVER <input type="checkbox"/> SEPARATOR <input type="checkbox"/> COMPLETE UNIT <input type="checkbox"/> SPACE RESTRICTIONS																														
32																			<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">LENGTH (mm)</th> <th style="text-align: center;">WIDTH (mm)</th> <th style="text-align: center;">HEIGHT (ft-in)</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>								LENGTH (mm)	WIDTH (mm)	HEIGHT (ft-in)												
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