VAAL UNIVERSITY OF TECHNOLOGY
FACULTY OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING

EXPERIENTIAL LEARNING

To fulfil the requirements of the National Diploma, a student must complete at least one year (52 weeks) of applicable experiential learning under the supervision of a qualified mentor, preferably during the second year, i.e. after completing the academical components S1 and S2 at the University.
The ideal is to give the student practical training in as many aspects related to Mechanical Engineering as possible. **This would imply exposure to at least the fundamental and core learning listed below. From the core learning 4 of the 5 topics must be covered.**

***** **Proposed P1 Training**
****** **Proposed P2 Training**

FUNDAMENTAL LEARNING

1 SAFETY MEASURES*

The main purpose of safety measures is to know the general safety condition of the plant or mine or factory which will include:

- Attending safety meetings;
- Have an understanding of the OHS Act as applied on the plant , factory or mine;
- NOSA course is recommended;
- Accompanying the Safety Officer once or twice on safety inspections.

2 FITTING*

2.1 Trained to handle the basic hand tools like:
Hammers, chisels, files, hack saw, measuring instruments, etc.
2.2 Trained to do lay-out procedures of parts to be cut, drilled or machined.
2.3 Trained to fit different types of keys.
2.4 Trained to do precise drilling like a five-hole flange.

3 MACHINING*

3.1 Basic Turning

Trained to do the following procedures on a centre lathe:

3.1.1 Parallel cutting;
3.1.2 Cross cutting;
3.1.3 Taper cutting;
3.1.4 Hole boring with the aid of a boring bar;
3.1.5 Drilling;
3.1.6 Screw thread cutting;
3.1.7 Turning with the aid of a driving plate;
3.1.8 Machining of long shaft by using a steady;
3.1.9 Off-centre turning with the aid of a four jaw chuck.

3.2 Basic Milling

The LT should get training in the following aspects of milling machines and operations:

- The use of vertical and horizontal milling machines;
- Various operations on milling machines;
- Identification and use of milling cutters;
- Workholding;
- The use of the dividing head;
- The relationship between working speed and tool life.

4 BASIC WELDING*

Practical exposure to the following welding processes:

Arc welding

- Flat and vertical welding
- Ratio between current and material thickness
- Electrode selection.

Gas welding

- Using metal fillers
- Brasing
- Flame cutting.

Limited exposure to TIG (Tungsten Inhert Gas) and MIG (Metal Inhert Gas) welding, with special reference to welding of metals such as aluminium, stainless steel, copper and brass.

5 INTERPRETATION OF TECHNICAL DRAWINGS*

Practical exposure to the following aspects of technical drawings:

- Orthographic projection.
- Development and interpenetration.
- Assembly drawings
- Tolerance and machining symbols
- Sectional views of assemblies of machine parts and castings

6 BEARINGS AND LUBRICATION*

The Learner Technician (LT) must be exposed to bearing fitting and bearing failure. The Learner Technician must also know the types of lubricants used on the plant.

7 PLANNING SYSTEMS**

The purpose is to plan a job in the plant and oversee the execution of the job and then write a report.

8 MAINTENANCE AND FAULT FINDING**

The LT must work with the maintenance planning division and also spend some time on an actual maintenance job. Planning and executing of a maintenance job (See 9) is recommended.

9 PROJECT WORK**

The LT must be exposed to at least one project. He must also write this project in the correct format as supplied in the "Project Report Guidelines for Experiential learning" supplied to the student.

CORE LEARNING

MAINTENANCE & ELECTROMECHANICAL

1 ALIGNMENT OF MECHANICAL SYSTEMS*

Trained to align for instance the following mechanical systems:

1.1 Motor to pump;
1.2 Motor to gearbox.

The above should be carried out by means of feeler gauges, dial test indicators and if possible using laser technology.

2 ELECTRICAL SYSTEMS*

The purpose is to give the mechanical LT some insight of the electrical side of the plant. A short course on the basic electrical systems used is recommended. The LT can then work with the electrical technician for a short period doing fault tracing.

3 ROTARY EQUIPMENT*

3.1 Pumps

Trained to distinguish between maintenance and fault tracing on the following types of pumps:

3.1.1 Single stage centrifugal pumps;
3.1.2 Multi-stage pumps;
3.1.3 Pumps for handling slurry (optional);

The training should include mechanical seals, and the student must at least be present at a complete overall of the above pumps.

3.2 Compressors

3.2.1 Identification of different types of compressors:

- Axial flow
- Radial flow
- Reciprocating
- Roots
- Vane
- Single and multi-stage.

3.2.2 Identification of rotors:

- Radial axial tangential
- Blade directions.

3.2.3 Application of technical data:

- Performance characteristics: pressure ratio, mass flow
- Power required, valves used, type of drive and lubricant used in the compressor.

3.2.4 Dismantling and assembly of a compressor

Identification of various parts
Measurement for wear and tear
Problems tracing.

3.2.5 Installation and commissioning of a compressor

4 BOILERS/PRESSURE VESSELS**

The LT must work with the boiler department. He must do inspections, fault tracing and if possible work with the inspection panel during the 2,5 yearly compulsory inspection. He must also help prepare the boiler for inspection and testing.

5 CONDITION MONITORING**

5.1 Vibration monitoring
5.1.1 Identify the vibration monitoring methods used in that company.
5.1.2 Obtain hands on experience with the most common methods used, by taking some vibration readings.
5.1.3 Study vibration charts recorded by the company and know how to identify a failure from the chart.
5.2 Oil analyses
5.2.1 Identify the methods of oil analyses used by the company, if the company performs their own oil analyses.
5.2.2 Obtain hands on experience with the most common methods used, by analysing oil samples.
5.2.3 Study oil analyses charts recorded by the company or obtained from contracting oil analyses companies. Learn how to identify a bad oil sample.
5.2.4 Identify the sampling technique used by the company.

Students can be asked to write a report on there findings with respect to the methods used in vibration monitoring and oil analyses.
Students must state the advantages and disadvantages of the methods used.
Students must always be asked to scrutinise the methods used and give their recommendations.

DESIGN

1 ROTARY EQUIPMENT*

1.1 Pumps

Trained to distinguish between maintenance and fault tracing on the following types of pumps:
1.1.1 Single stage centrifugal pumps;
1.1.2 Multi-stage pumps;
1.1.3 Pumps for handling slurry (optional);

The training should include mechanical seals, and the student must at least be present at a complete overall of the above pumps.

1.2 Compressors

1.2.1 Identification of different types of compressors:

- Axial flow
- Radial flow
- Reciprocating

- Roots
- Vane
- Single and multi-stage.

1.2.2 Identification of rotors:

- Radial axial tangential
- Blade directions.

1.2.3 Application of technical data:

- Performance characteristics: pressure ratio, mass flow
- Power required, valves used, type of drive and lubricant used in the compressor.

1.2.4 Dismantling and assembly of a compressor

- Identification of various parts
- Measurement for wear and tear
- Problems tracing.

1.2.5 Installation and commissioning of a compressor

2 VALVES AND SAFETY VALVES*

The purpose is to give the LT an insight into the different valves used in the plant. How to test valves and the method of replacing valves.

3 HEAT EXCHANGERS**

3.1 The LT must be exposed to different types of heat exchangers.
3.2 The LT must take part or supervise the following:

- The dismantling and assembly of a heat exchanger
- Identification of various parts
- Measurement for wear and tear
- Cleaning of the heat exchanger
- Tracing of problems
- Installation and commissioning.

4 PRESSURIZED EQUIPMENT**

Boilers/Pressure Vessels/Compressors

The LT must work with the boiler department. He must do inspections, fault tracing and if possible work with the inspection panel during the 2,5 yearly compulsory inspection. He must also help prepare the boiler for inspection and testing.

5 MATERIAL SELECTION*

- Physical, Mechanical & Thermal properties
- Materials selction process:
  - Analysis of material requirements;
  - Screening of candidate materials;
  - Selection of candidate materials;
  - Final selection.
- Sources of information on material Properties.
- Economics of materials:
  - Cost vs. Performance;
  - Failure analysis.

  (Eng. Design; George Dieter – ISBN –007-066265-7)

MANUFACTURING

1 QUALITY CONTROL TECHNIQUES*

- Strategic quality management.
- Organisation for quality.
- Control of quality.
- Quality assurance.
- Sample selection.
- Acceptance sampling.
- Assessment of quality.

2 PRODUCTION MANAGEMENT**

- Production perspectives.
- Production planning & control
- Material management.
- Materials requirement planning.
- Scheduling of process operations.
- Line balancing.

3 BUDGET CONTROL**

- Elements of cost.
- Methods of valuing material issues.
- Depreciation & obsolescence.
- Cost control accounts.
- Reconciliation of cost and financial accounts.
- Types of costing.
- Budgetary control.
- Profitability of new projects.

4 MATERIALS HANDLING*

- Elementary flow system.
- Material, equipment, people.
- Handling systems: Types, designs, constructing, evaluation.
- Materials handling problems.

5 INVENTORY SYSTEMS*

- Reasons for inventory.
- Objectives of inventory.
- Different types of inventory.
- Inventory models.

ELECTIVE LEARNING

1 PNEUMATICS AND HYDRAULICS

Trained to distinguish between and know the applications of the following hydraulic or pneumatic circuit components:

1.1 Pumps
1.2 Motors
1.3 Actuators
1.4 Accumulators
1.1 Filters
1.6 Reservoir
1.7 Heat exchangers
1.8 Seals
1.9 Different types of fluid.

Trained in fault tracing on systems.

2 VIBRATION ANALYSIS, MEASUREMENT AND BALANCING

2.1 Vibration Detection (on-line)
Vibration Analysis (diagnosis)
Vibration Correction (balancing on balancing machine)
Case Histories.

2.2 Areas that need attention (practical approach)
- What is vibration?
- What causes vibration?
- Characteristics of vibration: Frequency, displacement, velocity, acceleration, phase
- How much vibration is too much?

2.3 Equipment
FFT-analysers
Transducers - pick-ups (accelerometers) etc.
Balancing machines - types of unbalance and balance problems - single plane, etc.
Predictive maintenance (vibration) program.

3 PROPULSION OF MECHANICAL SYSTEMS

Trained to understand and maintain the following methods of propulsion:

3.1 V-belt drives
3.2 Chain drives
3.3 Fluid couplings
3.4 Braking systems.

4 VALVES AND SAFETY VALVES

The purpose is to give the LT an insight into the different valves used in the plant. How to test valves and the method of replacing valves.

5 WATER TREATMENT

The LT must work with the water treatment department. The main purpose is to know what type of water is used in the different sections, the re-use of water and the type of pumps used in the sections.

6 RIGGING

- Wire rope construction.
- Types of rope.
- Tensile strenght.
- Tolerances.
- Torque in ropes.
- Handling and maintenance of ropes.

7 ADVANCED ELECTRICAL SYSTEMS

- Cables & overhead lines.
- Transformers.
- Three phase induction motors.
- Synchronous machines
- Lighting.
- Various three phase systems.

8 SUPERVISION

It is recommended that the LT work with the foreman or supervisor towards the end of his 2nd semester of in-service-training and also do supervision work.

9 MATERIAL SELECTION

- Physical, Mechanical & Thermal properties
- Materials selction process:
  - Analysis of material requirements;
  - Screening of candidate materials;
  - Selection of candidate materials;
  - Final selection.
- Sources of information on material Properties.
- Economics of materials:
  - Cost vs. Performance;
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a The dismantling and assembly of a heat exchanger
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e Tracing of problems
f Installation and commissioning.

11 NON-DESTRUCTIVE EXAMINATION/TESTING

The LT should be exposed to both destructive and non-destructive testing.

Destructive Testing:

- Tension test.
- Torsion test.
- Hardness; Fatigue; Creep and stress rupture.
- Brittle fracture & Impact testing.

Non-destructive Testing:

- Surface & Sub-surface defects.
- Dye-penetrant testing.
- Magnetic particle testing.
- Eddy current testing.
- Ultrasonic testing.
- Radiographic testing.