CERTIFICATE IV IN ENGINEERING
(FLUID POWER)
Student Workbook 2
Engineering, Mechanical and Electrical

ENG708
MEM18011C

Certificate IV in Engineering (Fluid Power)

Student Workbook 2
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Introduction

This curriculum support material has been designed to provide the student with the knowledge and skills to achieve MEM18011C Shut down and isolate machine/equipment. This unit introduces the tagging and isolation procedures used in the general Fitting and Machining/Mechanical Fitting areas.

In working through this workbook, you will become knowledgeable about the tagging and isolating methods commonly used in manufacturing and engineering and how to correctly prepare equipment for servicing.
Occupational health and safety

The Occupational Health and Safety Act sets out regulations which you must follow. The Act also requires you to protect yourself in the workshop by wearing the following:

- protective clothing/equipment and drill-type overalls or drill-type trousers and shirt to protect your body in general
- safety glasses to protect your eyes
- earmuffs or earplugs to protect your hearing
- safety boots/shoes to protect your feet.

You must supply your own personal protective clothing and equipment, otherwise you will not be allowed into practical classes.

All accidents and injuries that occur during class must be reported immediately to the lecturer.

This workbook is designed so that you can work progressively through each section. It is important that you study and understand the sections on theory before you start any practical exercise.

You may feel awkward about asking questions in class. Lecturers are happy to help whenever you need:

- something to be made clearer
- an explanation of a word
- more information, for example about suggested reading material.

Remember to ask is to learn!

Review questions

Throughout this workbook there are exercises and review questions for you to do. They are there to help you summarise and review important parts of each section. When you think you know the material in each section, use the review questions to see how much you can understand and remember.
Assessments

You can ask for help from members of staff when you are working your way through the activities in this workbook.

Assessments, however, are a necessary requirement to evaluate your underpinning knowledge in the unit of competency listed.

Your assessment can take a number of forms such as a knowledge-based test, practical exercises, observation and/or portfolios, all of which can be found in the student assessment plan.

All assessments, including practicals, must be completed without assistance.

You may also find that some parts of this unit are integrated with other units.

Student assessment

There are generally a number of activities that you must complete before you are able to ask for an assessment. Make sure that you understand what is expected of you and that you know exactly how and when you are going to be assessed.
# Unit of competency

## Elements and performance criteria

<table>
<thead>
<tr>
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<td><strong>Shut down machine/equipment</strong></td>
</tr>
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<tr>
<td>1.2 Shut down sequence is undertaken safely and to standard operating procedures.</td>
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<td>1.3 Machine equipment is depressurised/emptied/de-energised/bled to standard operating procedures.</td>
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<td>1.4 Safe shut down of machine/equipment is verified.</td>
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<td>1.5 Safety/security lock-off devices and signage are installed to standard operating procedures.</td>
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<td>1.6 Machine/equipment is left in clean and safe state.</td>
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<td><strong>Isolate machine/equipment</strong></td>
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<td>2.1 Machine/equipment operation function is determined and understood.</td>
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Section 1 – Hydraulic safety

Introduction

Before you perform any checks on a system or dismantle any components, you should make sure that working conditions are safe. The rules which follow are also covered in MEM18018C Maintain pneumatic system components, MEM18019B Maintain pneumatic systems, MEM18020B Maintain hydraulic system components and MEM18021B Maintain hydraulic systems.

These rules must be observed before you start any testing or any maintenance on a hydraulic system. They form part of the assessment for this unit of competency.

1. **Isolate** the machine from external power supplies. This can be done through the personal padlock system, permanently disconnecting the machine and removing fuses. (See Figure 1.3.)

   **Note:** WA Electricity Regulations (1991) – Reg 19 only permits tradesmen to work with less than 115 volts direct current and 50 volts alternating current unless the tradesperson holds the required electrical licence.

2. Use the ‘tag system’ to prevent other people from attempting to operate the machine. This is very important particularly when you leave the machine unattended. The types of tags most commonly used are illustrated at Figure 1.1 and Figure 1.2. Complete the details on the back of the tag. These usually include:
   - your name
   - the date
   - your section/department
   - the reason for unserviceability.

**Danger tags**

Danger tags (Figure 1.1) are red and black. The wording underneath may vary, but at a minimum, **must** state that the system is not to be started and that removal of the tag could place someone at risk.

This tag is to be placed on the equipment to be isolated so that other personnel are alerted to the dangers of using this hazardous equipment.

The tag is to be attached to **all isolation points** of the equipment being worked on. Each tag is to be signed and dated by the person who places the tags.

Separate tags **must** be used by every person working on the job.
Section 1 Hydraulic safety

Fig 1.1 Danger tags

Courtey of Industrial Foundation for Accident Prevention

Fig 1.2 Examples of tagging and isolating

Courtey of North Safety Products
3. You should be familiar with the operation of the system before you isolate it and work on it. Refer to any maintenance documentation and consider also:

- the effect the system may have on other systems if it is placed out of service
- the nature of the fluid in the system, for example – whether it is acidic, caustic, pressurised or other
- the fluid temperature.

In addition to isolating, tagging and depressurising a system or component in a system, the following points should also be observed.

- Provide support for pressure-held loads that could fall when the pressure is removed as the working unit is being disconnected.
- Relieve the system pressure. It is dangerous to remove a hose that contains oil under pressure. After the pump has been switched off and the system is at rest, operate the valves each way to bleed the system of any line pressures.

Note: Although oil under pressure does not contain any stored energy such as with compressed air, energy can be stored in the form of pressurised flexible hoses in a cylinder holding up a load or in a charged accumulator.
4. Some hydraulic pumps and control valves are heavy. Before you remove them, provide a means of support such as a chain hoist, floor jack or blocks.

5. When you are working with mobile machines, make sure that the workshop space is large enough to conduct the maintenance procedure. For example, during testing, if the machine has a rotating boom, check whether it will collide with some part of the workshop during the test or if an activated device will hit the ceiling or overhead power lines when operated.

6. Keep the work area tidy and control other potential hazards. Use drain trays under hydraulic equipment and if any oil spillage occurs, clean it up immediately. Remember that one quality of oil is to reduce friction, and that oil on the floor will reduce the friction between your footwear and the ground and could potentially cause an accident.

7. Never service the hydraulic system while the motor, pump or actuators are operating unless it is absolutely necessary.

8. To ensure control of the unit, keep the hydraulics in proper adjustment.

9. When washing parts, use a non-volatile cleaning solvent that is compatible with the hydraulic system.

10. While using test equipment coupled to flexible hoses, tie down the hoses and/or the test equipment. As flexible hoses are pressurised, they stiffen and tend to straighten out. Any test equipment coupled to the end will lift up in the air and then, when the pressure is released, will crash down again causing damage to the test equipment.

11. Make sure that all line connections are tight and that lines are not damaged. Escaping oil under pressure is a fire hazard and can cause personal injury.

12. Although manipulating hydraulics control valves may bleed down a system, you need to be aware that pressure may still be trapped in the system when there are counterbalance and pilot-operated check valves incorporated. This is because hydraulic pressure is required to operate these valves. You should, therefore, make yourself familiar with the system and its components before you start working on it.
Section 2 – Pneumatic safety

Introduction

Compressed air is safer to use than electricity, but like any power source, it must be used with care. Every operator should be aware of the potential dangers when using high pressure compressed air.

The following rules must be observed before you start any testing or any maintenance on a pneumatic system. They form part of the assessment for this unit of competency.

- Isolate the compressor and/or the pneumatic machine from external power supplies and from all sources of pressure. Vent it completely to the atmosphere before you dismantle any components.
- When maintenance is carried out on electrically driven compressors, lock the switch in the open (off) position, or use other positive means of current interruption such as the removal of fuses.
- Similar precautions should be taken for other types of prime movers.
- Use the ‘tag system’ to prevent other people from attempting to operate the machine. This is very important particularly when you leave the machine unattended. The types of tags most commonly used are illustrated at Figure 1.1 and Figure 1.2.
- Provide support for pressure-held loads that could fall when the pressure is removed as the working unit is being disconnected.
- Relieve the system pressure. It is dangerous to remove a hose that contains air under pressure. After the compressor has been switched off and the system is at rest, operate the valves each way to bleed the system of any line pressures.
- Hold the end of any hose that is not fitted with a shut-off valve, while you turn on the air. This will stop the hose from whipping around under pressure.
- Wear protective goggles when you use air to clean down tools or fittings.
- Keep compressed air streams away from the body. Eye damage, ruptured eardrums, skin blisters and other injuries are common through careless use and horseplay. Air leaks should be checked by using a soapy water solution, not with your hands!
- Never direct an air stream at any opening of the body. Serious injury or death may result.
- Check that the exhaust air ducts of the tool are clean and that the casing is not damaged.
- Disconnect the air line before making any re-adjustments to the power tools.
- Some pneumatic components are heavy. Before you remove them, provide a means of support such as a chain hoist, floor jack or blocks.
- When you are working with mobile machines, make sure that the workshop space is large enough to conduct the maintenance procedure.
• Keep the work area tidy and control other potential hazards. Use drain trays under pneumatic equipment such as compressors and if any oil spillage occurs, clean it up immediately. Remember that one quality of oil is to reduce friction, and that oil on the floor will reduce the friction between your footwear and the ground and could potentially cause an accident.

• Never service the pneumatic system while the motor, compressor or actuators are operating unless it is absolutely necessary.

• To ensure control of the unit, keep the pneumatics in proper adjustment.

• When washing parts, use a non-volatile cleaning solvent that is compatible with the pneumatic system.

• Check the safety devices on the compressor as part of the regular maintenance procedure.

• Take steps to prevent inadvertent starting by disconnecting the control power when repairing compressors outside schedule maintenance.

• Before stripping or undertaking major overhauls on a compressor, prevent all movable parts with a mass exceeding 15 kilograms from rolling or moving.

• After such work has been completed, turn the compressor over manually at least one full revolution to ensure that there are no mechanical interferences within the compressor or its prime mover.

• Do not under any circumstances use flammable liquids to clean valves, filters, air passages of coolers, air pipes or any other part exposed to airflow during normal operation. The fumes may become trapped in components, for example compressor cylinders, and when they are compressed and heated, they can explode.

• If chlorinated hydrocarbon non-flammable liquids are used for cleaning, take appropriate safety precautions against toxic vapours.

• Do not use carbon tetrachloride.

• Never use an open flame for inspection to the interior of a compressor or pressure vessel.

• While using test equipment coupled to flexible hoses, tie down the hoses and/or the test equipment. As flexible hoses are pressurised, they stiffen and tend to straighten out. Any test equipment coupled to the end will lift up in the air and then, when the pressure is released, will crash down again causing damage to the test equipment.

• Make sure that all line connections are tight and lines are not damaged. Escaping air under pressure is a hazard and can cause personal injury.

**Recommended viewing**

Watch the video *Danger Tags, Locks and Out-of-Service Tags*. (Call No. 363.11 DAN) Publisher: Concept Corporate Communications (1998).
Section 3 – Fitting and machining workshop procedures

Use of personal danger tags and out-of-service tags

Tags within the workplace serve as a warning that plant and equipment to which a tag is attached cannot be operated. There are two types of tags which are commonly used in a workshop environment. These are personal danger tags and out-of-service tags.

It is vitally important that correct procedures are followed when these tags are in use so that injury to operators and damage to plant and equipment can be avoided. No piece of equipment to which a tag is attached may be operated and no tag may be removed except by those who have the authority to do so.

Personal danger tags

Personal danger tags are used to control dangers which may arise from situations where equipment is undergoing maintenance, is under repair or is being constructed or tested. It is important to keep the following in mind.

- Never operate any switch, control or valve which has a personal danger tag attached.
- Only those employees authorised to carry out repairs may attach a personal danger tag. All persons working on a piece of equipment must attach and remove their own personal danger tags. They must also ensure that all relevant details are completed on the tag, including their name, their contact telephone number, the date and the reason for attaching tag.
- Only the person whose name appears on the tag may remove it.
- If you think that the tag is no longer in effect, contact the name of the person whose name appears on the tag, or if not available, the technician or lecturer.
- The tag may be removed only when it has been cleared for safe operation.
Out-of-service tags

Out-of-service tags are placed on plant and equipment that is out-of-service for repair, alteration, commissioning and decommissioning. It is important to keep the following in mind.

- Never operate any switch, control or valve which has an out-of-service tag attached.
- If you find a piece of equipment that is faulty, you must isolate the equipment, attach an out-of-service tag to the point of isolation, for example plug, switch, and contact the technician or lecturer to repair or decommission the equipment.
- The person who attaches the out-of-service tag must include their name, their contact telephone number, the date and the reason for attaching the tag.
- Only the person authorised to carry out the repairs, for example the technician or lecturer, may remove the out-of-service tag once it has been determined that the equipment is safe to operate.
- The tag may be removed only when it has been cleared for safe operation.

If you have any queries, contact your lecturer, the technician or the OSH officer.
Activity 1
The questions which follow are designed to allow you to check your understanding of hydraulic and pneumatic machine safety before you do the practical task.

When you have completed this activity, check your answers with your lecturer or supervisor.

Question 1
State the procedure for isolating a hydraulic machine before removing a component for servicing.

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Question 2
In addition to isolating, list four (4) safety factors that must be considered when you are working on a hydraulic system.

• ___________________________________________________________________
• ___________________________________________________________________
• ___________________________________________________________________
• ___________________________________________________________________
• ___________________________________________________________________

Question 3
List four (4) safety factors that must be considered before you work on a pneumatic system.

• ___________________________________________________________________
• ___________________________________________________________________
• ___________________________________________________________________
• ___________________________________________________________________
• ___________________________________________________________________
Question 4
List two (2) methods that can be used to decommission a machine before servicing.

• ___________________________________________________________________

• ___________________________________________________________________

Question 5
Complete the following sentences.
Danger tags are coloured ____________ and ____________.

Yellow tags are called ____________________________________________.

Question 6
List the four (4) items of information that can be found on the back of danger tags.

• ___________________________________________________________________

• ___________________________________________________________________

• ___________________________________________________________________

• ___________________________________________________________________

Question 7
Identify the person allowed to perform the task, when the removal of electrical fuses is required to isolate a machine.

_____________________________________________________________________

Question 8
Explain why accumulators can present a safety hazard.

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________
Question 9
Complete the following sentence.
The only person who is allowed to remove a danger tag from a machine is __________
_____________________________________________________________________

Question 10
Explain why flammable liquids should not be used to clean compressor valves, filters, air passages of coolers, air pipes or any other part exposed to airflow during normal operation.
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Question 11
List three (3) methods that can be used to isolate a machine before maintenance.

• ___________________________________________________________________
• ___________________________________________________________________
• ___________________________________________________________________

The following questions relate to the Fitting and Machining workshop.

Question 12
Identify the personnel you should notify if you find a piece of faulty equipment in the fitting and machining workshop.

• ___________________________________________________________________
• ___________________________________________________________________
Question 13
Identify the personnel allowed to remove the out-of-service tag once it has been determined that the equipment is safe to operate.

• ___________________________________________________________________
• ___________________________________________________________________
• ___________________________________________________________________

Question 14
Who is allowed to attach a personal danger tag?

_____________________________________________________________________

When you consider that you have a good understanding of this topic area, ask for the Underpinning Knowledge assessment for this unit and undertake the practical assessments indicated below.

**Practical assessments – record of student progress**

<table>
<thead>
<tr>
<th>Type of equipment</th>
<th>Tagged and isolated correctly</th>
<th>Date</th>
<th>Assessor’s signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>hydraulic</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>pneumatic</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>water pumping</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>other</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
</tbody>
</table>
CERTIFICATE IV IN ENGINEERING (FLUID POWER)

Student Workbook 2

Student Workbook 2 is part of a series of resources developed for students undertaking MEM40105 Certificate IV in Engineering (Fluid Power). This workbook contains content and activities derived from the Unit of Competency listed below.

CATEGORY
Engineering, Mechanical and Electrical

TRAINING PACKAGE
• MEM05 – Metal and Engineering

COURSE / QUALIFICATION
• MEM40105 Certificate IV in Engineering (Fluid Power)

UNIT OF COMPETENCY
• MEM18011C Shut down and isolate machines/equipment

RELATED PRODUCTS
MEM40105 Certificate IV in Engineering (Fluid Power)
• ENG704 – Assessment Tools (CD)
• ENG705 – Practical Workbook 1
• ENG706 – Practical Workbook 2
• ENG707 – Student Workbook 1
• ENG709 – Student Workbook 3
• ENG710 – Student Workbook 4

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