



Exploration & Production

GENERAL SPECIFICATION

ROTATING MACHINERY

GS MEC 291

Air Compressor Package

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1. Scope

This specification covers the design, manufacture and shop testing of an air compressor unit for instrument air and service air supply.

The compressor unit shall be designed for a minimum uninterrupted operation of 3 years. This includes the minimum lifetime of any wearing part.

The air compressor unit shall comprise:

- Two X 100% or Three X 50 % electric motor-driven compressor sets as required in Project Specification,
- One instrument air treatment system,
- One packaged instrument air drum located as per Project requirements,
- Local panel(s) and Unit Control Panel as per Project requirements.

All deviations and exceptions to this specification or the documents referred to herein shall be stated in writing in the SUPPLIER proposal and shall be subject to COMPANY approval. In the absence of such a statement, it is assumed that the requirements of the specifications are met without exception. Failure to meet the requirements of this specification and referenced documents shall be corrected at SUPPLIER's cost.

Where this specification, or any other project document, allows the SUPPLIER to propose an "option", the SUPPLIER shall clearly state the selected option in his bid.

In cases the SUPPLIER provides outsourced equipment, he shall be responsible for the coordination of the sub-suppliers, and ensuring the full compatibility of all the equipment. In particular, they shall be compatible in terms of safety, environment, operability, dimensions, weight, performance, control, noise level and vibration behavior.

Components not mentioned in this specification that are necessary for the operation of the equipment or required by certifying agency, regulatory bodies or by law, shall be SUPPLIER standard components.

2. Reference documents

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

Standards

Reference	Title
ISA –S7.0.01-1996	Quality standard for Instrument Air
ASTM F 1941M	Standard Specification For Electrodeposited Coatings on Threaded Fasteners (Metric)
ASTM B 633	Standard Specification For Electrodeposited Coatings of Zinc on Iron and Steel
ISO 4042-1999	Fasteners - Electroplated coatings
ISO 5167	Measurement of fluid flow

Professional Documents

Reference	Title
API RP 552	Transmission systems - Section 21 - General Information on Pneumatic Systems Packaged, Integrally Geared Centrifugal air Compressors for Petroleum, Chemical, and Gas Industry Services Displacement compressor – Acceptance Tests
API 672	
ISO 1217	

Regulations

Reference	Title
94/9/EC (ATEX 100a ¹ /ATEX 95 ²)	European Directive 94/9/EC (23/03/94) on the approximation of the laws of the Member State concerning equipment and protective systems intended for use in potentially explosive atmosphere European Directive 1999/92/EEC (16/12/99) on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres
1999/92/EEC (ATEX 118 ¹ /ATEX 137 ²)	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS COR 350	External protection of structures and equipment by painting Electrical requirements for packaged units Electrical apparatus for potentially explosive gas atmosphere Instrumentation engineering, supply and construction general requirements. Instrument identification
GS ELE 011	
GS ELE 079	
GS INS 101	
GS INS 102	

¹ Reference to Articles 100/118 of the Treaty of Rome

² Reference to Articles 95/137 of the Treaty of Amsterdam

Reference	Title
GS INS 104	Design of the generation and distribution of instrument or gas
GS INS 107	Design and installation of instrumentation links
GS INS 110	Instrumentation for package units
GS MEC 101	Design and power margin
GS MEC 290	Rotating machines packages
GS PVV 112 – Class B10	Piping Materials Classes

3. Definitions and abbreviations

COMPANY	:	TOTAL E&P or any TOTAL E&P subsidiary.
CONTRACTOR	:	Any Company TOTAL E&P has signed a contract with for the Engineering, Procurement, Construction and Installation of a part of a project.
SUPPLIER or VENDOR	:	The package Supplier or Vendor.
PACKAGE	:	Prefabricated process or utility self-contained unit, generally able to operate on its own, supplied fully tested and ready for immediate installation.
SPL	:	Spare Parts List

4. Architecture

Refer to Air compressor package schematic attached in Appendix 1.

5. Instrument air quality

The quality of the instrument air at the outlet of the air drum shall be in accordance with [ISA standard S7.0.01](#) - Section 5, amended as follows:

- Pressure dew point as per [GS INS 104](#),
- Particle size as per paragraph 7.5.2 of this specification,
- Oil free.

6. Operating conditions

In normal condition, instrument and service air flow shall be supplied by the main compressor(s) in service. The standby air compressor shall start automatically if one of the main compressor(s) fails or if the air pressure in the instrument and service air drum falls below a preset value.

Operating philosophy is described in paragraph 10 of this document.

7. Amendments and supplements to [ISA S7.0.01](#)

7.1 Supplement to [ISA S7.0.01](#) - Annex B - Section B.1.1.1 - Intake filters

The suction system of each compressor shall be fitted with an air filter.

The size of each air filter shall be designed for six months of continuous operation in the local environment conditions without replacement of the filter cartridge (maximum allowable pressure loss 100 mm H₂O).

Air inlet (package enclosure or compressor air inlet) shall be supplied with a connecting flange to accommodate 316L stainless steel 3 mm thick air duct, to take the air from a clean and a non hazardous area.

Air inlets shall be rainproof and designed to avoid rain water ingress and shall be made of 316L Stainless Steel.

The air filter shall be fitted with a differential pressure gauge.

7.2 Amendments and supplements to [ISA S7.0.01](#) - Section B.1.1.2 - Compressor

Dry rotary or screw compressors are compressors that use no oil in the parts exposed to the compressed air.

For electric motor above 55 kW, compressors shall be of dry rotary screw type and designed for a maximum discharge pressure of 10 barg.

For flow above 5,000 Nm³/h, integrally geared centrifugal compressors as per API 672 may be proposed.

For electric motor below 55 kW, compressors shall be of dry rotary type (reciprocating is not allowed) and designed for a maximum discharge pressure of 8 barg.

The compressors shall be from a COMPANY approved MANUFACTURER and directly driven by an electric motor.

The compressor design flow shall account for the requirements of instrument and service air, and drier regeneration and associated margin as defined in GS MEC 101 with no negative tolerance. Design conditions shall be based on the maximum ambient temperature, maximum ambient relative humidity and minimum inlet pressure (clogged inlet filter).

7.3 Supplement to [ISA S7.0.01](#) Section B.1.1.3 – After-cooler and moisture separator

The air/air blast cooler radiator shall meet the requirements of the Regulations concerning pressure vessels of the country in which the air unit is to be installed.

The air cooler shall be sized according to the maximum package enclosure ambient temperature.

The maximum temperature of cooled air shall be 10°C above the ambient temperature.

For packages to be installed offshore or in a coastal environment, the bundles shall be made of one of these materials: 316L stainless steel or higher grade, aluminum minimum ASTM grade 5000, or carbon steel protected by a coating type HERESITE[®] from SAKAPHEN.

The fan shall be directly driven by an electric motor or by the compressor and made of corrosion proof material.

Fan blades and its guard shall be made of non sparking material for packages installed in a hazardous area.

Materials shall be clearly stated in technical proposal.

7.4 Supplement to **ISA S7.0.01** - Section B.1.1.3 - After cooler and moisture separator

The moisture separator shall be located after the air cooler.

It shall be sized according to the maximum relative humidity of the installation site.

The internal part shall be coated with a corrosion resistant paint system which shall be described in the proposal.

Automatic drain valve material shall be corrosion proof.

The automatic drain valve and the manual bypass outlet pipes shall be collected and brought to the edge of the skid.

7.5 Amendments and supplements to **ISA S7.0.01** - Section B.1.1.6 - Air treatment systems

Each unit shall include at least the following devices:

- Dual 100% of drier design flow pre-filters (1 in service + 1 in standby), filtration degree: 5 µm,
- Dual heatless adsorption type air drier, (1 in service + 1 in standby),
- Dual 100% of drier design flow after-filter,
- One bypass pipe with a valve for the drier and the dust filter,
- Drain traps with manual bypasses collected and brought to the edge of the skid,
- Interconnection piping,
- Instrumentation,
- Isolating and decompression valves required for a safe maintenance.

Pressure drop across the air treatment system package limit shall not exceed 0.7 bar with clogged filters and 0.3 bar with clean and new filters.

7.5.1 Amendments and supplements to **ISA S7.0.01** - Section B.1.1.6.2 - Air drier

The air drier shall be heatless type; flow shall be from top to bottom of the drier.

Each drier shall be designed for the cumulative air flow of compressors running in normal operating condition (1 out of 2 for 2 X 100% arrangement, or 2 out of 3 for 3 X 50% arrangement), for the flow corresponding to the discharge pressure being minimum operating discharge pressure.

For black start condition, VENDOR shall give the drier limitation and propose solution to ensure the integrity of the drier desiccant.

Special attention shall be given to the depressurization and pressurization phases, in particular those of the periodic regeneration cycles.

NOTE. Excessive air flow in the drier will cause excessive air velocity and destabilization/saturation of the active alumina bed leading to its destruction.

The exhausts shall be fitted with silencers.

The regeneration sequence shall be fully automatic and controlled by the package control system.



The two drier vessels shall be fitted with solenoid valves or On/Off valves with a pneumatic actuator driven by solenoid valves.

Solenoid valves shall comply with **GS INS 101**.

7.5.2 Supplement to **ISA S7.0.01 - Section B.1.1.6.3 – After-filter**

The after-filter shall have a filtration degree of 1 µm.

This filter shall be designed for six months of continuous operation without filter cartridge replacement.

7.5.3 Amendment to **ISA S7.0.01 - Figure B.1 - Compressed air drying system: desiccant drier**

The bypass lines of the pre-filter and the after-filter shall be replaced by a bypass line of the drier and the after-filter, as per drawing in attached appendix 1.

7.5.4 Piping, valves and pressure vessels

Unless otherwise specified, piping and valves materials shall be compliant with **GS PVV 112** Class B10 requirements.

Package limit flanges shall be in accordance with Project piping classes.

The pressure vessels and particularly those of the drier shall be designed, manufactured and inspected in accordance with recognized code, such as ASME, CODAP, BSI PD5000 or EN 13445 requirements and meet the requirements of the Regulations concerning pressure vessels of the country in which the air unit is to be installed.

8. Air drum

Unless otherwise specified, an air drum with a capacity at least equivalent to 20 minutes of instrument air consumption at full consumption rate shall be supplied and installed downstream of the air treatment system.

It shall be designed according to pressure vessels Project specifications.

The internal part shall be coated with a corrosion resistant system.

9. Package

The package shall be designed in accordance with **GS MEC 290** requirements.

Unless otherwise specified, the electric motor driven air compressors, the air coolers, the moisture separators and if practical the air treatment system shall be installed on a common skid.

Flexible hoses shall not be accepted.

10. Instrumentation - Control monitoring system

10.1 Instrumentation

At least the following instruments shall be installed:

Unit component	Required instrument	Instrument action	Transmission to installation control system (ICSS)
Air inlet filter	Differential pressure gauge		
Air compressors	Discharge pressure regulator	Intake air flow adjustment	
	Control air pressure gauge		
	Compressor discharge temperature transmitter	TSHH Shutdown of the unit	Yes
	PSV		
Moisture separator	Differential pressure transmitter	DPSHH Shutdown of the unit	Yes
Pre-filter	Differential pressure transmitter	DPSH	
Inlet line of the air drier	Temperature transmitter	TSHH Shutdown of the unit	Yes
	Flow transmitter		
Air drier	XV or solenoid valves	Control of the regeneration sequence	
	Pressure gauge, PSV		
After-filter	Differential pressure transmitter	DPSH	
Air line downstream of after-filter	Connection for moisture/dew point analyzer		
Instrument air drum	PSV		
	Pressure gauge		
	Pressure transmitters PT1 & PT2	See Note 1	Yes
Outlet of instrument air drum	2 pressure reducing valves (self acting PCV)	Regulation of instrument air pressure	
Airline downstream PCV	Pressure gauge		
	Connection for moisture transmitter		

Note 1:

By PT1:

- PSH Unloading and stopping the compressor(s)
- PSL Starting the main compressor(s)
- PSLL Starting the stand-by compressor

By PT2:

- PSL Shutting the service air distribution
- PSL Process shutdown

10.2 Local panel and annunciator

As a minimum, the units shall be equipped with a local on-skid control panel suitably accessible and visible and comprising the following:

- Emergency shutdown button.
- Normal start button.
- Compressor discharge air temperature gauge.
- Compressor discharge air pressure gauge.
- A 2 positions selector: "Normal" and "Maintenance".

This local panel shall be connected to the air compressor Unit Control Panel.

10.3 Unit Control Panel

The Unit Control Panel (UCP) shall be provided by the SUPPLIER and located in the Instrument room.

The air compressor system shall be normally controlled by this UCP and operated from the ICSS operator workstation.

This UCP shall be of P3 type, according to **GS INS 110**.

11. Workshop acceptance - Tests

The preliminary acceptance procedure shall take place in the assembly workshop on the completed air unit, and shall include:

- Checking the compliance of the equipment with the job specification,
- Checking the certificates of compliance for the hazardous area components,
- Testing the Control and Safety devices,
- Performance test at 100 % load,
- Flow shall be verified by means of flow transmitter and orifice plate, flange type according to ISO 5167,
- Instrument air analysis in accordance with the guidelines of **ISA S7.0.01** – Annex C - Section C.3 – Tests,

The final acceptance test shall take place on site, and shall include:

- Checking that the unit control system operates in accordance with the requirements of the job specification,
- Dew point tests (continuous monitoring over 72 hours) in accordance with the guidelines of **ISA S7.0.01** Annex C - Section C.3 - Tests.



12. Optional equipment

The following devices shall be proposed as options:

- 1) An air drum,
- 2) A portable dew point analyzer including the dew point sensor,
- 3) A spare air compressor.

13. Data sheets

Item	Requirement	Proposal	Comment
SUPPLIER			
Offer reference			
Instrument air quality	ISA S7.0.01 – Section 5		
Required flow at skid outlet			
Proposed flow at skid outlet			
Regulation/standard for pressure vessels	Regulation of the country of final installation		
Installation condition			
Suitability for hazardous area			
Air intake filters	1 per compressor		
MANUFACTURER			
Model			
Offshore design	Yes		
Design flow			
Filtration mesh	In accordance with the compressor VENDOR's recommendation		
Cartridge design	6 months of continuous operation		
Cartridge material	Dry cartridge		
Filter housing	Rainproof		
	Designed to avoid suction of rain water		
Air suction flange	Yes, for connection of a suction duct		
With a clogging indicator	Yes, or PDG		
Compressors			
Type	Dry type		
MANUFACTURER			
Model			
Discharge pressure design			
Margin for leakage	Yes, margin to provide		
Nominal discharge temperature at site conditions			
Maximum discharge temperature at site conditions			



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Item	Requirement	Proposal	Comment
Casing material			
Rotating parts material			
Bearings type and model			
Rotor sealing device			
Nominal speed			
Nominal shaft power			
Driver	Electric motor		
Electric motor MANUFACTURER			
Electric motor model			
Electric motor speed			
Electric motor suitable for hazardous area			
Coupling type			
Discharge pressure control system	Pressure regulator		
Construction code	Regulation of the country of final installation		
Air after-cooler			
Type	Air/air blast cooler - air/oil blast cooler		
Construction code	Regulation of the country of final installation		
MANUFACTURER			
Model			
Design temperature for the air/air heat exchanger			
Design pressure for the air/air heat exchanger			
Volume of air bundle			
Material of air bundle			
External coating of the air bundle			
Nominal cooled air temperature at site conditions			
Maximum cooled air temperature at site conditions			



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Item	Requirement	Proposal	Comment
Fan system			
Designed blast air flow			
Fan material			
Fan guard material			
Fan speed RPM			
Fan driver	Electric motor or compressor		
Driver speed RPM			
Fan shaft power			
Moisture separator			
Location	After the air after-cooler or forming part of the after-cooler		
MANUFACTURER			
Model			
Volume			
Maximum working pressure			
Max working temperature			
Material			
Internal paint system			
With automatic drain system	With an automatic drain valve		
With manual drain system	Yes		
Pre-filters			
MANUFACTURER			
Model/cartridge model			
Volume			
Inlet/outlet connections			
Casing material and coating			
Maximum working pressure			
Max. working temperature			
Design flow	m ³ /hr at pressure = ... bar g		
Filter cartridge material			
Filtration mesh (microns)			
Residual oil content after filtration	ppm by weight at site temperature		

Item	Requirement	Proposal	Comment
Designed for 6 months of continuous operation	Yes		
With automatic and manual drain systems	Yes		
Air drier			
Type	Heatless type		
MANUFACTURER			
Model			
Adsorption material			
Maximum allowable inlet temperature			
Maximum % moisture saturation of inlet			
Volume of one pressure vessel			
Inlet/outlet connections			
Vessels material and internal coating			
Maximum working pressure			
Minimum working pressure			
Max. working temperature			
Design flow	At least 1.7 nominal flow of 1 compressor (m ³ /hr at pressure = ... bar g)		
Regeneration air flow	m ³ /hr at pressure = ... bar g		
Guaranteed dew point at the outlet	At least 20°C less than the minimum site T°C at 8 bar abs.		
Regeneration sequence duration (seconds)			
Sweeping time (seconds)			
Exhausts fitted with silencers	Yes		
Control system			
Solenoid valve MANUFACTURER and model			
XV MANUFACTURER and model			
After-filter			
Type	High efficiency dust filter		
MANUFACTURER			

Item	Requirement	Proposal	Comment
Model/cartridge model			
Volume			
Inlet/outlet connections			
Casing material and coating			
Maximum working pressure			
Max. working temperature			
Design flow	m ³ /hr at pressure = ... bar g		
Filter cartridge material			
Filtration mesh (microns)	5 microns		
Residual dust content after filtration	ppm by weight at site temperature		
Designed for 6 months of continuous operation	Yes		
With hand operated drain system	Yes		
Instrument air drum			
Included in the supply			
Position	Horizontal or vertical position		
Installation on a separate skid			
Construction code	Regulation of the country of final installation		
MANUFACTURER			
Model			
Volume			
Inlet/outlet connections			
Material			
External paint system			
Internal paint system			
With lifting lugs			
With a man-way	20 inches minimum diameter		
With a pressure relief valve	Yes		
Relief valve MANUFACTURER and model			
Relief valve material			
PSV inlet/outlet connections			
With an automatic drain with a manual bypass	Yes		
With a pressure gauge	Yes		

Item	Requirement	Proposal	Comment
With pressure transmitters	Yes		
With an instrument air outlet pipe	Yes		
With a service air outlet pipe	Yes		
Skid			
Common skid for compression system and air treatment system	Yes		
Rigid skid for offshore installation	Yes		
With lifting lugs	Yes		
With a closed lower plane and a drain pipe brought to the limit of the skid	Yes		
Motor driven compressors installation	On flexible mountings		
Flexible hoses	Not accepted		
With zinc-dichromate plated screw fasteners for diameters above 12 mm	Yes, in accordance with B 633-85 standard classification Fe/Zn 12 SC3 and painted		
Screw fasteners of smaller diameters made of 316 L stainless steel	Yes		
Instrumentation			
Air inlet filter	PDG		
Screw compressors	Discharge pressure regulator		
	Control air pressure gauge		
	Discharge temperature transmitter => TSH		
Air-air blast cooler	Thermostatic valve on the air-oil heat exchanger		
Air line after moisture separator	PT => PSHL		
Pre-filter	PDT		
Inlet line of the drier	TT => TSH		
Air drier	XV + solenoid valves or solenoid valves		
	PG on each vessel		
After-filter	PDT		
Air line downstream after-filter	Connection for moisture analyzer		

Item	Requirement	Proposal	Comment
Instrument air drum	PSV		
	PG		
	2 x PT		
Instrument air outlet line	2 PCV (1 in service + 1 standby)		
	Connection for moisture analyzer (after PCV)		
Service air outlet line	XV		
	Flow limiter		
Control monitoring system			
UCP MANUFACTURER and model			
Electrical and Instrument systems			
Components suitable for hazardous area			
Electrical components marked with the appropriate authority certificates of compliance	Yes		
Power cables characteristics			
Others cables connected to a junction box located at the edge of the skid	Yes		
Cable glands material	Marine brass or AISI 316L Stainless Steel		
Cable trays material	316 L stainless steel		
Earthing terminals material	316 L stainless steel		
Paint system			
GS COR 350 paint system for the skid	Yes		
Paint system description for the others components	To be provided with the proposal		
Workshop acceptance tests			
Preliminary acceptance tests location	Assembly workshop		
Conformity checking with the job specification	Yes		
Checking of the certificates of compliance for components suitable for hazardous area	Yes		
Tests of the safety devices	Yes		



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Item	Requirement	Proposal	Comment
Performance test at 100 % load	Yes		
Instrument air analysis	In accordance with ISA S7.0.01 - Annex C Para. C.3		
Final acceptance procedure location	Site		
Test of the unit with the control system	Yes		
Dew point tests	In accordance with ISA S7.0.01 Annex C. Para. C.3		
Optional equipment			
A second drier with interconnect piping system	Yes		
A portable dew point analyzer	Yes		
A spare screw compressor	Yes		
Sizes and weights			
Skid length			
Skid width			
Skid height			
Compressor weight			
Drier weight			
Package weight			

Appendix 1 Air compressor package schematic

