

GENERAL SPECIFICATION

ROTATING MACHINERY

GS EP MEC 031

Rotating Machine Package Specification Motocompressor
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Rev.	Date	Purpose of the revision

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1. Scope

1.1 Purpose

This specification defines the minimum design, fabrication, inspection and testing requirements for the supply of the motocompressor (centrifugal type) packages. It is an exhaustive document detailing the scope of supply and the associated design rules requested by TOTAL E&P for the procurement of motocompressor packages.

1.2 Application

This document applies to the design of all centrifugal compressors packages driven by fixed or variable speed electric motors. It excludes any other type of gas compressor.

1.3 General rules

All deviations from this specification or the documents referred to herein shall be stated in writing in the Appendix 5 of this specification. 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. Exceptions and deviations to the specifications shall be part of Supplier's proposal and will be subject to Company approval.

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 ensure the full compatibility of all the equipment. In particular, they shall be compatible in terms of safety, environment, operability, dimensions, weight, performance, control, noise 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.

The present document remains a General Specification as long as the modifiable forms are not completed. It becomes the Project Specification once these modifiable forms are completed and shall therefore not be considered as a General Specification any more. Then, the General Specification shall be attributed a Project reference number with the associated Project front page.

Preamble shall be completed with the Project description (location, number of machines, etc...).

If Project specificities require amendments to non modifiable parts of this specification or to the documents referred to herein, they shall be considered as deviations and stated in writing in the Appendix 5 of this specification.

This specification will then be issued in two steps:

- Issued "for inquiry"
- Issued "for purchase".

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The applicable documents shall be considered in the following order:

- Local regulations
- Classification Society Rules (If applicable)
- Frame agreement if available - Frame agreement: Applicable ☐ - Not applicable ☐
- This completed specification and associated data sheets
- Referenced General Specifications
- Referenced Project specifications
- Codes and standards.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
1999/92/EEC (ATEX 118 ¹ /ATEX 137 ²)	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
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
API Std 617	Axial and Centrifugal Compressors and Expander-compressors for Petroleum, Chemical and Gas Industry Services
API Std 670	Machinery Protection Systems
ASME PTC 10	Performance Test Code on Compressors and Exhausters
ASME VIII Division 1	Boiler and Pressure Vessel Code
DIN 55473	Auxiliary means of packaging - Desiccant in bag - Technical delivery conditions
IP 15	Area Classification Code for Petroleum Installation handling flammable fluids - July 2005 (3 rd edition)

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

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

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Reference	Title
ISO 10438 (all parts) / API Std 614	Petroleum, petrochemical and natural gas industries - Lubrication, shaft-sealing and control-oil systems and auxiliaries / Lubrication, Shaft-sealing and Oil-control Systems and Auxiliaries
ISO 780	Packaging. Pictorial marking for handling of goods
NF H00-310	Industrial packagings. Flexible and heat sealing protection materials of low coefficient of water vapour transmission (P < 0.3 g/m ² 24 h)
NF H00-320	Packaging. Desiccant. Specifications and tests
US MIL D 3464E	Desiccants, activated, bagged, packaging use and static dehumidification
US MIL PRF 131K	Performance specification: barrier materials, watervaporproof, greaseproof, flexible, heat-sealable
US MIL-STD-2073-1 E	Standard practice for military packaging

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

TOTAL EP General Specification Referential is applicable for the following Project:

The following Company specifications are fully applicable to all purchased equipment as listed in paragraph 3.1 completed by the technical details reported in paragraph 4 and taken into account accepted deviations as listed in Appendix 5. The second level General Specifications mentioned in each individual specification are not applicable if they are not listed in the below tables. The standards, professional documents, regulations and codes mentioned in each General Specification are applicable.

The following list may also be complemented with other specific Project detailed specifications which would include additional requirements, as applicable or deemed necessary by Company or Contractor.

Reference	Title
GS EP COR 170	Materials for Sour Service (Upstream Applications) Specification for design
GS EP COR 350	External protection of offshore and coastal structures and equipment by painting
GS EP COR 354	External protection of onshore structures and equipment by painting
GS EP COR 356	Corrosion Protection of Fasteners for Subsea and Topside Applications

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Reference	Title
GS EP ELE 011	Electrical requirements for packaged units
GS EP ELE 031	Design of earthing and bonding systems
GS EP ELE 079	Electrical apparatus for potentially explosive gas atmospheres
GS EP ELE 111	Induction motors
GS EP ELE 121	HV Variable Speed Drive Systems
GS EP ELE 141	Power transformers
GS EP ELE 161	Electrical cables
GS EP EXP 217	Requirements to Vendors, Suppliers and EPC'S for spare parts
GS EP INS 101	Instrumentation engineering, supply and construction general requirements
GS EP INS 102	Instrumentation identification
GS EP INS 107	Design and installation of instrumentation links
GS EP INS 110	Instrumentation for package units
GS EP INS 120	Control and Choke Valves
GS EP INS 135	Cyber Security requirements for design and supply of ICSS and Package Systems
GS EP INS 137	On/off valve control panels and actuators functional and construction requirements
GS EP INS 900	Instrument hook-up diagrams
GS EP MEC 101	Driver Power Sizing
GS EP MEC 240	Special Purpose Couplings for Petroleum, Chemical, and Gas Industry Services according to API Standard 671
GS EP MEC 242	Special Purpose Gear Units for Petroleum, Chemical and Gas Service Industries According to API Standard 613
GS EP MEC 251	Supply of Axial and Centrifugal Compressors and Expander-compressors for Petroleum, Chemical and Gas Industry Services according to API Standard 617
GS EP MEC 253	Anti Surge System for Centrifugal and Axial Compressors
GS EP MEC 281	Lubrication, Shaft Sealing and Oil Control Systems and Auxiliaries according to ISO 10438 / API Standard 614
GS EP MEC 292	Rotating Machines Packages Installation Requirements
GS EP MEC 300	Noise and Vibrations of Rotating Machine Packages
GS EP PVV 102	Piping Hook-up Standards
GS EP PVV 112	Piping material classes

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Reference	Title
GS EP PVV 142	Valves
GS EP PVV 143	Metallic pipes
GS EP PVV 144	Fittings
GS EP PVV 145	Flanges
GS EP PVV 146	Bolting for piping
GS EP PVV 147	Gaskets for piping and vessels
GS EP PVV 175	Cleaning of piping and vessels
GS EP PVV 211	Design and fabrication of pressure vessels according to ASME VIII
GS EP PVV 412	Plate and frame heat exchanger
GS EP PVV 415	Design and fabrication of air cooler
GS EP PVV 611	Welding of pressure containing piping and equipment
GS EP PVV 612	Piping and equipment subject to severe sour service. Metallurgical and welding requirements
GS EP PVV 622	Piping and equipment subject to intermediate sour service. Metallurgical and welding requirements
GS EP STR 001	Weight monitoring and weighing offshore units
GS EP STR 103	Design and fabrication of skids and equipment supporting structures

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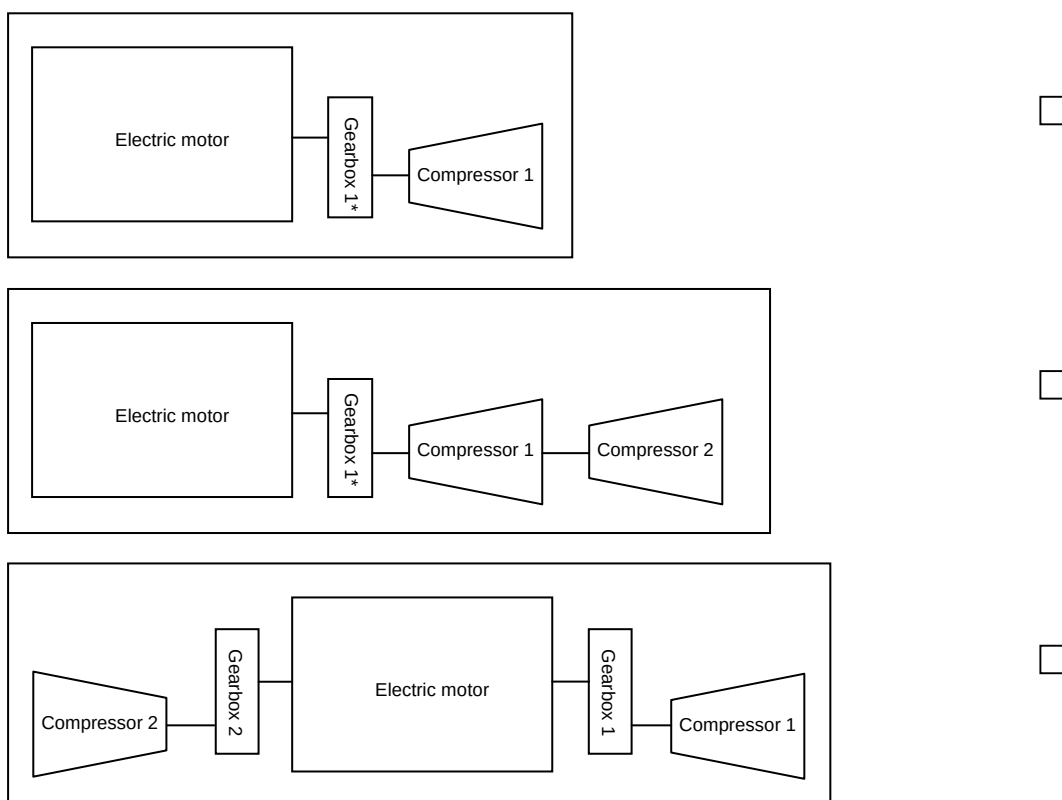
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3. Scope of supply and exclusions

3.1 Scope of supply

The scope of supply consists in identical motocompressor packages which overall layout is as per below scheme:



*: Gearbox may not exist for some applications (refrigeration compression).

The Vendor shall be responsible for the design, supply of materials, manufacture, assembly, supply of drawings and data, all Sub-Vendor co-ordination, testing, delivery and guarantees of the below components:

Note 1: The column "Required" indicates the level of requirement of each item, according to the below rule:

- "X" means that the item is a base case requirement.

-  means that the item is an optional requirement specific to the project. "Y" for YES if the option is selected or "N" for NO if the option is not selected.

Note 2: The column "Description" may offer alternative technical choices that shall be fixed prior to the issue "For inquiry" by ticking the appropriate mark box .

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#	Item	Description	Required	Tag	Quantity
1	ON SKID EQUIPMENT				
1.1	Compressor including but not limited to:				
1.1.1	Compressor 1	As per GS EP MEC 251 , GS EP COR 170 and as per data sheet referenced in paragraph 5.1 of this specification. The compressor will be equipped with dry gas seals as per GS EP MEC 251 chapter 1 paragraphs 2.8.1.3 and 2.8.4 and GS EP MEC 281 chapter 4 paragraph 4.1 and 4.2.5.	X		
1.1.2	Compressor 2	As per GS EP MEC 251 , GS EP COR 170 and as per data sheet referenced in paragraph 5.1 of this specification. The compressor will be equipped with dry gas seals as per GS EP MEC 251 chapter 1 paragraphs 2.8.1.3 and 2.8.4 and GS EP MEC 281 chapter 4 paragraph 4.1 and 4.2.5.	X		
1.1.3	Counter flanges	Companion flanges for compressor main process connections, as per GS EP MEC 281 , chapter 1 paragraph 5.4.1.	X		
1.1.4	Stage drains	As per GS EP MEC 251 chapter 1 paragraph 2.3.2.1.7.	X		
1.1.5	Temperature and vibration probes	As per GS EP MEC 251 chapter 2 paragraph 3.4.7.	X		
1.2	Electric motor including but not limited to:				
1.2.1	Main electric motor	As per GS EP ELE 111 and GS EP MEC 101 and as per data sheet referenced in paragraph 5.2 of this specification.	X		
1.2.2	Electric terminal box	HV electric terminal box mounted on the electric motor. The supply of the associated cable glands is defined in the data sheet referenced in paragraph 5.2 of this specification.	X		
1.2.3	Electric motor cooler	As per data sheet referenced in paragraph 5.2 of this specification.	X		
1.2.4	All associated instrumentation and auxiliary junction boxes		X		
1.3	Power transmission equipment including but not limited to:				
1.3.1	Gearbox 1	As per GS EP MEC 242 and data sheet referenced in paragraph 5.5 of this specification. 	X		
		Variable speed drive gearbox as per data sheet referenced in paragraph 5.5 of this specification.  N/A 			
1.3.2	Gearbox 2	As per GS EP MEC 242 and data sheet referenced in paragraph 5.5 of this specification. 	X		
1.3.3	Temperature and vibration probes	As per GS EP MEC 242 paragraph 6.4.2.	X		
1.3.4	LS flexible spacer type coupling 1	As per paragraph 4.2.3 of this specification.	X		
1.3.5	LS coupling guard 1	As per paragraph 4.2.3 of this specification.	X		

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1.3.6	LS flexible spacer type coupling 2	As per paragraph 4.2.3 of this specification.	X		
1.3.7	LS coupling guard 2	As per paragraph 4.2.3 of this specification.	X		
1.3.8	HS flexible spacer type coupling 1	As per paragraph 4.2.3 of this specification.	X		
1.3.9	HS coupling guard 1	As per paragraph 4.2.3 of this specification.	X		
1.3.10	HS flexible spacer type coupling 2	As per paragraph 4.2.3 of this specification.	X		
1.3.11	HS coupling guard 2	As per paragraph 4.2.3 of this specification.	X		
1.4	Mineral lube oil system including but not limited to (as per GS EP MEC 281 and data sheet referenced in paragraph 5.6 of this specification):				
1.4.1	Lube oil tank	As per GS EP MEC 281 part 2 paragraph 4.3.13.	X		
1.4.2	Oil mist separator	As per GS EP MEC 281 part 2 paragraph 4.3.5.1.	X		
1.4.3	Main oil pump	Driven by AC motor following GS EP ELE 111 .	X		
1.4.4	Standby oil pump	Driven by AC motor following GS EP ELE 111 .	X		
1.4.5	Lube oil run down tank	Made of stainless steel AISI 316L as per GS EP MEC 281 part 2 paragraph 4.9.2.	X		
1.4.6	Lube oil cooler	Lube oil air cooler made of AISI 316 stainless steel as per GS EP PVV 415 and as per GS EP MEC 281 part 2 paragraph 4.5.  Lube oil water cooler as per GS EP PVV 412 (oil pressure above water pressure) as per GS EP MEC 281 part 2 paragraph 4.5. 	X		
		 N/A Off skid			
1.4.7	Oil filters for lube oil	Twin AISI 316 stainless steel oil filters with continuous flow transfer valve for lube oil.	X		
1.4.8	All associated piping, piping accessories and valves	All associated interconnecting piping, piping accessories and valves made in AISI 316/316L stainless steel on the whole system as per paragraph 4.2.7.1 of this specification. Tubing is not allowed, except for the instruments impulse lines as per GS EP PVV 102 , GS EP INS 107 and GS EP INS 900 .	X		
1.4.9	All associated instrumentation	As per data sheet referenced in paragraph 5.6 of this specification and as per paragraph 4.2.5 of this specification.	X		
1.4.10	One local gauge panel	Made of AISI 316/316L stainless steel with instruments as per data sheet listed in paragraph 5.6 of this specification.	X		
1.5	Seal gas system including but not limited to (as per GS EP MEC 281 and data sheet referenced in paragraph 5.6 of this specification):				
1.5.1	All associated equipment	All equipment as required by GS EP MEC 281 and associated standard P&ID.	X		

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#	Item	Description	Required	Tag	Quantity
1.5.2	All associated piping, piping accessories and valves	All associated piping, piping accessories and valves as per paragraph 4.2.7.1 of this specification. Tubing is not allowed, except for the instruments impulse lines as per GS EP PVV 102 , GS EP INS 900 and GS EP INS 107 . Heat tracing on primary seal gas lines is required as per GS EP MEC 281 part 4 paragraph 4.1.	X		
1.5.3	All associated instrumentation	As per paragraph 4.2.5 of this specification, as required by GS EP MEC 281 part 4 paragraph 6, data sheet listed in paragraph 5.6 of this specification and mounted as per GS EP PVV 102 and GS EP INS 900 .	X		
1.5.4	Seal instrument panel 1	Panel frame made of AISI 316/316L supporting equipment as described in items 1.5.1, 1.5.2 and 1.5.3.	X		
1.5.5	Seal gas scrubber 1	As per GS EP MEC 281 part 4 paragraph 4.3.3 and paragraph 4.2.7.1 of this specification.	X		
1.5.6	Seal gas heater 1	As per GS EP MEC 281 , part 4 paragraphs 4.2.7 and 4.2.8.	X		
1.5.7	Booster system 1	As per GS EP MEC 281 part 4 paragraphs 4.2.7 and 4.2.8, skid mounted, including air or electric driven booster and all associated piping, valves and instrumentation.	X		
1.5.8	Seal instrument panel 2	Panel frame made of AISI 316/316L supporting equipment as described in items 1.5.1, 1.5.2 and 1.5.3.	X		
1.5.9	Seal gas scrubber 2	As per GS EP MEC 281 part 4 paragraph 4.3.3 and paragraph 4.2.7.1 of this specification.	X		
1.5.10	Seal gas heater 2	As per GS EP MEC 281 , part 4 paragraphs 4.2.7 and 4.2.8.	X		
1.5.11	Booster system 2	As per GS EP MEC 281 part 4 paragraphs 4.2.7 and 4.2.8, skid mounted, including air or electric driven booster and all associated piping, valves and instrumentation.	X		
1.5.12	Interconnecting piping	All interconnecting piping between seal gas panel / compressor / booster skid as per paragraph 4.2.7.1 of this specification. Tubing is not allowed, except for the instruments impulse lines as per GS EP INS 107 , GS EP PVV 102 and GS EP INS 900 . Heat tracing on primary seal gas lines –including booster skid- is required as per GS EP MEC 281 part 4 paragraph 4.1.	X		
1.5.13	Vents to flare	As per GS EP MEC 281 part 4 paragraph 4.2.17.	X		
1.6	Baseplate including but not limited to(as per paragraph 4.2.2 of this specification):				
1.6.1	Fabricated steel common base plate	As per paragraph 4.2.2 of this specification.	X		

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1.6.2	Baseplate support	3 points support 	Multipoint rigid support 	X		
		4 temporary supports and jacking points as per paragraph 4.2.2.1 of this specification.		X		
1.7	Controls and instrumentation including but not limited to:					
1.7.1	Terminal junction boxes	All terminal junction boxes located at skid edge as per GS EP INS 101 and GS EP INS 107.		X		
1.7.2	Cable glands	Cable glands for departing multi-core cables, defined by Project and blinded off suitably for transport and storage. In case the option is not selected, the gland plates shall be pre-drilled and blinded off.		Option		
		For all other cables, junction boxes shall be provided with cable gland plates and associated cable glands.		X		
1.7.3	Instrumentation cables	All instrument cables between instruments and skid mounted junction boxes / local gauge board indicator as per GS EP ELE 161 and GS EP INS 107.		X		
1.7.4	Instrumentation Cable trays	All necessary cables trays with covers made of AISI 316 between instruments and skid mounted junction boxes as per GS EP INS 107. Empty cable trays shall be installed for the departing multi-core cables –supplied and installed by others– between the terminal junction boxes and the skid edge.		X		
1.7.5	Actuated valves	All necessary control and actuated on-off valves as per GS EP PVV 142, GS EP INS 120 and GS EP INS 137.		X		
1.7.6	Shut down push buttons			X		
1.8	Electrical including but not limited to:					
1.8.1	Electrical cables trays	All necessary cables trays with covers made of AISI 316 between all electrical consumers mounted on skid and the skid edge.		X		
2	OFF SKID EQUIPMENT (shipped loose)					
2.1	Variable Speed Drive System including but not limited to:					
2.1.1	HV Variable Speed Drive	As per data sheet referenced in paragraph 5.3 of this specification and as per GS EP ELE 121  .	N/A (in case of variable speed drive gearbox) 	X		
2.1.2	Power transformer	As per data sheet referenced in paragraph 5.4 of this specification and as per paragraph 4.17 of GS EP ELE 121 and GS EP ELE 141.		X		
2.1.3	Harmonic Filter	As per GS EP ELE 121  .	N/A (in case of variable speed drive gearbox) 	X		

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2.2	Mineral lube oil system including but not limited to:				
2.2.1	Lube oil cooler	Lube oil air cooler made of AISI 316 stainless steel as per GS EP PVV 415 and as per GS EP MEC 281 part 2 paragraph 4.5. 	N/A, located on skid. 	X	
2.3	Valves, instruments and piping including but not limited to:				
2.3.1	Anti-surge valve 1, accessories and associated instrumentation	As per GS EP MEC 253 , paragraph 4, as per GS EP PVV 112 or Project piping classes -if any-, as per GS EP PVV 142 and GS EP INS 120 .	X		
2.3.2	Anti-surge valve 2, accessories and associated instrumentation	As per GS EP MEC 253 , paragraph 4, as per GS EP PVV 112 or Project piping classes -if any-, as per GS EP PVV 142 and GS EP INS 120 .	X		
2.3.3	Anti-surge control field instruments	As per GS EP MEC 253 , GS EP INS 101 , GS EP PVV 102 and GS EP INS 900 , as per approved Project Vendor list. Inline flow meters to be flanged body.	X		
2.3.4	Hot gas by-pass valve	To be supplied depending on the dynamic simulation results, as per GS EP INS 137 and GS EP PVV 142 .	X		
2.3.5	Flame arrestors	As per paragraph 4.2.7.2 of this specification.	X		
2.3.6	Compressor temporary suction strainer 1 and associated spool	As per GS EP MEC 292 , paragraph 4.4.2 and GS EP MEC 251 Chapter 1, paragraph 3.5.4.	X		
2.3.7	Compressor temporary suction strainer 2 and associated spool	As per GS EP MEC 292 , paragraph 4.4.2 and GS EP MEC 251 Chapter 1, paragraph 3.5.4.	X		
2.3.8	PDT	For temporary suction strainer DP monitoring.	X		
2.4	Controls & Instrumentation including but not limited to:				
2.4.1	UCP	As per GS EP INS 110 , including PLC for control/safety, panel mounted HMI. Full licenses for all software.	X		
2.4.2	ICSS interface	Communication cards, relays, signal convertors, etc. to interface with ICSS and support systems (if any).	X		
2.4.3	Shut down push button	Mounted on the UCP.	X		
2.4.4	VTMS	Vibration and Temperature Monitoring System to control the complete shaft line vibration and temperature sensors integrated inside UCP.	X		
2.4.5	Anti surge control	Software and panel-mounted hardware to control the compressor anti-surge system following GS EP MEC 253 , integrated inside UCP. Full licenses for all software.	X		
2.4.6	Load sharing control	Software and panel-mounted hardware to control the compressors load sharing, integrated inside the UCP.	X		

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2.5	Spare parts and special tools including but not limited to:				
2.5.1	Spare parts for commissioning and start-up	Detailed scope is given in the paragraph 8.1.1 of this specification.	X		1 set
2.5.2	Capital spare parts	Detailed scope is given in the paragraph 8.1.2 of this specification.	X		1 set
2.5.3	Special tools	Detailed scope is given in the paragraph 8.2 of this specification.	X		1 set
2.5.4	Tools trolley	Lockable trolley to carry the motocompressor package tools and special tools.	X		1
3	MISCELLANEOUS				
3.1	Baseplate anchors and shims	As per paragraph 4.2.2 and Appendix 2 of this specification.	X		
3.2	Off skid equipment anchors and shims	All anchors and shims for all off skid equipment supplied by Supplier.	X		
3.3	Piping	All necessary on-skid tubing / piping.	X		
3.4	Documentation	Set of documents as per Appendix 3 of this specification.	X		1 set
3.5	Package 3D model review	Review of the motocompressor package 3D models for maintenance areas review as per paragraph 4.2.11 of this specification.	X		1
3.6	Maintenance laptop	Including software for UCP configuration.	X		
3.7	Personal protection	As per paragraph 4.2.9.1 of this specification.	X		
3.8	Painting and coating	As per paragraph 4.2.8 of this specification.	X		
3.9	Limit flanges	All limit flanges as per GS EP PVV 112 or project piping classes-if available- equipped with blind flanges for transportation.	X		
3.10	Package packing and preservation	As per paragraph 9 of this specification.	X		
3.11	Earthing network	Earthing design and implementation as per GS EP ELE 031 and GS EP INS 107 .	X		
3.12	Oil conditioner		Option		1
3.13	Lube oil system flushing kit	Kit made of all necessary flexible hoses for machinery bearings bypass.	X		1 set
3.14	Walkways and ladders	Walkways and ladders to make access to any equipment mounted on the package.	Option		
3.15	Lifting tools for the complete package	Consists of slings, shackles, and spreader bar as per paragraph 4.2.2.4 of this specification and as per GS EP STR 103 .	X		1 set
3.16	Backup	Complete backup hard disk with application software, PLC program, HMI and any firmware prior to shipment.	X		
3.17	Software	OEM CD/DVD for any software used with full licenses.	X		
3.18	Specific climate considerations	☐ Tropicalization ☐ Winterization ☒ None	X		

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#	Item	Description	Required	Tag	Quantity
4	TESTS				
4.1	Factory tests				
4.1.1	Electric motor	As per paragraph 7 of GS EP ELE 111 and data sheet referenced in the paragraph 5.2 of this specification.	X		
4.1.2	HV variable speed drive	As per paragraph 7 of GS EP ELE 121 .	X		
4.1.3	Power transformer	As per paragraph 8 of GS EP ELE 141 .	X		
4.1.4	Gearbox	As per paragraph 4.3 of GS EP MEC 242 .	X		
4.1.5	Compressor	As per chapter 1 paragraph 4.3 and chapter 2 paragraph 4.3 of GS EP MEC 251 .	X		
4.1.6	Lube oil unit(s) and lube oil cooler(s)	As per part 1 paragraph 7.3 and part 2 paragraph 7.3 of GS EP MEC 281 .	X		
4.1.7	Seal gas panel	As per part 1 paragraph 7.3 and part 4 paragraph 7.3 of GS EP MEC 281 .	X		
4.1.8	UCP	As per paragraph 7.4 and Appendix 5 of GS EP INS 110 , including communication test with the ICSS.	X		
4.1.9	Actuated valve(s)	As per paragraph 11 of GS EP INS 120 (control). As per paragraph 8 of GS EP INS 137 (on-off).	X		
4.1.10	Complete unit tests	As per paragraph 7 of this specification.	X		
4.1.11	Noise and vibration tests	As per paragraph 7 of this specification.	X		
4.2	Site acceptance tests				
4.2.1	Complete unit tests	As per paragraph 7 of this specification.	X		

Vendor shall be responsible for the physical and technical compatibility of the entire package and shall ensure that all equipment and components provided are suitable for the operations intended.

3.2 Exclusions

The following equipment are not included in the scope of supply:

- Counter flanges, gasket and bolting for connecting flanges at battery limits of Vendor's supply (except compressor companion flanges in Vendor's scope)
- All piping outside the package
- Electric and instrument cables outside the package
- All earthing cables outside the package.

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4. Basis of design

This paragraph details the technical specificities of Project that are not covered in the Company General Specifications nor in the Project documents.

4.1 Particular specification for rotating equipment

This paragraph indicates where the Company General Specifications Project specificities are covered. The paragraphs mentioned in the following charts refer to TOTAL EP General Specifications Referential **2013**.

GS EP MEC 240		
Paragraph	Data Sheets	Project
5.3	X	
10.3	X	Site conditions as per paragraph 6.1 of this specification.
12.5.2	X	
12.5.3	X	
13.2.2.1		Drawings as per Appendix 3 of this specification.
A.2.5	X	Site conditions as per paragraph 6.1 of this specification.
A.4.1	X	Site conditions as per paragraph 6.1 of this specification.

GS EP MEC 242 (not applicable in case of variable speed drive gearbox)		
Paragraph	Data Sheets	Project
2.1.4	X	
2.1.6		Control of sound pressure level method: Refer to paragraph 4.2.9.2 of this specification for the maximum allowable sound pressure level.
2.1.10		Refer to paragraph 6.1 of this specification.
2.1.14	X	Refer to paragraph 6 of this specification.
2.1.16	X	
3.1	X	List of accessories to be supplied:
3.3.1.1	X	Gearbox mounted on:
4.1.1	X	
4.3.2.2.12	X	

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GS EP MEC 242 (not applicable in case of variable speed drive gearbox)

Paragraph	Data Sheets	Project
4.3.2.2.16		Additional speeds to be tested: Duration and data to be recorded:

GS EP MEC 251

Paragraph	Data Sheets	Project
Chapter 1		
2.1.1.1		CFD analysis required: ☐ Yes ☐ No
2.1.1.2	X	
2.1.8		Installation type:
		Environmental conditions are reported in paragraph 6 of this specification.
2.1.9		Control of sound pressure level method:
2.1.10		Liquid injection: ☐ Required ☐ Not required
2.1.14		Refer to paragraph 6.1 of this specification.
2.2.1.3		List of corrosive agents:
2.2.1.13		Methanol injection: ☐ Yes ☐ No
2.2.1.15.3		Environmental conditions are reported in paragraph 6 of this specification.
2.3.2.2.1	X	
2.8.1.1	X	
2.8.1.5		Nitrogen availability: refer to paragraph 6 of this specification.
3.3.2.1		Refer to paragraph 4.2.2 of this specification.
3.3.2.5		Refer to paragraph 4.2.2 of this specification.
3.4.2.1		Extent of process control by the machine control system:
4.3.8.2		Helium test: ☐ Required ☐ Not required

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GS EP MEC 251

Paragraph	Data Sheets	Project
4.3.8.6		Refer to paragraph 7 of this specification.
5.1.1		Refer to the Appendix 3 of this specification.
Chapter 2		
2.3.1.1	X	
2.7.1.1.2		Radial bearing type:
3.4.2.2		List of process controls to be performed by the machine control system:
4.3.3.2		Refer to paragraph 7 of this specification.

GS EP MEC 253

Paragraph	Data Sheets	Project
4.2		Anti-surge controller Supplier:

GS EP MEC 281

Paragraph	Data Sheets	Project
Part 1		
4.5.2		Environmental conditions are reported in paragraph 6 of this specification.
4.6.2		List of additional inspections required:
5.1.18		List of special requirements for piping, flanges, gaskets, instruments and o-rings, valves:
5.1.32		Valves according to ☐ Vendor ☐ CPY standard.
5.5.1		Intercooler between each compression stage: ☐ Required ☐ Not required
5.5.2		Intercooler (if any) type:
5.5.3		Aftercoolers supplied by: ☐ Vendor ☐ Contractor

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GS EP MEC 281

Paragraph	Data Sheets	Project
5.5.5		Water-cooled, shell and tube intercoolers and aftercoolers in accordance with:
5.5.10		Water-cooled double pipe feature: ☐ Required ☐ Not required
5.5.11		Intercoolers ☐ integrally on skid ☐ separately mounted.
5.5.12		List of materials of construction:
5.5.14		Piping between the compression stages, intercoolers and aftercoolers by: ☐ Vendor ☐ Contractor
6.2.1.3		☐ HA ☐ HOA starting switch for pump motor ☐ Required ☐ Not required
6.2.2.2	X	
6.2.2.4	X	
6.3.8.1	X	
6.4.2		Refer to paragraph 6 of this specification.
Part 2		
4.1.4	X	
4.4.13		Refer to paragraph 6 of this specification.
4.5.4.3		Separate supply of air cooled heat exchanger. Sizing and configuration of connections:
Part 4		
4.2.5		Dry gas seals maximum static pressure:
4.2.12		Code stamp: ☐ Required ☐ Not required

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4.2 Particular specification for rotating equipment - Packaging

4.2.1 General considerations / Safety and environment

The complete package shall be designed for _____ years of operation at least and shall be able to start at SOP.

Environmental conditions for the equipment design are indicated in the paragraph 6 of this specification.

When packages have to be installed in hazardous area zone 2, as per [IP 15](#), they shall be specified for gas group IIA and temperature class T3 (200°C) and [ATEX European directives 94/9/EC](#) and [1999/92/EEC](#) shall be applied.

In this case, packages shall be certified ATEX **Ex** II 3G and CE marked with the following requirements:

- Any instrumentation component shall be certified ATEX **Ex** II 2G and CE marked. For facilities located outside the European Union (EU countries), alternative IECEx scheme can be applied (IEC Scheme for Certification relating to Equipment for use in Explosive Atmospheres)
- Any electrical component shall be selected in accordance with [GS EP ELE 079](#)
- Any mechanical component certified ATEX **Ex** II 3G and CE marked.

Any equipment or system required to be left in operation when a safe or a hazardous area zone 2 becomes a hazardous area zone 1 (such as presence of gas, ventilation failure, etc.) shall be certified ATEX **Ex** II 2G and CE marked.

Package and all accessories shall bear their own marking, according to the mode of protection used.

4.2.2 Package configuration

4.2.2.1 Package base plate mounting

Mounting shall comply with the requirements of [GS EP MEC 300](#) and [GS EP STR 103](#).

When installed on concrete foundations, package base plate shall be multipoint rigid design with jacking bolts for leveling purpose.

When supported on 3 points:

- The location of the 3 points shall be subject to Company approval
- Package base plate shall be designed with 4 points for transportation purpose between the supporting facility fabrication yard and the site
- Package base plate shall be designed with 4 jacking points for leveling purpose and transportation support removal and 3 points installation at site.

20 mm thickness stainless steel shim packs and 50 mm thickness stainless steel sole plates of all the packages as well as anchor bolts shall be provided by Supplier.

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Contractor shall install, weld sole plates of all the packages in accordance with the Project specifications and Supplier requirements (number, size, location, material, strength and tightening torque).

The supporting structure shall be machined prior to welding the soleplates.

Refer to Appendix 2 for details.

4.2.2.2 Three points base plate package configuration

3 points base plate package shall be designed to accommodate as a minimum the driving and driven machineries with associated ancillaries.

However, for special applications, Projects may specify the whole scope of supply (with the exception of loose process component) be installed and supported by the package base plate only, as listed below (if any):

4.2.2.3 Package base plate construction details

Package base plate design shall conform to **GS EP STR 103** to maintain alignment of the line shaft under all operating condition whether normal, transient and abnormal.

Package base plate shall be designed with either:

- A non slip decking steel plate covering the top of the base plate and a drip pan and gutter all around with 2 drains points of 2" diameter minimum
- or
- Grating covering the top of the baseplate and a steel plate continuously welded at the bottom of base plate recovering any oil spill and drain points of 2" diameter minimum.

Priority shall be given to single structural welded baseplate supporting both driver and driven equipment. In case of separated driver skid and driven equipment skid, both skids shall have machined and doweled mating surfaces. Sections shall be bolted and fitted with suitable pins to form a single continuous structurally integral skid base for single lift prior to Ex-works delivery. The design of the bolted assembly shall be subject to Company review and approval.

The consideration of a single sub-frame (or soleplate) underneath to support driver/driven skids shall be subject to Company approval.

In any case, the complete shaft line skid mounted package shall be shipped in one piece and shall not be disassembled after the string tests.

All the equipment supported by the skid shall be contained within the skid projection footprint (meaning that no equipment overhung/projection outside the skid footprint is allowed). Projection outside the skid footprint may be allowed for the main motor HV terminal box but is subject to Company approval. When the main motor HV terminal box projects itself on the skid, an opening shall be done in the skid grating to allow passing the HV power cables depending on their allowable bending radius. This shall be evaluated between Company, Contractor and Vendor during the engineering phase.

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4.2.2.4 Package lifting appliances

Package lifting appliances, such as lifting beams or spreader bars, slings, shackles, etc., shall be included in the Vendor scope of supply and designed, tested and certified by an approved authority in accordance with **GS EP STR 103**.

Lifting appliances shall be load tested at 125% of the safe working load and certified. Visual inspections and NDT (dye penetrant and ultra sonic inspections) shall be performed after the load test.

4.2.3 Load couplings

Couplings shall conform to **GS EP MEC 240**.

4.2.4 Installation

The package shall be installed as per **GS EP MEC 292** requirements.

For packages to be installed on a floating structure, Vendor shall indicate the special devices installed to cope with the FPSO motions and accelerations indicated in the paragraph 6 of this specification. In any case, Vendor shall clearly indicate his layout requirements to ensure proper operation of the lube oil system and the drain system.

Vendor scope of supply shall include a vibration study according to and if required by **GS EP MEC 300**.

4.2.5 Instrumentation

The package instrumentation shall comply with **GS EP INS 101**, **GS EP INS 102**, **GS EP INS 107** and **GS EP INS 110** and control valves (including anti-surge and recycle valves) shall comply with **GS EP INS 120**. Actuated on-off valves shall comply with **GS EP PVV 142** and **GS EP INS 137**.

Thermowell design and instruments hook ups shall comply with **GS EP PVV 102** and **GS EP INS 900**.

Furthermore, machinery protection and monitoring system shall comply with **API Std 670** requirements. In particular, Appendix H - typical System arrangement plans shall apply.

Supplier shall provide with its technical proposal a preliminary set of vibration and temperature P&ID and interconnecting diagram.

Junction boxes shall be mounted at 1.6 m above grating.

4.2.5.1 General

The package is categorized as "P3 type Package".

4.2.5.2 Package control system configuration

Each package unit shall be supplied with its dedicated UCP compliant with **GS EP INS 110** and **GS EP INS 135** requirements.

The SIL requirements for the PLC are listed in the **GS EP INS 110**.

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Signals from any on package skid instrument required by the package control or by the ICSS, shall be wired up to dedicated junction boxes located at the package skid edges.

Interconnecting cables between UCP and skid, and in between UCP and ICSS/MCC will be supplied and installed by Contractor. Package Vendor shall adapt the number of terminals in marshalling cabinets and junction boxes to the type of multi-core cables in accordance with Contractor specifications. All spare wires shall be earthed through individual terminals, bonding is not permitted.

In addition, UCP shall include the following systems:

- A vibration monitoring system
- An anti-surge control system
- A load sharing control system.

The package shall be installed as per **GS EP MEC 292** requirements including remote access for vibrations analysis system.

4.2.5.3 Package control system philosophy

The control system of the package shall perform the main following functions:

- Sequencing
- Control
- Protection
- Monitoring and Display and Maintenance Functions
- Compressors load sharing.

4.2.5.4 Sequencing

The sequencing shall include:

4.2.5.4.1 Starting

Initiated by the Operator from the UCP panel, or/and from the central control room through ICSS Operator working station.

4.2.5.4.2 Loading

The sequencing shall include the compressor ancillaries and train valves typically:

- Suction and discharge valves
- Suction pressurization valve and differential pressure across the suction valve
- Vent valve(s)
- Compressor anti-surge valve(s)
- Compressor hot by-pass valve(s), if any.

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All these valves with the exception of the compressor anti-surge valve and hot by-pass valves being supplied by the Vendor will be operated by the UCP by means of auto reset solenoid valves. Open and close limit switches shall be hardwired to the UCP for discrepancy detection.

4.2.5.4.3 Stopping

The package may be shutdown either manually or automatically.

Manual stop (from UCP and from Central Control Room) shall be either:

- A normal stop
- An emergency stop.

Automatic stops shall be the responses of the control system to specific malfunction conditions of the packages or of the plant.

Depending on the type of malfunction, these shutdowns shall be:

- Identical to normal stops
- Fast stops identical to emergency stops.

The fast stop may be either with compressor pressurized or depressurized.

4.2.5.5 Monitoring and display & maintenance functions

Refer to **GS EP INS 110** relevant paragraphs.

4.2.6 Electrical

The design, manufacture, inspection and testing of electrical equipment provided with the packaged unit shall comply with **GS EP ELE 011**.

4.2.7 Piping, valves and vessels

4.2.7.1 Piping, tubing and pressure vessels

The fabrication, inspection and shipment of pipes, fittings and flanges shall comply with Company piping classes **GS EP PVV 112**, **GS EP PVV 143**, **GS EP PVV 144**, **GS EP PVV 145**, **GS EP PVV 146** and **GS EP PVV 147**.

When required by **GS EP COR 170**, **GS EP PVV 612** and **GS EP PVV 622** shall be applied.

Piping, tubing and pressure vessels shall be designed, fabricated, tested and installed in accordance with the applicable Project specifications.

However, Manufacturer standard piping specifications are acceptable in the package for all utility lines (oil, water, air, nitrogen). Manufacturer standard piping specifications shall be first provided to Company for approval.

All equipment piping systems shall have flanged high point vents and flanged low point drains.

These drains and vents shall terminate with an isolating valve and a blind flange.

All interconnecting piping shall be identified and tagged.

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A single block and bleed valve assembly shall be installed in each instrument take-off connection, except thermowell and vibration probes, and shall be located as close to the parent pipe or equipment as possible.

Double block and bleed valve assemblies instead of single block and bleed shall be provided when normal operating pressure is over 70 barg (normal operating pressure is the highest normal operating pressure of all process cases when the plant operates at steady state conditions).

Take-off connections, including the first valve shall be in accordance with the General Specifications and/or Project piping specification.

Each air-consuming instrument shall be provided with an AISI 316 filter regulator fitted with an AISI 316 pressure gauge and an AISI 316 isolating valve (refer to **GS EP PVV 102**, **GS EP INS 137** and **GS EP INS 900**). Instrument air tubing shall be made of AISI 316L. Fittings and accessories shall be made of AISI 316L stainless steel.

Threaded connections on any pipework or vessels are not permitted, except tapping points on instrument air distribution header(s).

Mitered bends are not permitted.

Pressure vessels as defined per **ASME VIII Division 1** § U.1 shall be designed as per **GS EP PVV 211** and **GS EP PVV 611** and shall be certified by an authorized agency agreed by the Company. ASME stamp is not required.

The cleaning of piping systems and/or vessels, which would normally be performed on site, but which may also be required to be performed at Manufacturer's facilities in special occasion shall comply with **GS EP PVV 175**.

4.2.7.2 Vents

All vents, which are interfaced between Supplier and Company, shall be routed to the skid edge or to a more appropriate location to be mutually agreed, and shall terminate by a flange fitted with a blind flange for transportation purpose.

Oil fume vents shall be provided with oil demisters and flanged flame arrestors with internals made of AISI 316L stainless steel.

Gas vents to atmosphere shall be provided with flanged flame arrestors with internals made of AISI 316L stainless steel.

4.2.7.3 Baseplate drains

All drains which are an interface between the Supplier and Company shall be routed to the skid edge and shall terminate by 2" ANSI 150 # flanges fitted with an isolating valve and a blind flange.

The drains shall be routed to plant hazardous open drain by Contractor.

4.2.8 Painting

Package unit shall be painted according to **GS EP COR 350** or **GS EP COR 354** according to site environment.

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For packages to be operated offshore or in coastal environment:

- Package skids and support structures, piping and pressure vessels within the scope of supply shall be painted according to **GS EP COR 350** system P01
- When required by **GS EP COR 350**, paragraph 3.2, components made of stainless steel shall be painted according to **GS EP COR 350**, paragraph 3.2
- Rotating machines shall be painted according to Supplier standard suitable for offshore environment, if approved by Company, or according to **GS EP COR 350** system P14.

4.2.9 Health Safety and Environment

4.2.9.1 Hot surfaces

Any hot surface that can be reached by Operators shall be insulated in such a way that their maximum skin temperature be lower than 70°C.

4.2.9.2 Noise level

All definitions, notations, testing methods, calculation methods and calculation procedures shall be in accordance with **GS EP MEC 300**.

All efforts shall be deployed to limit the average sound pressure level around the compressor package (and lube oil air coolers located off the main package skid) at 90 dB(A) at one meter.

However and in any case, no external noise attenuation devices and/or enclosures are allowed on the compressor and gearbox.

Supplier shall submit during tender the expected noise map at one meter of the sound pressure levels in dB(A) per octave bands and the maximum sound power level for each of the following:

- Compressor package
- Lube oil air coolers (if located off the main package skid).

4.2.10 Miscellaneous

4.2.10.1 Bolting

Package bolting shall be as follows:

- For diameter above 24 mm, bolting shall be according to **GS EP COR 356** paragraph 6
- For diameter up to and including 24 mm, bolting shall be of AISI 321 Stainless steel as a minimum
- Piping bolting shall be in compliance with **GS EP PVV 112** and **GS EP PVV 146**.

4.2.10.2 Interconnections

The package shall be designed to maximize factory assembly and testing, thus simplifying and reducing to a minimum installation and commissioning operations.

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The package shall be wired and designed to ensure minimum installation operations on site. All external connections shall be brought to skid edge:

- Within interconnecting junction boxes for instruments and controls, except for the electric motors and heaters power cables. Segregation shall be as per **GS EP INS 110** requirements
- With flanges for piping, as per **GS EP PVV 112**, and with counter flanges and associated bolting for compressor main flanges (the drawing of these counter flanges shall be submitted to Company for approval)
- Each utility which is interfaced between the Supplier and Company shall be routed through a manifold to a single point.

Interconnecting instruments junction boxes shall be provided with cable gland plates and associated cable glands.

For DC connection (if any), intermediate junction box shall be provided by Vendor, if required to accommodate Company interconnecting cables.

Any structure or item not installed for the transportation shall in any case be fully erected in the Supplier's workshop, match-marked for ease of reassembly at site.

In addition the package shall be suitable for an exposure to firewater (sea water, when located on offshore site) deluge.

4.2.10.3 Name plate's tags and labels

All major equipment shall be identified by AISI 316L stainless steel nameplates attached by AISI 316L stainless steel pins or screws. All operating notices, warning notices and nameplates shall be in the English and language.

4.2.10.4 Rotation arrows

Direction of rotation arrows shall be clearly and permanently marked on all rotating equipment.

4.2.11 Maintainability and accessibility

For all items within the package, Vendor shall comply with the following requirements:

- Accessibility for operation (position of instruments, legibility of readouts, operation of valves, etc.) and for maintenance. If necessary, an access platform with stairs or ladder shall be provided for equipment that cannot be accessible from the ground.
- Removable gratings or plates shall be provided around the machines to allow access and to protect equipment located in the bottom part of the package.
- Maintainability (disassembly, reassembly, adjustment) with the necessary space and handling devices as appropriate to bring any piece of equipment to dedicated lay down areas.
- Safety instructions.

All the above requirements shall be fully supported by an engineering handling study during Contract execution, for the following components but not limited to: driver, rotors, couplings, electric motors, gears, piping spools, etc.

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A design review of the package accessibility and maintainability shall be organized with Company and Contractor prior to package construction. This review shall be supported by Vendor 3D CAD models.

For equipment over 20 kg, jack screws, lifting lugs, eyebolts, or equivalent shall be provided to perform alignment, disassembly and re-assembly.

Equipment/driver alignment must include a minimum of:

- 20 mm AISI 316 stainless steel machined shims
- 3 mm AISI 316 stainless steel final adjustment shims.

These shims are part of the Vendor scope of supply.

4.2.12 Inspections

The inspections shall be conducted according to the Project ITP. As a minimum, the requirements reported in Appendix 4 shall apply. The weight control shall be performed as per **GS EP STR 001**.

4.2.13 Engineering documentation language and units

The engineering documentation shall be developed as follows:

Language: English and

Units:

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5. Data sheets

5.1 Compressor

5.1.1 Compressor 1

Reference / Revision: /

5.1.2 Compressor 2

Reference / Revision: /

5.2 Electric motor

Reference / Revision: /

5.3 Variable speed drive

Reference / Revision: /

5.4 Power transformer

Reference / Revision: /

5.5 Gearbox

5.5.1 Gearbox 1

Reference / Revision: /

5.5.2 Gearbox 2

Reference / Revision: /

5.6 Seal gas panel and lube oil system

5.6.1 Seal gas panel and lube oil system 1

Reference / Revision: /

5.6.2 Seal gas panel and lube oil system 1

Reference / Revision: /

5.7 Noise

Reference / Revision: /

5.8 Weight

Reference / Revision: /



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5.9 Data sheets templates

Each data sheet requested in the VDR enclosed in the Appendix 3 of this specification shall be filled in by the Vendor in the Company template format.

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6. Site conditions and utilities

6.1 Site conditions

LOCATION

ALTITUDE

CLIMATE

ATMOSPHERIC PRESSURE

Average		mbar
Minimum		mbar
Maximum		mbar

AMBIENT TEMPERATURE

Design (minimum / maximum)		°C
Normal		°C
Minimum		°C
Maximum		°C

WIND

Normal		m/s
Design		m/s
Direction		

RELATIVE HUMIDITY

Minimum		%
Maximum		%

ENVIRONMENT

Dust	
Smoke	
Other	

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BLAST

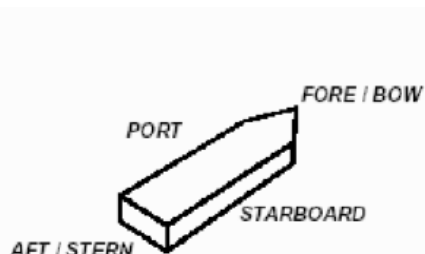
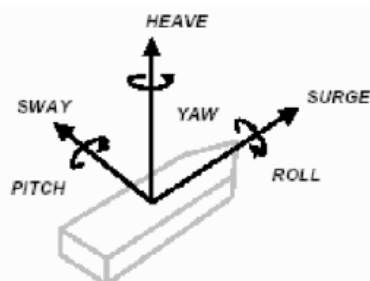
Equivalent static pressure (mbar)

CLASSIFICATION TYPE AREA
OPERATIONAL DESIGN CONDITIONS

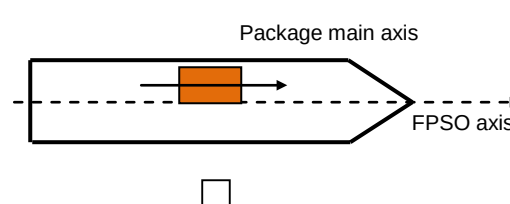
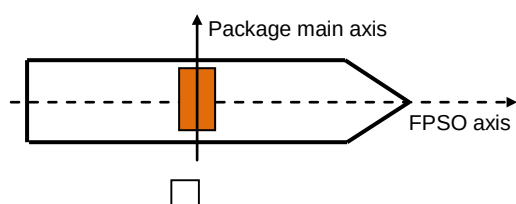
Project Phase:	During towing	On site	On site	
Condition:	Dry	Operating	Damaged	
Longitudinal acceleration (Surge)				m/s ²
Transversal acceleration (Sway)				m/s ²
Vertical acceleration (Heave)				m/s ²
Trim angle (Pitch)				°
List angle (Roll)				°

The motions and accelerations are given in the following way (typical):

Surge	X	Roll / List	Rotation / X
Sway	Y	Pitch / Trim	Rotation / Y
Heave	Z	Yaw	Rotation / Z


FPSO Orientation

FPSO Movement definition
TECHNICAL ROOM ENVIRONMENTAL CONDITIONS

The environmental conditions of technical room in which the UCP will be installed are specified in the document revision .

PACKAGE ORIENTATION ON FPSO


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6.2 Utilities

ELECTRICITY

Refer to:

- Project specification for electrical requirements for packaged units:

rev

- GS EP ELE 011**

UCP UPS Earthing Regime:

UCP Normal Power Regime:

INSTRUMENT AIR and NITROGEN

Type	Instrument Air	Nitrogen	
Min/max operating temperature			°C
Operating temperature			°C
Min/max operating pressure			Barg
Operating pressure			Barg
Oil concentration			
Dew point			°C @ barg

COOLING WATER SYSTEM

Type	Sea Water	Fresh Water	
Normal inlet temperature			°C
Min/max inlet temperature			°C
Min outlet temperature			°C
Max outlet temperature			°C
Supply pressure			Barg
Max allowable delta P			Bar
Calorific capacity			kJ/kg°C
Fouling factor			m ² .°C.h/kcal

FLARE

Type	HP	LP	
Max operating temperature			°C
Normal temperature			°C
Max operating pressure			Barg
Normal pressure			Barg

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7. Tests

The scope of this chapter is to describe the tests to be carried out on the completely assembled moto compressor package. With the exception of the site acceptance test, these tests shall be conducted in Vendor facilities before unit shipment.

The scope of these tests is to verify the satisfactory performance of the centrifugal compressor and of the electric motor, to demonstrate the satisfactory mechanical behavior of the complete compression train under full load conditions and to demonstrate the functionality of the main auxiliary systems of the package.

Note: An [ASME PTC 10](#) Type 2 test shall be carried out on one compressor, in accordance with [GS EP MEC 251](#), before performing the complete package test. As a reminder, the following sequence must be performed for compressors:

n packages	1	n-1	Test objectives	Duration	Required by
Centrifugal compressor					
1	API Std 617 MRT*	Standalone @ Vendor's	Mechanical check	Minimum 4 hours	API Std 617
2	PTC 10 Type 2	Standalone @ Vendor's	Thermodynamic check	Refer to GS EP MEC 251	GS EP MEC 251
3	PTC 10 Type 1	Yes**	Thermodynamic check	Refer to this specification	This specification
Package					
1	Package full load string test	Yes	Functional and mechanical check	Refer to this specification	This specification
2	Package no load string test	No	Functional and mechanical check	Refer to this specification	This specification

* Including spare compressor rotor

** The type 1 test shall be performed on a rotor (bundle) different from the one used for the type 2 test. This test may be performed standalone or in string test configuration, the latter being the preferred configuration.

In the previous chart, "standalone @ Vendor's" means that the test will be performed with the centrifugal compressor alone, i.e. not in string test configuration.

The following tests shall be carried out on the completely assembled package:

- Pre-test activities
- Centrifugal compressor [ASME PTC 10](#) Type 1 performance test, as per paragraph 7.2 of this specification, on the first motocompressor
- Compression train full load string test, as per paragraph 7.3 of this specification, on the first motocompressor. This activity shall include the functional test of all the main auxiliary systems of the package and package vibrations measurements according to and if required by [GS EP MEC 300](#).
- Compression train no load or partial load string test, as per paragraph 7.4 of this specification, on the other identical motocompressor train(s). This activity shall include the functional test of all the main auxiliary systems of the package and package vibrations measurements according to and if required by [GS EP MEC 300](#).

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- One fully assembled package shall be weighted before packing and shipment (except particular requirements of Project ITP).

The fully assembled and erected motocompressor package shall consist of the following main Project components:

- Electric motor fully assembled with all the relevant auxiliaries including, but not limited to, cooler, main terminal box ☒
- HV Variable speed drive system (if any) ☒
- Power transformer ☐
- Centrifugal compressor(s) fully assembled including all the auxiliary seal gas and lube oil piping ☒
- Gearbox ☒
- Common base plate fully assembled ☒
- Couplings ☒
- Mineral lube oil console including lube oil coolers ☒
- Mineral lube oil console interconnecting piping ☒
- Centrifugal compressor dry gas seal panel ☒
- Dry gas seal panel interconnecting piping ☒
- Package Unit Control Panels (UCP) ☒
- All the instrumentation ☒.

Project anti-surge control system and valve(s) shall not be used during the test.

The following main shop items shall be used for the string test:

- Gas coolers for test process gas cooling
- Gas analyzer
- Automatic acquisition system (for process and machinery data)
- All the equipment necessary for test conduction (piping, throttling valves, motors control center etc.).

Project special tools shall be used for unit erection.

The test procedure shall be issued 8 weeks prior the test (including noise and base plate vibration measurement proposed procedure).

The results of each test shall be recorded in appropriate log sheets provided by Vendor and signed as "witnessed" by all the parties.

After the completion of the tests, Vendor shall issue an official test report including all the above log sheets. Copy of raw data registered during the tests shall be handed over right after each test activity for Contractor inspection record.

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The following minimum information shall be clearly indicated in the completely assembled moto compressor package test procedure for Contractor quick reference during the test:

Electric motor

Mineral lube oil type			
	Unit	Min	Max
Mineral lube oil pressure	barG		
Mineral lube oil temperature	°C		
Electric motor speed range	rpm		
Electric motor 100% speed	rpm		
		Alarm	Trip
Shaft radial vibration unfiltered peak to peak	µm		
Journal bearings white metal temperature	°C		
Thrust bearings (if any) white metal temperature	°C		

Gearbox

Mineral lube oil type			
	Unit	Min	Max
Mineral lube oil pressure	barG		
Mineral lube oil temperature	°C		
Low speed shaft speed	rpm		
High speed shaft speed	rpm		
Gear ratio			
		Alarm	Trip
Low speed shaft radial vibration unfiltered peak to peak	µm		
High speed shaft radial vibration unfiltered peak to peak	µm		
Journal bearings white metal temperature	°C		
Thrust bearings white metal temperature	°C		



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Compressor (repeat this section for each compressor casing)

Mineral lube oil type			
	Unit	Min	Max
Mineral lube oil pressure (journal bearings)	barG		
Mineral lube oil pressure (thrust bearing)	barG		
Mineral lube oil temperature	°C		
100% speed	rpm		
Maximum continuous speed	rpm		
Minimum operating speed	rpm		
		Alarm	Trip
Shaft radial vibration unfiltered peak to peak	µm		
Shaft axial displacement	mm		
First critical speed	rpm		
Journal bearings white metal temperature	°C		
Thrust bearings white metal temperature	°C		

DGS Panel (repeat this section for each compressor casing)

		Alarm	Trip
Primary vent pressure high	barG		
Primary vent pressure low	barG		
Nitrogen Supply pressure	barG		

Mineral Lube Oil System

		Alarm	Trip
Lube oil supply header pressure	barG		
Lube oil supply header temperature (set point)	°C		

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7.1 Pre-test activities

Before commencing the factory testing of the completely assembled packages, the following minimum pre-test activities shall be carried out:

- Calibration of all Project instruments. Relevant calibration certificates shall be available at the time of the test for Contractor review. Spot checks of instruments calibration shall be required before test commencing
- Instrumentation and electrical equipment insulation and continuity tests
- Control loops check and functional test
- Safety and protection devices operational checks
- Serial link test
- Equipment tagging and labeling check
- Mechanical equipment alignment check
- Compressor plus seal gas panel plus interconnecting piping leakage test at site SOP
- Lube oil and seal gas systems flushing and cleanliness tests according to [API Std 614](#) Annex D.3
- Verification of the dynamic stiffness of the test bench as per [GS EP MEC 300](#).

The reports relevant to the mechanical equipment alignment check and to flushing and cleanliness checks shall be available for Contractor review during test.

Before commencing the tests the package shall be cleaned by Vendor and shall be visually inspected by Contractor.

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7.2 Centrifugal compressor ASME PTC 10 Type 1 performance test

The ASME PTC 10 Type 1 performance shall be carried out in order to demonstrate the satisfactory performance of centrifugal compressor(s).

This test shall be carried out operating the compressor(s) in a dedicated closed loop.

The test procedure shall include a summary table (see below) clearly indicating ASME PTC 10 Type 1 performance test conditions for each guaranteed point as well as the corresponding site conditions.

	Unit	Guaranteed Conditions	Type 1 Test	Deviation Test/Guaranteed	Limits
Gas Molecular Weight					ASME Code
Speed	rpm				ASME Code
Inlet Pressure	barA				ASME Code
Inlet Temperature	K				ASME Code
Inlet Density	Kg/m ³				ASME Code
Inlet Volume Flow	m ³ /s				ASME Code
Flange to Flange Polytronic Head	m				Exhibit D
Flange to Flange Polytronic Efficiency	%				Exhibit D
Machine Reynolds Number					ASME Code
Machine Mach Number					ASME Code
Volume ratio					ASME Code
Discharge Pressure	barA				
Discharge temperature	K				
Absorbed Gas Power	kW				Exhibit D

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The test procedure shall cover as a minimum the following requirements:

- a) A minimum of 5 test points evenly spaced from stonewall to surge on the speed line corresponding to the guaranteed point. One of the five points shall correspond to the guaranteed point.

In case of multiple guaranteed points, this step of the test shall be conducted for the point having the highest rotating speed.

- b) A minimum of 5 points evenly spaced from stonewall to surge at maximum continuous speed and at minimum operating speed with suction conditions as per point a).

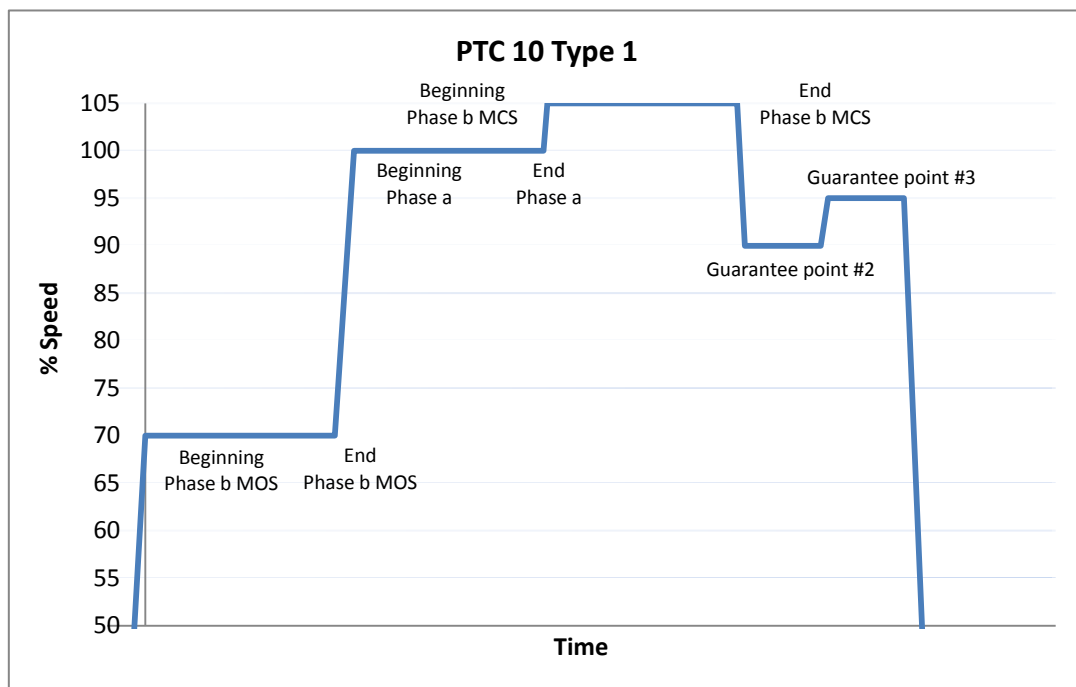
- c) The surge flow of the compressor shall be clearly identified for steps a) and b).

- d) One test point corresponding to each one of the other guaranteed points.

In addition to the thermodynamic readings necessary for the performance test, a complete set of mechanical readings, including vibrations spectra, shall be taken for each test point.

A FFT real time analyzer shall be available during the test allowing checking the vibrations spectra anytime.

Test gas composition shall be checked for each test point.



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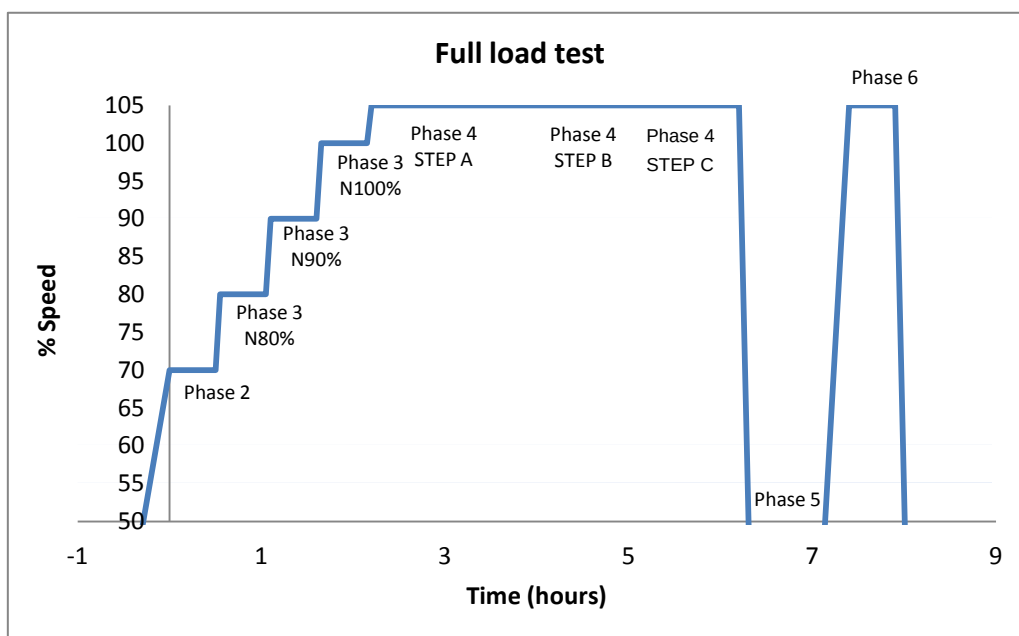
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7.3 Compression train full load test

This test shall be carried out to demonstrate the satisfactory mechanical behavior of the complete compression train under full load conditions and to demonstrate the functionality of the main auxiliary systems of the package.

This test shall be carried out according to the following test sequence.

1. Cold start up of the unit with minimum lube oil temperature (permissive to start temperature)
2. Increase the speed up to compressor(s) minimum operating speed (MOS) and take a complete set of mechanical readings.
3. Increase the speed by 10% increments up to compressor(s) maximum continuous speed (MCS) and take a complete set of mechanical readings for each speed increment.
4. Adjust compressor(s) process conditions to perform the compression train full load test steps A (full power), B (full pressure and temperature) and C as described hereafter.
5. Trip, wait 30 minutes, and restart the unit bringing the speed up to maximum continuous speed. The trip may be obtained simulating a train over speed, a lube oil low pressure etc.
6. Run at maximum continuous speed for minimum 30 minutes. Take a complete set of mechanical readings every 10 minutes.
7. Shut down the unit by a normal stop.



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Compression train full load test step A

The compressor(s) suction conditions and the test gas mixture shall be adjusted in order to increase the compressor absorbed power up to the maximum value of the compressor operating range. This value shall be set according to compressor performance curves and shall correspond either to the right limit of the compressor curve at maximum continuous speed or to the highest flow on the same speed line which is allowed by the electric motor available power.

The test conditions shall be determined on the basis of compressor expected performance curves.

This test step shall have a minimum duration of 2 hours.

During this test a complete set of mechanical readings shall be taken every 15 minutes.

During the first hour the compressor(s) bearings lube oil inlet temperature shall be kept at normal value.

During the remaining part of the test the compressor(s) lube oil inlet temperature shall be lowered to the minimum value (stabilized) for at least 30 minutes and then raised to the maximum value (stabilized) for at least 30 minutes.

During this step noise emissions shall be measured and recorded according to the testing procedure proposed by Vendor and approved by Contractor and Company. Noise measurement shall be performed in accordance with **GS EP MEC 300** for all equipment.

During this step base plate vibrations shall be measured and recorded according to and if required by **GS EP MEC 300**.

Compression train full load test step B

The compressor(s) suction conditions and the test gas mixture shall be adjusted in order to reach the highest discharge pressure and temperature of the compressor operating range. These values shall be set according to compressor performance curves and shall correspond either to the left limit of the compressor curve at maximum continuous speed or to the lowest flow on the same speed line which is allowed by the PSV setting.

The test conditions shall be determined on the basis of compressor expected performance curves.

This test step shall have a minimum duration of 2 hours.

During this test a complete set of mechanical readings shall be taken every 15 minutes.

During this test all the job filters, pumps, fans and coolers shall be subject to a changeover test. No trip of the unit shall occur during this activity.

Compression train full load test step C

During this test, the vibratory behavior of the shaft line shall be checked over the full operating envelop from stonewall to surge and from minimum operating speed to maximum continuous speed under loaded conditions.

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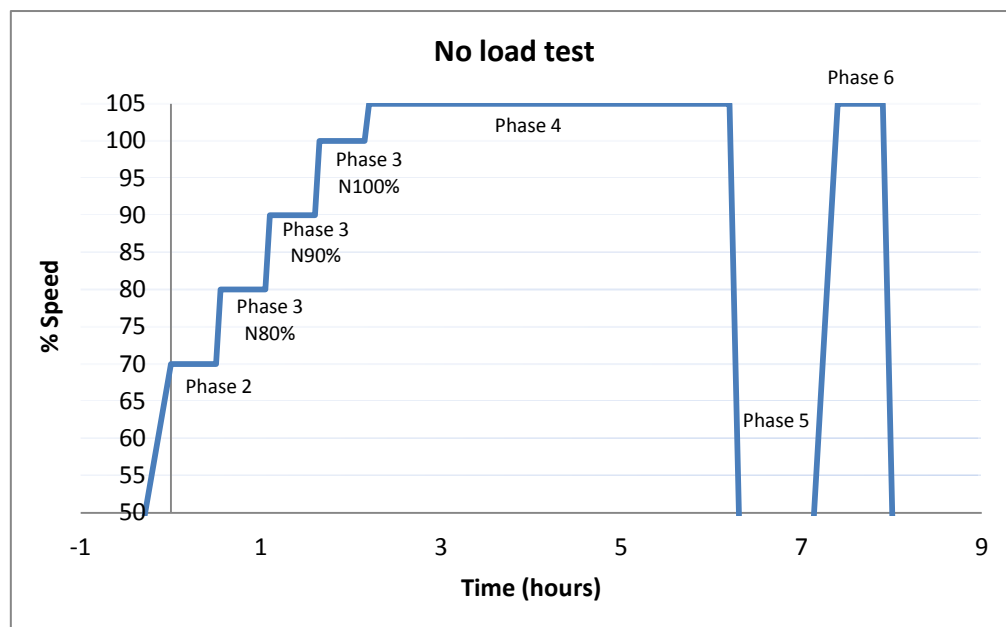
7.4 Compression train no load/Partial load test

This test shall be carried out to demonstrate the satisfactory mechanical behavior of the complete compression train under no load or part load conditions and to demonstrate the functionality of the main auxiliary systems of the package.

This test shall be carried out according to the following test sequence.

1. Cold start up of the unit with minimum lube oil temperature (permissive to start).
2. Increase the speed up to compressor(s) minimum operating speed (MOS) and take a complete set of mechanical readings.
3. Increase the speed by 10% increments up to compressor(s) maximum continuous speed (MCS) and take a complete set of mechanical readings for each speed increment.
4. Run the compressor train for 4 hours at MCS and no or part load conditions.
5. Trip, wait 30 minutes, and restart the unit bringing the speed up to maximum continuous speed. The trip may be obtained simulating a train over speed, a lube oil low pressure etc.
6. Run at maximum continuous speed for minimum 30 minutes. Take a complete set of mechanical readings every 10 minutes.
7. Shut down the unit by a normal stop.

A summary of all the sequences is given in the following graph.



During this test all the job filters, pumps, fans and coolers shall be subject to a changeover test. No trip of the unit shall occur during this activity.

During this test, base plate vibrations shall be measured and recorded according to and if required by **GS EP MEC 300**.

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7.5 Electrical

The following electrical parameters shall be recorded during all string tests in all test conditions:

- Motor windings temperature
- Motor bearings temperature
- Motor bearings radial vibrations
- Motor phase/current/voltage.

7.6 Post test inspections

After the complete package string test completion, the following shall be inspected:

- On the compressor: dry gas seals and bearings
- On the package: lube oil and seal gas filters cleanliness.

7.7 Test schedule

The different tests described in the previous paragraphs may be carried out in different days depending on their duration but the compression train full load test shall be the first one.

Nevertheless each test, as specified in the relevant paragraph, shall be carried out with no interruption during the same day.

7.8 Site acceptance test

All packages shall be submitted to Site Acceptance Tests (SAT) including a performance test done with the field instrumentation and additional, mutually agreed Contractor instruments, in order to check that the packages comply with the Exhibit D guarantees.

Vendor shall submit a site acceptance test procedure for Company approval. The final test program shall be issued at the ex-works delivery.

The test program shall be established using the following requirements as a minimum:

7.8.1 Pre-test activities

As a minimum, the following activities shall be performed prior to SAT.

- Lube oil and seal gas circuit cleaning and cleanliness test according to [API Std 614](#) annex D3
- Safety and protection devices operational checks
- Calibration of all job instruments
- Control loops check and functional test
- Serial links test
- Instrumentation and electrical equipment insulation and continuity tests
- Mechanical equipment alignment check
- Dry gas seals leakage rate measurement tests

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- Test run of the motocompressor: this run shall be performed in closed loop with nitrogen. During this test, the anti-surge valve shall be replaced by a spool piece equipped with an orifice, supplied by the Contractor. The Vendor shall calculate the diameter of this orifice and the associated operating conditions for this run (including the performance curves in these conditions). The test conditions, especially with reference to the compressor discharge temperature, shall be compatible with the design of the compressor. The minimum duration of this test shall be 4 hours during which the essential parameters of the package are monitored
- Anti-surge curve check (with the process gas) according to **GS EP MEC 253**.

These activities are carried out under the responsibility of the Vendor.

Note: These checks shall be part of Company's pre commissioning and commissioning and start-up procedures.

7.8.2 Test conduction

The purpose of this test is to demonstrate that the package exhibits a sound mechanical behavior **and** complies with the Exhibit D guarantees during 72 continuous run hour with actual process gas in open loop.

In particular, the following activities shall be done during the 72 hours:

- Compressor performances evaluation following the below methodology:
 - The analysis of the guarantee point(s) will be done through the capture of three (3) test points (one on the guarantee flow -or flow coefficient-, one on the guarantee flow minus 4% and one on the guarantee flow plus 4%)
 - The verification of the compressor operating range will be done on the iso-speed of the guarantee point. In case of multiple guaranteed points, this step of the test shall be conducted for the point having the highest rotating speed. Five (5) test points will be captured (three on the guarantee point as per the above, one close to the surge control line without anti-surge valve opening and one at the maximum flow).
- Verification of the mechanical behavior of the complete shaft line running at maximum available power at ambient temperature during the test and maximum continuous speed. This run will be done after the compressor thermodynamic performances evaluation.

The management of the SAT shall be as per the following scheme:

- SAT preparation by the Contractor (including the coordination with FO to implement the package test procedure in the production environment)
- Package test procedure by the Vendor
- Conduction of the test by FO based on the process conditions requirements given by the Vendor and the Contractor
- The package remains under the Vendor's responsibility during the SAT.

All the equipment necessary to perform the site acceptance tests shall be provided by the Contractor.

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In case of any trip caused by any component of the package itself, the complete 72 hours shall be repeated from the beginning. In case of any trip caused by any external source (process, external power supply, etc.), the test shall be restarted from the point of interruption.

7.8.3 Post-test activities

After the SAT, the following activities shall be performed:

- Removal of the compressor temporary suction strainer.
- Vendor shall supply a detailed SAT report including as a minimum the following elements:
 - List of the instruments used during the test
 - Gas analysis reports
 - Test points log sheets
 - Thermodynamic calculations summary for each test data point (including gas compressor mass and volume flow, polytropic head, polytropic efficiency, power and associated calculated gas thermodynamic data)
 - Summary chart of the package performances converted from the test to the Exhibit D conditions.

7.9 Acceptance criteria

The acceptance criteria for compressor [ASME PTC 10](#) Type 1 performance test (including SAT) shall be those indicated in the Exhibit D of the Contract.

The following tables summarize the mechanical acceptance criteria for the centrifugal compressor, the gearbox, the electric motor and the base plate which are applicable to the whole complete unit string test (including site acceptance test) excluding the hot restart and the compressor critical speed crossing.

Centrifugal compressor, main electric motor and gearbox vibrations:

Gearbox Low speed shaft radial Vibrations (µm pk to pk unfiltered)	Gearbox High speed shaft radial Vibrations (µm pk to pk unfiltered)	Centrifugal compressor Radial vibrations (µm pk to pk unfiltered)	Electric motor Radial vibrations (µm pk to pk unfiltered)
36	$25.4 \times \sqrt{\frac{12000}{N}} \times \sqrt{2}$ Or 36 Whichever is less	$25.4 \times \sqrt{\frac{12000}{N}} \times \sqrt{2}$ Or 36 Whichever is less	Refer to GS EP ELE 111

Any stable discrete, non synchronous vibration exceeding 20% of the allowable vibration as defined above shall be cause of rejection of the package.

Any unstable non synchronous vibration shall be cause of rejection of the package.

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Centrifugal compressor and gearbox journal and thrust bearing temperatures:

		Bearings metal temperature				
		Gearbox		Centrifugal Compressor		Electric motor
Oil inlet temperature (°C)	ΔT on bearings return lines (°C)	Journal (°C)	Thrust (°C)	Journal (°C)	Thrust (°C)	Journal (°C)
50	25	90	90	85	90	75
60	25	100	100	95	100	85

Absolute vibrations:

- 3 points support:

On bearing housings (mm/s rms)	On connecting point of the main rotating equipment to the baseplate (mm/s rms)	On connecting points of the baseplate to the test bench support (mm/s rms)
Electric motor: 3.5	3.5	3.5
Compressor: 3.5		
Gearbox: 3.5		
In all directions From 10 Hz up to 1000 Hz		

- Multipoint rigid support:

On bearing housings (mm/s rms)	On connecting point of the main rotating equipment to the baseplate (mm/s rms)	On connecting points of the baseplate to the test bench support (mm/s rms)
Electric motor: 2.3	2.3	2.3
Compressor: 2.3		
Gearbox: 2.3		
In all directions From 10 Hz up to 1000 Hz		

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8. Spare parts and special tools

This paragraph gives the minimum requirements of spare parts and special tools for this project. It shall be read in conjunction with **GS EP EXP 217**.

8.1 Spare parts

The Vendor shall provide the spare part lists on Company SPL forms, fully filled up. Company will provide electronic format of these SPL forms.

All spare parts shall have protective coatings applied and be uniquely packed and tagged.

Packing shall give protection for up to 18 months outside storage.

The Vendor shall be fully responsible for all claims attributable to unsuitable or unsatisfactory packing and protection.

Spare parts shall be separately crated from package loose items.

8.1.1 Commissioning and start up spare parts

The Vendor shall include in the scope of supply spare parts for pre-commissioning, commissioning and start up covering the whole scope of supply.

As a minimum the following spare parts shall be included in the Vendor scope of supply:

- Recommended spare parts for main electric motor
- Recommended spare parts for gearbox
- Recommended spare parts for compressor
- Recommended spare parts for any auxiliaries of the here above machinery's
- Ten (10) sets of filter cartridges for any filters of any oil systems, part of the scope of supply
- Ten (10) sets of filter cartridges for any filters of the seal gas system, if any
- For centrifugal compressor:
 - Two (2) sets of O'rings for the compressor bundle, covers and dry gas seals.
- Recommended spare parts for main electric motor
- For the UCP:
 - One (1) power supply card
 - One (1) digital input card
 - One (1) analogue input card
 - One (1) digital output card
 - One (1) analogue output card
 - One (1) communication interface card.

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- For the UCP machinery vibration system:
 - Five sensors of each type
 - One (1) monitoring power supply card
 - One (1) monitoring card of each type.
- Miscellaneous:
 - Five (5) IS barriers of each type
 - Five (5) relays of each type
 - Two (2) Fuses of each type
 - One (1) UCP HMI screen.

Any additional spare parts shall be added by the Vendor if deemed necessary for the flawless execution of the operations during commissioning and start up phases.

8.1.2 Capital spare parts

The following Capital spare parts shall be included in the Supplier scope of supply:

- **For main electric motor:**
 - One (1) set of sleeve bearings.
- **For centrifugal compressor:**
 - One (1) compressor bundle with N2 pressurized and pressure monitored steel container, per compressor type
 - One (1) set of compressor bearings and thrust bearing per compressor type
 - One (1) set of compressor seal cartridges including tertiary seals (DE and NDE cartridges) per compressor casing
 - One (1) anti-surge valve repair kit for each type of valve, if any (piston, cage and seal kits).
- **For gearbox:**
 - One (1) set of bull and pinion gears with N2 pressurized and pressure monitored steel container
 - One (1) set of gearbox journal and thrust bearings
 - One (1) complete variable speed drive gearbox, if any.
- **For couplings:**
 - One (1) high speed coupling
 - One (1) low speed coupling.
- **For lube oil system:**
 - One (1) set of AC lube oil pump and motor, if any
 - One (1) temperature control valve.

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8.2 Special tools

All special tools required for the site installation, commissioning and maintenance of the package and their auxiliaries shall be furnished.

All special tools required to perform the following activities shall be provided:

- **Erection, operation and maintenance:** These tools will remain the property of Company.
- **Commissioning:** These tools will be sent back to the Vendor at his own cost.

As a minimum the following shall be supplied:

- For erection, operation and maintenance:
 - All necessary spreader bars and slings to lift into position the unit
 - Jigs for shaft alignment
 - Bolt tensioning or torque applying devices for compressors
 - For centrifugal compressor, bundle removal system including rotor handling facilities, i.e. spreader bar, slings, runners, beams, etc.
 - Removal tool kit for any main load coupling
 - Thrust bearing removal kit
 - Dry gas seals removal kit
 - Any other necessary centrifugal compressor special tool
 - Recharging kit for any blade accumulator
 - Centrifugal compressor erection tools.
- For PLC based control systems, a programming console with a personal laptop computer, as applicable, shall be supplied complete with:
 - Development software
 - Application programs
 - Diagnostic software
 - Cord sets i.e. power supply and link with PLC's CPU
 - All rack-mounted control equipment shall be supplied with their extension cards. Cards to be inserted between rack mother boards and control cards for trouble shooting purpose.
- For site commissioning and start up:
 - Vibration probe calibrations equipment (wobulator)
 - Portable multi channel analyzer
 - Digital voltmeter
 - Proximitors
 - Portable particles counter

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- Portable electronic RPM counter
- Millivolt and milliamp sources
- DC power supply
- Variable resistor
- Pneumatic pressure pump.
- Flushing kits for all lube oil systems consisting of:
 - Portable electric pump unit when the pumps of the systems are not AC electrical driven
 - Hoses and flange adapters to bypass all bearings and to establish flushing circuits
 - Flushing blocks for electro-hydraulic servo-valves
 - Screen mesh or equivalent.

A detailed list with comprehensive identification, part number, tool drawing and application tool drawing shall be provided during contract stage.

Any tools, standard and special, required to perform the pre-commissioning and commissioning activities at the Supplier premises shall be provided.

All special tools shall be properly identified and tagged.

Their functionality shall be described in the operating manuals.

Supplier shall provide a lockable weatherproof container for storage of special tools fitted with shelves and bench with vice.

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9. Preparation for shipment

The purpose of the preservation and shipment requirement is to assure the best economical protection against adverse atmospheric weather, corrosion build up and mechanical damage due to storage and transportation from Vendor (Manufacturers, Packagers and Contractors) premises to Contractor yard and from Contractor yard to Company site.

The Vendor and/or Manufacturer shall issue necessary procedures which shall be applied to any equipment to cover:

- The preservation during workshop storage
- The preservation, packing and fastening of equipments during transportation from Vendor facilities to Contractor yard construction
- The preservation during construction works on the Contractor yard
- The preservation, packing and fastening of equipments during towing from Construction yard to Company site.

The procedures shall contain a check list including all preservation and packing tasks with provision for filling name and sign of the nominated people responsible to process with.

The hereafter requirements shall also be applied to the capital spares delivered with the contract. The capital spares shall always be preserved and packed for long term outside storage.

9.1 Preservation

The preservation duration will be selected by the Project in the package data sheet and/or equipment data sheets.

Two types of preservation can be applied depending on Project needs: short term preservation or long term preservation.

The considered preservation shall be valid for shipment between:

- Vendor premises and Contractor yard
- Contractor yard and site.

The short term preservation shall cover a period up to six (6) consecutive months after processing of the preservation. The considered storage shall be outside without protection.

The long term preservation shall cover a period up to twelve (12) consecutive months and be annually renewable during five (5) years.

The desiccant products shall be free of DMF content and shall be selected from Silica base. The regeneration of desiccant products is a mandatory requirement and shall be done by heating.

The desiccant products shall conform to the [NF H00-320](#) or [DIN 55473](#) or [US MIL D 3464E](#) standards.

The VCI and VPI shall conform to the [US MIL-STD-2073-1 E](#) standard. However necessary care shall be taken to use approved products compatible with the materials needing to be preserved.

All desiccant products locations shall be provided with a metallic label indicating their presence.

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The last mechanical and/or performance runs can be done with anti-corrosion additives mixed with the lube oil. However Vendor shall demonstrate that the anti-corrosion additives shall not compromise the life of the equipment.

All opening shall be closed with metallic blind and gasket to be air and water sealed.

Metallic labels with necessary cautions and instruction to remove preservative products prior equipment start-up shall be provided.

The labels shall be made of metal with black marking on yellow back ground.

9.1.1 Electrical motor

- Draining of liquid such as water, lube oil from systems where required
- Drying of circuits
- Cleaning of reservoirs with lint-free rags
- Spraying of Tectyl™ or VCI in the air system
- Spraying of Tectyl™ or VCI in the water cooling system
- Spraying of Tectyl™ or VCI in the lube oil system
- Insertion of desiccant product in the motor junction boxes, in motor bearing cases and in coolers by means of perforated metallic baskets fixed to blinds
- Preservation from foreign matters entrance
- Sealing of openings.

9.1.2 Gearbox

After completion of the tests the following shall be performed:

- Draining of liquid such as water, lube oil from systems
- Drying of systems
- Cleaning of reservoirs with lint-free rags
- Spaying of Tectyl™ or VCI in the reservoir and casing
- Spaying of Tectyl™ or VCI on the gear teeth
- Insertion of desiccant product inside the gear casing by mean of metallic basket welded to the closing blinds
- Preservation from foreign matters entrance by blinds
- Sealing of openings.

9.1.3 Compressor

After completion of the tests the following shall be performed:

- Refer to paragraph 4.3.8.5 of **GS EP MEC 251**
- Draining of liquid such as water, lube oil from systems

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- Drying of systems
- Cleaning of reservoirs with lint-free rags
- Spaying of Tectyl™ or VCI in the reservoir, lube system and casing
- Spraying of Tectyl™ or VCI in the air system
- Spraying of Tectyl™ or VCI in the seal gas system
- Insertion of desiccant product inside the reservoir, the compressor casing and the seal gas system by mean of metallic basket welded to the closing blinds
- Preservation from foreign matters entrance by metallic blinds
- Sealing of openings.

9.1.4 Instrumentation and electrical auxiliaries

- Draining
- Drying
- Insertion of soft bags desiccant products in instrument junction boxes and in instrument head
- Sealing of openings.

9.1.5 Control panels

- Draining of liquid such as water, where needed
- Drying of systems
- Cleaning of panels with lint-free rags
- Packing of all equipments not rack mounted
- Insertion of desiccant product inside the control panel, by means of soft bags
- Preservation from foreign matters entrance by metallic blinds
- Positive locking of all doors
- Sealing of openings.

9.1.6 Auxiliaries

The package auxiliaries generally include piping, filters, coolers, heat exchangers, heaters, valves, tanks, boosters, structural frames, walk ways, ladders and stairs, equipment needed for the operation of the package and not herewith listed.

- Draining of liquid such as water, lube oil from systems where required
- Drying of circuits
- Cleaning of reservoirs lint-free rags
- Spraying of Tectyl™ or VCI in the air system

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- Spraying of Tectyl™ or VCI in the water cooled system
- Spraying of Tectyl™ or VCI in the lube oil system
- Spraying Water resistant wax Tectyl™ and wrapping on all non painted interfaces
- Insertion of desiccant product in the piping system, junction boxes, equipments cases (including ducting) by means of perforated metallic baskets fixed to blinds or soft bags
- Preservation from foreign matters entrance
- Sealing of opening.

9.2 Packing

9.2.1 Weather protection

The design of the packing shall procure an optimal weather protection during oversea transportation and Contractor yard storage.

During the detail engineering phase, Contractor, in conjunction with Vendor, has to issue and submit the preservation and sea fastening procedures to Company representative for approval.

Contractor shall be fully responsible of equipment preservation until provisional acceptance on site.

The weather protection shall be made of heat welded multilayer film (polyester, aluminum, polyethylene) and shall be installed around the package. All lifting appliances and lifting points shall be provided outside the weather protection and shall not be subject to losses of sealing. The film shall conform to the [NF H00-310](#) or [US MIL PRF 131K](#) standard.

Prior to weld and seal the multilayer film, the hereafter sequences shall be applied, but are not limited to:

- A sweeping with Nitrogen shall be performed in order to remove the internal moisture as much as possible to get low residual humidity
- A set of desiccant bags shall be included to absorb residual moisture and trap during transportation and storage the moisture passing through the multilayer film envelope
- A moisture indicator (sensitive paper) shall be included inside the envelope prior sealing to perform the traceability of the internal atmosphere during transport and storage.

9.2.2 Mechanical and infestation protection

The mechanical and infestation protection shall be performed by a use of multilayer wooden plates (plywood).

The multilayer wooden plates shall be sea water resistant in case of overseas transportation. A selection of multilayer wooden plates in accordance with marine immersion resistant, French standard CTBX or equal classification requirements is required.

The construction of the overall mechanical protection shall be done in such a way that internal or external members shall not damage the weather protection.

The construction shall be done in such a way that rodents and insects cannot enter inside the box.

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All sensitive parts like antifriction bearing, rotor shaft, shall be locked in place and insulated by means of shock absorbers. The rotor locking devices shall be labeled with metallic instructions and cautions label with black making on yellow colored back ground labels shall be provided.

9.2.3 Fastening

All devices needed for the fastening, whatever the transportation mode considered (sea, onshore, rails, dirty and/or ice roads), shall be provided external to the mechanical protection. The fastening shall not affect the weather/mechanical protection integrity.

The fastening shall be part of the equipment design engineering phase and shall be provided to avoid any modification and/or welding on the equipment during its installation until completion.

During towing transportation, the 3 points mounted packages shall be locked in position to avoid any failure of the supports.

The AVM shall be delivered with the dedicated locking tools and locking devices for transportation.

The gimbals (spherical bearing supports) shall be delivered with the dedicated locking tools and locking devices for transportation.

The use of jacking tools and temporary support tools may be required for installation and/or transportation. The supply of those tools shall be done by the package Vendor along with the sub plate and the sole plate for the fixing of these tools.

The sub plate shall be directly welded by the Vendor and/or Manufacturer on the main base plate during the construction of the base plate, the sole plate shall be directly welded to the support by the Contractor during the construction of the support.

9.2.4 Marking

The minimal requirements for marking shall conform to the [ISO 780](#) code in addition to the specific requirement of the project.

9.2.5 Compressor specific

The compressor casing shall be preserved as per clause 9.1.3 and packed as per clause 9.2 during transportation from Vendor facilities to Contractor yard and from Contractor yard to Company site.

The dry gas seals shall be removed from the compressor and shall be transported preserved inside a heat sealed envelope and plain marine plywood boxes.

The spacers of the flexible couplings and the coupling hubs shall be removed from equipment and shall be transported preserved inside a heat sealed envelope and plain marine plywood boxes.

The rotor shall be locked in position for transportation. The locking devices shall be supplied by the Vendor.

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The main bundles and capital spare bundles delivered with the contract shall be preserved as per clause 9.1.3 and shall be packed inside specific N2 pressurized container designed for airways transportation. The container shall be sealed type, re-usable and shall be provided with:

- Internal or external vibrations and shocks absorbers and shock loggers. Drop acceleration limit shall be indicated by the Supplier
- External marking in accordance with [ISO 780](#) and Project specific requirements
- External lifting and handling devices and fastening provisions
- Atmospheric seals by means of replaceable gaskets or o-rings (air tight design)
- Internal rotors locking devices
- Internal harness for fastening
- Gauge for internal pressure measurement
- Pressure safety valve (bursting discs are not allowed)
- N2 filling port
- N2 pressure release and N2 container sweeping
- Monitoring device with announcement when reaching the N2 low pressure setting (to be connected to Company and/or Contractor storage monitoring system)
- Moisture indicator
- Internal provision for documentation storage
- Internal provision for desiccant products storage
- External 50 liters N2 filled bottle for emergency refilling
- Name plate
- Notified body certification plate with certification validity time
- External blank marking area and/or location to attached the AWB (Air Way Bill).

The design of the container has to provide capability of vertical storage and anchor points to change position from horizontal to vertical by means of lifting apparatus. The transportation shall always be done in horizontal position.

9.2.6 Dry gas seals specific

The capital spares delivered with the contract shall be preserved and packed as per dry gas seal Manufacturer standard.

9.2.7 Loose shipped items and auxiliaries

The loose shipped items delivered with the contract (including commissioning and start-up spare parts) shall be preserved as per clause 9.1 and shall be packed inside a VCI plastic bags as per clause 9.2.1 and clause 9.2.2 during transportation from Vendor facilities to Contractor yard and from Contractor yard to Company site, except for structural frames and ducting when part of the scope of supply.

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The packing boxes shall be provided with:

- Internal or external vibrations and shocks absorbers
- External lifting and handling devices and fastening provisions
- External marking in accordance with [ISO 780](#) and Project specific requirements
- Internal harness and/or means for fastening
- Moisture indicator
- Internal or external provision for documentation storage
- External blank marking area and/or location to attached the AWB (Air Way Bill).

9.3 Transportation

The Notified body responsible for transportation between Vendor facilities and port of shipment shall perform the assessment of the means, risks and constraints.

It shall be clearly specified in the Vendor proposal the means to be used for transportation, the loading of the equipments and the induce constraints due to sea, road, rails transportation in term of equipment assembly and number of packs.

A preliminary packing list including packing dimensions and weight table shall be attached to the Vendor proposal to give possibility to Company to assess the transportation impacts prior contract award.

The handling, loading and unloading procedures and the lifting drawings shall be part of the engineering phase and shall be developed by the Vendor.

The spreader bars, the lifting beams and ancillaries (slings, shackles) shall be supplied by Vendor and shall be load tested and certified by third party notified body. The use of synthetic slings is not allowed.



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Appendix 1

Appendix 1 Definition and abbreviations

AVM	Anti-Vibration Mount
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
DMF	Dimethyl Fumarate
FO	Field Operations
HMI	Human Machine Interface
ICSS	Integrated Control and safety System
ITP	Inspection Test Plan
MCC	Motor Control Center
OEM	Original Equipment Manufacturer
Package	Prefabricated process or utility self-contained unit, generally able to operate on its own, supplied fully tested and ready for immediate installation
PLC	Programmable Logic Controller
MRT	Mechanical Running Test
NDT	Non Destructive Test
SAT	Site Acceptance Test
SIL	Safety Integrity Level
SPL	Spare Parts List
Supplier or Vendor	The package Supplier or Vendor
UCP	Unit Control Panel
VCI	Volatile Corrosion Inhibitor
VPI	Vapor Phase Inhibitor
VTMS	Vibration & Temperature Monitoring System

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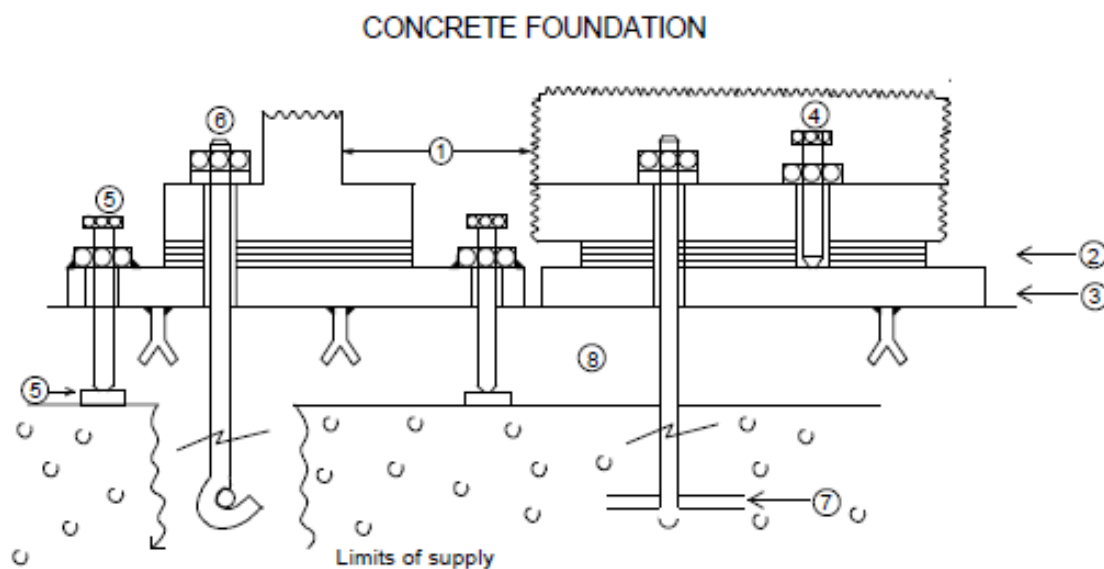
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Appendix 2 Baseplate installation

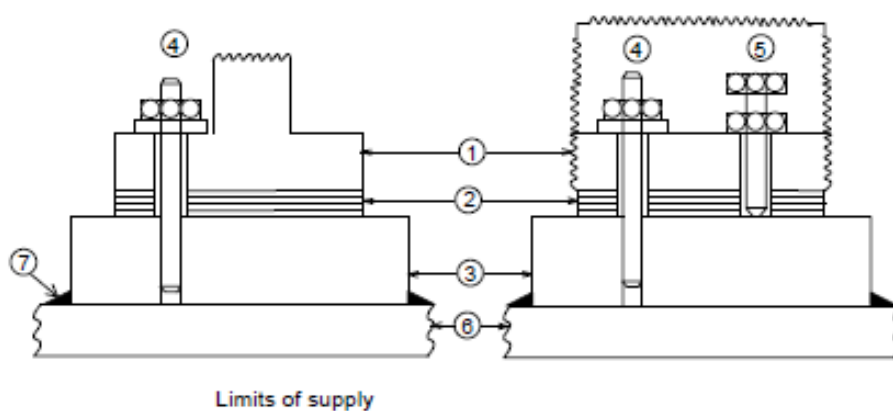

SUPPLIER

- ① Base plate
- ② Shims (20 mm min)
- ③ Sole plate (30 mm min)
- ④ Base plate levelling screws
- ⑤ Soleplate levelling screws
- ⑥ Anchor bolts
- ⑦ Anchor bars

CONTRACTOR

- ⑧ Non shrinking epoxy grout

STEEL STRUCTURE FOUNDATION



Limits of supply

SUPPLIER

- ① Baseplate or Gimbals or AVM
- ② Shims (20 mm min)
- ③ Soleplate (50 mm min)
- ④ Anchor bolts
- ⑤ Levelling screws

CONTRACTOR

- ⑥ Deck
- ⑦ Welding

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Appendix 3

Appendix 3 Vendor Document Register (VDR)

The following documents shall be delivered by the Package Vendor. This list is a mandatory base frame but might be extended on a Project basis.

(1) Documents to be supplied with offer.

Item	Designation	(1)
1	GENERAL DOCUMENTS	
1.1	General	
1.1.1	Vendor document register	X
1.1.2	Installation and operating manual index	
1.1.3	Installation and operating manual	
1.1.4	Special tools list	
1.1.5	Start up and commissioning spare parts list	
1.1.6	Operating spare parts list (with prices)	
1.1.7	Capital spare parts list	
1.1.8	Declaration of conformity for ATEX	
1.1.9	Monthly report	
1.2	Procedures & Reports	
1.2.1	Painting procedure	
1.2.2	Preservation procedure	
1.2.3	Packing procedure	
1.2.4	Weight data sheets with CoG	X
1.2.5	Compressor performance (ASME PTC 10 type 2) and mechanical test procedure	
1.2.6	Compressor performance (ASME PTC 10 type 1) test procedure	X
1.2.7	Gearbox test procedure	
1.2.8	Lube oil system test procedure	
1.2.9	Dry gas seals test procedure	
1.2.10	Package full load string test procedure	X
1.2.11	Package no/partial load test procedure	
1.2.12	Package site acceptance test procedure	
1.2.13	Reports for all the above tests (2)	
1.3	Manufacturing / Quality / HSE documents	
1.3.1	Quality control plan	
1.3.2	Inspection and test plan	
1.3.3	NDE procedures	
1.3.4	Welding procedures	
1.3.5	Vessel/exchanger code calculation notes	
1.3.6	Material certificates	

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Item	Designation	(1)
1.3.7	All tests and inspections certificates	
1.3.8	QA/ QC (Manufacturing data book) index	
1.3.9	QA/ QC (Manufacturing data book) Dossier	
2	STRUCTURAL	
2.1	Foundation drawing (multipoints, gimbals or AVM arrangement) - Plan view	
2.2	Foundation drawing (multipoints, gimbals or AVM arrangement) - Elevation view	
2.3	Foundation loadings (static and dynamic loads, permanent and temporary location)	
2.4	Baseplate calculation note including modal analysis and lifting appliance	
2.5	Lifting equipment general arrangement including lifting calculation	
3	MECHANICAL	
3.1	Arrangements	
3.1.1	General arrangement drawing - Plan view	X
3.1.2	General arrangement drawing - Elevation view	X
3.1.3	General arrangement drawing - Isometric view	X
3.1.4	General arrangement drawing including piping (plan, elevation and isometric views)	
3.1.5	Limits of supply table (interface and connection schedule)	
3.1.6	Allowable nozzles loads	
3.1.7	Lube oil console arrangement drawing	
3.1.8	Seal gas panel arrangement drawing	
3.1.9	Seal gas booster and heater arrangement drawing	
3.2	Data sheets	
3.2.1	Centrifugal compressor data sheet	X
3.2.2	Gearbox data sheet	X
3.2.3	Couplings (low and high speed) data sheets	
3.2.4	Lube oil system data sheets	
3.2.5	Seal gas panel data sheet	
3.3	P&IDs & Lists	
3.3.1	Gas compressor anti-surge and hot gas bypass simplified P&ID	
3.3.2	Lube oil system P&ID	X
3.3.3	Lube oil shaft line P&ID	X
3.3.4	Lube oil purifier P&ID	
3.3.5	Compressor seal gas P&ID	X
3.3.6	Lube oil system P&ID bill of material	
3.3.7	Lube oil shaft line P&ID bill of material	
3.3.8	Seal gas panel P&ID bill of material	
3.3.9	P&ID symbols table	
3.3.10	Utility list	
3.3.11	Equipment list	

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Item	Designation	(1)
3.3.12	Lubrication list and schedule	
3.4	Detail drawings	
3.4.1	Compressor outline drawing	
3.4.2	Compressor cross section drawing	X
3.4.3	Compressor sub assemblies drawings (rotor, aerodynamic, casing, bearings, dry gas seals)	
3.4.4	Dry gas seal drawing	
3.4.5	Gearbox outline drawing	
3.4.6	Gearbox cross section drawing	
3.4.7	Couplings (low and high speed) drawings	
3.4.8	Nameplate drawings (compressor, gearbox and gas turbine)	
3.5	Calculations & Performances data	
3.5.1	Compressor performances curves	X
3.5.2	Compressor thrust bearing sizing calculation	
3.5.3	Compressor lateral analysis	X
3.5.4	Gearbox lateral analysis	
3.5.5	Electrical motor lateral analysis	
3.5.6	Shaft line torsional analysis	
3.5.7	Package noise data sheet	
3.5.8	Dynamic simulation	
3.5.9	Seal gas dew point analysis	X
4	ELECTRICAL	
4.1	List of required documents as per GS EP ELE 011 , GS EP ELE 111 , GS EP ELE 121 and GS EP ELE 141	X
4.2	Seal gas heater data sheets	
4.3	Lube oil heater data sheets	
4.4	Electrical load list	X
5	INSTRUMENTATION	
5.1	General	
5.1.1	Package functional analysis (including compressor, main motor and all auxiliaries)	
5.1.2	Anti surge functional analysis	
5.1.3	Load sharing functional analysis	
5.1.4	Instruments hook ups	
5.1.5	All UCP general arrangements	
5.1.6	VDU displays (HMI video pages)	
5.1.7	PLC software	
5.1.8	UCP factory tests procedure	
5.1.9	Obsolescence dossier	

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Item	Designation	(1)
5.2	Data sheets	
5.2.1	Instruments data sheets	
5.3	P&IDs & Lists	
5.3.1	Vibration and temperature P&ID	X
5.3.2	Instruments list including service, range, trip and alarm levels	
5.3.3	Instruments and electrical cables list	
5.3.4	Modbus list including addressing	
5.3.5	I/O list	
5.3.6	List of software used	
5.4	Diagrams	
5.4.1	Control system architecture (including power supply)	
5.4.2	Interconnecting diagram (instrumentation and electrical)	X
5.4.3	Earthing diagram	
5.4.4	Logic diagrams	
5.4.5	Cause and effect chart	
5.4.6	Instrument loop diagrams	
5.4.7	UCP terminal strips	
5.4.8	Junction boxes terminal strips	
6	PIPING, VALVES and VESSELS	
6.1	General	
6.1.1	Piping classes	X
6.2	Data sheets	
6.2.1	Anti-surge valve data sheet	X
6.2.2	Hot gas bypass valve data sheet	
6.2.3	Oil cooler data sheets	
6.2.4	Seal gas filters data sheets	
6.2.5	Scrubber data sheet	
6.2.6	Lube oil filters data sheets	
6.2.7	Seal gas panel PCV data sheet	
6.3	Drawings	
6.3.1	Anti-surge valve drawing	X
6.3.2	Hot gas bypass drawing	
6.3.3	Oil cooler drawing (general arrangement and internals drawings)	
6.3.4	Seal gas filters drawings	
6.3.5	Scrubber drawing	
6.3.6	Lube oil filters drawings	
6.3.7	Seal gas panel PCV drawing	
6.3.8	Run down tank drawing	

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Item	Designation	(1)
6.4	Calculations & Performances data	
6.4.1	Calculation notes for safety relief valves	

(2) The package string test report shall include pictures of the package (four side views and four isometric views).



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Appendix 4

Appendix 4 Minimum inspection requirements

As a minimum, the following inspections shall be conducted on the package:

- Functional, performance and mechanical running test of all units
- Final inspection
- Final Dossier data book review.

Note: This list does not include the inspections to be conducted on each individual component constituting the package.



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Appendix 5

Appendix 5 Deviations to the contractual documents

If deviations are waived during the bid phase, they shall be listed in the following pages in the purchase revision.

The deviation list shall exhibit at least the following:

- Reference of the specification
- Paragraph of the specification
- Description of the deviation
- Reason for deviation
- Vendor proposal
- Company final position.

The deviations that are not accepted by Company shall appear in this list in order to give a complete overview of the technical discussions.

The following list contains pages.

Note: The deviation list might not be attached to this specification but referenced under a project document (as reported below).

Project document reference:

Revision