DEP SPECIFICATION

LUBRICATION, SHAFT-SEALING AND OIL-CONTROL SYSTEMS AND AUXILIARIES (AMENDMENTS/SUPPLEMENTS TO ISO 10438)

DEP 31.29.60.32-Gen.

February 2011
(DEP Circular 80/11 has been incorporated)

DESIGN AND ENGINEERING PRACTICE

DEM1

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The objective is to set the recommended standard for good design and engineering practice to be applied by Shell companies in oil and gas production, oil refining, gas handling, gasification, chemical processing, or any other such facility, and thereby to help achieve maximum technical and economic benefit from standardization.
The information set forth in these publications is provided to Shell companies for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual Operating Units to adapt the information set forth in DEPs to their own environment and requirements.
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TABLE OF CONTENTS

PART I. **INTRODUCTION AND GENERAL** 4
1. INTRODUCTION 4
1.1 SCOPE 4
1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS 4
1.3 DEFINITIONS 4
1.4 CROSS-REFERENCES 5
1.5 SUMMARY OF MAIN CHANGES 5
1.6 COMMENTS ON THIS DEP 6
1.7 DUAL UNITS 6
2. GENERAL 7

PART II **AMENDMENTS/SUPPLEMENTS TO ISO 10438** 8

ISO PART 1 **GENERAL REQUIREMENTS** 8
3. TERMS, ABBREVIATED TERMS AND DEFINITIONS 8
4. GENERAL 8
5. PIPING 9
6. INSTRUMENTATION, CONTROL AND ELECTRICAL SYSTEMS 11
7. INSPECTION, TESTING, AND PREPARATION FOR SHIPMENT 12
8. VENDOR'S DATA 14
APPENDIX G DEFINITIONS AND EXAMPLES OF VITAL, ESSENTIAL AND NON-ESSENTIAL SERVICES 15

ISO PART 2 **SPECIAL PURPOSE OIL SYSTEMS** 17
4 GENERAL REQUIREMENTS 17
5 PIPING 26
6 INSTRUMENTATION, CONTROL AND ELECTRICAL SYSTEMS 26
7 INSPECTION, TESTING, AND PREPARATION FOR SHIPMENT 30
ANNEX B PIPING AND INSTRUMENT DIAGRAMS 31

ISO PART 3 **GENERAL PURPOSE OIL SYSTEMS** 32
4 GENERAL 32
5 PIPING 34

ISO PART 4 **SELF-ACTING GAS SEAL SUPPORT SYSTEM** 35
4 GENERAL 35
5 PIPING AND TUBING 36
6 INSTRUMENTATION, CONTROL AND ELECTRICAL SYSTEMS 37
7 INSPECTION, TESTING, AND PREPARATION FOR SHIPMENT 37
ANNEX B PIPING AND INSTRUMENTATION DIAGRAMS 38

PART III **REFERENCES** 39

Documents
Document Sharing Hub

Full document details: SHELL 31.29.60.32 0

PART I. INTRODUCTION AND GENERAL

1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for lubricating oil, seal oil and control oil supply systems and shaft sealing systems using self-acting gas seals and auxiliaries. These systems may serve compressors, fans, centrifugal pumps, steam turbines, gas turbines, expanders, gears and electric motors. This DEP does not apply to shaft sealing for centrifugal pumps.

This DEP is based on ISO 10438:2007. Part II of this DEP amends, supplements and deletes various clauses/paragraphs of ISO 10438:2007. Clauses of ISO 10438 that are not mentioned in this DEP remain applicable as written.

This DEP is intended to be used in conjunction with the data/requisition sheet relevant to the equipment it serves.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual DEM 1 – Application of Technical Standards

This DEP is a revision of the DEP of the same number dated January 2010; see (I-1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process should be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The capitalised term **SHALL [PS]** indicates a process safety requirement.

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The word **should** indicates a recommendation.

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced by this DEP are listed in (Part III).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated January 2010. The following are the main, non-editorial changes.

Section	Change
General	The DEP has been revised to: reduce cross-referencing of other DEP's; simplify it and streamline its implementation; make it more suitable for use on Design Class 1-3 projects; incorporate useful content from regional specifications, with a view to eliminating those regional specifications.
	Part 1
3.1.55	Added new Definition.
5.1.2	Deleted references to DEP 31.38.01.12-Gen and DEP 31.38.01.15-Gen.
	Gaskets to also have internal centering ring
5.1.5	h) more specific requirement added; i) added this requirement
5.1.12	ISO requirement for tubing is adequate.
5.1.20	Threaded connections are acceptable for air or inert gas.
5.1.21	Threaded control valves are acceptable up to DN 25 (NPS 1) for air or inert gas in tubing systems. Soft seated and wafer type check valves shall not be used.
5.1.32	Deleted reference to piping class specifications for valves
5.1.35	Changed 'Cadmium and zinc' to 'Cadmium or zinc'
5.3.4	Deleted requirement for sampling connection (duplicate of 5.2.7).
6.1.2	Deleted reference to DEP 32.21.09.31-Gen and DEP 33.31.00.32-Gen
6.3.3.10	Transmitters shall be factory-calibrated
6.3.7	Deleted reference to DEP 32.31.00.32-Gen
6.3.8.2	Deleted reference to DEP 32.31.00.32-Gen
6.3.9.1	Deleted requirement for FI in coupling guard drain line.
6.3.9.3	Threaded flow indicators are acceptable in tubing systems.
	Part 2
4.1.5.1	Deleted reference to DEP 31.10.00.31-Gen
4.1.5.2	Deleted reference to DEP 31.10.00.94-Gen
4.1.10	Added "Seal oil system piping and components shall be designed for exposure to compressor casing maximum allowable working pressure."
4.1.16	Revised isolation requirements to align with revised Shell LOCK OUT TAG OUT policy.
4.1.21	Changed requirement for 316L or 316Ti to be for off-shore or coastal applications only.
4.1.23	Changed dynamic simulation to 'If specified'.
4.1.24	Changed shop or field verification to "If specified".
4.2.2	Deleted additional requirements for drain rims.
4.3.5.1	Added new requirement.
4.3.8	Added new requirements if winterization is specified.
4.3.12	Relaxed requirement for ladder/guard-rails to correspond to Shell Life-Saving rule.
4.4.1	If both pumps are motor-driven, power supplies from different feeders.
4.4.2	Vertically-mounted pumps submerged in the reservoir are acceptable. Such pumps may be cast iron.
4.4.9	Relaxed application of Shell motor spec to only 7.5 kW and larger (smaller motors are disposable). Added reference to new IEEE motor DEP.
4.4.22	New requirement
4.5.1.3	Deleted reference to air cooler DEP 31.21.70.31-Gen
4.5.2.2	New requirement
4.5.2.7	Deleted reference to cooler material DEP 31.21.01.31-Gen
4.7.2	New requirement.
4.7.4	Aligned with revised Shell LOCK OUT TAG OUT policy.
4.8.1	Added provision for an accumulator.
4.9.1.3	Deleted reference to ASME VIII and DEP 31.22.20.31-Gen, and PD 5500 and DEP 31.22.10.32-Gen.
4.9.1.6	New requirement.
4.9.2.1	Added provision for future run-down tank (if no run-down tank supplied).
5.1	Added 'tubing may be used in instrument sensing lines downstream of a root valve'.
7.1	Changed Operational test from Witnessed to Observed.
	Part 3
4.1.1.a	Added 'A vertically-mounted pump suspended in the reservoir is acceptable, and this pump may be cast iron.'
4.2.5	Deleted reference to DEP 31.10.00.31-Gen and DEP 31.10.00.94-Gen

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4.4.2	Deleted additional requirements for top openings
4.4.4.2	Deleted requirement for sloped bottom
4.4.4.3	Deleted requirement for 2" drain connection
4.4.7.a	Electric heaters 3-phase (facilitates inhibiting operation on low level)
4.4.8	Added requirements if winterization is required.
4.5.5	Relaxed application of Shell motor spec to only 7.5 kW and larger (smaller motors are disposable). Added reference to new IEEE motor DEP.
4.5.10	New requirement.
4.6.2.1.a	New requirement.
Part 4	
4.2.1	Deleted
4.2.7	Deleted requirement - API requirement is adequate.
4.2.11	Revised requirement for double block and bleed to align with SHELL Lock Out Tag Out policy.
4.2.18	Deleted reference to DEP 32.31.09.31-Gen
4.3.2.1	Deleted
4.3.1.1	Deleted
4.4.1	Re-worded requirement for isolation.
4.4.2	Deleted requirement for isolation (duplicates para 4.2.11).
5.2	Deleted Tubing limitations
5.4	Deleted reference to root valve on process piping
5.5	Deleted.
5.7	Changed 'vent and drain lines shall have the same rating as the compressor casing' to 'vent and drain lines shall have a minimum pressure rating of 20 bar (ga)'
5.8	Added specific requirement about pressure testing of tubing
6.3.1.1	Deleted
6.3.1.3	Deleted
7.3.3.4	Changed the requirement so that a functional test is required if a compressor string test is performed, otherwise not required
Annex B – B.10	Added "Shall not be used."
Annex B – B.11	Added "Shall not be used."
Annex B – B.12	Deleted "Add a PDIT between the secondary seal gas supply and the secondary vent" (Fig B.12 shows PDIT between primary vent and secondary seal gas supply

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at standards@shell.com, using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of "DEPs on the Web", available through the Global Technical Standards web portal http://sww.shell.com/standards and on the main page of the DEPs DVD-ROM.

1.7 DUAL UNITS

Amended per Circular 80/11
Dual units have been incorporated throughout this DEP.

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

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2. GENERAL

Part II of this DEP amends, supplements and deletes various clauses/paragraphs of ISO 10438:2007. For ease of reference, the clause numbering of ISO 10438 has been used throughout Part II of this DEP. Clauses of ISO 10438 that are not mentioned in this DEP shall remain applicable as written.

This DEP shall be used in conjunction with the data/requisition sheet relevant to the equipment it serves.

Notwithstanding the requirements of Part 1, Section 4.3.1 of ISO 10438, as supplemented by this DEP, the Principal shall advise whether general-purpose requirements or special-purpose requirements are to be applied to a particular piece of equipment. This shall be indicated on the equipment data sheets.

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PART II AMENDMENTS/SUPPLEMENTS TO ISO 10438

This part covers four Parts of ISO 10438:

- ISO PART 1: General Requirements
- ISO PART 2: Special Purpose Oil Systems
- ISO PART 3: General Purpose Oil Systems
- ISO PART 4: Self-Acting Gas Seal Support Systems

ISO PART 1 GENERAL REQUIREMENTS

3. TERMS, ABBREVIATED TERMS AND DEFINITIONS

3.1 TERMS AND DEFINITIONS

Add new clause:

3.1.55 **very toxic substances:** Substances that produce serious harm to health as a result of a single or short-term exposure. Amongst others, as defined in the data/requisition sheets, the following shall be considered very toxic:

- Levels of H_2S exceeding 1,000 ppm mole (vol) in process streams
- Other substances specified by the Principal to be very toxic

4. GENERAL

4.3 SYSTEM SELECTION

4.3.1 *Add to this clause:*

The Vendor shall base his offer on the requirements and recommendations of the appendices in Parts 2, 3, and 4. The final selection of the system shall be subject to the Principal's approval, irrespective of the schematics in the proposal.

Unless otherwise specified, lube and control oil systems shall be a single combined system for driver and driven equipment, including intermediate transmissions, if applicable.

Gas turbine driven equipment shall be served by the gas turbine oil system, except for aero-derivative gas turbine driven equipment, which may have separate oil systems for the gas generator part and the driven equipment part.

Lube and control oil systems for aero-derivative gas turbine gas generators are designed and constructed in accordance with Manufacturers' standards and, as such, may deviate from this DEP. However, detailed exceptions and deviations shall be subject to the approval of the Principal.

Special purpose oil systems in accordance with Part 2 shall be employed for the following equipment and services:

1. Lube and control oil systems for axial and centrifugal compressors in accordance with ISO 10439 / API 617 irrespective of the driver type.
2. Compressor shaft seal oil systems.
3. Pressurized lube and control oil systems for all equipment in unspared essential service.
4. All equipment driven by special purpose steam turbines or by gas turbines.

General-purpose oil systems in accordance with Part 3 shall be employed for the following equipment and services:

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1. Pressurized lube and control oil systems for spared equipment in essential services, driven by either an electric motor or a general-purpose steam turbine.
2. Lube and control oil systems for equipment in non-essential service.

For definitions of essential and non-essential service, refer to Appendix G.

Add new clause:

4.3.3 Seal oil systems SHALL [PS] be designed so that the release of process gas into atmosphere is positively prevented.

If it cannot be tolerated for the process gas to be contaminated by seal-oil, the design shall accommodate this requirement by appropriate buffering and filtration.

5. PIPING

5.1 GENERAL

5.1.2 *Add to this clause:*

Socket welded connections shall not be used in Group I and IV services. Threaded joints may be used only for instrument connections and in tubing systems.

All oil and gas containing piping material of Groups I and IV shall be stainless steel; this includes the supply and drain piping components connected to the main equipment casing or bearing housing.

Tables 1, 2, 3, 4: replace gasket requirements by:

All flange gaskets shall be spiral wound, austenitic stainless steel windings, graphite-filled with both an external centering ring and internal centering ring, (e.g. Flexitallic type CGI or equal).

5.1.4 *Add to this clause:*

Flanged connections shall terminate within the baseplate so any liquid drips are captured within the baseplate.

5.1.5 *Add to sub-clauses b, d & e:*

b) Piping shall be supported above the console deck to facilitate wash down. Piping shall be routed so that it does not create tripping hazards.

d) Piping Vent connections shall be DN 20 (NPS 3/4) in size and shall have valves.

e) Piping Drain connections shall be DN 20 (NPS 3/4) in size and shall have valves.

Add to this clause:

f) Pockets, traps, etc., which may collect debris and prevent thorough flushing and drainage, shall be avoided.

g) Headers shall terminate with blind flanges to accommodate flushing and/or cleaning.

h) Strain-free piping shall be installed so that shaft movement in either the vertical or horizontal directions at the coupling after the flange is tightened is not more than 50 µm (2 mil).

i) Block valves shall not be installed in piping where interruption of flow will result in machine damage.

5.1.7 *Replace this clause with:*

Pipe bushings and unions shall not be used in piping systems. The use of couplings in tubing systems shall be kept to a minimum.

Add to this clause

Swage fittings or reducer couplings shall be used. Reducer bushings shall not be used.

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5.1.8 *Add to this clause:*

PTFE tape shall not be used as a thread sealant.

5.1.12 *Add to this clause:*

Unless otherwise specified on the data sheets, all compression fittings shall be of the two-ferrule design. Tubing fittings shall be stainless steel.

Couplings in tubing systems shall not be located close to high-temperature equipment components such as turbine casings or steam piping.

5.1.18 *Add to this clause:*

Stainless steel weld neck flanges, raised face, shall be used for all flanged connections in pressurized oil lines. Stainless steel slip-on flanges are allowed in atmospheric oil drain lines and reservoir connections.

5.1.19 *Replace this clause by:*

All components shall be made of steel.

5.1.20 *Replace this clause by:*

Threaded or threaded seal welded pipe connections are not acceptable in any steam, oil or gas application, except that they are acceptable for air or inert gas. Threaded (but not seal-welded) connections shall be permitted downstream of instrument block valves.

5.1.21 *Add to this clause:*

All valves that are larger than DN 50 (NPS 2) shall be flanged, and all control valves shall be flanged, except that control valves up to DN 25 (NPS 1) in air or inert gas service in tubing systems may be threaded. Valves DN 100 (NPS 4) and smaller shall comply with ISO 15761. Valves larger than DN 100 (NPS 4) shall comply with ISO 10434. Globe valves shall also comply with applicable portions of ISO 15761 or ISO 10434. Soft seated and wafer type check valves shall not be used.

NOTES: 1. API 600 is equivalent to ISO 10434.

2. API 602 is equivalent to ISO 15761.

5.1.30 *In this clause, delete the words* "If specified,"

5.1.33 *In this clause, delete the words* "If specified,"

Add new clauses:

5.1.35 Cadmium or zinc plated studs, bolts, and nuts shall not be used.

5.2 OIL PIPING

5.2.1 *Replace the last two sentences of this clause by:*

Drain lines shall be connected individually to the return header at a 45° angle in the direction of flow at a point above the header centreline. The minimum size for drain lines shall be DN 50 (NPS 2), unless otherwise approved by the Principal.

Add to this clause:

Drain lines shall not be reduced in size from the machine drain connection to the return header. Branch connections (pressure and oil return) shall be flanged at the header and at the machine. Branch pipe shall not be directly welded to run pipe. Tees shall be used.

NOTE: The hydraulic design of drain lines for gears with high pitch line velocities shall prevent the backing up of drained oil into other components of the machine train.

Add new clauses:

5.2.5 Filter vent lines connected to the filter cover shall have flexible elements, such as stainless steel braided hose, of adequate length so that the filter cover can be opened in order to

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replace the cartridge. Pressure rating of flexible elements shall be a minimum of 1.5 times the pressure rating of the filters.

5.2.6 Main oil supply header shall have DN 20 (NPS 3/4) flanged and blinded connections in the top of the pipe just downstream of the lube oil filter and just downstream of each pressure regulating valve. Connections shall be used to inject nitrogen to aid cleaning.

5.2.7 A minimum of two oil sample connections shall be provided on the oil console piping: one on the supply piping between the supply pumps and the filters; and one on the return line from the main equipment.

5.3 INSTRUMENT PIPING AND TUBING

5.3.2 *Add to this clause:*

Instrument pressure connections to main headers shall be made with branch welding fittings (weldolets).

5.4 *Delete this clause*

5.5 *Delete this clause*

6. INSTRUMENTATION, CONTROL AND ELECTRICAL SYSTEMS

6.1 GENERAL

6.1.2 *Replace this clause by:*

Unless otherwise specified by the Principal, the Vendor shall supply all on-skid instrumentation, instrument piping, and cabling. Instrumentation of overhead and run-down tanks shall be included.

The instruments shall include pressure and temperature indicators, pressure and level transmitters, level switches, thermocouples and/or RTDs for indication, control, alarm and/or shutdown functions as described in ISO 10438 as amended by this DEP. Instruments and instrument signal lines shall be installed and lined up to a common junction box on the edge of the base plate.

Instrument makes and types shall be subject to the approval of the Principal and/or shall be chosen from a list of acceptable instruments which will be provided by the Principal. If the supply of above instrumentation is deleted by the Principal on the data/requisition sheets, only the instrumentation considered to be an integral part of the equipment shall be supplied by the Vendor. Furthermore only the various instrument connections and level indicators, as specified in this DEP, are required.

6.1.4 *Delete this clause*

6.2 ALARM, SHUTDOWN AND CONTROL SYSTEMS

6.2.1.2 *In this clause, delete the words* "If specified,"

6.3 INSTRUMENTATION

6.3.2 *Delete this clause*

6.3.3 Transmitters

6.3.3.1 *In this clause, delete the words* "If specified,"

6.3.3.10 *Add this clause*:

Transmitters shall be factory-calibrated.

6.3.4 Temperature Indicators

6.3.4.2 *Replace this clause by*:

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Temperature-sensing elements shall not be located in oil flow sight-glasses.

6.3.7 Level instruments

Add to this clause:

Displacer operated type level switches shall not be used. Sensing elements shall be made of stainless steel.

6.3.9 Oil sight flow indicators

6.3.9.1 *Replace this clause by:*

Flow indicators shall be furnished in the atmospheric oil-drain return line from each bearing, gear, seal, and, if specified (refer to ISO 10438, Part 2, 4.4.17), from each relief valve. Flow indicators shall not be installed in pressurized lines.

6.3.9.3 *Replace this clause by:*

Flow indicators shall have flanged connections, shall be of the bull's eye type and shall have a stainless steel body. Flow indicator sight glasses shall be made of non-flammable, permanently transparent material.

Flow indicators with a threaded type sight glass in the drain line shall not be used, except for tubing systems.

Flow indicators shall be mounted outside noise enclosures, unless the enclosures are of the "walk-in" type.

Flow indicators shall have a diameter not less that the inside diameter of the oil pipe.

6.3.10 Solenoid Valves

6.3.10.1 *Add to this clause:*

Solenoids shall have Class H high temperature coils.

6.3.12.5 *Add to this clause:*

e. Distributed Control System (DCS) shall not be used for controlling pressure-regulating valves or the auto-start of a spare pump.

6.4 ELECTRICAL SYSTEMS

6.4.2 *Add to this clause:*

All electrical components and installations SHALL [PS] be suitable for the area classification, gas grouping and temperature class specified on the data/requisition sheet.

6.4.12 *Add to this clause:*

Vendor-supplied electrical devices that require external connections provided by the Principal (except motor leads) shall be wired by the Vendor to terminal and junction boxes, segregated by voltage level, and mounted at the edge of the console baseplate.

7. INSPECTION, TESTING, AND PREPARATION FOR SHIPMENT

7.1 GENERAL

7.1.1 *Add to this clause:*

The Purchaser shall indicate whether, and to what extent, he will witness the Manufacturer's quality control, inspection and testing. This may include, but need not be limited to, the following:

- A check (against outline drawings which have been approved by the Purchaser) of all main dimensions, base plate dimensions, location of foundation boltholes, size/position/rating of flanges and coupling guard arrangement;
- An inspection of flange face finish;

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