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CLIENT:

PROJECT:

OPS DESIGN UPGRADE

DOCUMENT DESCRIPTION:

OUTBOARD SWIVEL
PIPE SWIVEL
SPECIFICATION

| Status/ Revision | Date (DD-MMM-YYYY) | N° of Pages | Written by | Checked by | Discipline Lead Engineer | I&I Dir. Approval for Issue |
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INFORMATION ON STATUS:

- P** Preliminary for Information
- C** For Comments and Approval
- V** Valid for Construction
- A** Approved For Construction
- X** "As Built"
- EPM** Engineering Project Manager or Assigned Substitute

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**OUTBOARD SWIVEL
PIPE SWIVEL
SPECIFICATION**

REVISION STATUS / SUMMARY OF CHANGES

| REVISION | REVISED CHAPTERS | REVISION DESCRIPTION | REASON FOR REVISION |
|-----------------|-------------------------|-----------------------------|----------------------------|
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1. **SCOPE OF THE DOCUMENT**

This SPECIFICATION and associated documentation provide the minimum requirements for the supply of the two Outboard Pipe Swivels to be installed on the XXXXX CALM BUOY.

2. **CODES, STANDARDS AND REFERENCES DOCUMENTS**

The CONTRACTOR is responsible for the quality of the work and compliance with the requirements of the applicable Codes, Standards, Regulations and PURCHASER SPECIFICATION.

In the event of conflict between this SPECIFICATION and any other SPECIFICATION, DATA SHEET, code, standard or regulation, the CONTRACTOR shall inform the PURCHASER in writing and receive written clarification from the PURCHASER.

The edition or revision of the documents shall be the latest edition or revision available at the time of award of the CONTRACT unless otherwise specified.

Any deviation from this SPECIFICATION or the Regulations, Codes and Standards listed below shall be clearly defined by the CONTRACTOR and agreed by the PURCHASER.

If this SPECIFICATION contains more stringent requirements than the Codes, Standards and Regulations, then this SPECIFICATION shall prevail.

2.1 **ASSOCIATED PURCHASER DOCUMENTS**

| | |
|---------|---|
| Ref [i] | Outboard Swivel – Pipe Swivel – General arrangement |
|---------|---|

And all associated documentation.

2.2 CODES, STANDARDS

| | | |
|----------|------------------------|--|
| Ref [1] | ASME III Division 1 | Nuclear Power Plant Components |
| Ref [2] | ASME IX | Welding & Brazing Qualifications |
| Ref [3] | NACE MR-01-75 | Sulphide Stress Cracking Resistant Metallic Material for Oil Field Equipment |
| Ref [4] | ASTM A388 | Ultrasonic Examination of Heavy Steel Forgings |
| Ref [5] | ASTM A435 | Straight-Beam Ultrasonic Examination of Steel Plates |
| Ref [6] | ASTM A564 | Standard Specification for Hot Rolled and Cold Finished Age-Hardening Stainless Steel Bars and Shapes |
| Ref [7] | ASTM E709 | Standard Guide for Magnetic Particle Examination |
| Ref [8] | ISO 68 | General Purpose Screw Threads - Basic Profile |
| Ref [9] | ISO 965/1 | ISO General Purpose Metric Screw Threads - Tolerances - Principles and Basic Data |
| Ref [10] | ISO 6508 | Rockwell Hardness Test |
| Ref [11] | ISO 6892 | Tensile Testing |
| Ref [12] | ISO 8501/1 | Preparation of Steel Substrates before Application of Paints and related Products - Visual Assessment of Surface Cleanliness (includes the Swedish Standard SS 05-59-00 "Pictorial Surface Preparation Standards for Painting Steel Surfaces") |
| Ref [13] | ISO 9001 | Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation & Servicing |
| Ref [14] | ISO 9002 | Quality Systems - Model for Quality Assurance in Production, Installation & Servicing |
| Ref [15] | ISO 9004 | Quality Management & Quality System Elements |
| Ref [16] | ISO 148 | Beam Impact Test (V-Notch) for Steel |
| Ref [17] | ISO R468 | Surface Finish |
| Ref [18] | EN 10204 | Metallic Products - Types of Inspection Documents |
| Ref [19] | SSPC | Steel Structures Painting Council |



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3. **DESIGN**

3.1 **LAYOUT**

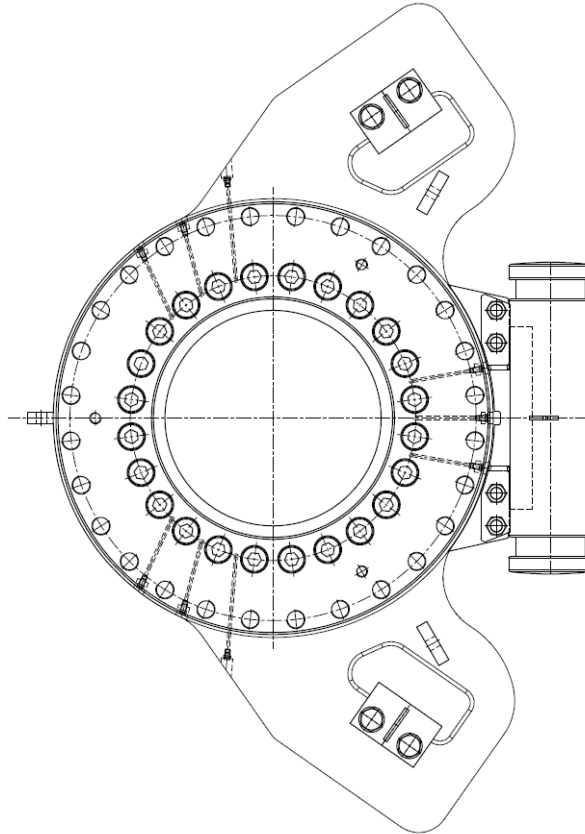


Figure 1: Top view of the Outboard Pipe Swivel

3.2 **COMPONENT DESCRIPTION**

The Outboard Pipe Swivel is designed to provide a rotating connection between the turntable piping and the floating hose, in order to reduce bending in this hose.

This swivel includes a three-race roller bearing, fastened between a fixed top ring and a rotating bottom ring, suitable for the forces, moments, and environmental conditions as defined in this SPECIFICATION and the relevant DATA SHEET. The complete unit is clamped between two ANSI flanges, a 32" Class 300 on the top side and a 24" Class 600 on the bottom side.

The Outboard Pipe Swivel is fitted with a Buffer attached on the revolving part, and four stoppers located on the fixed top ring, two on each side of the buffer. The first to make contact is replaceable, while the second is fixed.

3.3 GENERAL DESIGN COMMENTS

- 1) Tolerances of dimensions, form and position shall be in accordance with the CONTRACTOR's most stringent standards where not specified on the relevant ORDER DRAWING.
- 2) All bolt holes used for mounting the swivel shall have a small chamfer where they break through the outside surface.

4. MANUFACTURING / INSPECTION AND TESTING

MATERIALS

4.1

Top Rings with Stoppers and Bottom Rings with Buffer Support

4.1.1

The Top Rings with the Stoppers and the Bottom Rings with the Buffer Support shall be manufactured from forgings as per Material Data Sheet given in Appendix.B.

The material shall be subject to APPROVAL from the PURCHASER and shall be air melt, vacuum degassed steel.

The material shall meet the requirements stated in 4.3.3.1 and 4.3.3.2.

In addition, if stated in the relevant DATA SHEET, all material shall comply with the requirements of Ref [3].

Seal running surfaces and housings

4.1.2

Each of the lip and quad seals shall be mounted within, and shall run on, a corrosion resistant material subject to APPROVAL from the PURCHASER. If forged inserts are used, then they shall be welded to the rings.

Seals

4.1.3

All seals are in the CONTRACTOR's scope of supply.

The lip seals shall be purchased from PXL only, in accordance with the PURCHASER confidential SPECIFICATION "Elastomeric Lip Seals Fabrication and Inspection", latest revision resident in XXX.

"O" rings seals, "quad" seals and dust seals shall be made of seawater and crude-oil resistant 70 (± 5) NBR. "O" rings seals shall have vulcanized endings.

All seals and "O" rings, in contact with the product, shall be made of material resistant to aromatics and Sulphur.



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4.1.4 **Bolting**

- The Bolting Material used for the fixation of the stoppers shall meet the requirement of ASTM F568 M/ ISO898/1 Class 10.9.
- The Bolting Material used for the fixation of the buffer shall meet the requirements of ASTM F568 M /ISO898/1 Class 10.9.

4.2 **MANUFACTURING**

All rings shall be clearly identified by their proper designation:

- Nose Ring,
- Retaining Ring,
- Supporting Ring,
- Top Ring
- Bottom Ring

4.2.1 **Repair Welding**

No repair welding on the forgings is allowed.

4.2.2 **Bolting / Tapped holes**

Screw thread profiles shall be cold rolled in accordance with Ref [8]. The dimensions shall comply with the relevant ORDER DRAWING. The tolerance for threads shall be in accordance with Ref [9] Class 6g for screws and Class 6H for tapped holes.

4.2.3 **Welding**

The CONTRACTOR shall carry out any operation of welding in accordance with approved welding procedure specification(s) and the general requirements of Ref [2].

If stated in the relevant DATA SHEET, the welding procedure shall comply with the requirements of Ref [3] section 5.

4.2.4 **Surface Finish**

Roughness shall meet the requirements stated in 4.3.4 for seal running surface and 4.3.5 for seal grooves.

4.2.5 **Swivel Assembly Instructions**

The outboard pipe swivel shall be assembled and properly lubricated as follows:

- 1) Apply lubricant to all seal running surfaces. The lubricant shall be suitable with the seal material.
- 2) Adjust the complete bearing (with all seals) on the bottom ring, (orientation according to the positioning pin).
- 3) Apply MOLYKOTE 1000 on bottom screws and torque them in accordance with the requirements stated in the relevant ORDER DRAWING.
- 4) Adjust the top ring (with all seals) on the top side of the bearing (orientation according to the positioning pin).
- 5) Apply MOLYKOTE 1000 on top screws and torque them in accordance with the requirements stated in the relevant ORDER DRAWING.
- 6) Fill the bearing with the lubricant, via grease nipples, until it is visible through the relief ports (see section 4.2.8).
- 7) Fill area around screw heads with grease and plug the holes with temporary caps until the swivel is mounted between the flanges.
- 8) Assemble the buffer and the stopper using the dedicated bolts tensioned in accordance to general arrangement drawing.

4.2.6 **Plugs**

All holes on the outside surface of the swivel, other than mounting bolt holes are to be provided with plastic threaded plugs, to prevent deterioration from water and condensation accumulation once the bearing is installed.

4.3 **INSPECTION AND TESTING**

4.3.1 **Test Pieces**

Test pieces shall be prepared for all components.

The forged test pieces shall be obtained from either of the following methods:

- cut out from the forged rings themselves or,
- separately made, in such case, they shall be prepared by the same process as that of the corresponding ring, i.e. same ingot, forging method, heat treatment and also same section profile.

4.3.2 **Applicable Standards**

| | |
|---------------------------------|----------|
| Tensile Tests | Ref [11] |
| Impact Tests | Ref [16] |
| Roughness measurements | Ref [17] |
| Magnetic Particle Inspection | Ref [7] |
| Ultrasonic Testing for Forgings | Ref [4] |
| Ultrasonic Testing for Plates | Ref [5] |
| Hardness measurements | Ref [10] |

4.3.3 **Swivel Top & Bottom Rings, Buffer Support & Stoppers**

4.3.3.1 **Tensile tests**

Acceptance Criteria: as per relevant DATA SHEET.

4.3.3.2 **Impact tests**

Forging:

A minimum of three notched impact test specimens shall be prepared from material removed each test piece, in the final heat treated condition.

The specimen shall be preferably cut out in the transverse direction to the forging lines and shall be located 18 mm from the surface. On each specimen, the notch shall be machined parallel to the forging lines.

In case where the specimen cannot be taken in the transverse direction for practical reasons, the Impact values specified shall be multiplied by a factor of 1.48 for longitudinal sample testing.

Acceptance criteria: as per relevant DATA SHEET.

4.3.3.3 **Ultrasonic testing**

Forging:

After heat treatment, all ring forgings and test pieces shall be 100 % ultrasonically tested in accordance with ASME III DIV 1 subsection NB-2542.

Appropriate calibration notches described in NB-2542.2 (c) shall be in accordance with ASTM A 388, paragraph 7.3.

Recordable indications are as defined in paragraph 8 of ASTM A 388.

Results shall be reported in accordance with ASTM A 388, paragraph 9.

Acceptance criteria: as per ASME III DIV 1 subsection NB-2542.2 (a) and (c).

Unacceptable indications in any area of the forging may be cause for rejection.

4.3.3.4 **Magnetic Particle Inspection**

The pieces shall be 100% magnetic particle inspected.

Acceptance Criteria: No indication.



4.3.4 **Seal Running Surfaces**

4.3.4.1 **Roughness**

At least 2 transverse measurements per 90° sector shall be carried out on each seal running surface by means of an approved surface roughness recorder.

The PURCHASER may request additional similar measurements on any doubtful area.

Acceptance Criteria: 100% of the readings, as per the relevant ORDER DRAWING.

4.3.4.2 **Dye-Penetrant Examination**

Each seal running surface shall be 100% dye-penetrant examined.

Acceptance Criteria: No indication, unless otherwise agreed by the PURCHASER.

4.3.5 **Seal Grooves Roughness**

At least 2 transverse measurements per 90° sector shall be carried out on each seal groove by means of an approved surface roughness recorder.

The PURCHASER may request additional similar measurements on any doubtful area.
Acceptance Criteria: 100% of the readings, as per the relevant ORDER DRAWING.

5. PAINING

5.1 SURFACE PREPARATION

The surfaces to be prepared are split into two different systems as per the sketch below.

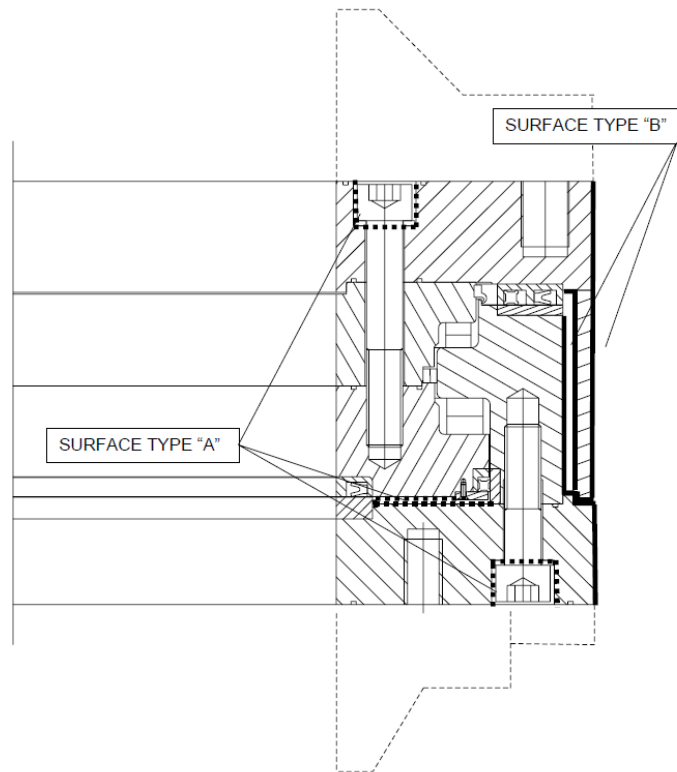


Figure 2: Surface preparation for painting

5.1.1 Solvent Cleaning

Any trace of grease or oil shall be removed before abrasive blasting, and the surface shall be completely dried. No acid washes or other solvent or cleaning solutions shall be used after sand blasting.

This includes inhibitive solutions intended to prevent rust. Solvent shall be approved by the paint manufacturer.

Special attention shall be paid to bolt holes and any area where access is limited.

5.1.2 Blasting

Preparation shall be in accordance with Ref [19] SP 10 "White Metal Blast Clean" or to a visual standard in accordance with SS-05-5900 Sa 3 Ref [12].

All welding areas shall be given special attention for removal of welding flux in crevices. Welding spatters, slivers, laminations and underlying mill scale not removed during fabrication and exposed before and during grit blasting operations shall be removed by the best mechanical means and the edges smoothed or rendered flush.



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Machined surfaces shall be carefully protected before blasting operation. The CONTRACTOR is responsible for protecting adequately all surfaces that should not be blasted.

5.1.3 **Primer Coating**

One coat of zinc-rich epoxy primer to a DFT of 40 microns shall be applied in accordance with the manufacturer's standards.

The blast-cleaned surface shall be rendered dust free and coated with one coat of the specified primer above within 6 hours of the blasting operation, and before surface cleanliness has deteriorated below Class 3.



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5.2 FINAL PAINTING

The surfaces shall be free from sharp points, weld spatter and flux and sharp edges shall be ground off. They shall be free from grease, oil, dirt, and moisture and shall be prepared as per section 5.1 before the swivel assembly.

Surface type A:

The surface shall NOT be painted and left primer coated (as per section 5.1).

Surface type B + buffer support / stoppers:

Final painting shall be applied strictly in accordance with the manufacturer's recommendations.

Coating shall be brushed on all areas which cannot be properly spray coated for any reason.

Manufacturer's recommendations for minimum drying time shall be strictly followed for the particular coating and applicable conditions.

The washer contact surface areas shall NOT be painted and left primer coated (as per section 5.1). They shall be carefully protected during painting of other surfaces.

The paint system shall be as follows:

Two layers abrasion resistant Epoxy: DFT 2x200 microns

One layer polyurethane: DFT 50 microns

Total: 490 microns (including primer)

The Final Color shall be as per mentioned in the PURCHASE ORDER.

The CONTRACTOR shall be responsible for producing paint repair procedures as required by the paint systems involved.

All external and unpainted surfaces of the swivel shall be protected against corrosion with "TECTYL 506" or equivalent after prior agreement with the PURCHASER.

6. FINAL TESTING

The CONTRACTOR shall inform the PURCHASER, within 10 working days notice, of any inspection event as requested in the contractual Quality Plan.

The responsibility of testing and inspection shall rest with the CONTRACTOR, who shall submit to the PURCHASER, test and inspection procedures for acceptance by the PURCHASER prior to commencement of the work.

6.1 MECHANICAL TESTS

After final assembly, the following data shall be recorded and checked against acceptance criteria stated in the relevant DATA SHEET or ORDER DRAWING.

- Concentricity of assembled bearing
- Axial and radial run-out
- Axial and radial clearances
- Total weight
- Number, position and diameter of grease lines and inlet ports.

6.2 PRESSURE TESTS

All tests shall be performed at ambient temperature using corrosion inhibited water (water mixed with 5% water miscible metal working fluid, e.g. Cincinnati Cimstar MB602-C).

Blind flanges shall be prepared as “test flanges” with the following equipment:

- One test fluid inlet,
- One air vent,
- One pre-calibrated pressure gauge (0-50 bar large dial)
- One pressure/time recorded.

A special rig is to be provided by the CONTRACTOR to perform functional tests. The rig shall be provided with a torque monitoring system allowing a continuous record.

During dynamic tests, the starting and running torques shall be continuously recorded.

During pressure tests all drains shall remain opened.

6.2.1 **Body Integrity Test**

The Swivel Unit shall be placed in an upright position and supported securely, leaving sufficient room around it for proper inspection during testing.

No oscillations or rotations are allowed during this test.

Fill-up the swivel with corrosion inhibited water and raise the pressure to the following static test pressure:

Static test pressure: 28.5 bar

Duration of the test: 2 hours after stabilization of the testing pressure

Acceptance criteria: No leakage.

6.2.2 Functional tests

Acceptance criteria

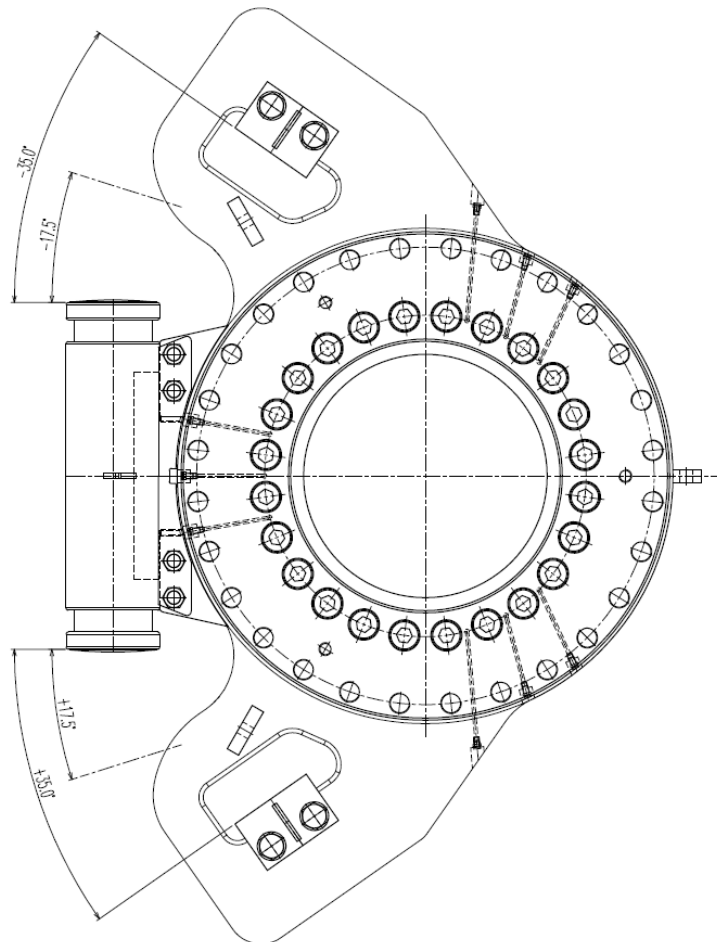
- a) During this test no leakage are acceptable,
- b) Recorder break-out torque value shall not exceed the requirements stated in the relevant DATA SHEET.

- Test at design pressure:

Fill-up the Swivel with corrosion inhibited water and raise the pressure to the following test pressure:

Design test pressure: 19 bar

Rotate the swivel such as the “stopper 1” is against the “buffer” (see sketch below). Then, rotate the swivel as follow:



-35°, 17.5°, -35°, 17.5°, -35°, +35°, -17.5°, +35°, -17.5°, +35° (Approx. values)

- This shall be repeated 15 times.
- Rotational Velocity: 1 Degree/Sec.



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- Test at low pressure:

Decrease the pressure to the following test pressure:

3.5 bar

The rotation tests at low pressure shall be the same as at the design pressure.

When all tests have been considered successful, the swivel shall be emptied, carefully dried and all bright metal surfaces mentioned in section 5.2 protected.

The swivel shall not be dismantled and shall be carefully stored in its transportation box.

7. **MAXIMUM OVERALL SIZE OF ITEM**

Not applicable.

8. **CERTIFICATION**

8.1 **MATERIAL CERTIFICATION**

The Certification requirements shall be:

EN10204 - 3.2

Inspection Certificates to be issued by the VENDOR and mechanical test to be independently witnessed by a body approved by the CONTRACTOR. Tests required to be carried out by a laboratory independent of the production function.

8.2 **MATERIAL TRACEABILITY**

The Traceability requirements shall be:

LEVEL I: Full traceability

Material and/or component are uniquely identified from original manufacturing source to point of receipt by VENDOR. The VENDOR shall operate a system to enable maintenance of the traceability of each item during construction and throughout its design life.

8.3 **MATERIALS MARKING**

All material shall be round nose die stamped with identification sufficient to assure traceability to the manufacturer, the cast/heat number, grade designation and contract number.



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9. **PREPARATION FOR DELIVERY / MARKING / PACKING**

9.1 **MARKING**

The following indications shall be hard stamped on a identification plate permanently attached to the upper part external shell:

- PURCHASE ORDER number.
- Swivel manufacturer.
- Bearing manufacturer.
- Bearing identification number.
- Swivel type / size and identification number.
- Date of manufacture of bearing and swivel.
- Endorsement by the CLASSIFICATION SOCIETY after final APPROVAL.

9.2 **PACKING AND TRANSPORTATION**

The Central Pipe Units shall be placed horizontally inside a reinforced timber crate and properly secured. The inner body of shell shall be dry to avoid corrosion.

Prior to securing inside the timber crate, the CPU shall be protected against corrosion and dust or water ingress as follows

- Raw machined surfaces shall be sprayed with "TECTYL 506 WD" or equivalent,
- Inlet and outlet flanges shall be closed using plastic or wooden blinds properly secured with temporary bolts and sealed using plastic film.
- Seal gap at the interface between fixed and rotating part shall be sealed by shrink wrap plastic film to avoid dust ingress.

Lifting shall be carried out using two soft slings passed around the rotating part and the fixed part of the CPU respectively. The transportation crate shall allow installation of those slings prior to lifting without any need to interfere with the timber crate.

Inspection release note:

Prior to transportation, the SUPPLIER shall obtain an inspection release note from the PURCHASER.



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10. CONTRACTOR DATA REQUIREMENTS

The CONTRACTOR shall prepare and furnish the equipment documentation including the data identified by the Codes listed below.

AA AB** AC** AD AN AR CB CC CD* CJ CK CM* CO CP* CQ CR* CS CT* CW* DA DB
DJ* DL* DR DS EA EC FC IR* NC SB* TQ* VDB

* Indicates document that shall not be sent to the PURCHASER for APPROVAL, but may be reviewed on site by the PURCHASER'S REPRESENTATIVE.

** Indicates document that shall be submitted with bid.

APPENDIX.A 24" OUTBOARD SWIVEL DATA SHEET

| DATA VALUES | | |
|--|---|--|
| Operating Conditions | <i>Ambient Temperature Range (°C)</i> | -2 to +42 |
| | <i>Product Temperature Range (°C)</i> | 10 to +37.8 |
| | <i>Fluid Product</i> | Crude Oil |
| | <i>Aromatic content</i> | < 25% vol. (occasionally up to 40% vol.) |
| | <i>Sulphur content</i> | < 3.38 wt |
| | <i>Swivel Design Pressure (barg)</i> | 19 |
| | <i>Swivel Design Life (years)</i> | 20 |
| | <i>NACE MR 01-75 requirements applicable</i> | No |
| Swivel Assembly Friction Torque tests | 5000 Nm at Design Pressure | |
| Swivel Assembly Torque Variation | <i>Variations of above torque test values in both tests shall not exceed +/- 10 %</i> | |
| Classification Society | B.V | |

APPENDIX.B MATERIAL DATA SHEET – FORGING

| Specification and material grade | | ASTM A694 Gr F60 | |
|--------------------------------------|--------------------------------------|--|--------------|
| | | Weldable | Non weldable |
| Max. allowable carbon equivalent CEV | | <0.45% | <0.55% |
| Heat treatment | | Normalized, Normalized and Tempered or Quenched and tempered | |
| Minimum Yield | | 415 MPa | |
| Tensile Strength | | 515 MPa | |
| Minimum elongation | | 20% | |
| Hardness requirements | Hardness range | 187 - 235 HB | |
| Toughness requirements | Parent Metal Impact Test Temperature | - 20°C | |
| | Minimum Average Impact Energy | 34 J | |
| | Minimum Individual Impact Energy | 24 J | |