



Document No.	GIS 34-104
Applicability	Group
Date	REVISION FOR REVIEW 10 January 2010

GIS 34-104

Reciprocating Compressors for Petroleum, Chemical, and Gas Industry Services (ISO 13707 or API 618)

Group Instruction for Supply

**BP GROUP
ENGINEERING TECHNICAL PRACTICES**

Foreword

This issue of Engineering Technical Practice (ETP GIS 34-104) incorporates changes to align with API Std 618 Fifth Edition.

- a. This specification is based on the API Standard 618, *“Reciprocating Compressor for Petroleum, Chemical and, and Gas Industries,”* (Fifth Edition, Publication date December 2007). The numerical identification of sections and paragraphs in this specification corresponds to section and paragraph numbering of the referenced industry standard. Requirements that are not revised remain applicable.
- b. This specification is modified from GIS 34-104, *“Guidance on Industry Standard for ISO 13707 Reciprocating Compressors (API 618)”* (Publication date June 3rd, 2003).

Copyright © 2010 BP International Ltd. All rights reserved.

This document and any data or information generated from its use are classified, as a minimum, BP Internal. Distribution is intended for BP authorized recipients only. The information contained in this document is subject to the terms and conditions of the agreement or contract under which this document was supplied to the recipient's organization. None of the information contained in this document shall be disclosed outside the recipient's own organization, unless the terms of such agreement or contract expressly allow, or unless disclosure is required by law.

In the event of a conflict between this document and a relevant law or regulation, the relevant law or regulation shall be followed. If the document creates a higher obligation, it shall be followed as long as this also achieves full compliance with the law or regulation.



Table of Contents

	Page
Foreword	2
Introduction	5
1 Scope	6
1.1 General	6
1.2 Alternate designs	6
1.3 Precedence	6
2 Normative references	6
3 Terms and definitions	7
3.63 Hydrogen rich service	7
3.64 Partial valve	7
3.65 Piston average speed	8
3.66 Port unloader	8
5 Requirements	8
5.1 Dimensions	8
5.4 Spare parts	8
6 Basic design	8
6.1 General	8
6.2 Bolting	8
6.4 Allowable speeds	9
6.5 Allowable discharge temperature	9
6.6 Rod and gas loads	10
6.7 Critical speeds	10
6.8 Compressor cylinders	10
6.9 Valves and unloaders	12
6.10 Pistons, piston rods and piston rings	14
6.11 Crankcases, crankshafts, connecting rods, bearings and crossheads	16
6.12 Distance pieces	16
6.13 Packing cases and pressure packing	16
6.14 Lubrication	17
6.15 Materials	19
6.15.4 Forgings	20
6.15.7 Welding	20
6.16 Nameplates and rotation arrows	21
7 Accessories	21
7.1 Drivers	21
7.2 Coupling and guards	22
7.3 Reduction gears	22
7.4 Belt drives	22



7.5	Mounting plates	22
7.6	Controls and instrumentation	23
7.7	Piping and appurtenances	25
7.8	Intercoolers and aftercoolers.....	26
7.9	Pulsation and vibration control requirements.....	27
7.11	Special tools	28
8	Inspection and testing	28
8.1	General.....	28
8.2	Inspection	28
8.3	Testing.....	29
8.4	Preparation for shipment.....	30
9	Vendor's data.....	31
9.1	General.....	31
9.2	Proposals.....	31
9.3	Contract data	31
9.4	Spare parts	32
R.1	Scope	33
R.2	Equipment set up.....	33
R.3	Post test inspections.....	33
R.4	Test procedure.....	33
R.5	Post test inspection.....	34



Introduction

Modifications are defined as Add, Delete, or Modify to Read. Resulting action of these modifications are defined below:

<u>Add</u>	Either a new text has been added to the existing paragraph or a new paragraph has been added. For a new paragraph, “ <u>Add</u> ” is placed above the paragraph number.
<u>Delete</u>	Either a complete paragraph has been deleted or the specific words identified within “.” in a statement of the paragraphs have been deleted.
<u>Modify to Read</u>	Either a specific statement of a paragraph or a complete paragraph has been rephrased.

1 Scope

Add

1.1 General

This Specification together with the related documents referenced below constitutes the minimum technical requirements for this equipment.

Requirements for integral gas engines and packaged high-speed separable engine driven reciprocating compressors for oil and gas production services are covered in GIS 34-103.

1.2 Alternate designs

The Vendor's quotation shall be in accordance with this Specification. As an option, the Vendor may supplement the basic quotation with alternate quotations provided the following conditions are met:

- a. The alternate quotation has significant process, price or delivery date advantage, is a superior product at a justifiably higher price, or a product of equal quality at a lower price.
- b. The alternate quotation states all deviations from this Specification and complete engineering details of alternate material and/or design is submitted to BP. Deviations from this Specification shall receive written approval from BP.
- c. Alternative designs with improved life cycle value or other advantages may be proposed if design and technology has demonstrable field experience. Acceptance of alternate offerings is subject to BP audit and approval.

1.3 Precedence

In case of conflicts, order of precedence shall be:

- a. Local codes and standards.
- b. Purchase order/requisition/contract.
- c. Project data sheet/drawings.
- d. This BP Specification.
- e. Referenced BP documents, codes and industry standards.

In the event of a conflict the manufacturer shall immediately notify BP for written resolution. Deviation from the requirements specified shall not be assumed acceptable by the manufacturer.

2 Normative references

API

Add

API RP 551

Process Measurement Instrumentation.

American Society of Mechanical Engineering (ASME)

Add

ASME PTC 9

Displacement Compressors, Vacuum Pumps, and Blowers.



Add**BP**

GIS 12-203	High Voltage Induction Motors (IEC).
GIS 12-204	Medium Voltage Induction Motors (API 541).
GIS 12-205	Synchronous Motors (IEC).
GIS 12-206	Synchronous Motors (API 546).
GIS 15-011	Noise Control.
GIS 18-014	Heat Exchanger Tube End Fixing.
GIS 26-101	Shell and Tube Heat Exchangers (ISO 16812 or API 660).
GIS 26-102	Double Pipe Heat Exchangers.
GP 36-25	Materials for Sour Service in Exploration and Production Operations (NACE MR0175).
GP 36-26	Materials for Sour Service in Refining and Marketing Operations (NACE MR0103).
GIS 34-201	Centrifugal Pumps (ISO 13709 or API 610).
GIS 34-302	Special Purpose Steam Turbines (API 612).
GIS 34-501	Special Purpose Gear Units (API 613).
GIS 34-503	Special Purpose Couplings (ISO 10441 or API 671).
GIS 34-701	Lubrication, Shaft-Sealing and Control-Oil Systems and Auxiliaries (ISO 10438).
GIS 34-705	Machinery Protection System (API 670).
GIS 46-010	Pressure Vessels.

Add**International Standards Organization (ISO)**Add

ISO 1813	Belt drives - V-ribbed belts, joined V-belts and V-belts including wide section belts and hexagonal belts - Electrical conductivity of antistatic belts: Characteristics and methods of test.
----------	---

NACE

NACE MR0103	Materials Resistant to Sulfide Stress Cracking In Corrosive Petroleum Refining Environments.
NACE MR0175	Materials for use in H ₂ S-containing Environments in Oil and Gas Production.

3 Terms and definitionsAdd**3.63 Hydrogen rich service**

Gas stream where hydrogen content exceeds 50 molar percent.

3.64 Partial valve

Suction valve with elements and plug unloader.



3.65 Piston average speed

Piston average speed is calculated by the following equation.

$$\text{US Units: Ft/Min} = (\text{Stroke})(\text{RPM})(2)/12.$$

3.66 Port unloader

Suction valve port without valve elements.

5 Requirements**5.1 Dimensions****Modify to Read**

Unless otherwise specified, vendor furnished data, drawings, documents, and nameplates shall be in the 'English' language, in 'SI' units with 'US Customary' units in brackets.

5.4 Spare parts

The vendor shall provide BP with the original manufacturers' part number for all bought out parts.

6 Basic design**6.1 General****6.1.1 Add**

Vendor shall supply a plan that identifies when the 3 years of uninterrupted service period begins. This plan should identify all required start-up and commissioning inspection requirements.

6.1.3 Delete

Delete "Unless otherwise specified".

6.1.6 Add

Sound pressure levels shall comply with GIS 15-011.

6.2 Bolting**Add**

6.2.6 The following bolting shall have rolled threads:

- a. Valve cover studs.
- b. Crosshead housing to frame bolting.
- c. Crosshead to distance piece bolting.
- d. Distance piece to cylinder bolting.
- e. Head to cylinder bolting.
- f. Packing case to head bolting.
- g. Main bearing studs.
- h. Connecting rod bolting.
- i. Crosshead bolting.
- j. Piston rod bolting.



- k. Piston through bolts.
- l. Cylinder support mounting bolting.

6.2.2 For hydrogen rich or corrosive services B7M bolting shall be supplied where contact with the process gas is possible. These areas include but are not limited to:

- a. Valve cover studs.
- b. Cylinder suction flange bolting.
- c. Cylinder discharge flange bolting.
- d. Indicator tap flange bolting.
- e. Jacket water flange bolting.
- f. Crosshead to distance piece bolting.
- g. Distance piece to cylinder bolting.
- h. Head to cylinder bolting.
- i. Packing case to cylinder/head bolting.
- j. Piston through bolts.

6.4 Allowable speeds

Add

6.4.1 For non-lubricated service or metallic wear bands, the maximum piston average speed shall be 213 meters per minute (700 feet per minute).

6.4.2 For lubricated cylinders, the maximum piston average speed shall be 228 meters per minute (750 feet per minute).

6.4.3 Maximum compressor speed shall not exceed 450 rpm.

6.4.4 Belt driven units shall not exceed 200 hp or 450 rpm. Drivers for belt driven compressors shall not exceed 900 rpm.

6.5 Allowable discharge temperature

6.5.1 Modify to Read

Predicated discharge temperatures of hydrogen rich services shall not exceed 121°C (255°F)

Add

For hydrocarbon lubricated compressors, the maximum actual discharge temperature shall not exceed the following limits:

Discharge pressure		Maximum actual discharge temperature	
bar (g)	psig	°C	°F
0 to 20	0 to 290	135	275
20 to 50	290 to 725	127	260
>50	>725	121	250

6.5.2 Add

Recommended alert and alarm set points shall be supplied. The following high discharge temperature alerts and alarms shall be considered maximum all lubricated compressors.

The alarm level is for indication only and shall not be used to trip the compressor. For E&P applications, these alarm levels shall be used to trip the compressor.



Discharge pressure		Alert		Alarm	
bar (g)	psig	°C	°F	°C	°F
0 to 20	0 to 290	155	315	165	325
20 to 50	290 to 725	147	300	157	310
>50	>725	141	290	151	295

6.6 Rod and gas loads

6.6.1 Modify to Read

Combined rod loading shall not exceed 80% of manufacturer's maximum allowable continuous combined rod loading for compressor running at any specified operating point. The combined rod loads shall be calculated on basis of set point pressure of discharge relief valve of each stage and of lowest specified suction pressure corresponding to each load step. Sufficient dated material shall be furnished with the proposal to document the authenticity of the frame load rating.

6.6.2 Modify to Read

The gas load shall not exceed 90% of the manufacturer's maximum permissible continuous gas loading at any specified operating load step. The combined rod loads shall be calculated on basis of set point pressure of discharge relief valve of each stage and of lowest specified suction pressure corresponding to each load step. Sufficient dated material shall be furnished with the proposal to document the authenticity of the frame load rating.

6.6.4 Modify Second Sentence to Read

Duration of this reversal shall not be less than $\pi/2$ radians (90 degrees) of crank angle. Reversal peak magnitude shall be a minimum of 10% of the peak magnitude in the opposite direction.

6.7 Critical speeds

6.7.4 Add

If torsional critical speeds exist between dead stop and trip speed or synchronous speed, torsional analysis shall include calculated transient vibratory torques and stresses generated in all system components during start-up and shutdown. Basis of this calculation and method of start-up and shutdown (in particular, pressures pertaining in individual compressor cylinders) shall be subject to agreement with BP.

In addition, transient vibratory torques and stresses generated in all system components during emergency shutdowns and fault conditions shall be calculated. For this, it should be assumed that there is insufficient time to vent down system with result that machine decelerates while loaded. If excessive stresses cannot be avoided, manufacturer shall propose installation of torque limiting drive release to prevent damage to machine components.

6.8 Compressor cylinders

6.8.1 General

6.8.1.1 Modify to Read

The maximum allowable working pressure of the cylinder shall be at least 5% higher than the specified relief valve set pressure. The vendor shall specify the relief valve set pressure if not provided by the purchaser.

6.8.1.3 Add

Cylinder pressure tap connections shall be located on the open side of all cylinders. Valves shall not be located in-between cylinders.



All piping and connections shall be located and arranged to permit unobstructed access between cylinder on 4 throw and large machines.

The following minimum clearance shall be followed. Deviations from these values require BP approval.

- a. Minimum distance between the compressor suction flange and pulsation dampener is 30 inches.
- b. Minimum distance between the compressor discharge flange and pulsation dampener is 30 inches.
- c. Minimum distance between discharge valves and compressor deck is 24 inches.
- d. Minimum distance between cylinders is 24 inches.

6.8.1.8 Add

Lubricant shall be specified for all torqued components

6.8.1.9 Add

Anaerobic adhesives or epoxy's to set studs shall not be used.

6.8.2 Cylinder appurtenances

6.8.2.2 Add

Detailed explanation of how the cylinder liner is retained shall be supplied.

Minimum liner radial thickness is 13 mm ($\frac{1}{2}$ inch) for cylinders diameters up to 250 mm (10 inches) and 19 mm ($\frac{3}{4}$ inch) for cylinder diameters over 250 mm (10 inch).

6.8.2.3 Modify to Read

- a. For lubricated service, running bore of cylinder liners and cylinders without liners (used for applications with metallic or non-metallic wear rings) shall have surface finish that does not exceed $0.5\text{ }\mu\text{m}$ ($20\text{ }\mu\text{in}$) arithmetic average roughness (Ra).
- b. Non-lubricated services shall have surface finish that does not exceed $0.3\text{ }\mu\text{m}$ ($12\text{ }\mu\text{in}$) Ra.

6.8.2.4 Delete

Delete "If specified,"

6.8.2.6 Modify to Read

Valve cage designs shall be of the cylindrical type held in place by a circular contact cover as shown in Annex J of the base standard.

6.8.3 Cylinder cooling

6.8.3.2 Add

Static cylinder cooling requires the written approval by BP.

6.8.3.3 Add

Thermal siphon cylinder cooling requires the written approval by BP.

6.8.3.4.1 Modify to Read

Forced-liquid coolant systems (see Figure G-1, Plan C) shall be provided.

Add

- 6.8.3.4.6 Vendor shall state in the required flow rate, temperatures and pressure loss for each cylinder in the proposal.

