SELECTION, OPERATION AND MAINTENANCE OF ROTARY EQUIPMENT COMPONENTS

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Prepared by

FUNCTIONAL COMMITTEE FOR REVISION OF STANDARDS ON ROTARY EQUIPMENT

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Preamble

Indian petroleum industry is the energy lifeline of the nation and its continuous performance is essential for sovereignty and prosperity of the country. As the industry essentially deals with inherently inflammable substances throughout its value chain – upstream, midstream and downstream – Safety is of paramount importance to this industry as only safe performance at all times can ensure optimum ROI of these national assets and resources including sustainability.

While statutory organizations were in place all along to oversee safety aspects of Indian petroleum industry, Oil Industry Safety Directorate (OISD) was set up in 1986 Ministry of Petroleum and Natural Gas, Government of India as a knowledge centre for formulation of constantly updated world-scale standards for design, layout and operation of various equipment, facility and activities involved in this industry. Moreover, OISD was also given responsibility of monitoring implementation status of these standards through safety audits.

In more than 25 years of its existence, OISD has developed a rigorous, multi-layer, iterative and participative process of development of standards – starting with research by in-house experts and iterating through seeking & validating inputs from all stake-holders – operators, designers, national level knowledge authorities and public at large – with a feedback loop of constant updation based on ground level experience obtained through audits, incident analysis and environment scanning.

The participative process followed in standard formulation has resulted in excellent level of compliance by the industry culminating in a safer environment in the industry. OISD – except in the Upstream Petroleum Sector – is still a regulatory (and not a statutory) body but that has not affected implementation of the OISD standards. It also goes to prove the old adage that self-regulation is the best regulation. The quality and relevance of OISD standards had been further endorsed by their adoption in various statutory rules of the land.

Petroleum industry in India is significantly globalized at present in terms of technology content requiring its operation to keep pace with the relevant world scale standards & practices. This matches the OISD philosophy of continuous improvement keeping pace with the global developments in its target environment. To this end, OISD keeps track of changes through participation as member in large number of international and national level Knowledge Organizations – both in the field of standard development and implementation & monitoring in addition to updation of internal knowledge base through continuous research and application surveillance, thereby ensuring that this OISD Standard, along with all other extant ones, remains relevant, updated and effective on a real time basis in the applicable areas.

Together we strive to achieve NIL incidents in the entire Hydrocarbon Value Chain. This, besides other issues, calls for total engagement from all levels of the stake holder organizations, which we, at OISD, fervently look forward to.

Jai Hind!!!

Executive Director
Oil Industry Safety Directorate
FOREWORD

The Oil Industry in India is more than 100 years old. As such a variety of practices are in vogue because of collaboration/association with different foreign companies and governments. Earlier, standardisation in design philosophies, selection, operating and maintenance practices at a national level were hardly in existence. This, coupled with feed back from some serious accidents that occurred in India and abroad, emphasised the need for the industry to review the existing state of art in designing, selecting, operating and maintaining oil and gas installations.

With this in view, the then Ministry of Petroleum and Natural Gas in 1986 constituted a Safety Council assisted by Oil Industry Safety Directorate (OISD) staffed from within the industry in formulating and implementing a serious of self-regulatory measures aimed at removing obsolescence, standardising and upgrading the existing standards to ensure safer operations. Accordingly OISD constituted a number of functional committees comprising of experts nominated from the industry to draw up standards and guidelines on various subjects.

The present standard on “Selection, Operation and Maintenance of Rotary Equipment Components” has been prepared by the “Functional Committee for Rotary Equipment”. The earlier title “Inspection of Rotary Equipment Components” has been modified by the Functional Committee. This document, based on the accumulated knowledge and experience of industry members and the various national and international codes and practices, is meant to be used as a supplement and not as a replacement for existing codes standards and manufacturer’s recommendations. It is hoped that the provision of this standard, if implemented objectively, may go a long way to improve the safety and reduce accidents in the Oil and Gas Industry. The users of this document are cautioned that no standard can be a substitute for a responsible and experienced engineer. Suggestions are invited from the users after it is put into practice to improve the standard further. Suggestions for amendment, if any, should be addressed to:

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These documents are intended to supplement rather than replace the prevailing statutory requirements.
FUNCTIONAL COMMITTEE FOR
REVISION OF STANDARDS ON ROTARY EQUIPMENT
(Complete Revision : July, 2008)

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# Selection, Operation and Maintenance of Rotary Equipment Components

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1.0 INTRODUCTION

Rotary equipment comprise of a number of components. These components are vital for proper functioning of the equipment. This document covers vital components like Bearings, Couplings and Transmission Belts.

2.0 SCOPE

This document covers the general considerations for Selection, Installation, Commissioning, Operation, Maintenance and Failure Analysis of Bearings, Couplings and Transmission Belts.

3.0 DEFINITIONS

3.1 SHALL
Indicates mandatory requirement

3.2 SHOULD
Indicates recommendation or that which is advised but not mandatory.

4.0 BEARINGS

The following considerations shall be made for selection and installation of bearings:

4.1 SELECTION

4.1.1 Bearing selection shall be done based on relevant equipment standards.

4.1.2 Factors to be considered to ensure safe operation of bearings include:

a) Static and dynamic load capacity
b) Lubrication system adequacy
c) Cooling system adequacy
d) Protection against environment factors like Dust, Moisture, Corrosive Atmosphere, High Temperature etc.
e) Monitoring and Protection provisions in accordance with relevant equipment standards

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4.1.3 Proper selection of lubricant shall be based on operating speed, ambient
temperature, service life and recommendations of equipment manufacturer.
Deviations, if required, shall be taken after due review and approval.

4.2 INSTALLATION

4.2.1 Dimensional tolerances on Shaft and housing shall be as per OEM recommendations

4.2.2 Bearing clearances in case of journal bearings shall be within OEM specified limits.

4.2.3 Installation of the anti-friction bearings shall be done by use of proper tools like
bearing installation kits and induction heaters.

4.2.4 Documented procedures should be in place for installation of bearings.

4.2.5 Proper training shall be imparted to the concerned personnel on the installation of
the bearings.

A sample checklist for installation of Anti Friction Bearing is placed at Annexure-1.

4.3 OPERATION AND MAINTENANCE

4.3.1 Lubricant type and grade used in the equipment shall be displayed on/ near the
equipment so as to avoid any mix up.

4.3.2 Periodic condition monitoring of the bearing and lubricant shall be carried out as per

4.3.3 For pressurized lubrication system in critical equipment, pressure, temperature,
level shall be monitored and alarms & trips shall be provided to protect against
lubrication failure. (Refer OISD-RP-124 for criticality of equipment).

4.3.4 Bearing temperature shall be monitored to assess condition of the bearings as per
OISD-RP-124. Alarms and trips should be in line with the individual equipment
standards.

4.3.5 Periodic checks should be carried out on the cooling water lines, where ever
provided, to ensure proper flow.

4.4 FAILURE ANALYSIS

Bearing failures shall be analyzed to identify causes and corrective actions shall be initiated to
prevent recurrence of such failures as per OISD-RP-126.

5.0 COUPLINGS

5.1 SELECTION

5.1.1 The couplings shall be as per manufacturer’s standard, but shall comply with individual
codes and standards as applicable to that particular class of equipment.

5.1.2 Couplings shall be designed for transient conditions.

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5.1.3 Couplings in equipment used for hydrocarbon service should preferably be of non lubricated Flexible Metallic type.

5.1.4 Couplings shall be provided with a guard capable of withstanding foreseeable external impact.

5.2 INSTALLATION & MAINTENANCE

5.2.1 Installation shall be done in accordance with OEM’s recommended practice.

5.2.2 Proper alignment of equipment shall be done before operation to avoid damage. Equipment alignment shall be within the allowable limits as specified by OEM. Equipment alignment records shall be maintained.

5.2.3 In case of lubricated couplings, periodic preventive checks shall be carried out.

5.2.4 Condition of coupling shall be assessed based on vibration analysis and periodic preventive checks.

5.3 FAILURE ANALYSIS

Coupling failures shall be analyzed to identify causes and corrective actions shall be initiated to prevent recurrence of such failures as per OISD-RP-126.

6.0 TRANSMISSION BELTS

6.1 SELECTION

6.1.1 Belts used in hydrocarbon service shall be Fire Resistant, Anti-Static type and as per BS: 2044.

6.1.2 Belt chords shall be non-metallic type.

6.1.3 A service factor of two shall be considered for belt selection.

6.1.4 In case of multiple V-Belts, matched set or banded belts shall be used.

6.1.5 To prevent accidental human contact, belts shall be provided with proper guards capable of preventing loose material from being sucked in between the belt.

6.2 MAINTENANCE

6.2.1 Belts shall be installed on clean pulleys.

6.2.2 Sheaves, teeth and pulleys shall be inspected for wear, prior to reinstallation.

6.2.3 Where taper lock bushes are used, it shall be inspected for proper alignment before installation of the pulleys.

6.2.4 Alignment of the driver and driven pulleys shall be carried out using appropriate methods, like water level or laser kits.

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6.2.5 Belt tension shall be adjusted by using tools like, belt tension meter as per API 1B. The belt tension measurement is described in Annexure-II.

6.2.6 Belts condition shall be checked periodically.

6.2.7 During storage, belts shall be protected from heat, dust, solvents and any deformation.

7.0 DOCUMENTATION

7.1 All relevant documents shall be maintained.

7.2 Documents may be maintained either in electronic or paper form.

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8.0 REFERENCES

This document refers to the following publications :-

8.1 OISD-RP-124 - Predictive Maintenance Practices

8.2 API 671- Published by the American Petroleum Institute

8.3 Rating life equation from ISO281:1990

8.4 Static Loads from ISO76:1987

8.5 Fits & tolerances from ISO286-2:1988

8.6 API 1B for V-Belts.

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### Annexure - 1

**SAMPLE ASSEMBLY CHECKLIST FOR ANTIFRICTION BEARINGS**

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<th>CHECKS</th>
<th>REMARKS</th>
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<tr>
<td>1</td>
<td>Dimensions of Shaft and Housing w.r.t standard</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Cleanliness of bearing seating area on the shaft and in the housing</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Oil supply and drain ports clean</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Mounting tools available</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Threads clear and without any defects</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Lock washer and locknut in good condition</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Bearings are clean and does not have rust/ polishing marks</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Labyrinth and isolators clean and o-rings if any are in good condition</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Housing vents are clean and threads are tight fitting</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Magnetic plugs is provided are cleaned and reinstalled with proper thread sealant</td>
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Annexure – 2

GUIDELINE FOR BELT TENSION MEASUREMENT

1.0 BELT TENSION
Belts need proper tensioning in order to keep the efficiency of the train and to obtain best life from the belt. The tension on the belt should be optimum and excessive or deficient amount of tension can result in decreased performance levels. A method for checking the tension of the belt is given in this annexure.

2.0 MEASUREMENT DEVICE
It is recommended that a belt tension meter be used for the setting of the belt tension. This is a combination load - deflection device that can provide a readout of both the load applied on the belt and the deflection from a reference point.

3.0 DEFLECTION FOR LOAD
The belt manufacturer provides the optimum deflection for a standard load. This needs to be followed while setting the deflection.

4.0 VEE- BELTS
Normally Vee belts are used as a pair or a matched set.
Step 1 - Set the deflection and load indicators to zero.
Step 2 - At mid point of the belt, press down the meter till the standard load is reached.
Step 3 - Readout the deflection of the belt with the other belt as the reference.
Step 4 - Adjust if necessary and repeat check for other belt.
Step 5 - In case the other belt displays deviation from the standard value, the belt needs to be changed, as the set cannot be considered a matched.

5.0 Timing Belts and Banded Vee Belts
Timing belts and banded vee belts do not have a point of reference. Hence a stretched thread needs to be used in place of Belt 2. This thread needs to be stretched across the two pulleys so as to resemble the second belt.
The method of measurement remains identical.

Note - Timing belts have a different tension value and care should be taken while applying values of tension arbitrarily.

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