**Supporting Knowledge**
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| Lesson Information | |
|---|---|
| **Lesson** | **Centrifugal Pump Rounds** |
| **Target Audience** | **Operations personnel who are responsible for monitoring, troubleshooting, and maintaining equipment to prevent incidents at ExxonMobil facilities.** |
| **Learning Pyramid Stage** | **This lesson is part of the Supporting Knowledge stage of the learning pyramid, bridging the gap between understanding facts and concepts, and applying them in real-world scenarios.**<br><br>**By including practical examples and building essential skills, it prepares learners for field work and prepares them for the next stage of the learning pyramid, the Know How stage.** |
| **Prerequisite Facts and Concepts Knowledge** | **Operators have factual knowledge of how pumps work and how they support ExxonMobil processes.**<br><br>**Operators also have conceptual knowledge of how centrifugal pumps operate, the key components and features of these pumps, and how to identify when a centrifugal pump is operating normally versus abnormally.** |
| **Course Duration** | **60 minutes** |
| **Delivery Method** | **Instructor-led in a classroom or technical training environment.** |

| Instructional Approach and Lesson Support Features | |
|---|---|
| **General Instructional Resources** | **This lesson includes features to support accessibility and enhance learning. These resources promote a user-friendly and engaging learner experience. Support features include:**<br>▪ **Training PowerPoint**<br>▪ **Video or audio clips**<br>▪ **Instructor guide**<br>▪ **Learner workbook with glossary of terms, training content, exercises, etc.** |
| **Lesson Support Features** | **This lesson uses a variety of instructional approaches designed to enhance learning, provide real-world context, and actively engage learners.**<br>**Instructional approaches included in the lesson:**<br>▪ **Interactivity for learner engagement and knowledge retention**<br>▪ **Scenarios for decision-making evaluation**<br>▪ **Gamification and hands-on activities (individual and teams)**<br>▪ **Knowledge checks**<br>▪ **Hands-on task(s)** |

**Commented [NC1]:** Is the right Exxon term?

**Commented [NC2]:** Is there a set time limit? Will this training be coupled with other training? What is the current process for training? Are all aspects of pump operation taught together? Is this module part of a day or day's long training?

**Commented [NC3]:** Verify where will/could training take place?

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| Competency Framework | |
|---|---|
| **Supporting Knowledge Competency Overview** | **Demonstrate knowledge of how to perform inspections and conduct checks on the spare pump, process parameters, mechanical seals, and lubrication systems, including the lube oil quality, oiler, sludge cup, force feeder tube, grease lubrications, and oil mister systems.** |
| **Supporting Knowledge Verifications and Learning Objectives** | **After completing this module, operators will be able to:**<br>▪ **Describe the functions, operations, and monitoring of a seal flush system.**<br>▪ **Explain how to perform inspections on mechanical seals (single seals, dual seals, and gas seals) to check for leakage and to ensure the integrity of the seal between the pump shaft and casing is maintained.**<br>▪ **Describe how to perform lubrication checks to ensure that the system is operating properly, and sufficient lubrication is occurring. Note: These checks include the lube oil, sludge cup, force feed lube, grease lubrication and oil mist, which are segmented into separate checks for training and verification purposes.**<br>▪ **Explain how to check the lube oil quality to determine the condition, and whether water or other contaminants are present.**<br>▪ **Explain how to check the oiler to provide a visual indication of the makeup oil available to the bearing housing and to ensure the oil level in the bearing housing is maintained.**<br>▪ **Explain how to check the sludge cup for contamination.**<br>▪ **Explain how to check the forced feed lube oil system's temperature, pressure, filter differential pressure, and oil reservoir level, and also perform checks on the auxiliary lube oil pump.**<br>▪ **Explain how to perform grease lubrications inspections to ensure proper grease lubrication of the pump and auxiliary equipment and that the grease cup levels are sufficient.**<br>▪ **Explain how to perform oil mister system checks to verify there is oil mist for the pump; check the condition of the oil mist tubing; and drain the snap drains, drain pots, and drain bottles; and dispose of all oil properly.** |
| **Specific Resources** | **• PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps**<br>**• PUM_-200-EN-01-TG-GBL-Operate Centrifugal Pumps**<br>**• UPUM-035K Centrifugal Pump Maintenance**<br>**• UPUM-503-EN-02-LG-GBL-Centrifugal Pump Theory and Operations (Skill Guide).docx** |

**Supporting Knowledge**
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**Structure**

| Lesson Units Overview | | | |
|---|---|---|---|
| **Unit Number** | **Unit Title** | **Description** | **Estimated Duration** |
| **1** | ***Introduction to Centrifugal Pump Rounds*** | **The welcome section introduces learners to the course, outlines its purpose, and sets the tone for an engaging and supportive learning experience.**<br><br>**Topics include:**<br>▪ **Engagement Opener.**<br>▪ **After completing this training module, operators will be able to perform centrifugal pump rounds.** | **5 minutes** |
| **2** | ***Functions and Operations of a Seal Flush System*** | **Seal flush systems are monitored routinely to ensure that adequate seal cooling and flush are present.** | **5 minutes** |
| **3** | ***Perform Inspections on Mechanical Seals*** | **Mechanical seals are checked to ensure that the integrity of the seal between the pump shaft and casing is maintained.** | **5 minutes** |
| **4** | ***Perform Lubrication Checks to Ensure That the System Is Operating Properly*** | **Routine checks of the pump lubrication system should be performed to ensure that the system is operating properly, and that sufficient lubrication is occurring.** | **5 minutes** |
| **5** | ***Check the Lube Oil Quality to Determine the Condition*** | **The lube oil system is routinely checked to ensure that the lube oil is in good condition, without any water or other contaminants in the oil.** | **5 minutes** |
| **6** | ***Check the Oiler to Provide a Visual Indication of the Makeup Oil Available to the Bearing Housing*** | **The oil maintains oil level in the bearing housing and provides visual indication of the makeup oil available to the bearing housing.** | **5 minutes** |

| | | | |
|---|---|---|---|
| **7** | ***Check the Sludge Cup for Contamination*** | **The sludge cup must be checked for contamination.** | **5 minutes** |
| **8** | ***Check the Forced Feed Lube Oil System's Temperature, Pressure, Filter Differential Pressure, and Oil Reservoir Level*** | **The Forced Feed Lube Oil System must be inspected to ensure proper temperature, pressure and oil reservoir level.** | **5 minutes** |
| **9** | ***Perform Grease Lubrications Inspections to Ensure Proper Grease Lubrication of the Pump and Auxiliary Equipment*** | **The following inspections are performed to ensure proper grease lubrication of the pump and auxiliary equipment:**<br>• **Grease cups**<br>• **Grease levels** | **5 minutes** |
| ***10*** | ***Perform Oil Mister System Checks to Verify There is Oil Mist for the Pump*** | **If a pump is equipped with an oil mist system, operators must verify there is oil mist for the pump.** | **10 minutes** |
| ***11*** | ***Summary*** | **Summary of all topics covered in the lesson.** | **5 minutes** |

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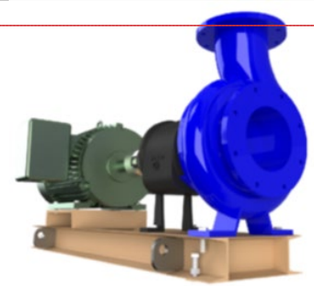
| Unit 1: Introduction – 10 minutes | | | | |
|---|---|---|---|---|
| **Unit 1 Topics: See lessons overview** | | | | |
| **Unit 1 Learning Objective**<br>▪ **Demonstrate knowledge and skills of how to perform inspections and conduct checks on the spare pump, process parameters, mechanical seals, and lubrication systems, including the lube oil quality, oiler, sludge cup, force feeder tube, grease lubrications, and oil mister systems.** | | | | |
| **Glossary Terms**<br>**Centrifugal Pump: A type of pump that creates centrifugal force to increase fluid pressure and move the fluid from the pump inlet to the pump outlet.** | | | | |
| **Topic** | **Subtopic** | **Instructional Strategy and Learning Exercises** | **Visual Overview** | **Content Source** |
| **Introduction** | • Pump Visual and Audible Inspections<br>• Seal System Inspections<br>• Lubrication Inspections | **Training Package, Learning Guide** |  | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 1 section 1)** |
| **Introduction** | **Housekeeping rules** | **Training Package, Learning Guide** | **TBD** | **N/A** |
| **Introduction** | **Learner expectations** | **Training Package, Learning Guide** | **TBD** | **N/A** |
| **Introduction** | **Class agenda** | **Training Package, Learning Guide** | **TBD** | **N/A** |
| **Introduction** | **Safety, Health, and Environmental Concerns** | **Training Package, Learning Guide** | **TBD** | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 2, section 2)** |

**Commented [NC4]:** Should there be an brief overview of the different types of pumps?

**Commented [NC5]:** Not needed if this is coupled with other training modules.

**Commented [NC6]:** Not needed if this is coupled with other training modules.

**Commented [NC7]:** Not needed if this is coupled with other training modules.

**Commented [NC8]:** This section is not in the Competency Framework, but I suggest we add it to give the learner context.

| | | | | |
|---|---|---|---|---|
| **Introduction** | **Centrifugal Pump Operator Rounds Overview** | **Training Package, Learning Guide** | **TBD** | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 3, section 3)** |

## Unit 2: How do I know the functions and operations of a seal flush system and how to monitor these systems? – 15 minutes

**Supporting Knowledge Verification: Describe the functions, operations, and monitoring of a seal flush system.**

**Glossary Terms ?**

| Topic | Subtopic | Instructional Strategy and Learning Exercises | Visual Overview | Content Resource |
|---|---|---|---|---|
| **Seal Flush System** | **Functions** | **Training Package, Learning Guide** | **3D pic/animation of Seal Flush System and components** | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6, section 3.3.2)** |
| **Seal Flush System** | **Operation** | **Training Package, Learning Guide** | **TBD** | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6, section 3.3.2)** |
| **Seal Flush System** | **Monitoring** | **Training Package, Learning Guide** | **TBD** | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6, section 3.3.2), PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6, section 3.3.2), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Seal Inspection section)** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Seal Flush System** | **Knowledge Check** | **1. Give learners various scenarios.**<br>**2. Have learners assess the scenarios for possible signs of seal failure (e.g., is there increased temperature, leakage, vibrations).** | **Seal Flush System graphic with:**<br>• **High temperature**<br>• **No leak**<br>• **No vibration** | **Seal Flush System graphic with:**<br>• **Normal temperature**<br>• **Leak**<br>• **No vibration** | **Seal Flush System graphic with:**<br>• **High temperature**<br>• **No leak**<br>• **Vibration** | **N/A** |

**Unit 3: How do I perform inspections on mechanical seals (single seals, dual seals, and gas seals) to check for leakage and to ensure the integrity of the seal between the pump shaft and casing is maintained? – 10 minutes**

**Supporting Knowledge Verification: Explain how to perform inspections on mechanical seals (single seals, dual seals, and gas seals) to check for leakage and to ensure the integrity of the seal between the pump shaft and casing is maintained.**

**Glossary Terms:**

| Topic | Subtopic | Instructional Strategy and Learning Exercises | Visual Overview | Content Resource |
|---|---|---|---|---|
| **Mechanical Seals** | **Single Seals Inspection** | **Training Package, Learning Guide** | **3D pic/animation of seals** | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6 table), PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6 table), PUM_-200-EN-01-LG-GBL-Operate Centrifugal** |
| **Mechanical Seals** | **Dual Seals Inspection** | **Training Package, Learning Guide** | **TBD** | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6 table), PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6 table), PUM_-200-EN-01-LG-GBL-Operate Centrifugal** |

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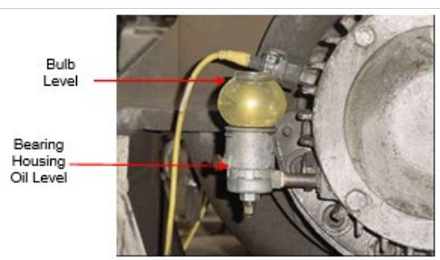
| Topic | Subtopic | Instructional Strategy and Learning Exercises | Visual Overview | Content Resource |
|---|---|---|---|---|
| **Mechanical Seal** | **Gas Seals Inspection** | **Training Package, Learning Guide** | **TBD** | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6 table), PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6 table), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Seal Inspection section)** |
| **Mechanical Seals** | **Check for leakage** | **Training Package, Learning Guide** | **TBD** | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6 table)** |
| **Mechanical Seals** | **Ensure the integrity of the seal between the pump shaft and casing is maintained** | **Training Package, Learning Guide** | **TBD** | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 5, section 3.3.1)** |

| **Unit 4: How do I perform lubrication checks to ensure that the system is operating properly and sufficient lubrication is occurring?** |
|---|
| **Supporting Knowledge Verification: Describe how to perform lubrication checks to ensure that the system is operating properly and sufficient lubrication is occurring. (Note: These checks include the lube oil, sludge cup, force feed lube, grease lubrication and oil mist, which are segmented into separate checks for training and verification purposes.)** |
| **Glossary Terms:** |

| Topic | Subtopic | Instructional Strategy and Learning Exercises | Visual Overview | Content Resource |
|---|---|---|---|---|
| **Lubrication Check** | **Lube oil** | **Training Package, Learning Guide** | **3D pic/animation of where lube checks are done.** | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 9, section 3.4), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Lubrication System Inspection section)** |
| **Lubrication Check** | **Oiler checks** | **Training Package, Learning Guide** |  | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 9, section 3.4.2)** |
| **Lubrication Check** | **Sludge cup** | **Training Package, Learning Guide** | **TBD** | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 11, section 3.4.3)** |

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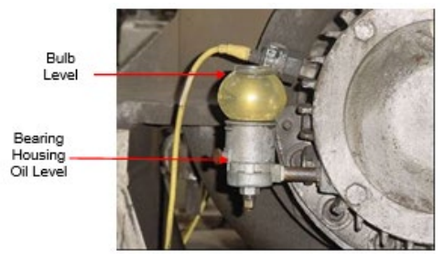
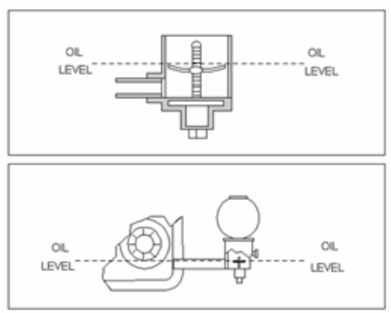
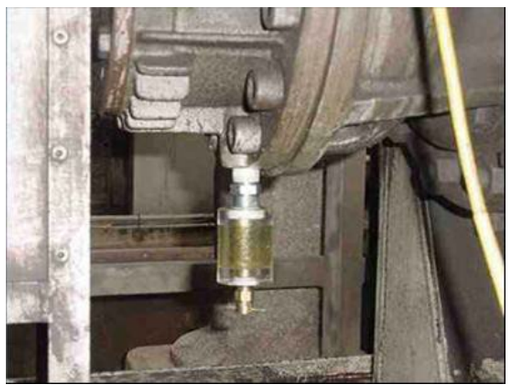
| Topic | Subtopic | Instructional Strategy and Learning Exercises | Visual Overview | Content Resource |
|---|---|---|---|---|
| **Lubrication Check** | **Force feed lube** | **Training Package, Learning Guide** | **TBD** | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 9, section 3.4)** |
| **Lubrication Check** | **Grease lubrication** | **Training Package, Learning Guide** | **TBD** | **Centrifugal Pumps_Training Package (page 9, section 3.4.5)** |
| **Lubrication Check** | **Oil mist** | **Training Package, Learning Guide** | **TBD** | **Centrifugal Pumps_Training Package (page 9, section 3.4.6)** |

| **Unit 5: How do I check the lube oil quality to determine the condition, and whether water or other contaminants are present? – 10 minutes** | | | | | | |
|---|---|---|---|---|---|---|
| **Supporting Knowledge Verification: Explain how to check the lube oil quality to determine the condition, and whether water or other contaminants are present.** | | | | | | |
| **Glossary Terms:** | | | | | | |
| **Topic** | **Subtopic** | **Instructional Strategy and Learning Exercises** | **Visual Overview** | | | **Content Resource** |
| **Checking Lube Oil** | **Determine oil condition** | **Training Package, Learning Guide** | **3D pic/animation of where lube checks are done.** | | | **Centrifugal Pumps_Training Package (page 9, section 3.4.1), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Lubrication System Inspection section)** |
| **Checking Lube Oil** | **Check for water or other contaminants** | **Training Package, Learning Guide** | **TBD** | | | **Centrifugal Pumps_Training Package (page 9, section 3.4.1)** |
| **Checking Lube Oil** | **Knowledge Check** | **Exercise: Provide three pictures of various lubes and have learner determine if it is clean or contaminated. Milky or emulsified oil indicates water contamination. Black lube oil with solid particles or metal filings indicates bearing failure. Dark colored contamination is probably from overheating due to an impending bearing failure.** | **Picture of clean lube** | **Picture of contaminated lube** | **Picture of contaminated lube** | **N/A** |

| **Unit 6: How do I check the oiler to provide a visual indication of the makeup oil available to the bearing housing and to ensure the oil level in the bearing housing is maintained?** | | | | |
|---|---|---|---|---|
| **Supporting Knowledge Verification: Explain how to check the oiler to provide a visual indication of the makeup oil available to the bearing housing and to ensure the oil level in the bearing housing is maintained.** | | | | |
| **Glossary Terms:** | | | | |
| **Topic** | **Subtopic** | **Instructional Strategy and Learning Exercises** | **Visual Overview** | **Content Resource** |
| **Oiler check** | **Visual indication of the makeup oil available to the bearing housing** | **Training Package, Learning Guide** | **3D pic/animation of where oiler checks are done.**   | **Centrifugal Pumps_Training Package (page 10, section 3.4.2), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Lubrication System Inspection section)** |
| **Oiler check** | **Relationship between oil level and the oiler bulb** | **Training Package, Learning Guide** | **Updated graphic with info below.**   | **Centrifugal Pumps_Training Package (page 10, section 3.4.2)** |

| | | | | |
|---|---|---|---|---|
| **Oiler check** | **Check the lubricant level and quality** | **Training Package, Learning Guide** | **TBD** | **Centrifugal Pumps_Training Package (page 11, section 3.4.2)** |

| **Unit 7: How do I check the sludge cup for contamination? – 5 minutes** | | | | |
|---|---|---|---|---|
| **Supporting Knowledge Verification: Explain how to check the sludge cup for contamination.** | | | | |
| **Glossary Terms:** | | | | |
| **Topic** | **Subtopic** | **Instructional Strategy and Learning Exercises** | **Visual Overview** | **Content Resource** |
| **Sludge Cup** | **Check for Contamination** | **Training Package, Learning Guide** | **3D pic/animation of sludge cup location.**  | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 11, section 3.4.3), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Lubrication System Inspection section)** |
| **Sludge Cup** | **Knowledge Check Idea 1** | **Training Package, Learning Guide** | **Visual examples of clean sludge cup and sludge cup with contamination.** | **N/A** |
| **Sludge Cup** | **Knowledge Check Idea 2** | **Training Package, Learning Guide** | **Visual examples of clean sludge and slide with various types of contamination.** | **N/A** |

| **Unit 8: How do I check the forced feed lube oil system's temperature, pressure, filter differential pressure, and oil reservoir level, and also perform checks on the auxiliary lube oil pump?** | | | | |
|---|---|---|---|---|
| **Supporting Knowledge Verification: Explain how to check the forced feed lube oil system's temperature, pressure, filter differential pressure, and oil reservoir level, and also perform checks on the auxiliary lube oil pump.** | | | | |
| **Glossary Terms:** | | | | |
| **Topic** | **Subtopic** | **Instructional Strategy and Learning Exercises** | **Visual Overview** | **Content Resource** |
| **Forced Feed Lube Oil System** | **Check system pressure** | **Training Package, Learning Guide** | **3D pic/animation of Forced Feed Lube Oil System.** | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 12, section 3.4.4), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Lubrication System Inspection section)** |
| **Forced Feed Lube Oil System** | **Check system filter differential pressure** | **Training Package, Learning Guide** | **TBD** | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 12, section 3.4.4)** |
| **Forced Feed Lube Oil System** | **Check system oil reservoir level** | **Training Package, Learning Guide** | **TBD** | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 12, section 3.4.4)** |
| **Forced Feed Lube Oil System** | **Perform checks on the auxiliary lube oil pump** | **Training Package, Learning Guide** | **TBD** | **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 12, section 3.4.4)** |

| **Unit 9: How do I perform grease lubrications inspections to ensure proper grease lubrication of the pump and auxiliary equipment, and that the grease cup levels are sufficient?** |
|---|

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**Supporting Knowledge Verification: Explain how to perform grease lubrications inspections to ensure proper grease lubrication of the pump and auxiliary equipment and that the grease cup levels are sufficient.**

**Glossary Terms:**

| Topic | Subtopic | Instructional Strategy and Learning Exercises | Visual Overview | Content Resource |
|---|---|---|---|---|
| Pump and auxiliary equipment | Ensure proper grease lubrication of the pump | Training Package, Learning Guide | 3D pic/animation of pump and auxiliary equipment needing to be checked. | PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 14, Section 3.4.5) |
| Pump and auxiliary equipment | Ensure proper auxiliary equipment lubrication | Training Package, Learning Guide | TBD | PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 14, Section 3.4.5) |
| Pump and auxiliary equipment | Inspect grease cup level | Training Package, Learning Guide | TBD | PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 14, Section 3.4.5) |
| Pump and auxiliary equipment | Knowledge Check | Training Package, Learning Guide | TBD | N/A |

**Unit 10: How do I perform oil mister system checks to verify there is oil mist for the pump; check the condition of the oil mist tubing; and drain the snap drains, drain pots, and drain bottles; and dispose of all oil properly?**

**Supporting Knowledge Verifications: Explain how to perform oil mister system checks to verify there is oil mist for the pump; check the condition of the oil mist tubing; and drain the snap drains, drain pots, and drain bottles; and dispose of all oil properly.**

**Glossary Terms:**

| Topic | Subtopic | Instructional Strategy and Learning Exercises | Visual Overview | Content Resource |
|---|---|---|---|---|
| Oil Mister System | Verify pump oil mist | Training Package, Learning Guide | 3D pic/animation of Oil Mister System. | PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 14, section 3.4.6), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Lubrication System Inspection section) |
| Oil Mister System | Inspect oil mist tubing | Training Package, Learning Guide | TBD | PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 14, section 3.4.6) |
| Oil Mister System | Drain snap drains | Training Package, Learning Guide | TBD | PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 14, section 3.4.6) |

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| Topic | Subtopic | Instructional Strategy and Learning Exercises | Visual Overview | Content Resource |
|---|---|---|---|---|
| Oil Mister System | Drain the drain bottles | Training Package, Learning Guide | TBD | PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 14, section 3.4.6) |
| Oil Mister System | Dispose of all oil properly | Training Package, Learning Guide | TBD | PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 14, section 3.4.6) |

| Unit 11: Summary | | | | |
|---|---|---|---|---|
| **Supporting Knowledge Verification:** | | | | |
| **Glossary Terms:** | | | | |
| **Topic** | **Subtopic** | **Instructional Strategy and Learning Exercises** | **Visual Overview** | **Content Resource** |
| Summary | Summary of all topics covered in the lesson – all of the above | Training Package, Learning Guide | TBD | PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 38, section 6) |
| Summary | Learner Questions | Discussion | TBD | N/A |
| Summary | Parting Information (if needed) | Discussion, Training Package, Learning Guide | TBD | N/A |

# Centrifugal Pump Glossary of Terms

UPUM-035K Centrifugal Pump Maintenance (in Webcat)

| Term | Definition |
|---|---|
| **Adapter** | Secures the pump body to the driver. |
| **Bearing Frame** | The framework of the bearing housing. |
| **Bearing Housing** | Houses the pump bearings installed on the pump shaft. |
| **Blind Flange** | Aa plate used to close a port, such as the suction and discharge ports of a pump. |
| **Casing** | The pump component that houses the impeller. |
| **Cavitation** | The formation and collapse of gas pockets in a liquid flowing through a pump. |
| **Centerline** | An imaginary line through the center of the shaft. |
| **Centerline-Mounted** | Describes the mounting of a pump on a supporting structure, in which the mounting feet are located on both sides of the casing, in line with the center line of the shaft. |
| **Centrifugal Force** | The forces that draw a rotating body away from its center of rotation. |
| **Centrifugal Pump** | A type of pump that creates centrifugal force to increase fluid pressure and move the fluid from the pump inlet to the pump outlet. |
| **Coupling Element** | Connects the pump to the driver. It consists of a hub on both the driver and the pump, and both hubs are connected by a flexible spacer element. |
| **Coupling Hub** | Connects the pump shaft to the driver by linking with the coupling element. |
| **Dial Indicator** | A device used to measure the axial movement and run out of a pump component relative to the shaft. |
| **Discharge Nozzle** | Let's fluid out of the centrifugal pump. |
| **Down Hole Submersible Pump** | A type of vertical pump that has its pump/driver assembly suspended in the fluid to be pumped. |
| **Driver** | A device, such as an engine or turbine, that drives a pump. |
| **Fretting** | Wear due to cyclical rubbing between two surfaces. |
| **Gasket** | A material that is placed between mating parts to prevent fluid from leaking. |
| **Gland Nut Pause Dictation** | See mechanical seal gland nut. |
| **Horizontal Pump** | A centrifugal pump with a horizontal pump shaft. |
| **Horizontally Split Casting** | A pump casing that is split parallel to the axis of rotation of the pump shaft. |
| **Hub Key** | Keeps the coupling hub in place on the shaft. |

| Term | Definition |
|---|---|
| **Impeller** | The pump component that causes fluid to move radially outward and increases the kinetic energy of the fluid. |
| **Impeller Eye** | The center of the impeller. |
| **Impeller Key** | Holds the impeller in position so that the impeller rotates together with the shaft. |
| **Impeller Locking Nut** | Locks the impeller in place to prevent it from moving laterally over the shaft. |
| **Impeller Spacer** | Maintains the spacing between impellers in a multi stage centrifugal pump. |
| **Impeller Wear Ring** | Reduces leakage between the impeller and the casing. |
| **Lathe** | A machine that holds and rotates a piece of wood or metal about a horizontal axis against a fixed tool that shapes the wood or metal. It may be used to support a pump shaft when determining shaft straightness. |
| **Lock Washer** | Keeps the thrust bearing lock nut from loosening as the shaft rotates. |
| **Mechanical Steel** | Prevents liquid from leaking into the pump interior, while allowing the shaft to rotate freely. |
| **Mechanical Seal Flush Piping** | Delivers cooling fluid to lubricate and cool the mechanical seal of the pump. |
| **Mechanical Seal Gland Nut** | Secures the mechanical steel to the stuffing box cover. |
| **Misalignment** | The incorrect positioning of one thing in relation to another thing. |
| **Multi-Stage Pump** | A pump that has more than one impeller inside its casing. |
| **Net Positive Suction Head** | The fluid pressure at the pump inlet minus the vapor pressure of the liquid. Net positive suction head is also known as NPSH. |
| **NPSH** | See Net Positive Suction Head. |
| **Oil Ring** | Provides lubricating oil to the bearings. |
| **Oil Ring Retainer Pause Dictation** | Keeps the oil ring in place on the shaft. |
| **Over Punk Impeller** | An impeller that is located at one end of the pump shaft. In this case, the bearings are found only at the other end of the shaft. |
| **Pressure Test** | A test used to check for leaks in an offline pump. |
| **Pull Out Assembly** | the group of pump components that can be separated from the casing. |
| **Pump Bowl** | Encloses the impeller in a vertical pump. In multi stage vertical pumps, each impeller is enclosed by individual pump bowls. |
| **Pump Shaft** | See shaft. |
| **Radial Bearing** | Absorbs the radial force acting at right angles to the shaft. |
| **Radial Bearing Cover** | Seals the bearing housing at the impeller side of the shaft. |

| Term | Definition |
|---|---|
| **Radially Split Casing** | A casing that is split perpendicular to the axis of rotation of the shaft. |
| **Rotating Assembly** | The group of rotating pump components |
| **Run Out** | The radial variation from a true circle. |
| **Shaft** | The pump component that transmits motion from the driver to the impeller. |
| **Shaft Spacer** | Increases the distance between the pump and the driver. In certain types of pumps, this makes it possible to remove the impeller while keeping the casing, pipings, and driver in place. |
| **Single Stage Pump** | A pump that has only one impeller inside its casing. |
| **Split Casing** | A pump casing composed of two parts that are fastened together. |
| **Submersible Pump** | a type of vertical pump in which the driver, suction nozzle, and pump bowl assembly are submerged in the liquid being pumped. |
| **Suction Nozzle** | Admits fluid into the side tropical pump. |
| **Sump** | A low-lying area that receives fluid coming from a higher elevation. |
| **Thermal Expansion** | The increase in the dimensions of a body due to an increase in its temperature. |
| **Thermal Stress** | The stress on a body when it is not able to freely undergo thermal expansion. |
| **Thrust Bearing** | Absorbs the axial thrust or force acting on the center line of the shaft. |
| **Thrust Bearing End Cover** | Seals the bearing housing at the power end side of the pump. |
| **Thrust Bearing Locknut** | Keeps the thrust bearing in a place on the pump shaft. |
| **Top Drive Pump** | A type of vertical pump that has its pump assembly suspended in the fluid to be pumped. The pump is connected to the driver by a shaft inside the discharge casing. |
| **Total Indicator Reading** | The reading from a dial indicator, which indicates the run out of the pump shaft |
| **Vertical Pump** | A centrifugal pump with vertical pump shaft |

| Resources/Content Location | Supporting Knowledge Topics/Unit | Supporting Knowledge Verifications | Sub Topics | Key Questions |
|---|---|---|---|---|
| • PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps<br>• PUM_-200-EN-01-TG-GBL-Operate Centrifugal Pumps<br>• UPUM-035K Centrifugal Pump Maintenance<br>• UPUM-503-EN-02-LG-GBL-Centrifugal Pump Theory and Operations (Skill Guide).docx | | | | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6, section 3.3.2) | • How do I know the functions and operations of a seal flush system and how to monitor these systems? | • Describe the functions, operations, and monitoring of a seal flush system. | Seal Flush System Functions | 1.Why is monitoring mechanical seals and seal flush systems important?<br>2.Where is seal leakage usually indicated?<br>3.How would you respond if a seal leak is observed while performing rounds? |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6, section 3.3.2) | | | Seal Flush System Operation | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6, section 3.3.2), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Seal Inspection section) | | | Seal Flush System Monitoring | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6 table), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Seal Inspection section) | • How do I perform inspections on mechanical seals (single seals, dual seals, and gas seals) to check for leakage and to ensure the integrity of the seal between the pump shaft and casing is | • Explain how to perform inspections on mechanical seals (single seals, dual seals, and gas seals) to check for leakage and to ensure the integrity of the seal between the pump shaft and casing is maintained. | Mechanical Seals Single Seals Inspection | 1.Why is monitoring mechanical seals and seal flush systems important?<br>2.Where is seal leakage usually indicated? |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6 table), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Seal Inspection section) | | | Mechanical Seals Dual Seals Inspection | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6 table), PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6 table), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Seal Inspection section) | | | Mechanical Seals Gas Seals Inspection | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6 table) | | | Mechanical Seals Check for leakage | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 5, section 3.3.1) | | | Mechanical Seals Ensure the integrity of the seal between the pump shaft and casing is maintained | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 9, section 3.4), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Lubrication System Inspection section) | • How do I perform lubrication checks to ensure that the system is operating properly and sufficient lubrication is occurring? | • Describe how to perfom lubrication checks to ensure that the system is operating properly and sufficient lubrication is occurring. Note: These checks include the lube oil, sludge cup, force feed lube, grease lubrication and oil mist, which are segmented into separate checks for training and verification purposes. | Lubrication Check: Lube oil | In the field, identify the key components of the lubrication system associated with the pump. |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 9, section 3.4.2) | | | Lubrication Check: Oiler checks | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 11, section 3.4.3) | | | Lubrication Check: Sludge cup | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 9, section 3.4) | | | Lubrication Check: Force feed lube | |
| Centrifugal Pumps_Training Package (page 9, section 3.4.5) | | | Lubrication Check: Grease lubrication | |
| Centrifugal Pumps_Training Package (page 9, section 3.4.6) | | | Lubrication Check: Oil mist | |
| Centrifugal Pumps_Training Package (page 9, section 3.4.1), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Lubrication System Inspection section) | • How do I check the lube oil quality to determine the condition, and whether water or other contaminants are present? | • Explain how to check the lube oil quality to determine the condition, and whether water or other contaminants are present. | Checking Lube Oil: Determine oil condition | |
| Centrifugal Pumps_Training Package (page 9, section 3.4.1) | | | Checking Lube Oil: Check for water or other contaminants | |
| Centrifugal Pumps_Training Package (page 10, section 3.4.2), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Lubrication System Inspection section) | • How do I check the oiler to provide a visual indication of the makeup oil available to the bearing housing and to ensure the oil level in the bearing housing is maintained? | • Explain how to check the oiler to provide a visual indication of the makeup oil available to the bearing housing and to ensure the oil level in the bearing housing is maintained. | Oiler check: Visual indication of the makeup oil available to the bearing housing | |
| Centrifugal Pumps_Training Package (page 10, section 3.4.2) | | | Oiler check: Relationship between oil level and the oiler bulb | |
| Centrifugal Pumps_Training Package (page 11, section 3.4.2) | | | Oiler check: Check the lubricant level and quality | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 11, section 3.4.3), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Lubrication System Inspection section) | • How do I check the sludge cup for contamination? | • Explain how to check the sludge cup for contamination. | Sludge Cup: Check for Contamination | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 12, section 3.4.4), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Lubrication System Inspection section) | • How do I check the forced feed lube oil system's temperature, pressure, filter differential pressure, and oil reservoir level, and also perform checks on the auxiliary lube oil pump? | • Explain how to check the forced feed lube oil system's temperature, pressure, filter differential pressure, and oil reservoir level, and also perform checks on the auxiliary lube oil pump. | Forced Feed Lube Oil System: Check system pressure | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 12, section 3.4.4) | | | Forced Feed Lube Oil System: Check system filter differential | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 12, section 3.4.4) | | | Forced Feed Lube Oil System: Check system oil reservoir level | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 12, section 3.4.4) | | | Forced Feed Lube Oil System: Perform checks on the auxiliary | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 14, Section 3.4.5) | • How do I perform grease lubrications inspections to ensure proper grease lubrication of the pump and auxiliary equipment, | • Explain how to perform grease lubrications inspections to ensure proper grease lubrication of the pump and auxiliary equipment and that the grease cup | Pump and auxiliary equipment: Ensure proper grease lubrication of the pump | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 14, Section 3.4.5) | | | Pump and auxiliary equipment: Ensure proper auxiliary equipment lubrication | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 14, Section 3.4.5) | | | Pump and auxiliary equipment: Inspect Grease cup level | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 14, section 3.4.6), PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide (Page 7, Perform Routine Lubrication System Inspection section) | • How do I perform oil mister system checks to verify there is oil mist for the pump; check the condition of the oil mist tubing; and drain the snap drains, drain pots, and drain bottles; and dispose of | • Explain how to perform oil mister system checks to verify there is oil mist for the pump; check the condition of the oil mist tubing; and drain the snap drains, drain pots, and drain bottles; and dispose of all oil properly. | Oil Mister System: Verify pump oil mist | o What are the indications of abnormal lubrication? |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 14, section 3.4.6) | | | Oil Mister System: Inspect oil mist tubing | o What are the consequences of a cooler leak in the pump forced feed lubrication system? |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 14, section 3.4.6) | | | Oil Mister System: Drain snap drains | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 14, section 3.4.6) | | | Oil Mister System: Drain the drain pots | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 14, section 3.4.6) | | | Oil Mister System: Drain the drain bottles | |
| PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (page 14, section 3.4.6) | | | Oil Mister System: Dispose of all oil properly | |

# Questions to SMEs for Supporting Knowledge Instructor-Led Training Design Document Centrifugal Pump Rounds

*Also see questions within the DD draft.*

| Topic/Unit # | Question | Response |
|---|---|---|
| General | Where will the training take place? At training center? Onsite? | |
| General | Is there a set time limit? | |
| General | Will this training be coupled with other training? | |
| General | What is the current process for training? From the past material, I see that learners were given the workbook prior to the class. Will that be the same process for this module? | |
| General | Are all aspects of pump operation taught together? Or will modules be taught separately? | |
| General | Is this module part of a day or day's long training? Or will it be taught as a stand-alone module? | |
| Missing sections? | During the rounds, should the following be added from to this module?<br>• Perform Spare Pump Checks<br>• Perform Routine Process Parameter Checks.<br>• Perform Routine Bearing Housing Checks.<br>• Perform Routine Driver Checks. | |
| Centrifugal Pump Operator Round learner task demonstrations | I pulled the below info from PUM_-200-EN-01-LG-GBL-Operate Centrifugal Pumps_Learning Guide. Can any of these task demonstration be pulled into the ILT DD and IL training? | |

## Centrifugal Pump Operator Rounds

***Trainee Instructions:***

- You can access and use your local procedures during this verification.
- You will be required to demonstrate that you can perform this task in accordance with local site procedure, ensuring that you can meet all key verification criteria.

- In addition to the demonstration of this task, you will be required to successfully answer a number of key questions about the actions that you are performing.
- You should practice performing this task with your Trainer at least two times prior to performing the verification.

| Task Element Demonstrated | Key Verification Criteria | Key Questions |
|---|---|---|
| Perform Routine Visual Surveillance. | ☐ Perform routine round pump visual surveillance checks.<br>a. Perform valve line up check.<br>b. Perform debris and pump damage inspection.<br>c. Perform ground strap check.<br>d. Perform coupling guard check.<br>e. Perform leak inspection.<br>f. Perform axial movement check.<br>g. Perform spare pump check.<br>h. Record/communicate any abnormal findings per local requirements. | ☐ What are the indications of abnormal pump operation?<br>☐ What are the consequences of unsatisfactory pump operation? |
| Perform Routine Audible Surveillance. | ☐ Perform routine round pump audible surveillance checks.<br>a. Monitor pump for abnormal noises.<br>b. Record/communicate any abnormal findings per local requirements. | ☐ What are typical abnormal noises that may be encountered when performing audible surveillance checks?<br>☐ When performing routine rounds on a centrifugal pump, how is pump cavitation detected?<br>☐ Why is cavitation in centrifugal pumps a problem?<br>☐ How would you respond to a centrifugal pump that is cavitating? |

| Task Element Demonstrated | Key Verification Criteria | Key Questions |
|---|---|---|
| Perform Routine Audible Surveillance. | ☐ Perform routine round pump audible surveillance checks.<br>a. Monitor pump for abnormal noises.<br>b. Record/communicate any abnormal findings per local requirements. | ☐ When performing routine rounds on a centrifugal pump, how is pump loss of prime detected?<br>☐ What actions should the operator take if a pump has lost prime? |
| Perform Spare Pump Checks | ☐ Check spare pump rotation.<br>a. Check that the shutdown pump is not rotating backwards.<br>• Check tachometer<br>• Check for Δ speed from normal speed<br>• If turbine driven, check overspeed trip lever<br>• Check for high pitched whine or other abnormal sounds<br>☐ Verify the spare pump is in the proper standby condition.<br>a. Valve lineups correct<br>b. Auto start switches in proper position if applicable.<br>☐ Test spare pump low pressure cut in.<br>a. Notify console.<br>b. Open valve on solenoid switch to simulate low pressure.<br>c. Verify alarm notification from console.<br>d. Ensure spare pump has started.<br>e. Shutdown spare pump and return to Auto standby mode. | ☐ Why is spare pump rotation checked?<br>☐ Why is the spare pump low pressure cut in test performed?<br>☐ What action should be taken if you suspect that a pump has a leaking check valve |

| Task Element Demonstrated | Key Verification Criteria | Key Questions |
|---|---|---|
| Perform Routine Seal Inspection. | ☐ As applicable, perform routine inspection of the pump seal and associated systems.<br>a. Check for seal leakage.<br>b. Check condition of seal.<br>c. Check seal flush temperature.<br>d. Check external seal flush flow.<br>e. Check condition of seal pot.<br>f. Check seal steam quench flow.<br>g. Check gas seal system.<br>h. Check pump jacket temperature, pressure, and cooling water flow.<br>i. Record/communicate any abnormal findings per local requirements. | ☐ Why is monitoring mechanical seals and seal flush systems important?<br>☐ Where is seal leakage usually indicated?<br>☐ How would you respond if a seal leak is observed while performing rounds? |
| Perform Routine Lubrication System Checks. | ☐ As applicable, perform routine inspection of the following:<br>a. Perform visual check of lube oil quality.<br>b. Check oiler condition.<br>c. Check sludge cup condition.<br>d. Check operation of the forced feed lube oil system.<br>• Oil temperature<br>• Oil pressure<br>• Oil filter differential pressure<br>• Lube oil reservoir level<br>• Auxiliary lube oil pump operation<br>e. Check operation of grease lubrication system.<br>f. Check operation of the oil mist system.<br>g. Record/communicate any abnormal findings per local requirements. | ☐ What are the indications of abnormal lubrication?<br>☐ What are the consequences of a cooler leak in the pump forced feed lubrication system? |

| Task Element Demonstrated | Key Verification Criteria | Key Questions |
|---|---|---|
| Perform Routine Process Parameter Checks. | ☐ As applicable, perform routine round pump monitoring of metered or gauged parameters.<br>a. Check pump discharge pressure.<br>b. Check pump suction pressure.<br>c. Check suction strainer differential pressure.<br>d. Record/communicate any abnormal findings per local requirements. | |
| Perform Routine Bearing Housing Checks. | ☐ As applicable, perform routine checks of bearings and bearing housing as follows:<br>a. Check bearing housing temperature.<br>b. Check bearing housing vibration.<br>c. Record/communicate any abnormal findings per local requirements. | ☐ What can be checked if bearing housing temperature is hotter than normal? |
| Perform Routine Driver Checks. | ☐ As applicable, perform the following routine checks of the pump driver:<br>a. Perform visual check for abnormal conditions.<br>b. Perform driver lubrication checks.<br>c. Check for vibration.<br>d. Check for abnormal noise.<br>e. Check power draw (for electric motors).<br>f. Record/communicate any abnormal findings per local requirements. | |

## Introduction to the Quality Assurance (QA) Checklist (see page 2-3)

The Quality Assurance (QA) Checklist for instructor-led design documents is a structured tool designed to ensure the quality, accuracy, and alignment of the Supporting Knowledge eLearning design document throughout the instructional design process. It reviews key elements such as alignment with the competency framework and adherence to instructional design standards.

### Key Roles and Uses

This checklist can be used by project managers and project manager assistants, quality assurance analysts, instructional designers, and style strategists to ensure alignment with the relevant competency framework and improve the overall quality of the eLearning design.

| Checklist Application by Role | |
|---|---|
| **Role** | **Application** |
| **Quality Assurance (QA) Analysts** | ▪ Apply the checklist to identify and address errors, inconsistencies, and gaps.<br>▪ Verify alignment with the competency framework and adherence to quality standards.<br>▪ Document any issues and suggestions that require input or changes from the instructional designer, style strategist, or subject matter expert (SME). Use the comments feature in MS Word to note these. |
| **Instructional Designers** | ▪ Confirm that the design document aligns with instructional strategies and the competency framework.<br>▪ Use the checklist to ensure design standards are met within each area, including content flow, learning objectives, instructional strategies, and learning exercises.<br>▪ Incorporate suggested changes into the design document based on reviewer feedback using this QA checklist. |
| **Style Strategists** | ▪ Review the design's adherence to style standards such as content clarity and ease. Add suggested changes directly in MS Word.<br>▪ Plan for additional content needs, such as an engaging opener and necessary media assets. |
| **Project Managers and Project** | ▪ Ensure design meets project goals.<br>▪ Confirm alignment with the competency framework and client expectations. |

| | |
|---|---|
| **Manager Assistants** | |

| **Quality Assurance (QA) Checklist** | | |
|---|---|---|
| **Section** | **Checklist Item** | **Verified** |
| **Competency Framework** | The design aligns with and reflects the primary supporting knowledge competency for the module or lesson. | |
| | As verifications are not included in the supporting knowledge stage, learning exercises and knowledge checks are integrated throughout the training design. | |
| | Topics from the competency framework are incorporated and arranged clearly and logically. | |
| | If any topics are suggested for addition or removal following the instructional designer's content analysis against the competency framework, an explanation and plans for client approval are provided. | |
| **Instructional Design** | Learning objectives are clearly defined and measurable and align with the goals of the module or lesson. | |
| | Content is structured in a logical sequence and aligns with curriculum standards. | |
| | Learning exercises and assessments are included to reinforce key concepts. | |
| | Proposed learning exercises and assessments are meaningful and achievable within project constraints. | |
| **Content Quality** | Content is accurate and aligns with project goals. | |
| | Technical content aligns with approved sources (WebCAT, master glossary, legacy content). | |
| | The content source and location details are provided for each topic. For example, PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps_Training Package (Page 6, section 3.3.2) | |
| | Glossary terms and definitions are included (as needed) for each content section and align with the approved definitions in the master glossary. | |
| | Knowledge checks, class exercises, ideas have been proposed. | |
| | Content flows in order of workflow process and steps. | |

| Quality Assurance (QA) Checklist | | |
|---|---|---|
| **Section** | **Checklist Item** | **Yes/No** |
| **Writing, Formatting, and Visual Design** | Placeholder descriptions for analogies, images, videos, or diagrams are appropriate and relevant to the content. | |
| | Tone, language, and technical depth are appropriate for the audience. | |
| | Free from grammatical, spelling, and punctuation errors. | |
| | Free from unnecessary jargon or overly complex language. | |
| | Acronyms are defined. | |
| | Consistent use of terminology, style, and formatting throughout. | |
| | Tables | |
| **Questions to be Asked and Answered** | Use comment feature in Word (or a separate document) to list questions and concerns for SME. | |
| **Final Approval** | Feedback from reviewers has been addressed. | |
| | Free from outstanding issues. | |
| | Ready for SME review. | |

| Element | Guidelines |
|---|---|
| **Facilitator Instruction Table** | [Will complete with style discussed, i.e. Header – Module title, row two slide and slide image and if there is no image instruction, remaining rows – icon and instruction] |
| **Facilitator Instructions** | [Will complete with directions such as italisize instructor speaking note, ask question and look for responses, acknowledge responses, and how and when to use each instruction, etc.] |
| **Accessibility Guidelines** | [Will be provided by developer?] |
| **Version Control** | [Complete with how version control will be done, i.e. footer left-aligned] |

Best


# LESSON TITLE

## EQUIPMENT TRAINING

### Supporting Knowledge

Trainer Guide

1/29/2024

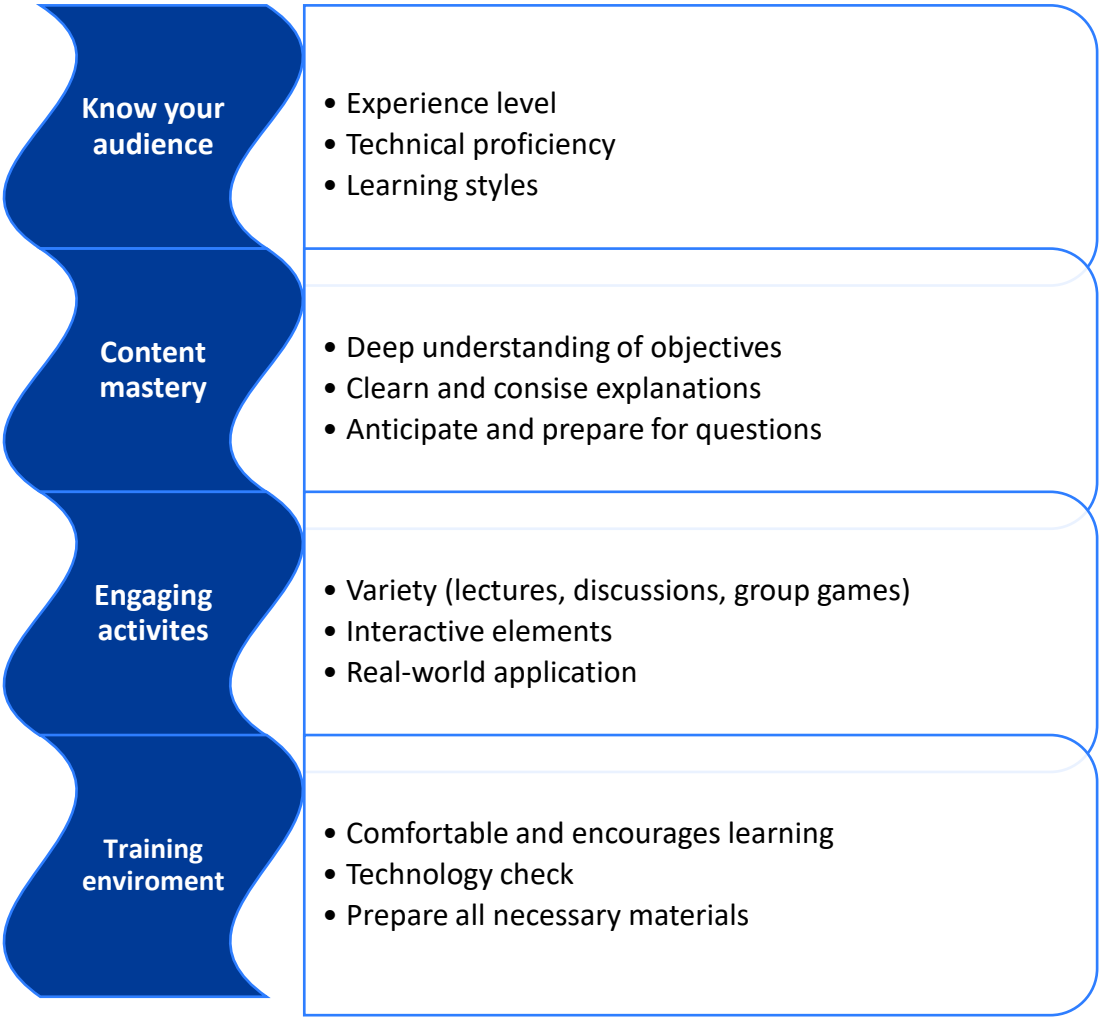
| Lesson Information | |
|---|---|
| **Lesson** | **Centrifugal Pump Rounds** |
| **Target Audience** | **Operations personnel who are responsible for monitoring, troubleshooting, and maintaining equipment to prevent incidents at ExxonMobil facilities.** |
| **Learning Pyramid Stage** | **This lesson is part of the Supporting Knowledge stage of the learning pyramid, bridging the gap between understanding facts and concepts, and applying them in real-world scenarios.**<br><br>**By including practical examples and building essential skills, it prepares learners for field work and prepares them for the next stage of the learning pyramid, the Know How stage.** |
| **Prerequisite Facts and Concepts Knowledge** | **Operators have factual knowledge of how pumps work and how they support ExxonMobil processes.**<br><br>**Operators also have conceptual knowledge of how centrifugal pumps operate, the key components and features of these pumps, and how to identify when a centrifugal pump is operating normally versus abnormally.** |
| **Course Duration** | **60 minutes** |
| **Delivery Method** | **Instructor-led in a classroom or technical training environment.** |
| **Facilitator Materials** | ▪ **Facilitator's guide**<br>▪ **Computer with training presentation (and viewing equipment)**<br>▪ **Pens, pencils, markers, paper**<br>▪ **Name tags/name tents**<br>▪ **Attendance sign-in sheet**<br>▪ **Course evaluation form**<br>▪ **Procedures, checklists** |
| **Participant Materials** | ▪ **Participant workbook**<br>▪ **Procedures, checklists** |

| Instructional Approach and Lesson Support Features | |
|---|---|
| General Instructional Resources | This lesson includes features to support accessibility and enhance learning. These resources promote a user-friendly and engaging learner experience. Support features include:<br>▪ Training PowerPoint<br>▪ Video or audio clips<br>▪ Instructor guide<br>▪ Learner workbook with glossary of terms, training content, exercises, etc. |
| Lesson Support Features | This lesson uses a variety of instructional approaches designed to enhance learning, provide real-world context, and actively engage learners.<br>Instructional approaches included in the lesson:<br>▪ Interactivity for learner engagement and knowledge retention<br>▪ Scenarios for decision-making evaluation<br>▪ Gamification and hands-on activities (individual and teams)<br>▪ Knowledge checks<br>▪ Hands-on task(s) |

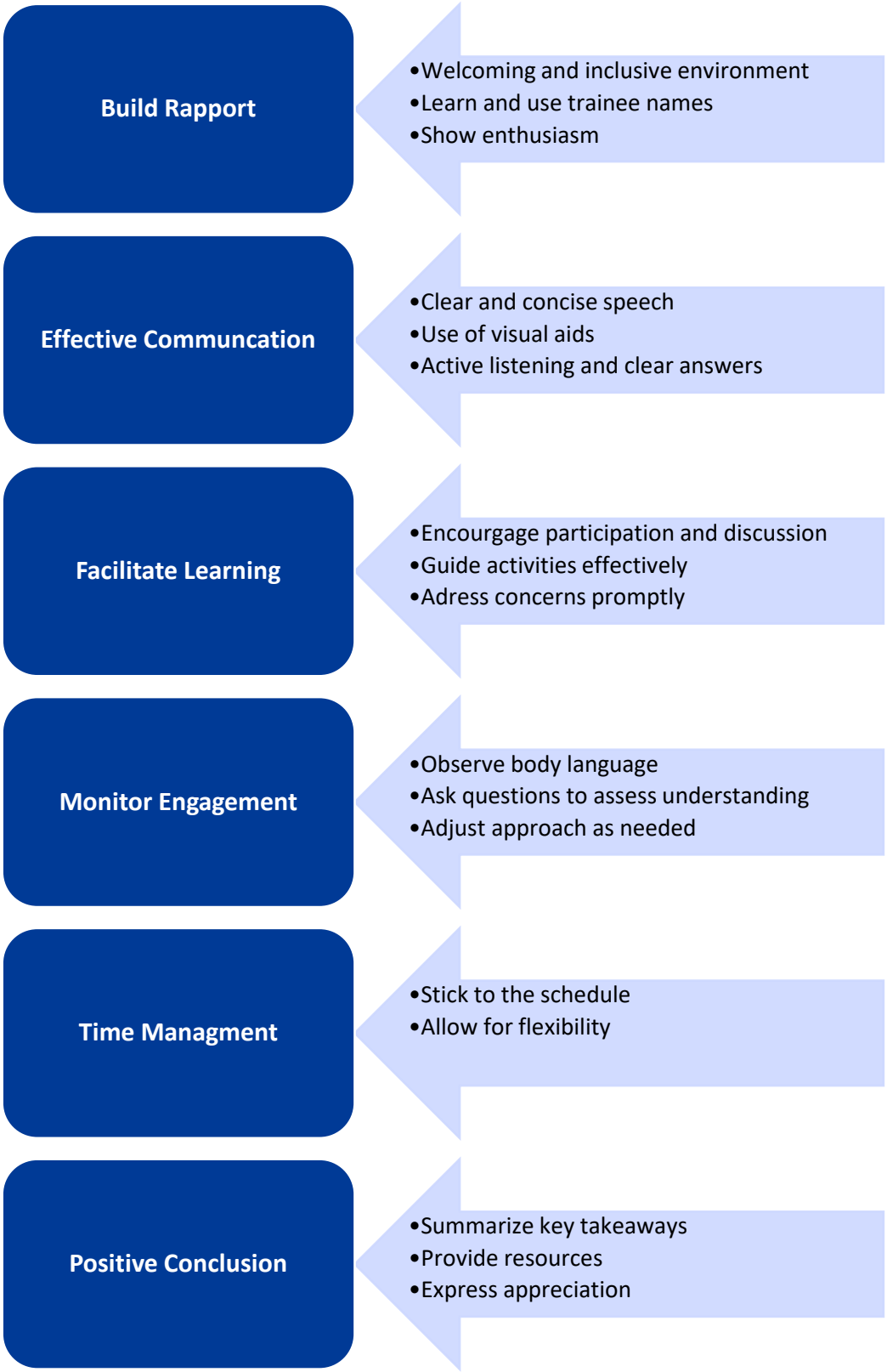
| Competency Framework | |
|---|---|
| Supporting Knowledge Competency Overview | Demonstrate knowledge of how to perform inspections and conduct checks on the spare pump, process parameters, mechanical seals, and lubrication systems, including the lube oil quality, oiler, sludge cup, force feeder tube, grease lubrications, and oil mister systems. |
| Supporting Knowledge Verifications and Learning Objectives | After completing this module, operators will be able to:<br>▪ Describe the functions, operations, and monitoring of a seal flush system.<br>▪ Explain how to perform inspections on mechanical seals (single seals, dual seals, and gas seals) to check for leakage and to ensure the integrity of the seal between the pump shaft and casing is maintained.<br>▪ Describe how to perform lubrication checks to ensure that the system is operating properly, and sufficient lubrication is occurring. Note: These checks include the lube oil, sludge cup, force feed lube, grease lubrication and oil mist, which are segmented into separate checks for training and verification purposes.<br>▪ Explain how to check the lube oil quality to determine the condition, and whether water or other contaminants are present.<br>▪ Explain how to check the oiler to provide a visual indication of the makeup oil available to the bearing housing and to ensure the oil level in the bearing housing is maintained.<br>▪ Explain how to check the sludge cup for contamination.<br>▪ Explain how to check the forced feed lube oil system's temperature, pressure, filter differential pressure, and oil reservoir level, and also perform checks on the auxiliary lube oil pump.<br>▪ Explain how to perform grease lubrications inspections to ensure proper grease lubrication of the pump and auxiliary equipment and that the grease cup levels are sufficient. |

| | |
|---|---|
| | ▪ **Explain how to perform oil mister system checks to verify there is oil mist for the pump; check the condition of the oil mist tubing; and drain the snap drains, drain pots, and drain bottles; and dispose of all oil properly.** |
| **Specific Resources** | • **PUM_-200-EN-01-TP-GBL-Operate Centrifugal Pumps**<br>• **PUM_-200-EN-01-TG-GBL-Operate Centrifugal Pumps**<br>• **UPUM-035K Centrifugal Pump Maintenance**<br>• **UPUM-503-EN-02-LG-GBL-Centrifugal Pump Theory and Operations (Skill Guide).docx** |

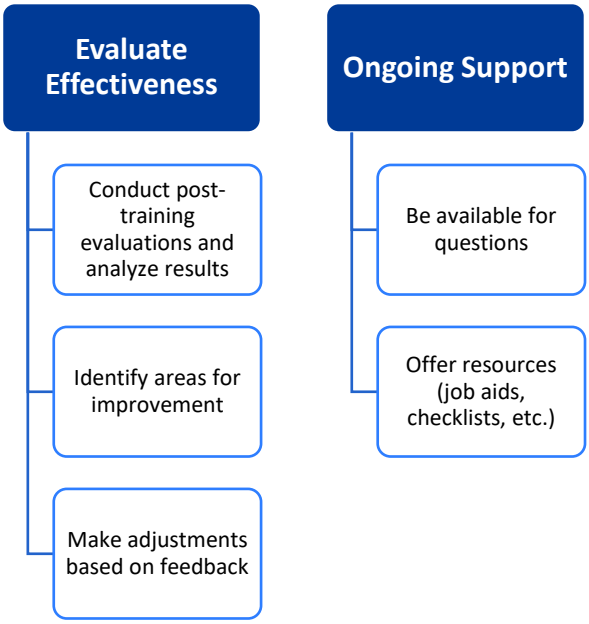
## Tips For Effective Classroom Trainers: Before Training



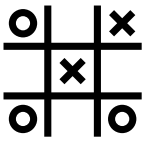
## Tips For Effective Classroom Training: During Training



## Tips For Effective Classroom Training: After Training




| Facilitator's Guide Icons Overview | | | |
|---|---|---|---|
| **SAFETY SHARE** | **SAY** | **EXPLAIN** | **REVIEW** |
| Provide safety tips, lessons, or practices | Deliver concise, impactful information | Provide thorough explanations and context | Facilitate reflection on activities or discussions |
| **ASK** | **DISCUSS** | **REFER** | **DEMONSTRATE** |
| Ask thought-provoking questions | Moderate discussion | Direct participants to key document(s) | Demonstrate behaviors, processes, or tools |
| **EMPHASIZE** | **ACTIVITY** | **IMPORTANT INFORMATION** | **VIDEO or ANIMATION** |
| Emphasize key takeaways | Perform hands-on or interactive activity | Highlight critical info | Show video or equipment amination |

| POLL | GROUP EXERCISE | GAME | REINFORCE |
|---|---|---|---|
|  |  |  |  |
| Poll participants to get feedback and opinions | Perform group hands-on or interactive activity | Facilitate game to assess and very knowledge | Reinforce key ideas and concepts |

| Unit 1: Introduction – 10 minutes | |
|---|---|
| **Facilitator Notes** | **Training strategy Icon (TSI) –** Indicates what learning strategy will be used during the training.<br><br>**Time Allotted** – Displays the length of each section within the moddule. The time allotted is an estimate. Based on your number of participants, be sure to recalculate the length of each activity. Also, you may need to alter an activity and or groupings.<br><br>**Content Points** - Contains the talking points, activity explanation, and questions for each section of the module.<br><br>**Visuals** – this column uses icons to represent the resources or activities used in each section of the module. The following icons appear in this guide. |

| TSI | Time in Minutes | Content Main Points | Training Visual |
|---|---|---|---|
|  | 1 | Welcome and agenda overview | Welcome slide in training PowerPoint.<br>Page 1 in learner workbook. |
|  | 2 | Ask participants XXXX. | N/A |
| | | | |
| | | | |
| | | | |

| Unit 2: XXX – 10 minutes | | | |
|---|---|---|---|
| **TSI** | Time | **Content** Main **Points** | Training Visual |
|  | 1 min | Section topics and learning goals. | Slide XXX in training PowerPoint.<br>Page XXX in learner workbook. |
|  | 1 minute | System components. | 3D pic/animation of XXX System and components. |
| | | | |