

GENERAL SPECIFICATION

ROTATING MACHINERY

GS EP MEC 281

**Lubrication, Shaft Sealing, and Oil Control Systems
and Auxiliaries according to ISO 10438 /
API Standard 614**

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1. Scope

The purpose of this specification is to clarify the requirements of [ISO 10438/API Std 614](#) standard Fifth edition, April 2008 and Errata May 2008.

Technical proposal shall be supported by DS EP MEC 281 part of the Appendix B of this specification.

This document modifies or complements some requirements of [ISO 10438/API Std 614](#) standard, when deemed necessary considering Company experience.

The paragraph numbering is identified in the same way as in [ISO 10438/API Std 614](#) except for additional requirements, which may be presented with new paragraph numbers. The summary sheet at front indicates where to find the information for each paragraph of [ISO 10438/API Std 614](#) shown with a bullet.

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
API Std 614	Lubrication, shaft-sealing, and Oil-control Systems and Auxiliaries
API Std 661	Air-Cooled Heat Exchangers for General Refinery Service
API Std 675	Positive Displacement Pumps - Controlled Volume
ASME VIII Division 1	Boiler and Pressure Vessel Code
ASTM E 1003	Standard Test Method for Hydrostatic Leak Testing
ISO 10438 (Parts 1; 2; 3; 4)	Petroleum, petrochemical and natural gas industries - Lubrication, shaft-sealing and oil-control systems and auxiliaries - (Parts 1; 2; 3; 4)
ISO 13709	Centrifugal pumps for petroleum, petrochemical and natural gas industries
ISO 5199	Technical specifications for centrifugal pumps - Class II
ISO 80000-1:2009	Quantities and units



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

Reference	Title
GS EP INS 107	Design and installation of instrumentation links (Appendix 3)
GS EP MEC 101	Driver Power Sizing
GS EP PVV 112	Piping material classes

3. Comments to [ISO 10438-1/API Std 614](#)

Part 1 - General Requirements

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1. Scope	
1.1 New paragraph	Oil systems shall be supplied in accordance with the standards ISO 10438/API Std 614 . Vendor shall clearly indicate and submit in his proposal any deviation to this standard and this document.
2. Normative references	
The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.	Clarification Any amendments to reference documents shall be submitted to Company for review.
4. General	
4.1 Dimensions and Units	
Drawings and maintenance dimensions shall be in SI units or United States customary (USC) units. Use of an SI datasheet indicates that SI units shall be used. Use of an USC datasheet indicates that USC units shall be used. Note: Dedicated datasheets for SI units and for USC units are provided in Appendix B in each of the four parts of ISO 10438.	SI units data sheets that indicates that SI units shall be used. The SI system of units (ISO 80000-1:2009) shall be used in all technical documents, drawings, design notes, etc., prior to or following the order, except with regard to the names of NPT taper screw threads.
4.3 System selection	
4.3.1 Annexes in ISO 10438-2, ISO 10438-3 and ISO 10438-4 provide schemas and diagrams of typical complete lubrication, oil-type shaft-sealing, dry gas face-type shaft-sealing and control-oil systems. These schematics and diagrams illustrate the general philosophy and requirements of this part of ISO 10438 and are included to assist the purchaser in the selection of an appropriate system. Symbols	Addition Vendor's proposal shall clearly include details of the proposed oil systems schematics and diagrams. Any others symbols necessary for purchaser understanding shall comply with ISA standards.

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shown on these schematics and diagrams are identified in Annex B of this part of ISO 10438. The purchaser and the Vendor shall agree upon a mutually acceptable system before the order is released.	
4.3.4 The purchaser shall define the scope of supply, the level of quality or the brand of components, the system type, the general arrangement (including plan and elevation views of the console orientation), the space available for the console, the service (special purpose or general purpose) and other requirements. Annexes C and D of this part of ISO 10438 are intended to assist in this definition.	Oil systems come under the responsibility of the rotating equipment Manufacturer or the Vendor who has the full responsibility of the shaft line.
4.4 Pressure design code	
The pressure design code shall be specified or agreed by the purchaser. Pressure components shall comply with the pressure design code and the supplementary requirements in this part of ISO 10438.	ASME VIII Division 1 and/or PD 5500 shall be applied.
4.5 Basic design	
4.5.2 The equipment, including all auxiliaries, shall be suitable for operation under the environmental conditions specified. These conditions shall include whether the installation is indoors (heated or unheated) or outdoors (with or without a roof), maximum and minimum temperatures, unusual humidity, and dusty or corrosive conditions.	According to Projects specifications and data sheets.
4.6 Welding	
4.6.2 In addition to the requirements of 4.6.1 and the applicable piping code, the purchaser may specify that additional radiography, magnetic particle inspection or liquid-penetrant inspection of specific welds on equipment and/or piping is required. Note 1: ISO 15649 already includes a level of NDT inspection for piping. Note 2: ISO 10438-3 systems do not require radiography of piping (see ISO 10438-3:2007,	According to Project specifications.

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5.1.2).	
5. Piping	
5.1 General	
5.1.2 Auxiliary systems are defined as piping systems that are in the following services: a. Group I, Auxiliary process fluids (see Table 1): 1. Sealing fluid 2. Gland and flushing fluid 3. Recirculation fluid 4. Balance gas 5. Buffer gas 6. Fuel gas or oil 7. Drains and vents associated with Group I systems 8. Starting gas 9. Separation gas 10. Solvents Injection b. Group II, steam and air (see Table 2): 1. Sealing steam 2. Steam injection 3. Water injection 4. Starting air 5. Instrument and control air 6. Drains and vents associated with Group II systems c. Group III, Cooling water (see Table 3): 1. Cooling water 2. Liquid wash (water based) 3. Drains and vents associated with Group III systems d. Group IV (see Table 1D) 1. Lubricating oil 2. Control oil 3. Seal oil (see 5.4 for seal oil contaminated with process fluid) 4. Drains and vents associated with Group	Modification Table 1, 2, 3 and 4 are applicable with the following modifications. Company piping classes GS EP PVV 112 shall apply whatever the fluid considered. Pipe and pipe fitting: Schedule shall be selected from GS EP PVV 112. Weld neck shall be use only for NPS above 1 ½ inch, socket weld shall be use for NPS under 1 ½ inch. Threaded connections are not permitted for flammable and toxic gas. Flanges: Weld neck shall be used only for NPS above 1 ½ inch, socket weld shall be use for NPS under 1 ½ inch. Schedule shall be selected from GS EP PVV 112 Tubing and tube fittings: Shall be in compliance with GS EP INS 107 Appendix 3. Use of tubing and tube fittings shall be only limited to the instruments links Gaskets: Only spiral wound with non asbestos filler shall be used whatever the class selected. Flange boltings: material selection shall prevent seizing.

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IV systems Auxiliary systems shall comply with the requirements of Tables 1 to 6, except as modified in referencing standards, including references to Tables 1 through 6 in ISO 10438-2, ISO 10438-3 and ISO 10438-4.	
5.1.4 The Vendor shall furnish all piping systems, including mounted appurtenances, located within the confines of the main unit's base area, any oil console base area or any auxiliary base area. The piping shall terminate with flanged connections at the edge of the base. When soleplates are specified for the equipment train, the extent of the piping system at the equipment train shall be defined by the purchaser. The purchaser shall furnish only interconnecting piping between equipment groupings and off-base facilities.	Piping shall terminate with flanges connections, according to Company piping classes (refer to GS EP PVV 112), at skid edge, except for liquid wash which are generally provided with quick coupling connectors.
5.1.18 Special requirements for piping, flanges, gaskets, instruments and o-rings, valves and other appurtenances in special and/or hazardous service shall be specified by the purchaser.	If any, it shall be specified in Project specifications, otherwise Vendor specifications will be applied.
5.1.27 If specified, test valves shall be supplied adjacent to all of the instruments. Test valves shall terminate with a plugged DN 15 (NPS 112) connection (5.1.25). If specified, test valves in oil lines shall be vented back to the reservoir. Test valves may be combined with instrument valves supplied in accordance with 5.1.24.	Instruments shall always be provided with instrument valve including drain, vent and test port. These functionalities may be incorporated in a single manifold assembly. Drain shall always be back to the reservoir.
5.1.30 If specified, each utility such as air and inert-gas supply, cooling water supply and return lines and others as specified shall be manifolded to a common connection.	This paragraph is applicable.
5.1.32 If specified, valves shall be in accordance with purchaser-specified standards in addition to the mandated requirements of this part of ISO 10438.	If any, it shall be specified in Project specifications, otherwise Vendor specifications will be applied.
5.1.33 If specified, flanged gate valves shall be in accordance with ISO 10434 and ISO 15761 in addition to the mandated	This paragraph is applicable.

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requirements of this part of ISO 10438.	
5.4 Process piping	
5.4.1 The extent of, and requirements for, process piping to be supplied by the Vendor shall be specified.	Vendor shall provide all required process piping -internal to its package- for dry gas seals system and compressor companion flanges according to GS EP PVV 112 piping classes. The companion flanges drawings shall be submitted to Company and/or Contractor for approval.
5.4.2 If specified, the Vendor shall review all piping, appurtenances (pulsation suppression devices, intercoolers, aftercoolers, separators, knockout drums, air intake filters, expansion joints) and supports immediately upstream and downstream of the equipment and supports. The purchaser and the Vendor shall mutually agree on the scope of this review.	This paragraph is applicable, the extent of the Vendor scope shall only be the review and the advice of herewith stated.
5.5 Intercoolers and aftercoolers	
5.5.1 When specified, the Vendor shall furnish an intercooler between each compression stage.	If any, according to Project specifications.
5.5.2 Intercoolers shall be air-cooled or water-cooled as specified.	If any, according to Project specifications.
5.5.3 The purchaser shall specify whether aftercoolers shall be furnished by the Vendor.	If any, according to Project specifications.
5.5.5 Water-cooled, shell-and-tube intercoolers and aftercoolers shall be designed and constructed in accordance with TEMA Class C or R, as specified. When TEMA Class R is specified, the heat exchanger shall be in accordance with ISO 16812 as specified. Note 1: It is necessary to exercise caution regarding the susceptibility of heat exchangers and their supporting structures to pulsation-induced vibration. Note 2: For the purposes of this provision, ANSI/API Std 660 is equivalent to ISO 16812.	If any, according to Project specifications and data sheets.
5.5.10 If specified, water-cooled double-	If any, according to Project specifications and

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pipe intercoolers and aftercoolers shall be furnished. A finned double-pipe design may be furnished only when specifically approved by the purchaser.	data sheets.
5.5.11 Intercoolers shall be either integrally mounted on a skid or separately mounted, as specified.	If any, according to Project specifications and data sheets.
5.5.12 Materials of construction shall be those specified.	According to Project specifications and data sheets.
5.5.14 If specified, the Vendor shall furnish the fabricated piping between the compressor stages (or the nozzles of centrifugal compressor bodies) and the intercoolers and aftercoolers. Interstage piping shall conform to the piping design code (e.g. ISO 15649).	According to Project specifications and data sheets.
6. Instrumentation, Control and Electrical Systems	
6.1 General	
	Instrumentation, control, electrical systems and installation shall comply with the applicable Contract specifications.
6.2 Alarm, shutdown and control systems	
6.2.1 General	
6.2.1.2 If specified, shutdown-sensing devices shall be provided with valving, bridging links or other approved protocol to allow replacement with the equipment in operation. Isolation valves for shutdown-sensing devices shall be provided with a means of locking the valves in the open position.	This paragraph is applicable.
6.2.1.3 If specified, a hand-auto (HA) or hand-off-auto (HOA) starting switch for the pump motor(s) shall be provided. The HA switch shall contain manual-on and automatic-start positions only, with a separate manual reset button. When an HOA switch is provided, there shall be a separate set of contacts to indicate or alarm that it is in the off position. Note: The manual reset button of the HA	Refer to Project specifications, if any, remote station shall only include a start button and the reset button shall be replaced by mushroom type emergency button embedded protection and with locking device.

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control allow the standby pump to be manually shut down while the switch is in the automatic-start position only if the primary pump is providing sufficient pressure (that is, if the pressure-rising limit relay of the low-pressure switch (PSL) has been satisfied). A separate electrical disconnect switch with a lockable off position should be provided at a remote location and should be used only for pump maintenance or during the time the equipment is shut down. This is normally accomplished in the motor control center.	
6.2.2 Alarm and shutdown systems	
6.2.2.2 The purchaser shall specify the alarms and shutdowns required which, as a minimum, should include those listed in ISO 10438-2:2007, Table 1; ISO 10438-3:2007, Table 3; ISO 10438-4:2007, Table 1. Note: Guidance for the use of various specified arrangements can be found in IEC 61511 (all parts).	Refer to Project specifications and Project data sheets for minimum requirements.
6.2.2.4 The purchaser shall specify the extent to which alarm/shutdown systems are supplied and installed by the equipment Vendor.	Refer to Project specifications and Project data sheets for minimum requirements.
6.2.2.5 Unless otherwise specified, the alarm/shutdown system shall comply with the following requirements. b) Any alarm parameter, reaching the alarm point, shall initiate an audible warning or flashing light or both, as specified. It shall be possible to determine which parameter initiated the alarm. c) Any shutdown parameter, reaching the shutdown point, shall cause the equipment to shutdown and shall initiate an audible warning or a flashing light or both, as specified, which shall be distinguishable from those associated with an alarm. It shall be possible to determine which parameter initiated the shutdown.	b) It shall be configured on UCP/HMI, first out indicator is always mandatory. c) It shall be configured on UCP/HMI, first out indicator is always mandatory.

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6.2.3 Alarm and shutdown arrangements	
Alarm and shutdown arrangements shall be one of the following as specified.	
6.2.3.1 Arrangement 1 Both shutdown and alarm switches shall be connected through normally energized, fail-safe circuits. The shutdown circuit wiring shall be completely independent from the alarm circuit wiring and shall be mechanically protected.	Arrangement 1 is not applicable.
6.2.3.2 Arrangement 2 6.2.3.2.1 Shutdown functions shall be initiated by local, direct-acting switches connected in a normally de-energized circuit. 6.2.3.2.2 Alarm functions shall be comprised of locally mounted transmitters (electronic or pneumatic, as specified) connected to either separate, panel-mounted switches or to a multi-point, scanning-type monitor. 6.2.3.2.3 Where multi-point, scanning-type monitors are used, the alarm setting for each function shall be separately and independently adjustable.	Arrangement 2 is not applicable.
6.2.3.3 Arrangement 3 6.2.3.3.1 Each function for which both an alarm and a shutdown have been specified shall be provided with three separate and independent transmitters (electronic unless agreed to otherwise). The detail arrangement should be jointly developed between the purchaser and the Vendor or Vendors of the system and the served equipment. 6.2.3.3.2 Each transmitter shall be independently connected to one of three independent, multi-points, electronic, scanning-type monitors for each transmitter input. 6.2.3.3.3 The shutdown and alarm function outputs from the three instruments shall be connected through "two-out-of-three" voting	Arrangement 3 is applicable with following clarifications. Only two separate and independent transmitters shall be provided with separated impulse lines whenever possible. Transmitters shall electronic intelligent HART protocol type, 4-20 mA output signals. The arrangement shall be as per Manufacturer standard. Transmitters shall always be supported from brackets. This paragraph is not applicable.

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logic and shall allow the operation of any one alarm or shutdown function to initiate an alarm. Operation of two shutdown functions monitoring the same parameter initiates a separate alarm and shall cause the served equipment to shutdown. If any one transmitter is faulty, then the remaining two transmitters vote "one-out-of-two" for shutdown. If a second transmitter becomes faulty, then the system shuts down the served equipment. 6.2.3.3.4 Alarm functions not associated with a shutdown function shall be provided with one single transmitter. The detailed arrangement should be jointly developed by the purchaser and the Vendor or Vendors of the system and the served equipment. Note: This arrangement (Arrangement 3) has the following advantages. a) Any shutdown or alarm function can be tested at any time with the equipment in service without the need to disarm any part of the system. b) Failure of any one component initiates an alarm but does not result in equipment shutdown. c) The use of modem, digital instrument technology is facilitated.	This paragraph is applicable.
6.2.4 Annunciators	
6.2.4.1 If specified, the Vendor shall provide a console-gauge-board-mounted and/or a control-panel mounted annunciator.	Console gauge board shall be replaced by transmitters fitted with analog display. Annunciator shall be provided and installed in UCP (Unit Control Panel) located in instrument room.
6.2.4.2 The Vendor shall furnish a first-out annunciator when an annunciator system is specified. The annunciator shall contain a minimum of 25% spare points and, if specified, shall be arranged for purging. A summary (or common) output circuit shall be provided, as a minimum, for actuation of a remote signal when any function alarms or trips. The sequence of operation shall be as specified below.	This paragraph is fully applicable without any restriction.

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a) The first parameter to reach alarm or shutdown shall cause the flashing of a light and the sounding of an audible device. b) The alarm or shutdown condition shall be acknowledged by operating an alarm silencing button, common to all alarms and shutdowns. c) When the alarm or shutdown is acknowledged, the audible device shall be silenced but the light shall remain steadily lit as long as that alarm or shutdown condition exists. d) If another parameter reaches an alarm or shutdown level the light shall return to the flashing condition and the audible device shall sound, even if the previous alarm/shutdown condition has been acknowledged but still exists.	
• 6.2.4.3 If specified, the annunciator sequence shall be selected from ISA 18.1 by the purchaser.	Annunciator system shall be built in the UCP (HMI) though PLC logic with first out indication flashing, audible alarm, manual acknowledge and manual reset.
• 6.2.4.4 If specified, a separate first-out indication shall be provided.	A separate first out indication shall be part of the logic and shall be implemented in the UCP (HMI), no others configuration are requested.
6.3 Instrumentation	
6.3.1 Instrument installation and gauge boards	
6.3.1.1 Instruments for the console, gas seal module and equipment may be local or gauge-board mounted as specified.	Instruments for the console, gas seal module and equipment shall be local and gauge-board mounted.
• 6.3.1.3 If specified, a common panel shall be provided and shall include all panel-mounted instruments for the driven equipment and the driver. Such panels shall be designed and fabricated in accordance with the purchaser's description. The panel shall be freestanding, located on the base of the package or machine base-plate or in another location, as specified. The instruments on the panel shall be clearly visible to the operator from the driver control location. A lamp test push button shall be provided if the panel contains indication lamps.	This paragraph is applicable except the provision of lamp test and indicating lamps.

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The instruments mounted on the panel shall be specified. Wiring inside of the panel shall be nearly run in wire ducting.	The instruments shall be wired to junction boxes located at skid edge. The use of ducting shall be only for 316 SS flexible conduits, all other ducting shall be made of 316 SS cables trays with solid 316 SS covers.
6.3.1.4 Unless otherwise specified, panel fronts shall be made of steel plate at least 3 mm (118 in) thick, reinforced, self-supporting and closed on the top and sides. Tops and sides shall be a minimum of 12 gauges. If specified, panels shall be totally enclosed to minimize electrical hazards, to prevent tampering or to allow purging for safety or corrosion protection. All instruments shall be mounted flush on the front of the panel and all separate fasteners shall be of corrosion-resistant metal. All interior and exterior surfaces of carbon steel panels shall be suitably prepared and coated with an industrial grade painting system.	Panel front shall be made of 316 SS minimum grade, self supporting, and enclosed on the top and side wherever possible. All instruments shall be 316 SS external body including a display and shall be low voltage certified ATEX Ex II 2G and CE marked (Zone 1, temperature class T3), certified panel don't need to be fully enclosed. Painting is not required over 316 SS.
6.3.1.5 Panel-mounted and console-gauge-board-mounted instruments shall be specified by the purchaser. (See datasheets for an equipment instrumentation list.)	Panel shall be with 316 SS certified transmitters ATEX Ex II 2G and CE marked (Zone 1, temperature class T3) including display. Dial gauge board is not necessary.
6.3.1.7 When more than one wiring point is required on a unit for control or instrumentation, the wiring to each electrical control device or instrument shall be provided from common terminal boxes with terminal posts. Unless otherwise specified, multiple terminal boxes are required for segregation of different AC and DC electrical signals.	Clarification Multiple terminal boxes are requested for segregation between: - AC Low voltage (110 and/or 400 VAC) - DC very low voltage (24 and/or 48 VDC) - Explosion proof Instrumentation - Intrinsically safe circuits.
6.3.1.8 If specified, signal-segregation requirements in addition to the requirements defined in 6.3.1.7 shall be provided.	Segregation shall as a minimum between: - AC Low voltage (110 and/or 400 VAC) - DC very low voltage (24 and/or 48 VDC) - Explosion proof Instrumentation - Intrinsically equaly safe circuits.
6.3.1.10 All wiring shall be installed in metal conduits, cable trays or enclosures, as	Clarification Metal conduits are not allowed, only 316 SS

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specified.	minimum grade cable trays including covers shall be used
6.3.2 Switches	
• 6.3.2.4 The purchaser shall specify whether switches shall be connected to either open (de-energize) or close (energize) to initiate alarms and shutdowns.	Switches are no more admitted and shall be replaced by ladder logic built in processor logic controller. Logic shall always build in fail safe circuits.
• 6.3.2.6 If specified or approved, multi-point instruments may be used, except that alarms and shutdowns shall be connected to separate instruments, and separate alarm or shutdown contacts (switches) shall be provided. Each alarm and shutdown level shall be separately adjusted.	This paragraph is not applicable.
6.3.3 Transmitters	
• 6.3.3.1 If specified transmitters shall be provided.	Transmitters shall always be provided.
• 6.3.3.2 The purchaser shall specify output signal type, indicating or non-indicating (blind) type, housing type and power supply requirements.	Transmitters shall be: • Hart protocol design electronic intelligent type • 4-20 mA output • 24 VDC or 48 VDC input supply • Certified ATEX Ex II 2G and CE marked (Zone 1, temperature class T3) • 316 Stainless steel housing • Indicating display type.
• 6.3.3.3 Transmitters shall be of analogue or digital type, as specified.	Refer to above comments in 6.3.3.2.
• 6.3.3.4 The purchaser shall specify transmitters that are non-hazardous, non-incentive, explosion-proof or intrinsically safe (IS), as required by the electrical area classification. Note: Transmitters for normally hazardous electrical area classifications can be satisfied by more than one transmitter configuration, i.e. intrinsically safe or explosion proof.	Refer to above comments in 6.3.3.2. Note is applicable.

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6.3.8 Pressure indicators	
6.3.8.1 Pressure indicators shall be located per the datasheets. Note: This refers to local indication of pressure and can be accomplished by indicators and/or pressure indicating transmitters.	Refer to Project data sheets for compliance with the extend of supply.
6.3.8.3 If specified, liquid-filled gauges or dampened movement gauges shall be furnished in locations subject to vibration.	This paragraph is applicable.
6.3.8.6 The Vendor shall supply all pressure indicators and transmitters as defined on the datasheets.	This paragraph is applicable.
6.3.9 Oil sight flow indicator	
6.3.9.2 If specified, flow indicators shall also be installed in the drain lines of totally enclosed, dry coupling guards. Note: Flow indicators in dry coupling drain lines can be used to detect excessive oil leakage into the dry coupling guard.	This paragraph is applicable. Flow indicators shall also be installed in the drain lines from cavity between tertiary seal and radial (or thrust) bearing.
6.3.9.3 Unless otherwise specified, the flow indicator shall be flanged.	This paragraph is applicable.
6.3.9.5 When specified, restrictive flow indicators shall be installed in the pressurized inlet line to each continuously lubricated coupling.	This paragraph is applicable.
6.3.10 Solenoid valves	
6.3.10.3 When continuously energized solenoids are specified for trip circuits, the Vendor shall provide the purchaser with the coil rating and estimated service life of each solenoid coil based on continuously energized operation. Dual-coil solenoids may be specified for any trip function. Each coil shall be capable of keeping the solenoid in its energized condition. Separate relays shall energize each coil.	The Vendor shall provide the purchaser with all technical information concerning the type of solenoid valves to be used.
6.3.11 Pressure-limiting valves and pressure safety relief valves	
6.3.11.4 Pressure-limiting valves and pressure	Modification

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safety relief valves.	Rupture disks are not allowed. Pressure safety valve shall be used in place of rupture disks.
6.3.11.5 If specified, thermal relief valves shall be provided for components that can be blocked in by isolation valves.	This paragraph is applicable.
6.3.12 Control valves and regulators	
6.4 Electrical Systems	
6.4.2 The characteristics of electrical power supplies for motors, heaters, and instrumentation will be specified.	This paragraph is applicable, refer to Project specifications.
6.4.6 If specified, instrument and control wiring may be solid conductors in areas not subject to vibration.	Rigid metallic conduits are not accepted, wiring shall be from cables and cables trays.
6.4.11 Electrical materials, including insulation, shall be corrosion resistant and non-hygroscopic insofar as is possible. If specified for tropical location, materials shall be given the treatments specified as follows. a) Parts (such as coils and windings) shall be protected from fungus attack. b) Unpainted surfaces shall be protected from corrosion by plating or another suitable coating.	Electrical, control, instruments materials and installation shall be provided according to Company specifications. Request for derogation will be presented by the Vendor when necessary. Note a) is applicable. Note b) Unpainted surface shall be always 316 SS minimum grade.
6.4.13 Control, instrumentation, and power wiring (including temperature element leads) within the limits of the baseplate shall be installed in rigid metallic conduits, cable trays, or enclosures as specified, properly bracketed to minimize vibration and isolated or shielded to prevent interference between voltage levels.	316 SS minimum grade cable trays including covers shall be used in place of conduits. Only limited portions of 316 SS minimum grade flexible type conduits are authorized when cable trays cannot be installed. Cable trays shall be supported with 316 SS means, including bolting and shall be equipped with soft material protections at both ends to avoid losses of seal of external cables envelops. Cable trays shall be properly grounded at both ends. If the cable trays are multiple segments built, continuity shall be ensured between each segment.
6.4.18 If specified, conduit drains shall be provided in all conduit low points for indoor	316 SS minimum grade cable trays including covers shall be used in place of conduits. Only limited portions of 316 SS minimum grade

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installations.	flexible type conduits are authorized when cable trays cannot be installed, however those portions shall be submitted to Company prior acceptance.
7. Inspection, Testing and Preparation for shipment	
7.1 General	
• 7.1.1 The purchaser shall specify the extent of participation in the inspection and testing.	Inspection and testing will be carried out according to Company Project QA/QC plan.
• 7.1.2 If specified, the purchaser's representative, the Vendor's representative or both shall indicate compliance in accordance with the inspector's checklist in the applicable chapter by initialling, dating and submitting the completed checklist to the purchaser before shipment.	This paragraph is applicable.
• 7.1.5 The purchaser shall specify the amount of advanced notification required for a witnessed or observed inspection.	Advance notification will be according to Company Project contract requirements.
7.1.6 When shop inspection has been specified, the purchaser and the Vendor shall coordinate manufacturing hold points and inspectors' visits.	Clarification, in addition When the main equipment full load and/or string test is specified, the complete lube oil system shall be mandatory used. The Company reserves the right to request installation of screen meshes at selected locations upstream and/or downstream filters before the beginning of full load/string test to check cleanliness of the whole system. In case filters differential alarm set point is activated and/or unacceptable screen mesh cleanliness, the full load/string test shall be postponed until the cleanliness of all lube oil system components have been satisfactorily demonstrated by the Vendor and accepted by the Company. When lube oil components cleanliness is satisfactorily achieved, the final full load and/or string test shall be carried out.

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7.2 Inspection	
7.2.1 General	
7.2.1.1 The Vendor shall keep the following data available for at least 20 years: a) Necessary or specified certification of materials, such as mill test reports. b) Test data and results to verify that the requirements of the specification have been met. c) Fully identified records of all heat treatment, whether performed in the normal course of manufacture or as part of a repair procedure. d) Results of quality control tests and inspections. e) Details of all repairs. • f) Other data specified by the purchaser or required by applicable codes and regulations. g) Purchase specifications for all items on bills of material. h) Results of documented tests and inspections, including fully identified records of all heat treatment and radiography.	f) For other data specified in the contract and/or in the Project specifications and data sheets, it shall be also kept during 20 years.
• 7.2.1.3 In addition to the requirements of the governing piping, pressure vessel and welding code or standard, the purchaser may specify the following: a) That parts shall be subjected to surface and subsurface examination b) The type of examination required, such as magnetic particle, liquid penetrant, radiographic and ultrasonic examination.	Company Project QA/QC plan shall apply.
7.2.2 Material Inspection of pressure vessels and piping systems	
7.2.2.1 General	
7.2.2.6 Positive material identification (PMI)	
• 7.2.2.6.1 If specified, the following alloy items shall be subject to PMI testing: a) Overhead seal tank b) Rundown oil tank.	This paragraph is applicable.

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• 7.2.2.6.2 In addition to the components outlined in 7.2.2.6.1, other materials, welds, fabrications and piping shall be PMI tested as specified and fully defined, including any sampling requirements.	This paragraph is applicable.
Addition When radiographic, ultrasonic, magnetic particle or liquid penetrant inspection of welds or materials is required or specified, the criteria in 7.2.2.2 through 7.2.2.5 shall apply unless other criteria are specified by the Purchaser. Cast iron may be inspected in accordance with 7.2.2.4 and 7.2.2.5. Welds, cast steel, and wrought material may be inspected in accordance with 7.2.2.2 through 7.2.2.5.	Following non destructive tests on welds: • Radiographic or ultrasonic examinations and • Magnetic particle, or liquid penetrant examinations shall be performed. Following non destructive tests on cast iron, steel and wrought: radiographic, ultrasonic, magnetic particle, or liquid penetrant inspections shall be performed. Acceptance criteria shall be as per paragraphs 7.2.2.2 through 7.2.2.5.
7.2.3 Mechanical Inspection	
7.2.3.1 During assembly of the system and before testing, each component and all piping and appurtenances shall be inspected to ensure they have been cleaned and are free of foreign materials, corrosion products and millscale.	Clarification & Addition Vendor shall specify the piping cleanliness level required with the corresponding standard. The oil piping shall be designed and routed in such way that all piping can be dismantled or broken on site, to be cleaned separately or by group of assembled sections. The cleaning method shall be passivation followed by neutralization, drying and preservation, handled by specialized qualified Sub-Vendor. For onsite final flushing, all bearings inlet and outlet piping sections shall be provided with Te, engineered prefabricated and removable bypasses, with spades located at inlet and outlet of bearing housing, supplied as special tools to minimize piping disassembly. Vendor shall provide the dedicated study and detailed drawings covering the piping design, the cleaning and the final flushing procedures to be approved by Company; but when required the Company reserves the right to ask for Company's flushing procedure application

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7.2.3.2 If specified, the purchaser may inspect the equipment and all piping and appurtenances for cleanliness before heads are welded onto vessels, openings in vessels or exchangers are closed or piping is finally assembled.	Lube oil components cleanliness is a “holding” point. Inspection will be carried out according to Vendor project QA/QC plan. Advance notification will be according to Company Project contract requirements. The lube oil system flushing before the string test execution shall be performed with flexible hoses and adapters dedicated to the job and supplied by the Vendor.
7.2.3.3 If specified, the hardness of parts, welds and heat-affected zones shall be verified as being within the allowable values by testing. The method, extent, documentation and witnessing of the testing shall be mutually agreed upon by the purchaser and the Vendor.	To be mutually agreed between Company and Vendor and included in the Vendor Inspect and test plan.
7.3 Testing	
7.3.2 Hydrostatic test	
7.3.2.1 Pressure-containing parts (including auxiliaries) shall be tested hydrostatically with liquid at a minimum of 1.5 times the maximum allowable working pressure (MAWP) unless limited by the hydrotest pressure of a component in the system that has been hydrotested to 1.3 times its MAWP. In this case, hydrotest shall be a minimum of 1.3 times the MAWP. Minimum hydrotest pressure shall not be less than 150 kPa (1.5 bar; 20 psi). The test liquid shall be at a higher temperature than the nil-ductility transition temperature of the material being tested. See ASTM E 1003. Note 1: The nil-ductility temperature is the highest temperature at which a material experiences complete brittle fracture without appreciable plastic deformation. Note 2: The ASME pressure vessel code and other pressure vessel codes allow hydrotesting to 1.3 times MAWP.	Clarification & Addition System shall be design in such way that all components shall support the hydrotest at 1.5 times the MAWP. ASTM E 1003 significance and use is restricted use of the sole hydrotest when toxic or explosive gas is expected, consequently and prior shipment after full component assembly, the Vendor shall performed a leak test at the MAWP under N₂+He as tracer gas for leak detection. Whatever the method of testing, Vendor has to provide in the hydrotest and leak test report the full traceability of the tests by producing the test chart records showing as minimum, pressure, time, temperature pressure ramp-up and release.
7.4 Preparation for shipment	
7.4.3 The equipment shall be prepared for shipment after all testing and inspection have	Clarification & Addition Prior shipment and after testing, any tested

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been completed and the equipment has been released by the purchaser. The preparation shall include that specified as follows. a) Except for machined surfaces, all exterior surfaces that can corrode during shipment, storage or in service shall be given at least one coat of the manufacturer's standard paint. The paint shall not contain lead or chromates. Note: Austenitic stainless steels are typically not painted. b) Exterior machined surfaces except for corrosion-resistant material shall be coated with a suitable rust preventive. c) The interior of the equipment shall be clean; free from scale, welding spatter and foreign objects; and sprayed or flushed with a rust preventive that can be removed with solvent. d) Internal surfaces of bearing housings and carbon steel oil systems' components shall be coated with an oil soluble rust preventive that is compatible with the lubricating oil. e) Flanged openings shall be provided with metal closures at least 5 mm (3/16 in) thick with elastomer gaskets and at least four full-diameter bolts. For studded openings, all nuts required for the intended service shall be used to secure closures. Each opening shall be car sealed so that the protective cover cannot be removed without the seal being broken. f) Threaded openings shall be provided with steel caps or round-head steel plugs in accordance with ANSI/ASME B16.11. The caps or plugs shall be of material equal to or better than that of the pressure casing. In no case shall non-metallic (such as plastic) caps or plugs be used. g) Openings that have been bevelled for welding shall be provided with closures designed to prevent entrance of foreign material and damage to the bevel. h) Lifting points and lifting lugs shall be clearly identified on the equipment package. The recommended lifting arrangement shall be as	equipment component and auxiliary shall not be disassembled and/or removed from single lifting assembly design for packing purpose. The design of any equipment, component and auxiliary shall take account of packing and fastening at engineering stage.

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described in the installation manual. i) The equipment shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number of the equipment for which it is intended. In addition, crated equipment shall be shipped with duplicate packing lists, one inside and one on the outside of the shipping container. j) The base and all components and piping of a package or an assembled oil system or dry gas seal module shall be shipped as a single assembly and shall be temporarily braced as necessary to prevent damage during shipment. To minimize the entrance of contaminants, no component shall be disassembled for shipment except as required for protection against vibration or other damage during handling and shipment. k) Pumps and drivers shall be uncoupled and exposed shafts and shaft couplings shall be wrapped with waterproof, mouldable waxed cloth or volatile corrosion inhibitor paper. The seams shall be sealed with oil proof adhesive tape. l) Each filter shall be shipped with clean elements installed and shall carry outside a securely affixed all-weather tag stating "SHIPPED WITH CLEAN ELEMENTS INSTALLED".	
• 7.4.7 If specified, one copy of the Manufacturers standard installation instructions shall be packed and shipped with the equipment.	Manufacturer installation instruction shall be part of the commissioning manual.
8. Vendor's data	
8.2 Proposals	
8.2.3 Technical data	
• 8.2.3.2 If specified by the purchaser, procurement of components shall not proceed without the purchaser's review and acceptance of the components selected. If specified by the purchaser, the manufacture of the console shall not proceed without the	Manufacturer can proceed without purchaser's formal approval. However Vendor shall submit the layout of components and piping for purchaser review.

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purchaser's review of the layout of components and piping.	
8.3.3 Technical data	
8.3.3.1 When specified, the Vendor shall submit certified copies of the test data to the Purchaser prior to shipment.	This paragraph is applicable.
8.3.3.2 If specified, the Vendor shall submit certified copies of the test data to the purchaser before shipment.	This paragraph is applicable.
8.3.4 Progress reports. If specified, the Vendor shall submit progress reports to the purchaser at the intervals specified. Note: Refer to the description of item m) in Annex C for the content of these reports.	This paragraph is applicable, refer to project specification.
8.3.6 Installation, operation, maintenance and technical data manuals	
8.3.6.1 General	
8.3.6.4 Technical data manual If specified, the Vendor shall provide the purchaser with a technical data manual within 30 days of completion of shop testing.	This paragraph is applicable.

Annex D (informative)

Oil or gas filter performance and oil-system cleanliness testing

API	GS
D.2.6 Dry gas seal filtration On most dry gas seal systems, there are two sets of gas filters; one for the separation gas and one for the seal gas. The separation gas is generally an inert, dry gas, such as nitrogen. Unless there are special circumstances identified to the Vendor, the filters for separation gas do not require coalescing capability. if the seal gas has a dew point too close to operating temperature (including any Joules Thompson effect at the: control valve) downstream of the controlling device, a seal gas filter/separator should be supplied with elements that are a combined filter/coalescer or with two separate elements, one for filtering and one for coalescing (see ISO 10438-4:2007, 4.2.7).	Clarification Separation gas is requiring installation of duplex filter type without coalescing element whatever fluid Nitrogen or Air instrument. Seal gas filter shall be of combined duplex filter/coalescer type. Air Instrument supply shall be provided with duplex filters, filtration of 3 micron size replaceable elements.

4. Comments to ISO 10438-2/API Std 614

Part 2 - Special-purpose oil systems

ISO / API	GS
1. Scope	
This part of ISO 10438, in conjunction with of ISO 10438-1, specifies requirements for oil systems for special-purpose applications. These oil systems can provide lubrication oil, seal oil or both. These systems can serve equipment such as compressors, gears, pumps and drivers. Note: The term "special-purpose application" is defined in ISO 10438-1.	Special purpose oil system shall be used for: • Power generation units • Compressor trains units • Pumping system units with the inclusion of drivers and gears (if any).
4. General requirements	
• 4.1.4 The purchaser shall specify the equipment's normal operating point and alternate operating points including transients.	Refer to the equipment data sheet.
• 4.1.5 Control of the sound pressure level (SPL) of all equipment furnished shall be a joint effort of the purchaser and the Vendor having unit responsibility. The equipment furnished by the Vendor shall conform to the maximum allowable sound pressure level specified. In order to determine compliance, the Vendor shall provide both maximum sound pressure and sound power level data per octave band for the equipment.	Oil systems shall be considered as part of the main rotating equipment supply and, as such shall comply with the contractual specified noise requirements of the package.
• 4.1.6 The purchaser shall specify whether the seal-oil and lube-oil systems are to be separate or combined. Note: Annex B contains piping and instrument diagrams (P&IDs) for typical arrangements.	Seal-oil and lube-oil systems shall be separate.
• 4.1.7 Where oil is supplied from a common system to two or more machines (such as a compressor, a gear and a motor), the oil's characteristics shall be specified by the Owner on the basis of mutual agreement with all Vendors supplying equipment served by the common oil system. Note: Site conditions with extreme variations,	Whenever possible, Total brand lubricating oils shall be used. Vendor shall clearly indicate in the proposal the type of lubrication oil to be used.

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such as desert or arctic applications, can also require special oil grade viscosity and increased oil supply temperatures.	
• 4.1.8 The system shall be designed to supply oil to all equipment specified.	Vendor assuming full responsibility of the complete shaft line shall check the oil characteristics for the combined oil system.
• 4.1.10 The seal-oil system shall be designed to serve the full range of equipment operating conditions specified. These conditions may include but are not limited to the following: a. Settling-out pressures b. Process relief valve settings c. Shop test and field run-ins d. Start-up conditions.	This paragraph is applicable, case selection shall be the worst condition.
4.1.12 The arrangement of the equipment, including piping and auxiliaries, shall be developed jointly by the purchaser and the Vendor. The arrangement shall provide adequate clearances areas and safe access for operation and maintenance.	Clarification & Addition A maintenance review shall be organized between the Vendor and the Company. This review shall take place before the manufacturing of the Lube Oil System, Seal, Gas Panel and interconnecting piping internal to the package. This review shall be based on CAD 3D models (if available, otherwise 2D models will be used). As a minimum, the following shall be reviewed but not limited to: • Access to LOS manual valves • Access to LOS filters • Access to manhole • Gauges and digital display location for ease of reading. Access to main components for dismantling (LO pumps, filters cartridges, LO coolers plates -if any-). The Company reserves the right to ask for layout modification if state of the art for ease of maintenance and accessibility are not met. The date of this meeting shall be mutually agreed between Vendor and Company during the KOM.

ISO / API	GS
• 4.1.13 If applicable, the purchaser shall specify minimum requirements for clearance around and access to components (especially clearance around and access to coolers, filters and hand valves).	Clearance around equipments shall be designed in such a way that all permanent access shall be provided for operation and maintenance of the machineries. Any pieces of equipment, any electrical material or instrument shall be accessible from skid edge or from gangways with grating adequately located within the confines of the unit. This shall comply with the environment data requirement defined in Project specifications.
4.1.15 Valved vents, drains and piping shall be furnished to permit draining, cleaning and refilling of idle components while the equipment is in operation.	Clarification & Addition An accessible and dedicated lube oil sampling point shall be provided. The sampling point shall be located upstream lube oil filtration.
• 4.1.16 The purchaser shall specify when and where double block and bleed valves are required for isolating a component and how they are arranged.	Instruments, filters, coolers shall be provided with block, bleed and vent valves, however the double block and bleed valve shall always be provided for high pressure and sour gas services. Company shall have the right to request additional double block and bleed where necessary.
• 4.1.17 Coolers, filters, overhead oil tanks, drain traps, accumulators and other pressure vessels shall be in accordance with the specified pressure design code (Refer to ISO 10438-1:2007, 4.4). If specified by the purchaser, vessels shall be code stamped. Note 1: Code stamping might not be applicable for pressure design codes other than ASME. Note 2: Refer to ISO 10438-1:2007, 4.5.7. Local jurisdictions can require a code stamp and conformity assessment markings.	ASME code Section VIII is applicable.
• 4.1.19 The Vendor shall advise the purchaser of, and both parties shall mutually agree upon, any special provisions that are necessary to ensure that an adequate supply of backup lube or seal oil or both is maintained in the event of complete failure of the primary lube- or seal-oil supply system. These provisions may include: emergency	In addition, any emergency pumps required to protect the unit shall be fed from DC power supply. In such case, the complete system such as but not limited to the distribution panels, the motor starters, the junction boxes, the cables shall be designed and certified for zone 1.

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pumps, accumulators, rundown tanks and special arrangements for equipment safety and protection when the equipment decelerates. Provisions shall be adequate for coast-down time, cool-off time and block-in time as applicable; the purchaser shall specify the required block-in time. The purchaser and the Vendor shall mutually agree upon the system and its components.	
4.2 Baseplates	
4.2.1 The system shall be designed as a single console, in multiple packages or in any other arrangement as specified. Each package shall have a structural steel baseplate with all system components and related valves and manifolds mounted on the baseplate. The major component supports (pumps, filters, coolers, reservoir, etc.) shall be mounted directly on structural steel.	This paragraph is applicable, however the Lube Oil System shall be fully integrated on the main equipments base plate.
4.2.3 If specified, flat decking may be furnished. Note: Minor puddling of fluid can occur.	Flat decking on the base plate is not admitted, design shall be in such way that puddling of fluid shall not occur.
4.2.7 When epoxy grout is specified, the Vendor shall pre-coat all the grouting surfaces of the mounting plates with a catalyzed epoxy primer applied to degreased white metal. The epoxy primer shall be compatible with epoxy grout. The Vendor shall submit instructions for field preparation of the epoxy primer to the purchaser.	This paragraph is applicable when epoxy grout is used.
4.2.9 If specified, the baseplate shall be designed for column mounting (that is, of sufficient rigidity to be supported at specified points) without continuous grouting under structural members. The baseplate design shall be mutually agreed upon between the purchaser and the Vendor.	This paragraph is applicable. The base plate design is the sole responsibility of the Vendor.
4.3 Oil Reservoirs	
4.3.2 Protection From Dirt and Water	
4.3.2.2 Unless otherwise approved, pumps, coolers or filters shall not be mounted on top	Equipment may be mounted on top of the reservoir whatever installation, onshore or

ISO / API	GS
of the reservoir. Note: It is possible that this can be a user consideration for offshore or other installations where available space is limited.	offshore.
4.3.4 Manways and Drains	
To ensure complete drainage, the bottom of each reservoir shall slope continuously, at least 1:50 (1/4 in/ft), to a low point. A flanged drain connection (with a valve and a blind flange) at least 50 mm (2 in) in size shall be provided. Manway openings shall be provided which will permit unobstructed entry for inspection and cleaning of all interior compartments. If entry is required for cleaning and unless otherwise specified, manways shall be located on top of the reservoir and each manway shall be at least 60 cm x 60 cm or 45 cm in diameter (24 in x 24 in or 18 in, in diameter). Internal manways are not acceptable.	The drain tube shall be routed to the limit of the skid. The flange shall be located outside the skid edge. In addition, oil reservoirs shall be provided with two flanged connections with valves and blind flanges for connecting to an oil conditioner unit.
4.3.5 Features and Appendages	
4.3.5.1 The oil reservoir shall have the following features and appendages: a) Capacity to settle moisture and foreign matter adequately and to provide allowance for rundown from the entire system. b) Provisions to eliminate air and minimize migration of foreign matter to each pump suction. c) A reflex-type, welding-pad oil level glass (with stainless steel weld pad and carbon steel cover) arranged to cover the span from at least 25 mm (1 in) above the rundown level to 50 mm (2 in) below the pump suction loss level. The oil level glass shall be located as far away as possible from the oil return lines and be visible from the perimeter of the unit (see 4.3.3.1). The maximum and minimum operating levels, rundown level and suction-loss level shall be indicated on the level glass. If more than one level glass is provided, they	In addition, the reservoir shall be provided with: • A local temperature gauge • A vent mist eliminator, (fan extractor shall be accepted as long as a backup is included). The Vendor shall clearly indicate in its proposal the residual reject of lube oil in the atmosphere. c) This paragraph is not applicable when the Lube Oil System is enclosed in the main equipments baseplate only level gauges and level transmitters shall be used as per project specifications.

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shall be offset. d) Unless otherwise specified, a fill opening at least 50 mm (2 in) in diameter, which automatically closes (normally held shut by a spring) and is equipped with a stainless steel fine-mesh strainer basket that has an open area equal to 200% of the internal pipe area. Note: Some users pipe up fill connections using the connections provided in 4.3.9. If manual fill is used, the connection described above is required. e) Blind-flanged vent connection at least 50 mm (2 in) in diameter. f) For lube-oil reservoirs, a weatherproof, corrosion-resistant filter-breather cap at least 50 mm (2 in) in diameter with filtration rating of 10 pm beta 10 or better. (For reservoirs containing seal oil, see 4.3.5.2). g) Internal baffles that do not trap gas. h) If the driver of the train is lubricated by the same system as the compressor and the oil reservoir contains the seal oil, a separate connection shall be provided on the reservoir for the compressor seal-oil return line. Note 1: This line prevents pressurization of the drivers lube-oil drain header if the compressor seals fail. Note 2: If this option is incorporated, it requires separate bearing and seal-oil drains from the compressor.	h) This clause is applicable.
4.3.7 Heating	
4.3.7.2 Purchaser shall specify whether the heaters are steam or electric.	Heaters shall be electric powered.
4.3.7.7 If specified, the Vendor having train responsibility shall conduct an analysis of the complete system, including lube-oil console, interconnecting piping, rundown tanks, equipment heat loss and other system components, to verify that the complete system heats up to the minimum equipment starting temperature in 12 h when ambient temperature is at the minimum specified	This paragraph is applicable.

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value.	
4.3.8 Provision for insulation	
If specified by the purchaser, reservoirs shall be fitted with insulation clips. The purchaser shall furnish and install the insulation.	Clarification When insulation and heat tracing are required by Project specifications or by extreme weather conditions, they shall be provided and shall be installed by the Vendor before shipment.
4.3.10 Provision for oil conditioner	
4.3.10.1 If specified, the Vendor shall provide a 25 mm (1 in) flanged, valved and blinded connection (see Figure B.24, Footnote i), located below the minimum operating level for use as an oil supply connection for an oil conditioner.	This paragraph is applicable; reservoir shall be always design as figure B.24 with additional requirement herewith specified (High & Low oil level specific functions).
4.3.12 Special Features	
4.3.12.1 Reservoir tops shall be provided with the following: • If specified, an accessible ladder with extended handrails • If specified, handrails around the perimeter of the reservoir top • If specified, non-skid surfaces decking (checker or diamond plate or hot-dipped galvanized steel grating).	This paragraph is applicable when final base plate installation is located at more than 0.30 m above ground or deck level in the following conditions: Base plate level above 0.30 m and up to 1.5 m access stairs and necessary handrails shall be provided for stairs and baseplate where necessary. Base plate level above 1.50 m access ladders including safety cage and necessary handrails shall be provided for baseplate where necessary. Non skid surfaces decking shall be provided, hot dip galvanized steel grating or fire resistant polyester fibre grating is preferable. However when checker or diamond plates are provided, they shall be painted with anti-slippage coating.
4.3.13 Materials	
Materials Unless otherwise specified, reservoirs and all appendages welded to reservoirs shall be fabricated from austenitic stainless steel in accordance with ASTM A 240/A 240M. Pipe	Reservoirs and all appendages to reservoirs shall be fabricated from AISI 316L SS as a minimum material grade. When drop in design reservoir cannot be supplied, the reservoir shall be fully 316L SS clad including all welded appendages. All 316L SS appendages

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connections shall be as specified in 5.1. Note: Carbon steel appendages, such as ladders and handrails, can be bolted to clips welded to the reservoir.	welded to the reservoir shall be painted with the same painting system selected for reservoir. Clarification For reservoir located within-skid, only drop-in designs shall be accepted.
4.3.14 Grounding Two grounding clips or pads diagonally opposed to each other (see Figure B.24) shall be welded to the reservoir. The pads shall accommodate a 13 mm (1/2 in UNC) bolt.	Clarification Only 316L SS two diagonally grounding pads fully welded on reservoir and on baseplate shall be provided. The pads shall accommodate 13 mm metric bolts.
4.4 Pumps and Drivers	
4.4.1 The oil system shall include a main oil pump and a standby oil pump both suitable for continuous operation. For non shaft-driven pumps, the main and standby pumps shall be identical. The purchaser shall specify whether horizontal centrifugal or rotary pumps shall be used. Except as modified in this part of ISO 10438, pumps shall conform to ISO 13709. Note: For the purpose of this provision, API Std 610 is equivalent to ISO 13709.	This paragraph is applicable. However main oil pump and standby oil pump can only be centrifugal as per ISO 13709, ISO 5199 or API Std 675 screw types.
4.4.3 If specified by the purchaser, an emergency oil pump shall be furnished to allow safe shutdown without damage to the equipment in the event that both the main and standby pumps fail. The purchaser and driven equipment Suppliers shall define the requirements for safe shutdown. Note: A lube-oil rundown tank can provide bearing oil for rundown. Some times an emergency oil pump with separate power source is supplied in order to allow cool-down oil after coast-down or seal oil.	This paragraph is applicable but safe shutdown of equipment remains the sole responsibility of Vendor. However if separate source is supplied, it shall DC source system ATEX certified for use in hazardous area. The Vendor shall provide the complete DC source system including batteries, chargers, starters and internal connections between subsystems.
4.4.4 Unless otherwise specified, oil pumps not submerged inside the reservoir shall be equipped with mechanical seals that have carbon rings with mating tungsten or silicon carbide rings; Buna or Viton gaskets 2) and O-rings; and end plates with throttle bushings as	Vendor standard shall be clearly indicated in his proposal.