

# **TWIN-SHAFT SCREW COMPRESSORS**

## **5.7. Dynamics**

(5.7.2.1\_Modification) A torsional vibration analysis of the complete coupled train shall be performed for all compressor units; compressor vendor shall be responsible to implement required corrective actions.

(5.7.2.6\_Addition) The transient torsional vibration analysis shall also consider the following transient load cases:

- Re-acceleration following a momentary power interruption;
- 2 & 3 phase short circuit;
- Malsynchronous run up of synchronous motors.

(5.7.3.6\_Addition) The shaft vibrations shall be measured in accordance with API 670 for dry screw compressors.

## 5.8. Bearings

(5.8.1.1\_Addition) Hydrodynamic radial and thrust bearings shall be supplied for dry screw compressors.

(5.8.1.5\_Modification) Delete "if specified". Hydrodynamic thrust bearings on oil-flooded screw compressors shall be fitted with bearing-metal temperature sensors of the RTD type installed in accordance with API 670.

(5.8.2.4\_New) Rolling element bearings shall be manufactured by SKF, FAG or NSK. Bearings from other manufacturers may be acceptable as long as they are manufactured by a worldwide known and highly respected manufacturer, designed, built and tested under globally relevant standards and there are a large number of references in similar equipment. These alternative manufacturers shall be submitted to \_\_\_\_\_ for approval.

(5.8.3.2.1\_Modification) Delete "or other types approved by the purchaser".

## 5.9. Bearing housings

(5.9.6\_Modification) Delete "if specified".

(5.9.7\_Replacement) Oil-flooded screw compressors shall be fitted with seismic vibration transducers installed on the bearing housings in accordance with API Standard 670. Metric fasteners are required with M8 threads.

(5.9.8\_Modification) Delete "if specified".

## 5.10. Lube-oil and seal-oil systems

(5.10.1.2\_Addition) Delete "if specified by the purchaser".

(5.10.2.3\_Replacement) Oil systems shall conform to \_\_\_\_\_ pecification \_\_\_\_\_, chapters 1 "*General considerations*" and 2 "*Special purpose oil systems*".

(5.10.2.4\_Replacement) Delete this paragraph.

(5.10.2.5\_Modification) If the compressor train includes a gearbox, and the driver is operating at fixed speed, the main oil pump shall be driven by the low speed shaft of the gearbox.

(5.10.3.1.2\_Addition) Synthetic oil compatible with the process gas shall be used.

(5.10.3.1.3\_Modification) The oil system shall be in accordance with Annex E, Figure E-2, Typical arrangement 2, except that an oil separator with an external coalescing chamber in accordance with Figure E-5 shall be supplied.

(5.10.3.1.6\_Addition) The components listed shall also meet the additional requirements of specification ED-K-04.00, chapters 1 "*General considerations*" and 3 "*General purpose oil systems*".

(5.10.3.2.c\_Addition) The duplex filters shall also meet the additional requirements of \_\_\_\_\_ specification ED-K-04.00, chapters 1 "*General considerations*" and 3 "*General purpose oil systems*".

(5.10.3.3.1\_Modification) The oil cooler shall also meet the additional requirements of \_\_\_\_\_ pecification ED-K-04.00, chapters 1 "*General considerations*" and 3 "*General purpose oil systems*". Unless otherwise specified, or required by 5.10.3.3.2 below, a single oil cooler is required.

(5.10.3.3.2\_Modification) If the compressor train is unspared, dual coolers shall be provided.

Additionally, if rolling-element bearings are being supplied, another nameplate of the same material with the following data of the installed bearings shall be included:

- Bearing manufacturer;
- Complete manufacturer's code;
- Internal clearance and/or pre-load;
- Type and quantity of lubricant.

## **6. ACCESSORIES**

### **6.1. Drivers**

(6.1.1.1\_Addition) The Vendor shall be responsible for the installation onto the baseplate and the alignment of the driver at their facilities.

(6.1.1.3\_Addition) The driver shall be capable of starting under the following conditions:

- At the lowest specified ambient temperature (only applicable to process air compressors);
- At settle-out pressure.

(6.1.1.4\_Replacement) Vertical jackscrews shall be provided for each drive train component irrespective of its weight.

(6.1.2.2\_Modification) Motors shall conform to (low voltage) or (high voltage) specifications. In addition motors rated at 375 kW (500 hp) or above, shall be balanced in accordance with API 541 or API 546, and they shall also meet vibration requirements of API 541 or API 546 (as applicable).

(6.2.7\_New) Couplings shall be supplied by a vendor approved by

(6.2.8\_New) Couplings that conform to API 671 shall be hydraulically fitted. The vendor shall furnish the necessary pumps, hoses and fittings, pressure gages, and other equipment required for the installation and removal of coupling hubs.

(6.2.9\_New) Couplings shall be balanced to ISO 1940 grade G6,3. Each major component of factory assembled sub-assembly shall be separately balanced in order to get the limit stated above. Couplings that conform to API 671 shall be balanced per Method 2 of the standard. The vendor shall provide balancing certificates for each coupling.

(6.2.10\_New) The minimum coupling service factor shall be 1.5. Service factor shall be calculated based on driver rated power.

(6.2.11\_New) Coupling guards shall be made of non-sparking material, and meet the requirements of API 671 Appendix D. They shall not be removable without the use of suitable tools.

#### **6.4. Controls and instrumentation**

(6.4.1.2\_Modification) Instrumentation and installation shall conform to

(6.4.2.2\_Addition) Vendor shall state the minimum allowable speed of the compressor.

(6.4.2.4\_Modification) Oil-flooded compressors shall be furnished with a constant-speed drive, and the control signal shall actuate the slide-valve volume-control device.

(6.4.3.1\_Modification) Delete "if specified". Unless otherwise specified, panels shall be installed on the baseplate.

(6.4.3.2\_Modification) Delete "if specified". Panels shall also conform to

(6.4.3.5\_New) All the instruments supplied by the vendor shall be mounted on a local gauge board, located on the baseplate of the unit. If auxiliary consoles are being supplied (e.g. lube oil system), each console shall be furnished with a local gauge board.

(6.4.4.2\_Modification) Delete "if specified". A speed signal shall also be provided for remote indication.

(6.4.4.3.1\_Modification) Delete "if specified".

(6.4.4.3.2\_Modification) Delete "if specified".

(6.4.4.3.4\_New) Probes, cables and proximitors shall be calibrated for the actual shaft material.

(6.4.4.6.3\_Modification) The vendor shall supply the relief vales in accordance with

(6.4.4.6.4\_Modification) Delete "if specified".

(6.4.4.7\_Modification) Delete "if specified" (only for dry screw compressors).

(6.4.4.8\_Modification) Delete "if specified" (only for dry screw compressors).

(6.4.5.1.2\_Modification) Alarms listed in Table 9 are required, as applicable. Shutdowns are required due to the following conditions:

- Low lube-oil pressure;
- High thrust bearing temperature;
- High compressor discharge temperature;
- High gas differential pressure;
- Overspeed (only for variable speed units);
- Axial position movement (only for dry screw compressors);
- High radial shaft vibration (only for dry screw compressors);
- High casing or bearing housing vibration (only for oil-flooded screw compressors);

## 6.5. Piping

(6.5.2\_Addition) Piping shall be in accordance with API 614, as amended by  
In addition, the following requirements shall be considered:

- Cooling water piping shall be made of galvanized steel or stainless steel tubing, with threaded fittings and valves and a minimum size of ¾ NPS (NPS 2 for inlet and outlet headers). The outlet header shall have a drain valve upstream of the isolation valve;
- Unions are not allowed regardless of the service; piping joints shall always be flanged;
- Piping shall be as a minimum NPS ¾, except for mechanical seal piping which has a minimum NPS ½;
- Sight flow indicators shall be of the floating hollow ball type and splinter-proof glass suitable for high temperatures;
- Cylindrical threads are not permitted;
- Orifice plates shall be fitted with a tab to allow their identification. The orifice diameter shall be permanently marked on it;
- When tubing is allowed, compression fittings and tubing shall be supplied by HOKE or SWAGelok. Tubing and fittings from other manufacturers may be acceptable as long as they are manufactured by a worldwide known and highly respected manufacturer, designed, built and tested under globally relevant standards and there are a large number of references in similar equipment. These alternative manufacturers shall be submitted to \_\_\_\_\_ for approval.

## **7. INSPECTION, TESTS AND PREPARATION FOR SHIPMENT**

### **7.1. General**

(7.1.1\_Addition) In addition to the tests specified on the data sheet, the following tests are always required. The manufacturer shall furnish certificates of all tests -regardless of whether they are witnessed or not-, which shall be signed by the inspector prior to authorizing the shipment.

- Hydrostatic – It shall only be witnessed in the case of compressors with high alloy steel parts under pressure (e.g.: austenitic stainless steel, Incolloy, Inconel or Monel);
- Mechanical run test (including heat run tests and leakage tests) – It shall be witnessed for all compressors;
- Post-test inspection – it shall be witnessed for all compressors;
- Performance – it shall be witnessed for all compressors;



## **9.2. Globally relevant codes and standards**

ANSI/NACE MR 0175	(identical to ISO 15156, all parts)
API 541	Form-Wound Squirrel Cage Induction Motors — 500 Horsepower and Larger
API 546	Brushless Synchronous Machines — 500 kVA and Larger
API 610	Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
API 614	Lubrication, Shaft-sealing and Oil-control Systems and Auxiliaries
API 670	Machinery Protection Systems
API 671	Special Purpose Couplings for Petroleum, Chemical and Gas Industry Services