OPITO APPROVED STANDARD

Offshore Oil & Gas Industry

Transformation Scheme

Mechanical Program Training Standard
The content of this document was developed by OPITO.

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INTRODUCTION

The Transformation Scheme has been designed to assist the oil and gas industry meet its needs for recruiting core crew technicians. It is intended to deliver a reliable stream of process and maintenance technicians to offset increased demand, natural attrition and redeployment outside the UKCS.

The scheme will attract skilled workers into the industry who have gained knowledge and experience in other industries. They will receive the appropriate training to develop their existing skills and provide a foundation of knowledge and practice which would lead to further training within the industry allowing them to become a skilled worker in the oil and gas industry. The training content has been aligned as far as possible to the underpinning knowledge and understanding for the SVQ Level 2 in Process Engineering Maintenance.

In order for the scheme to be delivered consistently between training sites the OPITO Transformation Program standards were developed. These standards outline the twelve week program and provide the essential delivery criteria to ensure that delegates can apply their core discipline within the industry after completing required safety courses.
SECTION A TRAINING PROGRAM

A.1 Target Group

This mechanical training standard has been developed for skilled workers' who wish to use their prior mechanical maintenance/installation skills in the offshore oil and gas industry.

A.2 Candidate Prior Achievement

Candidates wishing entry into the Transformation Program for Mechanical Training should be an experienced mechanical technician (Industrial/Armed Forces) qualified to N/SVQ Level 2 or 3 or equivalent in Mechanical Maintenance/Installation.

Candidates should have a sound knowledge and understanding of health and safety procedures and practices within the mechanical installation/maintenance industry.
A.3 Training Outcomes

Following a series of explanations, demonstrations and opportunities to practice candidates will be assessed against the standards relating to the following training outcomes.

On completion of this training, candidates will be able to describe the principles of:

Week 1
a) The principles and safe practice of the science and technology which supports hydrocarbon process operations

Week 2
a) The principles and safe practice associated with the safety-critical processing environment in which working and communicating effectively with others is a key part

Week 3
a) Bearing types, applications, maintenance and clearances
b) Dynamic seal types and mechanical seal maintenance

Week 4
a) The principles of mechanical maintenance, process isolations and types of pumps

Week 5
a) Pump maintenance, inspection, clearances & troubleshooting

Week 6
a) Pump removal, reinstallation or rebuilding

Week 7
a) Couplings and alignment of rotating machinery couplings and laser alignment techniques

Week 8
a) Piping systems, bolt tensioning procedures and pressure testing procedures

Week 9
a) Principles of Power Generation Equipment

Week 10
a) Valve identification, maintenance, repair and testing

Week 11
a) Components and faultfinding on the Perkins 4236 diesel engine

Week 12
a) Principles of construction and operation of reciprocating and rotary air compressors

Continued…
A.3 Training Outcomes continued...

On completion of this training, candidates should provide evidence that they have knowledge and understanding of:

Week 1
  a) The science and technology that underpins hydrocarbon exploration and exploitation
  b) The properties and behaviours of hydrocarbons
  c) The science and technology that underpins hydrocarbon movement, storage and processing

Week 2
  a) The safe working practices implemented on oil and gas facilities

Week 3
  a) Bearing removal and measurement of shafts, housings and bearings to determine fit
  b) Installing packings on pumps and removing and lapping seal faces on mechanical seals

Week 4
  a) Preparing and documenting mechanical and electrical isolations

Week 5
  a) Determining pump faults and preparing a performance curve

Week 6
  a) Carrying out a mechanical isolation of process plant pumps including setting the mechanical seal working length

Week 7
  a) Drive coupling alignment with the reverse periphery method or using laser alignment

Week 8
  a) Gasket and flange selection; using clamp couplings and torque wrenches; pressure testing

Week 9
  a) Describe Power Generation Equipment

Week 10
  a) Removing and replacing valves; strip inspection and refurbishment

Week 11
  a) Component removals and replacements on a Perkins 4236 diesel engine

Week 12
  a) Using reciprocating and rotary air compressors
A.4 Training Program

The training program outlined below will assist candidates to meet the stated learning outcomes.

In order to make efficient use of time and ensure effective learning, the three phases of overview, demonstration and practice should be integrated wherever practical. **Full use should be made of visual/audio-visual aids, computer based training, videos and course hand-out materials.** Contents in [Appendix 1](#) must be covered prior to course commencement.

The understanding and practice of **Health and Safety** procedures is an **ESSENTIAL** element of this course and should be an **integral part of the delivery** of ALL course outcomes.

The requirement for an Integrated Safe System of Work process incorporating risk assessments, permits to work and other relevant safety procedures and documentation should be incorporated into all relevant course topics.

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**WEEK 1 INTRODUCTION TO THE OIL & GAS INDUSTRY**

**Instructors will provide an overview of:**

a) The properties and behaviours of hydrocarbons  
b) The exploration and exploitation of hydrocarbons  
c) The movement and storage of hydrocarbons  
d) The processing of hydrocarbons

**Candidates will demonstrate their knowledge and understanding of the practice and application of:**

a) The science and technology that underpins hydrocarbon exploration  
b) The science and technology that underpins hydrocarbon exploitation  
c) The properties and behaviour of hydrocarbons  
d) The science and technology that underpins hydrocarbon movement and storage  
e) The science and technology that underpins hydrocarbon processing

**A combination of 90% theory to 10% practical is suggested for the topics in week 1.**
WEEK 2    HEALTH & SAFETY AND THE WORKING ENVIRONMENT

Instructors will provide an overview of:

a) National/International legislation (e.g. Health & Safety at Work Act, Control of Substances Hazardous to Health, Prevention of Fire Explosion and Emergency Response, Design and Construction Regulations, Safety Case etc)
b) Local rules and regulations (e.g. Safe Operating Procedures)
c) Safe Systems of Work
d) Permit to work systems, safe isolation and other appropriate safety documentation
e) Electrical safety
f) Electricity at Work Regulations and how they are applied in the industry
g) I.E.E. Wiring Regulations and how they operate in the industry
h) Legislation-PFEER, DCR and Safety Case
i) Environmental management (including waste management)
j) Response to emergencies and critical situations
k) How to work effectively with colleagues
l) How to communicate effectively with others
m) Personal Protection Equipment (PPE)

Candidates will demonstrate their knowledge and understanding of the practice and application of:

a) Identify the relevant rules and regulations applicable to the processing working environment
b) How and when to access and refer to the relevant rules and regulations regarding health, safety and the processing working environment
c) How the relevant rules and regulations should be interpreted and applied to the different aspects of processing operations
d) What would be the impact of compliance and non-compliance with the rules and regulations relevant to the processing working environment
e) The principles of establishing and maintaining effective working relationships with colleagues and others
f) The establishment and maintenance of effective working relationships with colleagues and others
g) The principles of effective communication with colleagues and others
h) Effective communication with colleagues and others

A combination of 90% theory to 10% practical is suggested for the topics in week 2.
(1) BEARINGS (TYPES & APPLICATION)

Instructors will provide an overview of:

a) Bearing types and applications  
b) Rolling element bearings  
c) Lubrication requirements  
d) Bearing maintenance fits and clearances including:  
   - Dismounting and mounting procedures plain sliding element  
   - Dismounting and mounting procedures rolling element

Candidates will demonstrate their knowledge and understanding of the practice and application of:

a) Bearing identification  
b) Determining rolling element bearing codes from dimensions  
c) Measurement of shaft, housings and bearings to determine fits  
d) Checking radial clearances of plain and rolling element bearings using DTIs and/or plastigage  
e) Checking axial clearance on thrust bearings including the setting up of axial displacement probes  
f) Measurement of shaft run-out and pump checks that should be carried out prior to installing new bearings  
g) Practical bearing removal and replacement on selected pumps  
h) Practical bearing removal on plain bearings  
i) Identification of failed bearings including spalling, rubbing, uneven wear, electrical arcing, brinelling and wiping of white metal bearings

Continued…
WEEK 3    BEARINGS and MECHANICAL SEALS continued…

(2) DYNAMIC AND MECHANICAL SEALS

Instructors will provide an overview of:

a) Dynamic seals types & principles including:
   - Soft packings
   - Mechanical seals

b) Mechanical seal maintenance including:
   - Troubleshooting
   - Removal
   - Care
   - Installation

Candidates will demonstrate their knowledge and understanding of the practice and application of:

c) Measuring cutting and installing packing on pumps

d) Removal, inspection, lapping seal faces, correct assembly and installation of mechanical seals

e) Pump checks and dimensional checks that are required prior to installing new mechanical seals

A combination of 40% theory to 60% practical is suggested for the topics in Week 3.
WEEK 4 PUMPS AND PROCESS ISOLATIONS

Instructors will provide an overview of:

a) Mechanical maintenance management
b) Process isolations requirements
c) Pump types and applications
d) Appropriate electrical isolations are in place
e) Centrifugal pump maintenance & inspection, clearances & tolerances

Candidates will demonstrate their knowledge and understanding of the practice and application of:

a) Using work permits and job cards
b) Defining work descriptions
c) Creating and recording effective work histories
d) Preparing and documenting isolations both mechanical and electrical
e) Using Risk Assessment documentation (i.e. Identify all the hazards implement suitable and appropriate control measures
f) Checking shafts for bow, out of round and concentricity with housings
g) Checking bearing fits on shafts and in housings
h) Checking wear ring and impeller clearances
i) The use and interpretation of manufacturer’s data charts and tables

A combination of 40% theory to 60% practical is suggested for the topics in week 4.

WEEK 5 PUMP MAINTENANCE AND TROUBLESHOOTING

Instructors will provide an overview of:

a) Pump maintenance & inspection, clearances & tolerances
b) Pump troubleshooting
c) Vibration analysis and data collection

d) Determining pumping faults on plant
e) Determining faults by testing methods
f) Plotting a pump performance curve
g) Preparing a fault finding chart for a pump

100% practical is suggested for the topics in week 5.
WEEK 6   PUMP REMOVAL AND REINSTALLATION

Instructors will provide an overview of:

a) Pump removal and re-installation including:
   - Removal
   - Stripping & inspecting
   - Fits & clearances
   - Rebuilding
   - Commission & testing

Candidates will demonstrate their knowledge and understanding of the practice and application of:

a) Raising a work permit
b) Working alone or as part of a two man team
c) Identify all hazards and implement suitable and appropriate control measures
d) Carrying out a mechanical isolation of process plant pumps
e) Assessing the condition of the pump
f) Rebuilding the pump
g) Setting the mechanical seal working length
h) Reinstalling and commissioning the pump

Candidates to prepare a report on:

a) The condition of the pump and rebuilding the pump
b) Final acceptance of the work

100% practical is suggested for the topics in week 6.
WEEK 7  ROTATING MACHINERY, COUPLINGS AND DRIVES

Instructors will provide an overview of:

a) Rotating machinery couplings & drives alignment.
b) Rotating machinery alignment (reverse periphery)
c) Laser alignment techniques
d) Reverse alignment using DTI's (clock gauges)

Candidates will demonstrate their knowledge and understanding of the practice and application of:

a) Removal and replacement of drive couplings, hubs, drive belts & pulleys*
b) Alignment using the reverse periphery method (offshore standard)
c) Cutting and preparing shims
d) Use of Optalign laser alignment kit (Pruftechnic)

A combination of 20% theory to 80% practical is suggested for the topics in week 7.
WEEK 8 PIPING SYSTEMS & PRESSURE TESTING

(1) PIPING SYSTEMS

Instructors will provide an overview of:

a) Piping systems including:
   - Materials
   - Sizes & pressure rating
   - Joining methods & procedures
   - Dismantling and assembly procedures
   - Reading and interpreting P&IDs

b) Bolt tensioning procedures for safety critical applications such as:
   - Torque loading
   - Hydraulic tensioning
   - Flange break management

Candidates will demonstrate their knowledge and understanding of the practice and application of:

a) Use of P&IDs and documentation (including identifying line numbers, joint/bolt specifications from the piping specifications etc)

b) Dismantling and assembly piping procedures
c) Identification of materials
d) Gasket selection
e) Identification of plant for RF flanges
f) Using fibre & spiral wound gaskets
g) Using piping trainer for RTJ flanges
h) Using clamp couplings
i) Bolt tensioning using torque wrenches and hydraulic torque wrenches
j) Interpreting data tables and applying appropriate bolt tensions to a selection of flanged connections

(2) PRESSURE TESTING

Instructors will provide an overview of:

a) Pressure testing procedures

b) Health & Safety issues associated with pressure testing

Candidates will demonstrate their knowledge and understanding of the practice and application of:

c) Pressure testing

A combination of 20% theory to 80% practical is suggested for topics in week 8.
WEEK 9  POWER GENERATION EQUIPMENT

Instructors will provide an overview of:

a) The general principles of operation of turbines
b) The main differences between heavy industrial and aero-derivative engines

100% theory is suggested for topics in week 9.

WEEK 10  VALVE MAINTENANCE AND TESTING

Instructors will provide an overview of:

a) Valve identification including:
   - Types
   - Applications
   - Troubleshooting
   - Repair
b) Valve maintenance, repair & testing including relief valves
c) PSV testing (use of test specification and acceptance criteria API527 and ASME UG136)

Candidates will demonstrate their knowledge and understanding of the practice and application of:

a) Removal and replacement of valve from plant; strip inspection and refurbishment
b) Raising appropriate permits
c) Stripping and inspecting, and overhauling as necessary, 3 different types of valves (to include 1 relief valve)
d) Recovering damaged seats & disks by lapping

A combination of 10% theory to 90% practical is suggested for topics in week 10.
# WEEK 11  DIESEL ENGINES

**Instructors will provide an overview of:**

- The Perkins 4236 diesel engine including:
  - The principles of operation of a diesel engine (including firing sequence and timing sequence)
  - Component removals and replacement
  - First line servicing procedures
  - Fault finding

**Candidates will demonstrate their knowledge and understanding of the practice and application of:**

- Injector removal, testing and reinstallation
- Fuel pump removal, reinstallation and timing adjustment
- Water pump removal & replacement
- Cylinder head removal/replacement and tappet adjustment
- Fuel, oil & air filter replacements
- Bleeding the fuel system
- Changing the oil
- Drive belt tensioning
- Establishing coolant concentration and levels
- Checking coolant system for leaks
- Servicing the battery
- Diagnosing starter problems
- Battery cranking checks
- Diagnosing starter solenoid failure
- Dealing with air in the fuel lines
- Fuel lift pump failure

A combination of 20% theory to 80% practical is suggested for the topics in week 11.
WEEK 12  RECIROCATING AND ROTARY AIR COMPRESSORS

Instructors will provide an overview of:
   a) Air compressor types including:
      - principles of operation and construction
      - dismantling, inspection and assembly procedures
      - different seal types (wet seal oil systems and dry gas seals)

Candidates will demonstrate their knowledge and understanding of the practice and application of:
   a) Using reciprocating and rotary air compressors
   b) Using the Broomwade 6010E
   c) Preparing a commissioning checklist and performing all the operations to re-commission 6010Es

A combination of 20% theory to 80% practical is suggested for the topics in Week 12.
A.5 Duration of Training

The Transformation Program Electrical training has a duration of 12 weeks.

The total training day includes:

- contact time
- refreshment and meal breaks
- travel between training sites where applicable

Contact time for candidates should not run consecutively for more than 2 hours without a refreshment break. The total contact time per day shall not exceed 8 hours and the total training day shall not exceed 10 hours.

A.6 Assessment

Candidates attending this training and assessment program will be given a series of explanations and demonstrations which will identify what they are expected to know and do.

Following the theory and demonstration elements there will be written examinations and practical tests allowing candidates to demonstrate their knowledge and understanding of the requirements for the offshore electrician’s role.

Assessments should be carried out over the duration of the course and the total assessment time should not be more than 20% of the entire contact time allocation for the program.

All assessments should be conducted under controlled and supervised conditions. Training providers should have a policy and procedure in place for dealing with persons not meeting the stated learning outcomes.
SECTION B RESOURCES

B.1 Staff

In order for a training program to be delivered successfully it is necessary to have appropriate people in presenting and supporting roles.

Training staff will:

- Have appropriate knowledge & experience
- Be trained in instructional/assessment techniques and/or have proven instructing/teaching experience
- Be included in an ongoing training and development program, which ensures they are aware and knowledgeable of all changes to legislation and industry requirements

B.2 Trainer/Candidate Ratio

The following ratios show the maximum number of candidates that should be taught by one instructor in the different aspects of the course.

The ratio shown for theory sessions indicates the maximum number of candidates that should attend the course in any one session.

Theory

| 1 : 12 |

Demonstrations

| 1 : 12 |

B.3 Facilities

To ensure proper presentation and demonstration the training provider should provide a work space that will not be used simultaneously for any other activity and which includes:

Theory training area(s) with sufficient room to allow candidates to participate fully in group theory or syndicate paper exercises. Each candidate should be afforded ample space to be comfortable when carrying out theoretical exercises.

Practical training area(s) with adequate floor space and work tops for each candidate to participate fully in practical demonstrations and exercises.

Safety Requirements: it is the responsibility of the training provider to ensure that the health and safety of candidates, staff and other personnel is maintained at all times.
B.4 Equipment & Reference Material

The following equipment and reference material is required to meet the stated content of the training course.

- Examples of a risk assessment, work permits, job cards, manufacturer’s data cards and tables
- Designated PowerPoint presentations
- Variety of bearings and shafts, lubrication and measuring devices
- Soft packings for bearings
- Mechanical seals for bearings
- Variety of non-running pumps
- Optalign (laser alignment kit)
- Variety of gaskets, flanges and clamp couplings
- Torque wrench
- Hydraulic torque wrench
- Pressure testing equipment
- Three different types of valves (including one relief valve)
- Valve test kit
- Valve repair materials
- Perkins 4236 diesel engines
- Reciprocating air compressors
- Rotary air compressor
- Broomwade 6010E

Please note: Due to the variety of forms, records, plans, schedules etc. used offshore the examples used for training purposes may differ from those found onsite. Training examples should represent the range of documents available and should be as typical and current as possible.

All equipment must be maintained, and where appropriate, inspected and tested in accordance with current standards/legislation.
B.5 Registration and Certification

Successful candidates completing the 12 week course will be issued with an OPITO endorsed certificate for the Transformation Scheme – Mechanical Program. The issue of a certificate indicates that the delegate has achieved a level of competence to enable him/her to become an offshore mechanical technician under supervision for further installation specific training and development.

The issue of the certificate indicates that the candidate has achieved the level of training as defined by the oil and gas industry and approved by OPITO. The details of each delegate will be registered on Vantage, the industry’s central recording data base.

It is the responsibility of the training provider to issue the delegates with a certificate containing the following:

- Establishment Name
- Full OPITO Course Title & registration Code
- Delegate’s Name
- Course Dates
- Unique Certificate Number (UCN) – Refer to OPITO UCN Guidance doc. for details
- Itemised Module Titles
- Establishment Signatory

Each individual attending any OPITO approved course must complete a central register form. The forms must be returned by the training establishment to OPITO within one week of the training delivery.

Please note: New training providers (to OPITO) will be required to send both the original (paper) registration forms, and the electronic registration until notified otherwise by Central Register.
Appendix 1 OPITO Information

The topics listed below are to be delivered as part of the introduction to this course and included in the Lesson Plans/Instructor guides/Exercise Plans. Additional introduction topics may include training centre layout and alarms, emergency actions, first aid and domestic arrangements.

Mandatory OPITO Information:

a) Medical Fitness
b) Certification Periods
c) CR/Vantage (provided by OPITO)
d) OPITO Customer Service Statement (provided by OPITO)
e) The roles of employers and training providers (provided by OPITO)
f) What is OPITO’s role in industry? (provided by OPITO)
g) Current Global Network of training providers (provided by OPITO)
h) Emergency Response Framework (provided by OPITO – applicable for ER Training Providers)