



Exploration & Production

## GENERAL SPECIFICATION

### ROTATING MACHINERY

#### GS MEC 261

**Reciprocating compressors  
(comments to API 618)**

|      |       |                               |
|------|-------|-------------------------------|
|      |       |                               |
|      |       |                               |
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## Foreword

The requirements of **API 618** standard "Reciprocating compressors for general refinery services" (fourth edition, June 1995 and later published errata if any) form an integral part of the present specification.

The paragraph numbers used in section 3 and indicated in *italic*, are those of **API 618** standard, except for additional requirements which may be presented with new paragraph numbers.

## 1. Scope

This specification clarifies how to use the recommendations of **API 618** for supply of reciprocating compressors to the COMPANY.

## 2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

| Reference      | Title                                                   |
|----------------|---------------------------------------------------------|
| <b>API 618</b> | Reciprocating compressors for general refinery services |

## 3. Comments to API 618 (references of paragraphs as per API 618)

### 1.1 Scope

(Clarification) The purpose of this specification is to set minimum requirements for design, construction, inspection and testing of reciprocating compressors used in critical or hazardous services.

### 1.2 Alternative designs

(Clarification) The compressors shall comply with ISO standards and have dimensions and data generally expressed in metric units (flange and piping designation may still be indicated in inches). American standards referenced in **API 618** may be replaced by International or European standards which can be demonstrated as equivalent or more stringent.

### 1.3 Conflicting requirements

(Addition) In case of conflict between technical documents the priority shall be given to the more specific document and to the most stringent requirements. **VENDOR** shall bring attention of the Purchaser on any such technical conflicting requirements for resolution before proceeding with design and construction.

### 1.4 Definition of terms

(Addition) **Compressor set**: Complete compression unit including the base plate, the compressor, the driver, the lubrication system, the seal system and where applicable the pulsation suppression devices, the cooling system, the gear and the control system.

**1.4.4** (Substitution of term to be defined) **Inlet volume flow** ( $\text{m}^3/\text{h}$  or  $\text{m}^3/\text{s}$ ).

**1.4.5** (Clarification) **Combined rod loading** shall be determined for each compression stage with the piston speeds and the expected internal pressures (taking into account the valve pressure drops) corresponding to:

- The specified operating conditions
- The maximum differential pressure which would be obtained if the compression stage suction pressure was at minimum specified value and the compression stage discharge pressure was equal to the pressure safety valve setting.

**1.4.27** (Clarification of second sentence) **VENDOR** shall clarify the expected values of pressure drop or power requirement of the various elements of his supply (for information). The determination of **rated power** shall include any necessary allowance on all the expected values.

## 2 Basic design

### 2.1 General

**2.1.2** (Addition) When standard "low noise" equipment is available this equipment shall be proposed as an option by **VENDOR**, even if not mandatory for compliance with the specified sound pressure level.

**2.1.7** (Clarification) All elements of supply shall be suitable for the area classification. This requirement covers electrical items like motors and heaters, instruments using electronic devices and also mechanical parts which may produce sparks in case of accidental friction.

Attention of the **VENDOR** is required on classification, which may result from the equipment itself.

**2.1.10** (Clarification) **VENDOR's** scope of supply shall include all the accessories and auxiliary circuits mentioned in **API 618** standard and necessary for operation of the compressor set in the specified conditions.

Auxiliary circuits shall be designed to minimise the number of external connections (typically a single inlet connection and/or a single outlet connection). Accessories and auxiliary circuits shall be fully assembled (and tested as much as possible) in **VENDOR's** works.

**2.1.11** (Clarification) **VENDOR** shall provide suitable packing and handling devices for shipment. Specific requirements for site installation and connection shall be included in **VENDOR's** recommendations.

**2.1.12** (Clarification) The specified operating points shall be understood "at limits of supply" and with no negative tolerance for flow and discharge pressure.

**2.1.14** (Clarification) Unless otherwise specified, equipment shall be suitable for outdoor installation, without roof or shelter protection.

**2.1.15** (Addition) **VENDOR** shall also calculate the isentropic compression coefficient and indicate the gas state equations used for determination of gas parameters.

**VENDOR** may be required to use gas parameters values calculated by **COMPANY**.

**2.1.16** (Clarification) **VENDOR** shall clearly indicate with his proposal any limitation or particular procedures for partially or fully unloaded operation resulting from specified points, starting or stopping sequences.



## **2.2 Allowable speeds**

(Addition) The rated speed shall not be higher than 1000 RPM and the average piston speed shall be limited to 5 m/s for lubricated cylinders or 3 m/s for non-lubricated cylinders.

## **2.3 Allowable discharge temperature**

**2.3.1** (Clarification) VENDOR shall indicate calculated adiabatic discharge temperatures and expected discharge temperatures.

Expected discharge temperatures shall be within API limits or with lower values according to VENDOR actual experience.

**2.3.2** (Clarification) On each compression stage discharge, control devices shall be installed to generate alarm and shutdown signals when the temperature rises above the maximum expected value (typically alarm for 20°C excess, shutdown for 25°C excess).

## **2.6 Compressor cylinders**

**2.6.1.4** (Clarification) Single acting, step piston and tandem cylinder arrangements should be avoided.

**2.6.2.3** (Clarification) Nominal and maximum torque values for all studs and bolting shall be included in VENDOR's documentation.

## **2.9 Crankshafts, connecting rods, bearings, and cross heads**

(Clarification) Minimum bearing life for operation under specified conditions shall not be less than 24000 hours for high speed compressors (RPM > 750) and 32000 hours for other compressors.

## **2.10 Distance pieces**

**2.10.2** (Clarification) Access openings shall be fitted with gasketed solid metal covers, in case of toxic or flammable gas.

**2.10.4** (Addition) Vent of the distance piece adjacent to cylinder shall be connected as follows:

- For compression of non-flammable and non-toxic gas, to a local vent
- For compression of a flammable non-toxic gas to a remote vent with flame arrestor or to a flare system
- For compression of a toxic gas to a flare or a gas treatment system.

## **2.11 Packing case and pressure packing**

**2.11.3** (Addition) Methods of detection of pressure packing leakage shall be proposed as option by the compressor VENDOR.

**2.11.5** (Clarification) If cooling of packing is required, the VENDOR shall supply a closed liquid cooling system properly dimensioned for the most stringent ambient and operating conditions.

## **2.12 Compressor frame lubrication**

**2.12.3** (Clarification) The lube oil system shall include full flow twin filters with transfer valve. The compressor sump, or the oil reservoir (if separately installed) shall be equipped with an oil thermometer.



When the oil tank is separate, it shall be made of 316 L stainless steel.

**2.12.3.2** (Clarification of last sentence) The auxiliary lube oil pump driver shall be sized for the pump power and the required starting torque at an oil viscosity corresponding to the lowest ambient temperature.

**2.12.7** (Clarification) Based on specified minimum ambient conditions, the VENDOR shall determine if electric oil heaters are necessary and supply them accordingly. Compressor sets without heater shall not have any operating limitation due to minimum ambient temperature.

### **2.13 Cylinder and packing lubrication**

**2.13.1.1** (Clarification) Cylinder and packing lubrication shall be done with a single plunger-per-point system.

**2.13.1.4** (Clarification) Same comment as for 2.12.7 above.

### **2.14 Materials**

**2.14.1.6** (Clarification) The Purchaser will specify gas composition and any erosive agents present in the fluids or in the environment. If concentration of these erosive agents is not quantified, the VENDOR shall state any concentration limitation implied by his compressor and material selection.

**2.14.6.1** (Clarification) The Purchaser shall be given notice of any major component non-conformity. Non-critical component small repairs, covered by existing and proved internal procedures, can be done without prior approval of Purchaser.

**2.14.7.5.1** (Addition) All welding of pressure-containing parts shall be subjected to 100% radiography.

## **3 Accessories**

### **3.1 Drivers**

**3.1.1.2** (Clarification) When several operating conditions are specified, VENDOR shall determine the worst case (operation and starting) for sizing accordingly the driver. Load on driver in case of operation of a compression stage against safety valve setting discharge pressure shall be evaluated.

**3.1.2.3** (Clarification) Except otherwise specified or requested by VENDOR, electric motors shall be suitable for direct starting with the compressor pressurised but unloaded. The starting voltage shall be assumed as 80% of nominal voltage at motor terminals.

**3.1.3.1** (Substitution to first sentence) Turbines shall be supplied in accordance with the Purchaser's specifications.

### **3.2 Couplings and guards**

**3.2.1.2** (Clarification) Model, material, service factor and mounting arrangement of coupling will be VENDOR's standard. Coupling MANUFACTURER shall be from the agreed SUB-VENDORS list or approved by Purchaser.

**3.2.2.1** (Clarification) Removable coupling guards shall effectively enclose any moving part and may be of VENDOR's standard. The coupling guard must be resistant enough to sustain a vertical load of 75 kg without permanent deformation.



### **3.5 Mounting plates**

**3.5.1.2.5** (Clarification) Alignment positioning screws shall be provided for each compressor set component that weights more than 50 kilograms to facilitate longitudinal, transverse and vertical adjustments.

### **3.6 Controls and Instrumentation**

**3.6.2.2** (Addition) The compressors shall always be started unloaded. If they are in automatic-starting service, they shall be equipped with automatic unloading devices. The VENDOR shall clearly indicate the maximum time the compressors can withstand unloaded operation.

**3.6.3.1** (Clarification) A local gauge panel for the complete compressor set or two gauge panels (one for compressor and one for driver) shall be supplied.

**3.6.4.3.2** (Clarification) All pressure gauges shall be of liquid-filled.

**3.6.4.5.1** (Clarification) Relief valves within limits of compressor set shall be supplied by VENDOR but in accordance with make and type agreed by Purchaser.

**3.6.5.1** (Clarification of first sentence) Protective devices shall be furnished by the VENDOR.

**3.6.6.6** (Clarification) Unless otherwise specified all electrical material shall be given protective treatments as per sections 3.6.6.6.1 and 3.6.6.6.2.

**3.6.6.7** (Modification of first sentence) All wiring shall be done with cables adequately protected along their run against mechanical stresses or damage. Different voltage levels (power and instrument) shall be segregated in different cables and in different junction boxes.

### **3.7 Piping and appurtenances**

**3.7.1** (Addition) VENDOR shall be in charge of piping connections and supports design (calculation notes to be handed over to COMPANY).

**3.7.1.5** (Clarification) VENDOR shall supply all process and auxiliary piping inside the base frames up to a limited number of connections located at skid edge (refer to 2.1.10).

**3.7.1.7** (Clarification) VENDOR will be given drawings and information on the equipment immediately upstream and downstream of limits of supply for incorporation in the calculation of the pulsation suppression devices. VENDOR shall review and comment these documents and request further details if necessary.

**3.7.1.14** (Clarification) Each utility shall be manifolded to a common connection.

**3.7.6.3** (Clarification) Pulsation suppression devices and temporary start up screen (to be installed just upstream of suction pulsation suppression device) shall be supplied by VENDOR.

### **3.8 Intercoolers and aftercoolers**

**3.8.3** (Addition) The VENDOR shall supply thermowells on the cooling-water inlets and outlets of the intercoolers and aftercoolers.

### **3.9 Pulsation and vibration control requirements**

**3.9.2.1** (Addition) The approach selected shall be approach 3, and the VENDOR shall supply pulsation suppression devices on suction and discharge of each stage. The VENDOR shall carry out and hand over to the COMPANY a complete acoustical and mechanical study, taking



into account suction, discharge and inter-stage piping, as well as the compressor's upstream/downstream capacities.

**3.9.3.4** (Substitution) The welds shall be 100% radiographed. The internal portions of the welds shall be ground smooth. Where this is technically impossible, the first pass shall be made using TIG welding process.

**3.9.3.13** (Addition to second sentence) Inspection openings in each pulsation suppressor compartment shall allow inspection of all compartment welds.

**3.9.4** (Substitution to first sentence) The **VENDOR** shall be in charge of the decision of use, design, fabrication and fitting of pulsation suppression devices supports. The decision of use shall be based on compressor design, volume of pulsation suppression devices and results of the acoustical and mechanical study.

### **3.10 Air intake filters**

(Addition) Mounting of inlet filter shall be designed to limit vibrations of the filtration media to an acceptable level. If connection between the air filter and the first cylinder inlet flange uses a flexible piping, this piping shall be designed for complete vacuum.

## **4 Inspection, testing and preparation for shipment**

### **4.1 General**

**4.1.1** (Addition) Inspection, testing and preparation for shipment shall be in accordance with specifications appended to call for bid and purchase order.

## **5 VENDOR's data**

### **5.1 General**

**5.1.1** (Addition) Information to be furnished by **VENDOR** shall be in accordance with Purchaser's specifications.

### **5.3 Contract data**

**5.3.3.1** (Clarification) **VENDOR** shall submit performance curves or tables and shall assume complete responsibility for design, engineering and manufacture of the compressor in such a way that it can provide the guaranteed capabilities in industrial service. This responsibility also extends to the specification of the parts and accessories sub-contracted by the **VENDOR**.

**5.3.3.2** (Clarification) Rod-load and gas-load charts shall be furnished for the worst specified operating conditions and in case of operation of one cylinder against safety valve setting discharge pressure.

**5.3.3.4** (Clarification) Curves of compressor resisting torque and curve of driver starting torque versus speed in the specified starting conditions shall be supplied. Calculation of time for acceleration to full speed shall take into account any necessary allowance over the expected parameters.

**5.3.5** (Addition) **VENDOR** shall submit progress reports at regular interval (as requested in particular specification or in **VENDOR** document register) and in addition as soon as an unexpected event may justify extra resources to maintain the scheduled delivery date.