SFEU

Scottish Further Education Unit

Skills for Work: **Engineering Skills Intermediate 2**

Maintenance

Support Material

May 2008

Scotland's Colleges

Acknowledgements

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Engineering Skills: Maintenance (Intermediate 2)
F39D 11

Introduction

These notes are provided to support teachers and lecturers presenting the Scottish Qualifications Authority Unit F39D 11*, Engineering Skills: Maintenance (Intermediate 2)*.

Enquiries relating to this support pack or issues relating to copyright should be addressed to:

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Further information regarding this Unit including Unit Specifications, National Assessment Bank materials, Centre Approval and certification can be obtained from:

The Scottish Qualifications Authority
Optima Building
58 Robertson Street
Glasgow
G2 8DQ

Website: www.sqa.org.uk

Class Sets

Class sets of this pack may be purchased direct from the printer. Costs are dependent on the size of the pack and the number of copies. Please contact:

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Disclaimer

Whilst every effort has been made to ensure the accuracy of this support pack, teachers and lecturers should satisfy themselves that the information passed to candidates is accurate and in accordance with the current SQA arrangements documents. SFEU will accept no responsibility for any consequences deriving either directly or indirectly from the use of this pack.

Contents

How to Use this Pack

None of the material in this pack is mandatory. Rather, it is intended as a guide and an aid to delivery of the Unit and aims to provide centres with a flexible set of materials and activities which can be selected, adapted and used in whatever way suits individual circumstances. It may also be a useful supplement to tried and tested materials and approaches that you have developed yourself. The pack is available on the SFEU website in Word format to enable you to customise it to your suit your own needs.

The **Reference Section** of the pack provides information on the rationale for, and ethos behind, the *Skills for Work* courses, the Course Rationale, and the Employability Skills Profile for Intermediate 2 Engineering showing where the specified employability skills and attitudes can be evidenced and assessed throughout the Course and in this unit.

The **Tutor Support Section** contains a suggested approach to teaching the Unit; advice on learning and teaching with under-16s; guidance on unit induction, unit delivery and advice on integrating the development of employability skills throughout the unit; a scheme of work with a series of suggested lesson plans and advice on Health and Safety considerations. This section also suggests resources which may be useful for tutors and students.

The **Student Support Section** contains guidance and instruction on manufacturer's specifications, drawings and safety instructions, guidance on Health and Safety issues, a range of student activities covering the practical outcomes of the unit and a glossary of terms used in maintenance.

You may wish to place material from the student notes on your own college Intranet by downloading this pack from the Skills for Work section of the SFEU website www.sfeu.ac.uk/skills_for_work

Activities are identified with the symbol: 

Reference Section

What are Skills for Work Courses all about?

Skills for Work Courses are designed to help candidates to develop:

- skills and knowledge in a broad vocational area
- Core Skills
- an understanding of the workplace
- positive attitudes to learning
- skills and attitudes for employability.

A key feature of these Courses is the emphasis on **experiential learning**. This means learning through practical experience and learning by reflecting on experience.

Learning through practical experience

Teaching/learning programmes should include some or all of the following:

- learning in real or simulated workplace settings
- learning through role play activities in vocational contexts
- carrying out case study work
- planning and carrying out practical tasks and assignments.

Learning through reflecting at all stages of the experience

Teaching/learning programmes should include some or all of the following:

- preparing and planning for the experience
- taking stock throughout the experience - reviewing and adapting as necessary
- reflecting after the activity has been completed - evaluating and identifying learning points.

The *Skills for Work* Courses are also designed to provide candidates with opportunities for developing **Core Skills** and enhancing skills and attitudes for **employability**.

Core Skills

The five Core Skills are:

- Communication
- Numeracy
- Information Technology
- Problem Solving
- Working with Others

Employability

The skills and attitudes for employability, including self-employment, are outlined below:

- **generic skills/attitudes valued by employers**
  - understanding of the workplace and the employee's responsibilities, for example time-keeping, appearance, customer care
  - self-evaluation skills
  - positive attitude to learning
  - flexible approaches to solving problems
  - adaptability and positive attitude to change
  - confidence to set goals, reflect and learn from experience.
- **specific vocational skills/knowledge**
  - Course Specifications highlight the links to National Occupational Standards in the vocational area and identify progression opportunities

Opportunities for developing these skills and attitudes are highlighted in each of the Course and Unit Specifications. These opportunities include giving young people direct access to workplace experiences or, through partnership arrangements, providing different learning environments and experiences which simulate aspects of the workplace. These experiences might include visits, visiting speakers, role play and other practical activities.

A Curriculum for Excellence (Scottish Executive 2004) identifies aspirations for every young person. These are that they should become:

- successful learners
- confident individuals
- responsible citizens
- effective contributors.

The learning environments, the focus on experiential learning and the opportunities to develop employability and Core Skills in these Courses contribute to meeting these aspirations.

The Course in Engineering Skills (Intermediate 2)

Course Rationale

The Engineering Skills (Intermediate 2) Course has been designed to provide a basis for progression into further education or for moving directly into training in employment within an engineering sector. The overall purpose of the Course is to ensure that candidates start to develop the generic and practical skills, knowledge and understanding, and employability skills needed within an engineering sector.

The engineering sector includes the following:

Mechanical	Manufacture	Maintenance
Fabrication	Welding	Electrical
Electronic	Foundry	Automotive
Control	Transport	Aeronautical
Communications	Space	Energy Generation
Conservation	Marine	Water
Desalination	Oil/Gas	Petroleum

This Course focuses on the broad areas of Mechanical, Fabrication, Electrical, Electronic, Maintenance, Manufacture, and an element of Design. This will allow the candidates to gain transferable skills which can be applied to any of the above engineering areas.

The primary target group for this Course is school candidates in S3 and above. It may be suitable for candidates entering engineering for the first time but also for those who have completed the Engineering Skills (Intermediate 1) Course. This Course will build on the skills and knowledge developed in the Engineering Skills (Intermediate 1) Course and will introduce candidates to a wider range of engineering applications.

It is anticipated that, for this group of candidates, the Course will rely on and build on existing partnerships between schools and colleges and employers (or other agencies). This may be particularly pertinent in the case of the Engineering Skills Course due to the specialist expertise and facilities available in, for example, further education colleges and training providers. Nevertheless, the Engineering Skills Course is designed at a level and scope such that it can be delivered in schools, if the school has suitable facilities and teaching expertise. A partnership approach would still be necessary in order to provide the contact with the workplace which is an essential part of the experience for candidates. The Course is also suitable for adult candidates who are seeking to enhance their employability and develop introductory vocational skills in an engineering sector.

The general aims of the Engineering Skills (Intermediate 2) Course are to:

- widen participation in vocationally-related learning for school candidates from S3 upwards
- allow candidates to experience vocationally-related learning
- provide candidates with a broad introduction to the engineering vocational sector
- encourage candidates to foster a good work ethic, including timekeeping, a positive attitude, and other relevant employability skills
- provide opportunities to develop a range of Core Skills in a vocational context
- encourage candidates to take charge of their own learning and development
- provide a range of teaching, learning, and assessment styles to motivate candidates to achieve their full potential
- facilitate progression to further education and/or training
- encourage candidates to plan their work and review their progress
- encourage candidates to develop a positive attitude to waste minimisation and environmental issues

In particular, the aims of the Engineering Skills (Intermediate 2) Course are to:

- encourage candidates to consider a career in the engineering industry
- develop an awareness of what opportunities there may be within engineering in terms of the types and range of career options
- enable candidates to develop and apply practical, technical, and communication skills as a foundation for future learning and progression
- develop the candidates' awareness of their individual strengths and weaknesses in relation to the requirements of engineering, and to reflect on how this affects their employability potential
- give candidates the technical knowledge, skills, and understanding associated with a range of skills in engineering at this level
- give candidates an introduction to the design cycle
- encourage candidates to apply their knowledge and understanding of engineering by using skills of evaluation and problem solving in a vocational context
- develop an awareness that health and safety issues are integral to the world of work generally and engineering in particular
- prepare candidates for further learning opportunities, study, and training for employment in engineering and related occupations

The Engineering Skills (Intermediate 2) Course has been designed with National Occupational Standards in mind. The standards set for first-year apprentices in the engineering industry, and the standards set out in the Intermediate 2 Course, are broadly comparable in terms of skills and tolerances.

While no formal entrance qualifications are required for this Course, it would be expected that candidates embarking on the Course would have the following:

- basic proficiency in literacy
- basic proficiency in numeracy
- some aptitude for graphical forms of communication (the reading of basic engineering drawings is developed in the Course)
- motivation to work as part of a team

This Course supports progression into appropriate further education, training, or employment. The Course provides the basis for candidates to gain an insight into engineering occupations such as Mechanical, Fabrication, Automotive, Aeronautical, Electrical, and Electronic, Marine, Control, Maintenance, and Manufacture and to use their studies to help them decide the career they wish to follow. Candidates studying this Course in Engineering and choosing a skills option, may be aiming to progress into an apprenticeship in industry. Candidates who are uncertain which trade to follow may undertake vocational courses at further education colleges.

The Intermediate 2 Course should facilitate progression to a relevant vocational Course or an appropriate National Certificate/Qualification programme.

Unit Outcomes, PCs and Evidence Requirements

National Unit Specification: statement of standards

Unit: Engineering Skills: Maintenance (Intermediate 2)

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

Outcome 1
Identify, select, and use tools and equipment to assess the functionality of an engineering part.

Performance Criteria

a) Interpret and use manufacturers' drawings and specifications.
b) Identify, select, and use tools and equipment to test an engineering part.
c) Correctly determine whether the engineering part is functional.
d) Correctly observe safe working practices in all practical activities.

Outcome 2
Identify, select, and use tools and equipment to maintain an engineering part.

Performance Criteria

a) Interpret and use manufacturers' drawings and specifications correctly.
b) Identify, select, and use tools and equipment to disassemble an engineering part correctly.
c) Identify, select, and use tools and equipment to repair an engineering part correctly.
d) Identify, select, and use tools and equipment to reassemble an engineering part correctly.
e) Correctly observe safe working practices in all practical activities.

Outcome 3
Review and evaluate own employability skills in practical engineering contexts.

Performance Criteria

a) Review and evaluate own employability skills.
b) Seek and record feedback on own performance in employability skills.
c) Make a judgement on own strengths, weaknesses, and learning points in relation to employability skills.
d) Identify action points for improvement in relation to employability skills.

Evidence Requirements for the Unit

Performance and written/oral evidence is required to show that all Outcomes and Performance Criteria have been achieved.

Performance evidence will be supported by assessor checklists. This evidence will be generated from an integrated assignment consisting of practical activities carried out in supervised workshop conditions.

The evidence may be gathered at different points throughout the Unit.

The maintenance activities which include testing, disassembly, repair, and reassembly of an engineering part (an engineering part can be defined as a system, subsystem, item, or component)
in a safe manner will cover:

- interpretation of manufacturers' drawing and specifications
- identification, selection, and use of tools and equipment to test an engineering part:
- mechanical and/or electrical
- identification, selection, and use of any three of the following tools and equipment for disassembly:
- screwdrivers, spanners, hammer, holding devices, extractors, pliers
- identification, selection, and use of any three of the following tools and equipment for repair:
- files, scrapers, pliers, hammer, holding devices, drills, taps, dies, reamer
- identification, selection, and use of any three of the following tools and equipment for assembly:
- screwdrivers, spanners, hammer, holding devices, insertion tool, extractors, pliers

Candidates will be required to carry out a quality check before submitting their work for final assessment.

The standard for the final assessment is expressed in the National Assessment Bank (NAB) material, in which the reassembled engineering part must conform to the manufacturer's original specification.

Written/Oral Evidence

Candidates will complete a self evaluation review of their own performance against the following employability skills:

- showing health and safety awareness — to include wearing Personal Protective Equipment (PPE), safe working practices, and understanding a basic risk assessment
- interpreting engineering drawings and specifications
- working cooperatively with others — to include seeking advice, following instructions and working in a team
- planning and preparing for work — to include selection of correct tools and equipment
- awareness of environmental considerations — to include safe and correct disposal of waste/hazardous materials, waste minimisation, and fume and dust control
- quality checking own work
- self review and evaluation — to include identifying strengths and weaknesses, identifying learning points from practical experiences and having a positive attitude to learning

A signed record of the review must be retained by the assessor as assessment evidence.

The National Assessment Bank (NAB) item for this Unit provides an appropriate practical assignment, an appropriate candidate review sheet and assessor checklists. These exemplify the national standard. Centres wishing to develop their own assessments should refer to the NAB to ensure a comparable standard.

NB Centres must refer to the full Unit Specification for detailed information related to this Unit.

Employability Skills Profile

In addition to the specific, vocational skills developed and assessed in this Course, employability skills are addressed as detailed in the table below. For the purposes of the table, the Units are referred to as A, B, C and D as indicated.

Engineering Skills (Intermediate 2)

Mechanical and Fabrication	**=**	**A**
Electrical and Electronic	**=**	**B**
Maintenance	**=**	**C**
Design and Manufacture	**=**	**D**

Employability skills/attitude	Evidence
• maintaining good timekeeping and attendance	A, B
• showing health and safety awareness	A, B, C, D
• selecting and using engineering tools and materials	A, B
• interpreting engineering drawings and specifications	B, C, D
• working cooperatively with others	C, D
• planning and preparing for work	C, D
• applying time management	D
• awareness of environmental considerations	B, C
• quality checking own work	A, B, C, D
• self review and evaluation	A, B, C, D

Assessment evidence in all Units:

Assessor observation checklists of practical activities and candidate review sheets.

Careers Scotland Support

for School/College Collaboration for Scotland's Colleges in the Scottish Enterprise area

Since August 2006 Careers Scotland (SE and HI areas) has been funded by the Scottish Government to support College/School Collaboration and encourage and promote vocational educational choices for pupils in schools.

Careers Scotland (now part of Skills Development Scotland) has an important role to play in selection, recruitment and pre-entry career guidance, as well as ongoing support and pre-exit career guidance, to ensure the pupils' experience of SfW is capitalised upon in any future career planning.

Careers Scotland activity takes place locally and nationally under 4 objectives:

- Providing careers advice, guidance and employability support to pupils and their parents pre, during and post vocational education experience, focusing primarily but not exclusively on SfW pupils - demonstrating how these educational choices have implications for future career options, and support the achievement of future career goals and supporting effective transitions
- Providing targeted support to pupils at risk of becoming unemployed who would benefit from undertaking a vocational course
- Partnership working to ensure vocational study is given parity of esteem with other school and post school options, focusing on recruitment / selection and retention of pupils on vocational courses
- Capacity building through relevant shared CPD events and resource development to increase understanding of the process of uptake of vocational options and facilitate more effective support to pupils navigating these options

For further information on Careers Scotland (SE)'s involvement in school/college collaboration locally, please get in touch with your Careers Scotland Regional contact:

South East (Edinburgh & Lothians; Forth Valley; Borders)
Stephen Benwell 01786 452043 stephen.benwell@careers-scotland.org.uk

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Tutor Support Section

Introduction

The purpose of this Unit is to enable students to identify, select and use tools to carry out basic maintenance and repair of engineering parts and equipment. Students will perform maintenance operations, disassemble, test, maintain, repair and re-assemble engineering parts. During the practical work students will learn engineering terminology and maintenance skills and will also develop work practices and behavioural attitudes that will enhance their employability skills.

Students will be working in an engineering environment and the requirement to promote and ensure safe working practices are adhered to is essential at all times.

Safe working practices should include:

- keeping the work place tidy and free from obstruction
- maintaining good working relationships with others
- maintaining a positive attitude to instruction
- using tools for their intended use only
- using tools correctly
- complying with manufacturers' safety instructions
- being appropriately dressed for workshop activities
- wearing the relevant Personal Protective Equipment (PPE)

In addition to being taught the correct techniques for maintenance, candidates should be given support in all aspects of the practical activities and employability skills.

The time allocations for each Outcome are intended as a guide only. The actual time spent on each Outcome will depend on the ability and prior experience of the student.

The Outcomes in this Unit are practical and students should be given plenty of opportunity to handle and work with tools and equipment relevant to the maintenance of equipment. A key aspect of the practical activities is the development of student confidence and therefore students should be given adequate support in all stages of practical work.

The Unit has been designed to allow progression for those students who have already completed *Skills for Work* Intermediate 1 Units.

Learning and Teaching with Under 16s

Scotland's Colleges have made significant progress in meeting the needs of young learners. Our knowledge of the learning process has increased significantly and provides a range of strategies and approaches which gives us a clear steer on how lecturers can add to their skill repertoire. Lecturers can, and do, provide a stable learning environment where young students develop a sense of self-respect, learn from appropriate role models and see an opportunity to progress. There are basic enabling skills for practical application which can further develop the learning process for this group of students. So what are the characteristics of effective learning and teaching which will help to engage young learners?

Ten ways to improve the learning process for under 16s
(This list is not exhaustive!)

1. **Activate prior knowledge and learning** – ascertain what the learner knows already and teach accordingly. Young people do have life experience but it is more limited than adult learners and they may not always be aware of how it will assist them in their current learning.

   Tips - Question and answer; Quick Quiz; Quick diagnostic assessment on computer; present key words from the course or unit and see how many they recognise or know something about.

2. **Tune learners into the Big Picture** – the tutor knows the curriculum inside out and why each lesson follows a sequence, however the young learner does not have this information and is re-assured by being given the Big Picture.

   Tips – Mind map or concept map; use visuals, for example wall displays of diagrams, photographs, flow charts; explain the learning outcomes in language they will understand; We Are Learning Today (WALT) targets and What I'm Looking For (WILF) targets; give clear and visible success criteria for tasks.

3. **Use Advance Organisers** – these are lists of the key concept words that are part of the course or unit.

   Tip – Highlight on any text the concept words that you will be using; make a visible list and put it on display – concept words can be struck off or referred to as they occur (NB this helps with spelling and independent learning as they do not have to keep checking meaning); highlight essential learning and action points.

4. **Vary the teaching approaches**. The two main approaches are instructing and demonstrating, however try to provide opportunities to facilitate learning.

   Tips – Ask students what they know now that they did not know before, or what they can do now they could not do before, at appropriate points in the lesson or teaching block; ensure there are problem solving activities that can

be done individually or in groups; ask students to demonstrate what they have learned; use a range of question and answer techniques that allow participation and dialogue, eg. provide hints and cues so that they can arrive at answers themselves.

5. **Preview and review of learning**. This helps to embed previous learning and listening skills and provides another opportunity to elicit learner understanding. Consolidates and reinforces learning.

   Tips – At the beginning of each lesson, or session, review previous learning and preview what is coming up; at the end of each lesson or session, review what has taken place and what will be focussed on next time – these can both be done through question and answer, quizzes and mind mapping activities.

6. **Language in the learning environment**. Do not assume that the language which is used in the learning environment is always understood by young learners, some words may be familiar but do not have the same meaning when used vocationally.

   Tips - At appropriate points ask students what words mean; explore the various meanings of words to find out if they may have come across this language in another context; by looking at the structure and meaning of words there is an opportunity for dialogue about learning and to build vocabulary.

7. **Giving instructions in the learning environment**. This is one of the most difficult tasks a tutor has to do whatever the curriculum area. With young learners this may have to be repeated several times.

   Tips – Ask a student to repeat back what you have asked them to do before beginning a task; ask them to explain the task to one of their peers; use the KISS principle – Keep It Short and Simple so that they can absorb and process the information.

8. **Effective feedback**. Feedback is very important for the learner to assess their progress and to see how and what they can improve. Provide opportunities to engage in dialogue about the learning function of assessment – provide details of the learner's strengths and development needs either in written or spoken form. With younger learners identifying one or two areas for development is sufficient along with acknowledgement of what has been done well.

   Essentially, learners are helped by being given a **specific** explanation of how work can be improved. You can also use summative assessment formatively, ie. as an opportunity to identify strengths, development needs and how to improve.

   Tips – Ask students themselves to identify their own strengths and development needs – self evaluation; peer evaluation of work can be successful once they have been taught how to do it; the tutor can produce a piece of work and ask students to assess it anonymously; have a discussion about the success criteria for the task and ensure the students are clear about

them; allow learners to set criteria for success and then measure their achievements against these.

9. **Managing the learning behaviour**. Under 16s are coming into Scotland's Colleges and training establishments from largely structured and routine-driven environments in schools and early feedback from those undertaking Skills for Work courses indicates that they very much enjoy the different learning environment that colleges and other training providers offer. Remember though that these are still young learners. They will still expect tutors to provide structure and routine, and will perform best in a calm, orderly learning environment. Young students will respond to firm, fair, and consistent management. Such routines have to be established quickly and constantly reinforced.

   Tips - Health and safety is non-negotiable and consequences of non-compliance with the regulations should be made clear and adhered to at all times; set out your expectations from day one and provide a consistent message; have clear beginnings, middles and endings for each session; be a positive role model for your students, ie. be there before they are and manage the learners with respect; always deliver what you promise; build up good relationships and get to know the learners, make the curriculum interesting and stress the relevance of the learning; set up a positive behaviour management system. By following these guidelines you will build up two-way respect, which, while sometimes challenging to achieve, can be very powerful and work to everyone's benefit.

10. **Care and welfare issues**. School/college partnerships mean increasing numbers of young learners in college. Tutors have to be aware of their professional responsibilities and mindful of young people's rights. However tutors have rights too, in terms of feeling safe and secure in working with young people and there are basic steps staff can take to minimise risks. It is essential that colleges ensure that tutors have a working knowledge of the Child Protection policies (local authority and college documentation) and follow procedures and policies diligently. School/College Liaison Officers will be familiar with these documents and can provide support and advice. There are also training sessions on Child Protection available from SFEU (see the following page).

    Tips - Avoid one-to-one situations with young students in a closed area; do not do or say anything that could be misinterpreted; if the opportunity arises, do some observation in schools to see and discuss how teachers use the guidelines for their own protection as well as the young person's.

Most young people are a delight to work with and they will positively enjoy the experience of learning in college. However, there will inevitably be some who are disengaged, disaffected and who have not yet had an opportunity to experience success. '*Skills for Work*' is a unique educational initiative that young people can be motivated to buy into – you as the tutor are key to the success of these programmes.

Skills for Work Workshops

To take this 10 point plan forward and to add to it, you can attend one of SFEU's *'Get Skilled Up'* half day workshops for tutors delivering *Skills for Work* Courses, when we explore further the learning process and look at a range of specific teaching and learning techniques to use with the under 16 age group. To find out when the next event is visit our website www.sfeu.ac.uk or contact the Learning Process team at SFEU on 01786 892000.

Child Protection Workshops

These are run on a regular basis by staff at SFEU in Stirling and also in colleges. For more information on these workshops please contact members of the Access and Inclusion team at www.sfeu.ac.uk or contact the team at SFEU on 01786 892000.

General Guidance on Unit Delivery

The emphasis in this unit is on a practical approach in which the students complete practical tasks and exercises to develop maintenance skills. The unit is also designed to highlight the employability skills that are valued by employers.

The Unit should be delivered in a workshop environment with students. Students must wear overalls, safety footwear and other PPE (Personal Protective Equipment) as required in the workshop. They should be made aware that employability skills such as attendance, punctuality, working with others, seeking advice and reviewing their progress will also be developed, supported and monitored. It is important that students evaluate their progress with employability skills and at the same time start to evaluate their practical skill development and state what they were good at and what they were not so good at in both areas. There should be adequate time to progress maintenance skills whilst at the same time giving each student a good insight to engineering both locally and nationally.

Associated knowledge and skills to be developed include:

- names and use of tools
- workshop practice
- understanding manufacturers' specifications
- commonly used maintenance terminology.

The Unit could be integrated for delivery with other units of the course and if this is the case this support pack should be used in conjunction with that of other units.

The unit is also an ideal opportunity to progress Core Skills within the context of engineering maintenance:

Numeracy Skills: Students will be interpreting manufacturers' numerical data and the testing of engineering parts will require numerical interpretation.

Working with Others: During maintenance operations students will be actively encouraged to seek advice from their tutor and work with their peers as part of a team.

Problem Solving: Functional checks will present problems to the student and they will be required to arrive at efficient and cost effective solutions.

Communication: Students will be interpreting a manufacturer's specification and drawings and will be required to follow oral and written instructions.

IT: Students will be provided with opportunities to research the Internet to seek additional information about maintenance tools and procedures.

Unit Induction

An induction session in week 1 will prepare students well for the unit and help to clarify aims and expectations, what the unit is all about and any uncertainties they may have about the unit and how it will be delivered. Induction may include the following:

- an outline of the Unit content – what they're going to be doing
- how it fits in to the *Engineering Skills* Course
- your plans for teaching the Unit – how they'll be learning the practical skills
- assessment methods and schedule
- where employability fits in – start by asking them what they think!
- a section on health and safety
- you might also think about inviting a representative from a service provider to speak to the class about the types of employment available in their organisation, about employment and educational opportunities prospects in maintenance, and to reinforce the value that employers put on employability skills.
- the importance of regular attendance and good timekeeping to encourage employability skills development - get them into good habits just as if they were at work and in employment!

Health and Safety - Note

Students need to understand their roles and responsibilities in relation to health and safety. Students may already have an appreciation of health and safety issues in one of the other course units but it should be pointed out to them that in this unit they may be dealing with a different set of potential hazards such as flammable fuels, or disposal of waste oil, and that each practical activity will start and end with health and safety issues relevant to the practical skills covered in the lesson.

Scheme of Work

The content of the Unit begins with the interpretation of a manufacturer's specification and drawings. After that the candidate will be required to correctly select and use tools and equipment to test and assess the functionality of engineering parts. This is followed by developing skills in the disassembly, repair and reassembly of engineering parts. On acquisition of the basic maintenance skills the candidates are required to use the manufacturer's specification, tools and equipment to carry out maintenance procedures.

The Outcomes should be taught in the order listed in the Unit. The review and evaluation of employability skills should be integrated in all the activities undertaken in the unit.

At the beginning and throughout each Outcome of the Unit the following should be emphasised and adhered to:

Safe Working Practices in the Workshop	**The Care and Use of PPE**
• Workshop Safe Working Practices • Workshop Housekeeping • Health and Safety • Accident Procedures • Fire Alarm Procedures	• footwear • overalls • eye protection • hand protection • gloves

Outcome 1 (approximately 12 hours)

Identify, select and use tools and equipment to assess the functionality of an engineering part.

Interpret a manufacturer's specification and drawings	• health and safety, safe working practices and employability • manufacturer's safety instructions • component identification • function of components and parts • manufacturer's maintenance requirements
Identify, select and safely use tools to test an engineering part	• health and safety, safe working practices and safety regulations relating to the handling and storage of flammable fuels • identify and use tools by name and purpose • disassembly and testing of an engineering part
Determine if an engineering part is functional	• health and safety, safe working practices and safety regulations relating to manual handling techniques • disassembly and functional checks of engineering parts

Outcome 2 (approximately 23 hours)

Identify, select and use tools and equipment to maintain an engineering part

Interpret and use a manufacturer's specification and drawings correctly	• manufacturer's specification and drawing interpretation • manufacturer's safety instructions
Identify, select and safely use tools and equipment to repair an engineering part correctly	• health and safety, safe working practices handling sharp objects • identify and use tools by name and purpose • repair and reassembly of an engineering part
Identify, select and safely use tools and equipment to disassemble and reassemble engineering parts correctly and carry out maintenance tasks	• health and safety, safe working practices and safety regulations relating to the handling and disposal of waste oil • disassembly and reassembly of an engineering parts and equipment • carry out maintenance tasks

Outcome 3 (approximately 5 hours)

Review and evaluate own employability skills in practical engineering contexts

Review and evaluate own employability skills Seek and record feedback on own performance in employability skills Make a judgement on own strengths, weaknesses and learning points in relation to employability skills Identify action points for improvement in relation to employability skills	Candidates will complete a Review Sheet covering: • maintaining good attendance • maintaining a tidy workplace • sourcing and use of tools in a correct and safe manner • using tools solely for the purpose for which they are designed • showing health and safety awareness • positive attitude to learning • wearing appropriate PPE • preparing appropriately to carry out tasks

Health and Safety Considerations

General safety in the workplace

This deals with the issues of:

- General Health and Safety
- Personal Protective Equipment (PPE)
- Safe working techniques (including tool-handling)
- First Aid
- Fire Alarm
- COSHH
- Good housekeeping in the working environment
- Manual handling

Each student will require the minimum **PPE** of safety boots and overalls for most workshop activities. In some cases students may require additional equipment such as goggles, gloves, safety spectacles or ear defenders.

Safe working techniques will include general workshop behaviour and protocol. This will include the correct handling and transportation of tools; tool safety; workshop layout; and procedures for starting and finishing practical activities.

First Aid considerations should include awareness of the nearest first aid station, first aider, first aid procedures, accident and 'near miss' reporting, and avoidance of potential accidents.

Fire Alarm evacuation procedures should be practised and students made familiar with the audible warning sound, alarm points, location of fire fighting equipment, fire exits, assembly areas and correct conduct under alarm conditions.

The **Control of Substances Hazardous to Health** (COSHH) must be stressed if students are subjected or exposed to any chemicals, fumes, dust or irritants.

Good housekeeping is the welfare of all participants and the general working conditions in the workplace. This will include safety, PPE, behaviour, conduct, storage and condition of tools and equipment, walkways and handling and disposal of waste oil and scrap materials.

Manual handling techniques should be discussed and encouraged as a matter of good safety practice.

Personal Safety

The students need to appreciate that they are responsible for their own safety and the safety of others. This will include their conduct and behaviour in all activities. Safe working practices in workshops and the safe use of tools and equipment should be emphasised.

In all the activities students are asked to perform they should be encouraged to make sound judgements on issues such as:

- the effect of their actions on fellow students
- are the tools and equipment in good usable condition?
- are they being asked to carry out an action they are unfamiliar with?
- should they seek advice from an appropriate person?

Students' personal dress should be hardwearing and give protection against grease/oil/heat etc. This clothing should not have any loose sleeves.

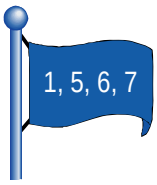
No jewellery of any form should be worn and neither should any piercings be worn.

Further information on Health and Safety can be found in the SFEU Publication '*Engineering Skills: Course Guidance and Employability Skills Intermediate 2*.

Signposting of Employability Skills

In addition to the specific vocational skills developed in this Unit, students will have opportunities to develop and apply their knowledge and understanding of the employability skills.

Throughout the pack there are numbered flags, like the one shown here, showing which specific employability skill can be highlighted and/or assessment evidence recorded when students are busy with the various activities in the Unit.



1	Maintaining good timekeeping and attendance	6	Planning and preparing for work*
2	Showing health and safety awareness*	7	Applying time management
3	Selecting and using engineering tools and materials	8	Awareness of environmental considerations*
4	Interpreting engineering drawings and specifications*	9	Quality checking own work*
5	Working cooperatively with others*	10	Self review and evaluation*

The employability skills marked with an asterisk* are directly assessed in this Unit.

Guidance on Integrating Employability Skills

Opportunities to learn and develop all of these skills are distributed throughout the course.

It is strongly advised that course teams meet together to discuss and agree a co-ordinated approach to the teaching and developing of the employability skills throughout the Course and to ensure that the team has a common interpretation of the skills and attitudes.

The Unit is designed to give the students the technical knowledge, skills and understanding of maintenance but also it should develop student awareness of what opportunities there may be within engineering in terms of the types and range of career paths and options.

It is anticipated that the development and recording of employability skills will be ongoing throughout each activity and practical assignment. It should be stressed

at unit induction that that skills valued by employers such as timekeeping, attendance etc will be monitored and recorded and that all students will be encouraged to show a positive attitude. Tutors should look for every opportunity to teach about the value of developing good employability skills as well as teaching engineering maintenance skills.

Generating Evidence and Assessment Opportunities for Employability Skills

The unit is designed around practical assignments which should enable the students to develop and apply practical, technical and communication skills as a foundation for future learning and progression. As instances arise naturally within the completion of practical work or activities, job roles and career paths may be discussed so that all students are aware of progressions within the engineering sector. These discussions will also encourage an interest in engineering in general.

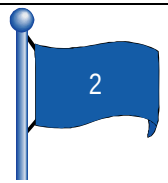
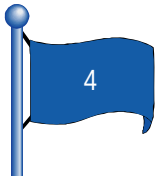
It is important in that the students develop the ability to reflect on how they performed in the completion of tasks. In the context of this Maintenance unit this will involve reflection on the development of both practical and employability skills. The skill of evaluation lets the candidates analyse what they did well, what they did not do so well and how they can improve. This means they will develop an awareness of their individual strengths and weaknesses.

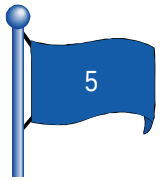
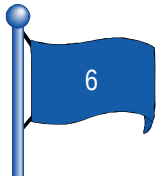
The unit also encourages the students to apply new skills, knowledge and understanding of engineering in the completion of practical assignments by using skills of evaluation and problem-solving in a vocational context.

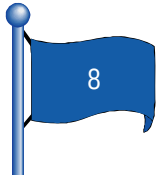
The following employability skills will be assessed in this unit. However, please note that it is expected that all the other employability skills are also developed throughout the unit.

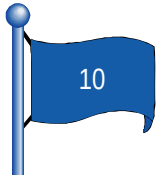
- showing health and safety awareness
- interpreting engineering drawings and specifications
- working cooperatively with others
- planning and preparing for work
- awareness of environmental considerations
- quality checking own work
- self review and evaluation

You will find and create countless opportunities to help students develop their employability skills. Here are some ways of going about it to get you thinking!

Employability Skills	**Delivery Advice**	**Possible Activities/Contexts**
 **Showing health and safety awareness**	Emphasise the importance of maintaining health and safety awareness at all times, of wearing appropriate PPE and the importance of **spotting** potential risks and hazards. This should lead to the application of Safe Working Practices – keeping walkways clear, correct manual handling techniques, tool and equipment safety etc.	Students could be given a "spot the hazard cartoon" as a competitive quiz. This could be followed up with a basic risk assessment to identify potential hazards in the workshop. Group setting of guidelines on behaviour in the workshop.
 **Interpreting engineering drawings and specifications**	Emphasise the importance of following drawings and specifications accurately. Tutors should take the opportunity in all tasks which involve using drawings to reinforce the importance of correct interpretation and of following instructions in the correct sequence	Form small groups; give out a simple drawing and specification of an object. Using simple building materials ask the groups to build the object. Were there any differences?

 **Working cooperatively with others**	Working co operatively with others is in many ways a question of communication. Get the class into the habit of working as a team to set up the workshop for activities and tidy up during and at the end of work sessions. Get them to speak to each other – and to you – about the sharing of workspace, tools, equipment and materials. Respect for others is an important factor in being an effective team player. Encourage the students to support each other and encourage peer **acceptability** in seeking advice or assistance from each other and from the tutor. Students should be praised for seeking advice and reassured that you welcome their questions and that it also helps them to demonstrate a positive attitude to learning.	Form small groups and ask the students to design a poster about asking for advice similar to the drawing in the student support notes. Look for opportunities for pair and team working, mixing different school groups if applicable.
 **Planning and preparing for work**	Emphasise the **benefits** of planning and preparing for work – and the consequences of poor preparation. It is worthwhile spending a little time identifying the objectives of each session and encouraging the students to think about how they will go about it, what equipment they will need, what the sequence of the work should be etc. A planning sheet that can be used at the beginning of every session will ensure that planning and preparation becomes a routine part of each task.	Form small groups and devise a simple planning sheet to secure all tools and materials from stores; briefly outline how the job will be done and so on.

 **Awareness of environmental considerations**	Emphasise the importance of **awareness** of environmental considerations. Students should be encouraged to think about the need for environmental **awareness** - why they should save energy, switch off lights, equipment and machinery etc. Discuss with them the concept of the Greenhouse Effect and ways to minimise the effect. Students should understand why it is important to dispose of waste material safely and be shown the correct methods of doings this. They should be encouraged to eliminate as much wastage as possible.	Have students contribute to a workshop environmental policy that everyone adheres to. Form small groups and ask the students to find out themselves the correct disposal routes for waste oils.
 **Quality checking own work**	Emphasise the importance of **continually** checking as work progresses.	In pairs, students could be asked to outline to each other if their work in progress is acceptable against specification, drawings and so on. In time this should help give them confidence in evaluating their own work.

 **Self review and evaluation**	Encourage the students to genuinely **participate** in the self review and evaluation process. Individual and group discussions can help the students get into the habit of evaluating their performance as a natural part of their work routine	• Conversations with tutor. • Quality checking. • Self evaluation exercises. • Students could be given a small reflective log book to record their learning from practical experiences.

Resources

It is expected that this unit will be taught in an experiential manner within a fully equipped, safe and suitably arranged maintenance workshop.
Resources required for individual lessons are set out in each lesson plan.

It is particularly important that, as the handling of fuels and waste oil is an integral part of the unit, any participating centre has such resources and ensures safe working practices.

Useful Websites

Listed below are websites that may be of assistance to you or your students:

- **Careers, Safety and Employability**

Careers Scotland
http://www.careers-scotland.org.uk/home/home.asp

SEMTA
http://www.semta.org.uk/

The Scottish Electrical Charitable Training Trust
http://www.sectt.org.uk/

EMTA Awards Ltd (EAL) Engineering and Technology industry awarding body
http://www.eal.org.uk/

Health and Safety Executive
http://www.hse.gov.uk

COSHH – Control of Substances Hazardous to Health
http://www.hse.gov.uk/coshh/

Employability Framework for Scotland
http://www.scotland.gov.uk/Topics/Business-Industry/Employability

- **Tools and Materials**

Videos of lawnmower maintenance
http://www.expertvillage.com/video/1763_lawn-mower-repair-lifting-mower.htm
http://www.expertvillage.com/video/1768_lawn-mower-repair-replacing-blade.htm

Wikipedia: free encyclopaedia
http://en.wikipedia.org/wiki/Main_Page

Tool-up (commercial site)
http://www.toolup.co.uk/

Encyclopaedia
http://www.encyclopedia.com/

Technology Student
http://www.technologystudent.com/index.htm

FENC – aims to be the leading community for vocational blended learning
http://www.fenc.org.uk

Lessons, Materials and Tools

In the following lesson plans, which are intended as a guide only, the simple practical tasks are designed to integrate basic engineering skills such as:

- Interpretation of engineering drawings and specifications
- Identification, selection and use of tools:
  - for testing an engineering part
  - for functional checks
  - for repairs
  - for disassembly and reassembly of parts and for basic maintenance tasks
- Employability skills

Each lesson should start with the health and safety requirements that will be applicable to that particular lesson and any additional PPE that might be required.

The types of engineering part selected for maintenance is left to the discretion of each centre but could be selected from the following list:

- Motor Vehicle Parts/Components
- Small Diesel Generator
- Industrial Valves or Machinery
- Domestic Appliances
- Bicycle
- Electric Motor
- Motor Cycle
- Lawnmower

The following lesson plans are based on the maintenance of a petrol lawnmower. The lessons plans can be adapted to enable other types of engineering parts and equipment to be used.

For each *Lesson Plan*, the tools and equipment applicable to the lesson are listed. This list is for guidance only and can be supplemented as necessary.

Activities – refers to the named activity found in the Student Support Section.

During the practical activities the use of tools and equipment for testing, functional checks and for maintenance will provide opportunities to discuss the varying roles and responsibilities within the engineering industry. This could include the maintenance tools and practices used by local engineering firms.

Practical Tips

It is expected that as each basic practical skill is demonstrated, good practice will be emphasised. Also good trade specific hints or tips should be included in the lesson. It is also suggested that some or all of the following should be integrated with the range of practical activities:

- The use of employed apprentices attending college to aid workshop sessions
- The use of various speakers/experts/tradespersons to aid employability skills and knowledge of local industry
- The use of ICT if appropriate
- The use of online videos dealing with maintenance topics

Lesson 1

Interpret and Use Manufacturers' Drawings and Specifications

Objectives:

- Safe working practices, health and safety regulations and employability – to establish a level of knowledge and understanding of health and safety and employability.
- Identify the main parts of a lawnmower and state their function
- Interpret safety instructions from the manufacturer's specification
- Interpret the basic maintenance requirements of a lawnmower

Resources:

- Manufacturer's specification and drawings
- Student Support Section materials
- A walk-behind lawnmower and lawnmower parts

Learning and teaching process:

- use group discussion to determine the level of student knowledge of health and safety issues; develop this to discuss the need for general health and safety in the workshop environment; emphasise the student's own health and safety and that of others in the workplace in order to create a safe learning environment for everyone. Use this opportunity to promote awareness of employability skills such as attendance, punctuality and especially behaviour in relation to safety requirements.
- use the manufacturer's safety instructions and form small group discussions relating to a simple risk assessment when working with lawnmowers (That is identifying hazards, the risk, persons at risk, risk rating (low/medium/high), existing control measures and any action required.
- identify the listed parts of a lawnmower and interpret the function of the listed parts
- interpret the basic maintenance requirements of a lawnmower

Activities

- Equipment you can maintain
- Why do employers value workers who can work safely?
- Part identification
- Interpret a manufacturer's safety instructions
- Interpret maintenance needs

Answer to Activity: Equipment you can maintain

1. Something you can drive - **car**
2. Something you can wash clothes in - **washing machine**
3. Something you can cut grass with - **lawnmower**
4. Something to keep you cool - **fan**
5. Something electrical to power equipment - **motor**
6. Something to span water - **bridge**

Lesson 2

Identification, Selection and Use of Tools to Test an Engineering Part

Objectives:

- Identify safe working practices and health and safety regulations relating to the handling and storage of flammable fuels.
- Identify and use tools by name and purpose – the safe use and recognition of tools in terms of their name and purpose. Emphasis should be on the correct use for each tool and their use in testing procedures where appropriate.
- Correct method of removing a spark plug from a lawnmower
- Correct method of testing the condition and fitness for purpose of a spark plug

Resources:

- PPE
- Manufacturers' specification and drawings
- Student Support Section materials
- A walk-behind petrol lawnmower
- Tools:
    - box spanner to remove spark plug
    - box spanner bar
    - light hammer to assist in removal of spark plug if appropriate
    - steel feeler **gauge**
    - spark plug wire brush

Learning and teaching process:

- use group discussion to highlight the health and safety regulations and precautions relating to handling of flammable fuels and fumes
- identify listed tools by name and by purpose
- state and demonstrate correct methods/techniques of using the listed tools
- allow candidates to practise tool usage on simple tasks
- demonstrate correct testing of spark plug

Activities

- Tool identification for maintenance
- Fastener identification for maintenance
- Removing a spark plug
- Testing an engineering part
- Checking a spark plug gap

Answer to Activity: Fastener Identification for Maintenance

You can find six different types of fasteners used in maintenance in the table of letters below – you are to circle the words that identify a type of fastener.

A	I	B	E	Y	U	W	U	H	U
B	L	O	O	J	R	B	E	I	P
N	N	L	V	T	Q	O	W	R	A
E	C	R	E	O	Q	L	O	L	H
W	I	N	G	N	U	T	N	K	B
A	S	M	Z	U	S	X	U	W	S
S	E	J	A	T	H	C	K	Q	C
H	N	Q	O	Y	L	U	R	J	R
U	H	R	K	I	I	I	U	E	E
R	A	D	P	P	K	P	M	G	W

Lesson 3

Checking an engineering part is functional

Objectives:

- Safe working practices - following a manufacturer's safety instructions and manual handling techniques
- Identify and use tools by name and purpose – the safe use and recognition of tools in terms of their name and purpose. Emphasis should be on the correct use for each tool.
- Correct method of removing a lawnmower blade and air filter
- Correct method of establishing the functionality of an engineering component including the importance of visual inspection and comparison with the manufacturer's instructions and data.

Resources:

- PPE
- Manufacturer's specification and drawings
- Student Support Section materials
- A walk-behind petrol lawnmower
- Tools:
    - box spanner to remove blade
    - box spanner bar
    - light hammer to assist in removal of blade if appropriate
    - wooden block
    - pliers

Learning and teaching process:

- use group discussion to emphasise the need to follow the manufacturer's safety instructions - specifically handling sharp blades, correct manual handling techniques when positioning lawnmower and correct way to tilt back lawnmower
- state and demonstrate correct methods/techniques of using the listed tools
- correct methods of removing blade and removing air filter
- correct assessment of the functionality of a lawnmower blade and air filter

Activities

- Removing a lawnmower blade
- Checking the functionality of an engineering part

Lesson 4

Identification and Use of Tools to Repair an Engineering Part

Objectives:

- Safe working practices – following a manufacturer's safety instructions
- Identify and use tools by name and purpose – the safe use and recognition of tools in terms of their name and purpose. Emphasis should be on the correct use for each tool.
- Correct methods of handling, setting up and repairing a blade
- Correct method of checking the blade balance
- Correct method of re-assembly of the blade

Resources:

- PPE
- Manufacturer's specification and drawings
- Student Support Section materials
- Lawnmower blade
- Tools:
    - file(s)
    - vice
    - scrapers/wire brush
    - blade balancer (or some other method to check the blade balance)

Learning and teaching process:

- group discussion to emphasise the need to follow manufacturers' safety instructions specifically for repairing blades and to correct the blade balance
- identify listed tools by name and purpose
- state and demonstrate the correct methods/techniques of using the listed tools
- allow candidates to practise tool usage on simple tasks

Activity

- Maintenance procedure for lawnmower blade

Lesson 5

Identification, Selection and Use of Tools and Equipment to Disassemble and Reassemble Engineering Parts and carry out Maintenance Tasks

Objectives:

- Safe working practices - following the manufacturer's instructions and health and safety regulations relating to the handling, storage and disposal of waste oil and waste materials.
- Identify and use tools by name and purpose – the safe use and recognition of tools in terms of their name and purpose. Emphasis should be on the correct use for each tool.
- Correct methods of disassembly and reassembly of engineering parts when carrying out the following maintenance tasks:
  - oil change (correct disposal of waste oil and waste materials)
  - throttle control cable adjustment
  - spark arrestor maintenance
  - recoil starter cord maintenance procedure
  - replace recoil starter cord
  - check wheels and adjust the cutting height
  - check and adjust the tightness of nuts, screws, engine-head bolts, wing nuts and cables
  - clean equipment
  - prepare the lawnmower for winter storage
  - (optional extension work: check valve clearance)

- Identify maintenance **period**s and make up a maintenance **schedule**
- Correct methods of: handling, care and storage of tools – the correct method of tool transportation, the care of the tool in terms of usage and storage should be demonstrated and emphasised
- Correct methods of waste oil disposal and soiled material disposal.

Resources:

- PPE
- Manufacturers' specifications and drawings
- Student Support Section materials
- A walk-behind petrol lawnmower
- Tools:
  - spanner(s)
  - pliers
  - screwdriver(s)
  - torque wrench
  - cleaning tools
  - wire brushes
  - hammer
- Container for waste oil
- Lubricants and cleaning materials

Learning and teaching process:

- use group discussion to emphasise the safe handling, storage and disposal of waste oil and waste materials
- identify listed tools by name and purpose
- state and demonstrate correct methods/techniques of using listed tools
- allow candidates to practise tool usage on simple tasks
- use group discussion to develop the need for proper care and storage of listed tools.

Activities

- Replace recoil starter cord
- Identify maintenance periods and make up a maintenance schedule

Practical Activity Checklist

Checklist to monitor each student's progress in completing the lessons.

Student Name	**Lesson 1**	**Lesson 2**	**Lesson 3**	**Lesson 4**	**Lesson 5**

Student Support Section

Tutor Note on Student Activities

This section includes both student notes and activities. These materials are not mandatory but offered to centres as a flexible set of materials and activities which can be selected, altered and used in whatever way suits individual centres and their particular situation. For example, in the case of the student activities you might want to talk through the instructions with the learners and then give the instructions out on paper as reminders. You are encouraged to adapt and use the materials creatively in ways which will best engage your students.

It is not intended that the *Student Support Section* is issued to students as a complete pack. Rather the materials are designed to be issued in small sections only, to reinforce practical workshop activity. Handout materials and activity sheets should be issued at an appropriate time –(which could be before, during or after the topic has been fully covered with the students).

This *Student Support Section* focuses on the trade specific aspects of the unit. Further information and activities on the following aspects, which should be incorporated into learning and teaching throughout the unit, can be found in the SFEU publication: *Engineering Skills: Course Guidance and Employability Skills Intermediate 2:*

- health and safety
- employability skills.

Online research and practical activities will provide students with a more **blended** approach to teaching and learning. School students will be familiar with this approach. For students returning to study, you may need to spend time supporting them in the use of electronic resources. Useful online videos are available that will reinforce the learning of the practical maintenance activities.

Welcome to the Maintenance Unit!

The purpose of this Unit is to introduce you to basic maintenance practices and to give you some experience in handling the tools and equipment which you will use when you are carrying out maintenance. The unit is designed to be mainly practical but also has an emphasis on helping you develop employability skills.

In this unit you will use tools and equipment to test, disassemble, repair and re-assemble engineering **parts** and carry out basic maintenance tasks on a lawnmower. Your tutor may then give you further examples to work on when you gain the skills required.

You will learn to carry out maintenance tasks **safely** by following safe working practices and following safety **instructions**.

The skills and practices you learn during this unit will help you to decide if you would like to make a career in engineering maintenance.

Listen to your tutors – they have the experience, knowledge and skills in maintenance which they want to pass on to you. They are there to help you and will welcome your questions.

If at any time you are unsure or need to ask a question - just ask.

A wise person once said

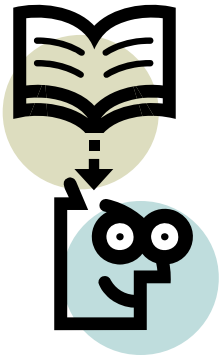
“It is a sign of strength not weakness to ask for advice”

What is Maintenance?

A means of keeping a part or piece of equipment in working order.

How do you do maintenance?

You do maintenance by gaining the experience, knowledge and skills to select and use the correct tools safely and by following maintenance instructions.



Why do you do maintenance?

You do maintenance to keep parts and equipment in good working order. If you don't do this the parts and equipment won't work so well and won't last as long.

Where do you do maintenance?

You do maintenance in a **workshop**.

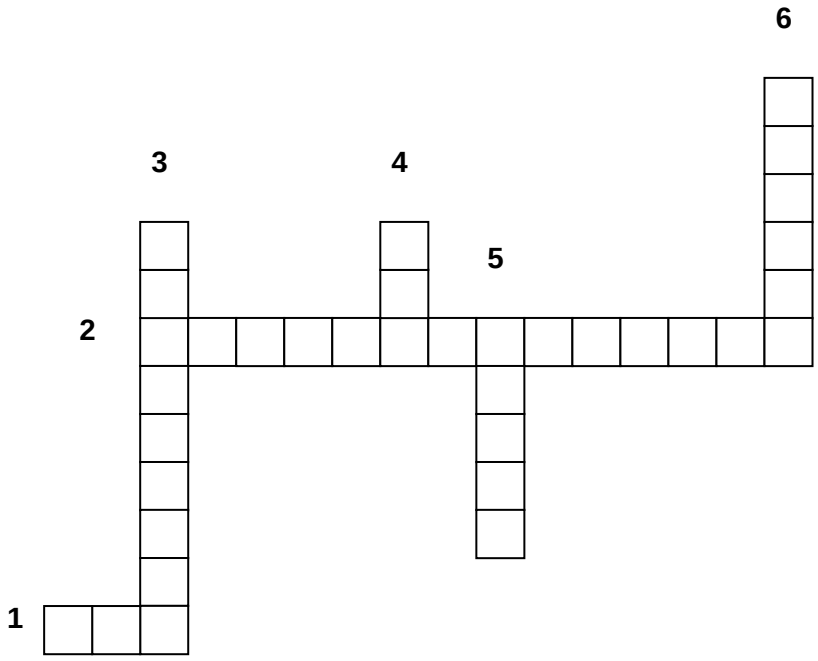
EMPLOYABILITY

You **must** listen to your tutor's safety instructions in the workshop.

What needs maintenance?

Activity: Equipment you can maintain

You can fill in the crossword using the clues:



Clues:

Start from the bottom left-hand corner:

1. Something you can drive (3 letters)
2. Something you can wash clothes in (14 letters)
3. Something you can cut grass with (9 letters)
4. Something to keep you cool (3 letters)
5. Something electrical to power equipment (5 letters)
6. Something to span water (6 letters)

Employability

This unit will also help you to develop employability skills.

All engineers and craft persons have specific **practical skills** in terms of their trade eg. as electricians, plumbers, motor mechanics, but they also have **employability skills**.

Employability skills are valued by employers because they mean that their employees:

- understand the workplace and their responsibilities as employees, for example timekeeping, appearance, customer care, working safely
- can think about the work they've done and how they did it – and decide what they could do to improve it
- are keen to learn
- try to work out solutions to problems instead of walking away from them or leaving them to someone else
- have confidence to set goals, reflect and learn from experience.

These employability skills are in this Maintenance Unit and to get the most out of your unit you should:

✓ follow health and safety instructions

✓ interpret engineering drawings and specifications accurately

✓ co-operate with your tutor and classmates

✓ plan and prepare your work

✓ be aware of environmental considerations

✓ check your work as it develops

✓ try to identify your own strengths and weaknesses and take action to improve your work and your skills.

Safety

It is essential that you follow the safety instructions from your tutors to prevent injury to you, your classmates and your tutors.

Here are the kinds of hazard warnings you will meet during the maintenance tasks:

Flammable Fuels

Do's and Don'ts

Do's

- do disconnect **spark plug** before handling fuel
- do use approved metal containers
- do keep any fuel containers in a designated lockable store outside the work area
- do have a dry powder fire extinguisher available
- do warn others before fuel draining or refilling begins

Don'ts

- don't allow smoking in the area
- don't allow sources of ignition e.g. electrical work or welding during draining or refilling
- don't pour fuel into a drain
- don't spill any fuel during draining or refilling
- don't have mobile 'phones near fuel

Waste Oil

Do's and Don'ts

Do's

- do disconnect the spark plug before draining oil
- do use approved metal containers
- do use absorbent material to clean spills immediately
- do take your waste oil to an oil recycling bank

Don'ts

- don't allow smoking in the area
- don't pour oil into a drain
- don't spill any oil during draining or refilling

Everyone in the workplace is responsible for their own safety and the safety of others who might be affected by their work. This means that, no matter how new and inexperienced you are to any workplace or engineering workshop **you** have a responsibility for safety.

The successful and safe completion of any practical work starts with everyone thinking about health and safety and what steps must be taken to ensure that the workplace is a safe and secure environment.

Always:

- **'think safety'**
- **act responsibly**
- **plan your work**
- **keep your work area tidy**
- **ask questions if you are not sure**.

Activity: Why do employers value workers who can work safely?

Fill in the table with why you think employers value workers who can work safely:

	Employers value working safely because
1	
2	
3	
4	
5	
6	

Manufacturer's Specification and Drawings

Before you start maintenance you should know about the manufacturer's specification but what is a specification?

A **specification** is a list that shows you what type of parts make up the equipment. For example a lawnmower specification will accurately describe:

- the type of lawnmower eg. rotary action
- the engine type eg. four stroke petrol
- the engine capacity eg. 0.4 litre
- the fuel tank capacity eg. 1.0 litre
- the dimensions eg. length, width, height
- the weight eg. 24kg
- the cutting width eg. 400mm

This lawnmower has a similar specification:

Before you start maintenance you should also know about the manufacturer's **drawings** but what do the drawings tell you?

Drawings show you:

- each part of the equipment
- what they look like
- how these parts are assembled
- how these parts work
- how the equipment works
- where the part is located

These are some parts of a lawnmower:

Ask your tutor if you are not sure what these parts are.

Activity: Part Identification

Your tutor will show you some lawnmower parts – fill in the table with what you think they are called and what they do:

Part	Part Name	Part Purpose
Part 1		
Part 2		
Part 3		
Part 4		
Part 5		
Part 6		
Part 7		
Part 8		
Part 9		

Manufacturer's Safety Instructions

You must follow the manufacturer's safety instructions for your own safety and the safety of others.

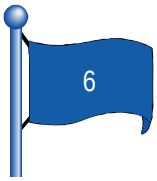
Activity: Interpret Manufacturer's Safety Instructions

Your tutor will give you some safety instructions – write down in the table why you think the safety instruction is needed:

Safety Instruction	Why is the safety instruction needed?
1	
2	
3	
4	
5	

Maintaining a Lawnmower

Before you start your maintenance jobs you should know the reasons why the maintenance is needed. This will help you decide if the part or equipment needs to be replaced, cleaned or repaired when you do the maintenance.



Activity: Interpret Maintenance Needs

Your tutor will give you a list of some lawnmower maintenance jobs – fill in the table with why you think these jobs are needed:

Maintenance Job	The reason the maintenance job is needed
1	
2	
3	
4	
5	

Tools for Maintenance

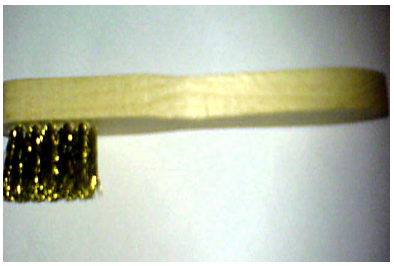
The type of tools you will need for maintenance will depend on the type of maintenance tasks you are asked to do.

For example what kind of maintenance and equipment do you think these tools are needed for?

Insulated Tools

Ask your tutor if you are not sure!

Some of the tools you will be using for your maintenance of a lawnmower are:



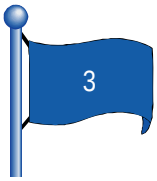
You need a range of tools for maintenance because of the different types of **fastener** used on engineering equipment, but what is a fastener? A **fastener** is something that helps to assemble or holds parts together like a nut, or clip, or screw, or bolt, or a wing nut.

Some of the **fasteners** you will be using for the maintenance of a lawnmower are:

Activity: Tool Identification for Maintenance

Your tutor will show you some tools – fill in the table with what you think they are called and what they do:

Tool	Tool Name	Tool Purpose
Tool 1		
Tool 2		
Tool 3		
Tool 4		
Tool 5		
Tool 6		
Tool 7		
Tool 8		



Activity: Fastener Identification for Maintenance

You can find six different types of fasteners used in maintenance in the word search below – circle the words that identify a type of fastener.

A	I	B	E	Y	U	W	U	H	U
B	L	O	O	J	R	B	E	I	P
N	N	L	V	T	Q	O	W	R	A
E	C	R	E	O	Q	L	O	L	H
W	I	N	G	N	U	T	N	K	B
A	S	M	Z	U	S	X	U	W	S
S	E	J	A	T	H	C	K	Q	C
H	N	Q	O	Y	L	U	R	J	R
U	H	R	K	I	I	I	U	E	E
R	A	D	P	P	K	P	M	G	W

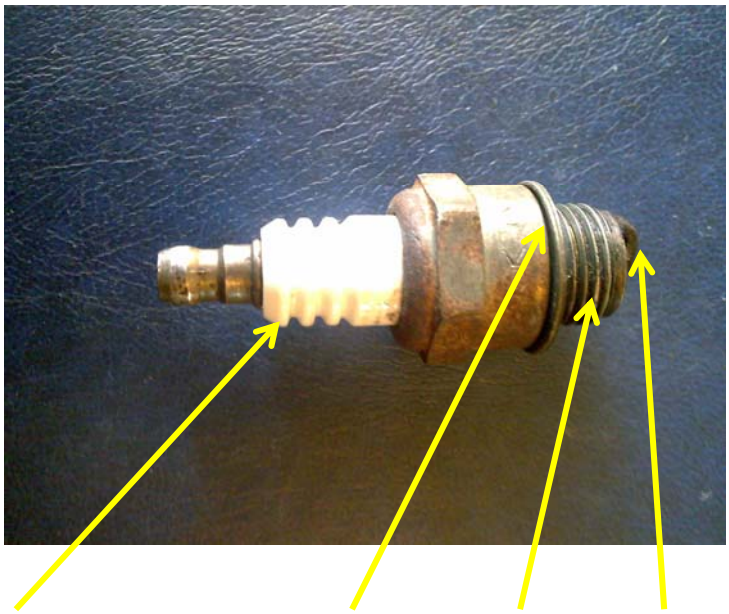
Testing an Engineering Part

During maintenance you may have to **test** some **parts or equipment:**

- is the shape correct and accurate?
- is it the right size?
- does it meet the specification?
- is it safe?
- does it look damaged
- does it do what it's supposed to do?

You are going to carry out the testing of an engineering part to decide if the part is reusable or needs repaired, replaced and/or cleaned.

The part you are going to test is a lawnmower spark plug so what are the different things that make up a spark plug?



Insulator Washer Thread Electrode

What does a spark plug do?

The lawnmower you will be maintaining has a petrol engine. The spark plug fits into the cylinder head of the engine and is protected by a spark plug cap.

The spark plug provides a spark which ignites the petrol inside the engine and this gives the engine the energy to work.

Activity: Removing a Spark Plug

You are now going to **safely** follow a maintenance **procedure** to remove the spark plug:

- Check the lawnmower throttle lever is in the off position
- Disconnect the spark plug cap
- Attached a box wrench onto the spark plug
- Place the box wrench bar in the box wrench
- Rotate the box wrench until the spark plug loosens
- Remove the spark plug by hand

EMPLOYABILITY

Did you listen to your tutor's instructions?

Activity: Testing an Engineering Part

3

After you have taken out the spark plug - fill in the table with what you think might make a spark plug not suitable for reuse:

Reasons not to reuse a spark plug
1
2
3
4

EMPLOYABILITY

Were you on time for classes?

Before you test any engineering part you should carry out a **visual inspection** to see if you can spot anything wrong.

For your spark plug do you think there are any of the following faults?

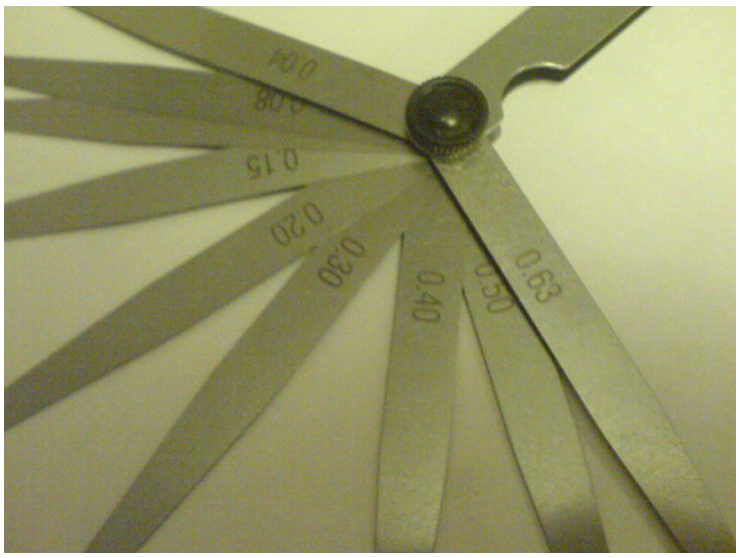
- chipped **insulator**
- cracked insulator
- deposits around the plug gap
- damaged thread
- damaged washer

EMPLOYABILITY

Did you use the correct tools safely?

Activity: Checking a Spark Plug Gap

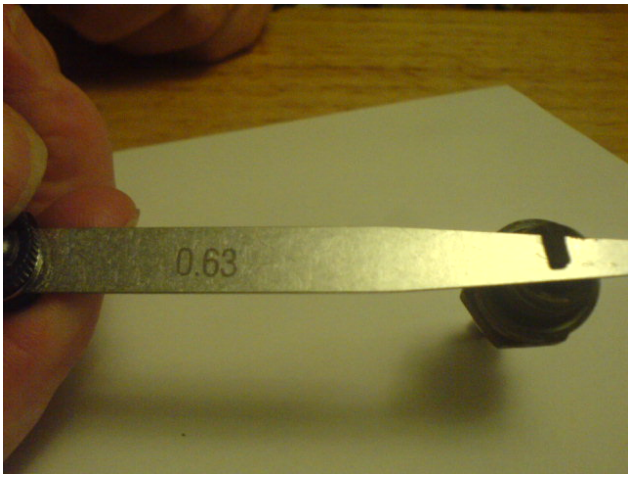
You can do the **test** as follows - you will need a steel feeler gauge:



The steel feeler gauge checks if the spark plug gap is correct.

Your tutor will let you know what size the gap should be for your spark plug.
Let's say the gap size for your spark plug should be between 0.6mm and 0.7mm, then which one of the gauge sizes above should you choose to test the size of the spark plug gap? Place this gauge in the gap.

Does your gauge fit inside the gap?



If your gauge does fit the gap then it has passed the test.

Before you put the spark plug back you should clean any deposits around the gap with a spark plug brush. Then do a final check to make sure that there is no other damage to the plug.

Cleaning a spark plug

If your gauge does **not fit** the gap it has not passed the test. Now you have to decide why the gauge did not fit?

Did deposits prevent the gauge fitting? You could clean the deposits with a wire brush and try the test again.

You could also try to bend the side electrode carefully.

If you still cannot fit the gauge into the gap, or if there is damage to the plug such as a cracked insulator, you must replace the plug with a new spark plug.

You have just tested and maintained an engineering part. You have decided if the part is:

- **reusable**
- **needs cleaned**
- **needs repaired, or**
- **needs replaced.**

The reason why maintenance is done – is to keep parts in good working order.

EMPLOYABILITY

Did you show a positive attitude?

Checking that an Engineering Part is Functional

Sometimes you cannot carry out a test and you have to decide if a part and equipment works correctly some other way. For example:

- damage is visible
- equipment does not start
- equipment is vibrating
- equipment is making a noise
- equipment is overheating
- equipment is giving off smoke and fumes
- equipment is not performing correctly.

A **visual inspection** means you can look to see if there is any damage.

The photos below show some damaged lawnmower parts. Why might these need to be repaired or replaced?

Damaged lawnmower blade

Frayed recoil starter cord

Activity: Maintenance Procedure: Removing a Lawnmower Blade

2, 3, 4, 5
6, 9

You are now going to **safely** follow a maintenance procedure to remove the lawnmower blade:

- check the lawnmower throttle lever is in the off position
- disconnect the spark plug cap
- tilt the lawnmower back and secure (If no means of securing in the back position is available – then tip over on its side away from the air **filter** side.)
- check for fuel and oil leaks
- place a wooden block through the lawnmower to prevent rotation of blade
- attach a box wrench onto the blade
- place the box wrench bar in the box wrench
- rotate the box wrench until the blade loosens
- remove the blade

Box wrench on blade nut

Hex socket and bar on blade nut (preferable if nut is very tight)

Activity: Checking the Functionality of an Engineering Part

After you have removed the blade - fill in the table below with some reasons why a blade is no use:

Reasons why a blade is no use
1
2
3
4
5

EMPLOYABILITY

Did you wear the correct PPE?

Before you decide if the blade works correctly you should carry out a **visual inspection** to see if you can spot anything wrong.

For your blade - do you think any of the following apply?

- blade has bits missing
- topside **bevel** edge (cutting edge) damaged or blunt
- **burrs** on lower edge
- blade may not be balanced (one half of blade is heavier than the other)
- damaged nuts
- damaged washer
- blade rusty and/or dirty

EMPLOYABILITY

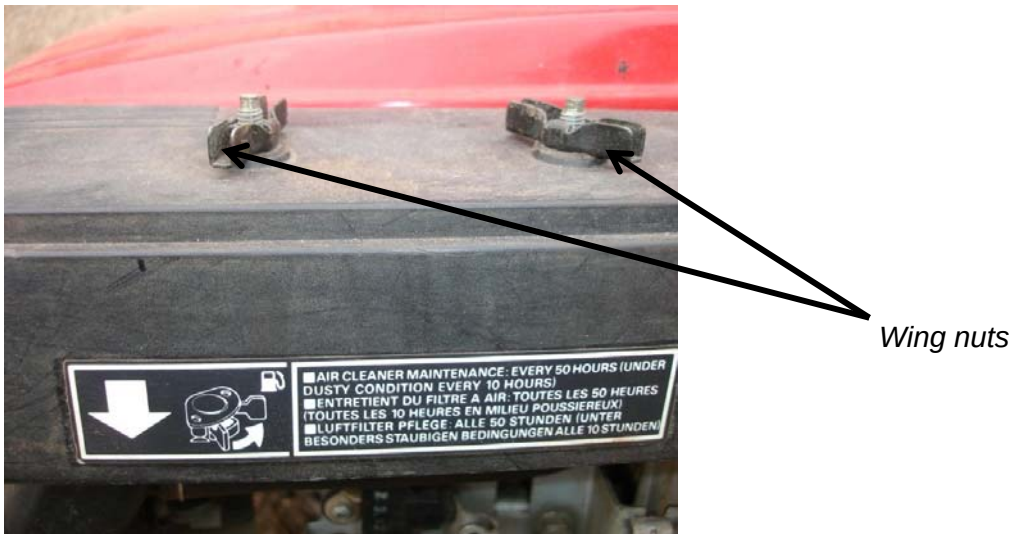
Have you attended classes?

2, 4, 6, 9

Activity: Checking the Air Filter

You are now going to check if the air filter is functional.

Where is the air filter? - Inside the air filter housing.



Air filter housing

You are now going to **safely** follow a maintenance procedure to remove the air filter:

- check the lawnmower throttle lever is in the off position
- disconnect the spark plug cap
- loosen and remove the wing nut
- remove the housing cover
- remove the air filter element

EMPLOYABILITY

Did you do the work **safely?**

Activity: Checking the Functionality of an Engineering Part

After you have taken out the **air filter** - fill in the table with the reasons you think might make the air filter no use:

Reasons why an air filter is no use
1
2
3
4

Before you decide if the air filter is working correctly you should carry out a **visual inspection** to see if you can spot anything wrong.

For your air filter do you think any of the following apply?

- grass or dirt clogging the filter element
- bits of filter element missing
- filter element soaked in excessive oil
- damaged wing nut
- damaged cover

Air filter elements blocked with grass and dust preventing the proper flow of air

Foam Filter

Cartridge filter (used and new)

Repairing an Engineering Part

You are now going to repair a lawnmower blade then re-assemble it back onto the lawnmower.
(You can use the blade you removed from the lawnmower earlier).

Activity: Maintenance Procedure for Lawnmower Blade

You are now going to **safely** follow a maintenance procedure to repair then reassemble a lawnmower blade:

- place the blade in a vice
- sharpen the blade (top side only) using a file and taking care to keep the original bevel edge
- clean the blade using a wire brush
- balance the blade using a balancer or place a bolt through the blade and insert into vice
- check the blade balance
- clean blade shaft
- place the blade on the blade shaft
- attach the blade nut to the blade
- place a wooden block through the lawnmower to prevent rotation of blade
- attach a box wrench onto the blade
- place the box wrench bar in the box wrench
- rotate the box wrench until the blade tightens
- ensure correct **torque** has been applied (from the **manufacturer**'s instructions)

EMPLOYABILITY

Did you follow instructions?

Maintaining Engineering Parts and Equipment

You are going to disassemble, re-assemble and carry out a range of lawnmower maintenance tasks:

- oil change (correct disposal of waste oil and waste materials)
- throttle control cable adjustment
- spark arrestor
- replace recoil starter cord
- check wheels and adjust cutting height
- check and adjust tightness of nuts, screws, engine head bolts, wing nuts and cables
- clean equipment
- prepare the lawnmower for winter storage

(Note: You may have to amend some of these procedures to suit your lawnmower)

Activity: Oil Change

2, 4, 5, 6
7, 8

You are now going to **safely** carry out an oil change:

- using the manufacturer's **drawings** locate the position of the oil drain plug
- check the lawnmower throttle lever is in the off position
- disconnect the spark plug cap
- tilt the lawnmower back and secure
- check for fuel and oil leaks
- place box wrench on oil drain plug
- insert box wrench bar into box wrench
- place approved waste oil container beneath drain plug
- rotate box wrench until drain plug is loose
- remove drain plug by hand
- drain oil
- replace drain plug and tighten with box wrench
- place lawn mower on ground
- from manufacturer's specification identify new replacement oil type
- remove oil filler cap
- refill with new oil to upper oil level on stick
- using cloth wipe clean oil stick and check new oil level
- replace oil filler cap

Activity: Throttle control cable adjustment

2, 3, 4, 6, 9

You are now going to **safely** carry out an adjustment of the throttle control cable:

- using the manufacturer's drawings locate the position of the:
  - choke arm
  - control lever
  - choke
  - throttle lever
  - lock nuts and adjuster
- disconnect the spark plug cap
- move the lawnmower throttle lever to the 'start' (choke) position
- check the position of the choke arm (it should have moved anticlockwise)
- loosen the control cable locknuts
- move the adjuster to suit
- tighten the lock nuts
- check the choke arm position (it should move fully anticlockwise)

EMPLOYABILITY

Did you check the drawings?

Activity: Spark arrestor maintenance

2, 3, 4, 6, 9

You are now going to **safely** carry out spark arrestor maintenance:

- using the manufacturer's drawings locate the position of:
  - spark arrestor screws
  - tail pipe
  - spark arrestor
  - spark arrestor plate
- remove the two spark arrestor screws
- remove tail pipe
- remove spark arrestor
- remove plate
- clean deposits using a fine wire brush
- replace the plate
- replace tail pipe
- replace the spark arrestor
- tighten screws

EMPLOYABILITY

Have you identified your strengths and weaknesses?

Activity: Replace recoil starter cord – maintenance procedure

You are going to make up a maintenance procedure to **safely** replace the recoil starter cord. – Fill in the table with what you think the steps should be and what PPE you may need for each step.

Replace recoil starter cord	Maintenance Steps	PPE
1		
2		
3		
4		
5		
6		
7		
8		

After your tutor has checked your maintenance procedure you can carry on and replace the recoil starter cord.

Activity: Replace recoil starter cord

You are now going to **safely** replace the recoil starter cord using your own maintenance procedure:

-
-
-
-
-

Activity: Carrying out Maintenance Tasks

3, 5, 6, 7, 8, 9

You are now going to **safely** carry out the following maintenance tasks:

- check wheels and adjust cutting height
- check and adjust tightness of nuts, screws, engine head bolts, wing nuts and cables
- clean **equipment**
- prepare the lawnmower for winter storage

EMPLOYABILITY

Have you taken action to improve your work and skills?

Frequency of maintenance

You have carried out a range of maintenance tasks on a lawnmower but how often do you think you will need to carry out these tasks? For example how many times should you do an oil change; change the air filter; check the spark plug?

The answer will depend on a number of factors:

- are there stones in the grass
- is the ground uneven
- is the area dry and dusty
- has the lawnmower been used properly
- the age of the lawnmower
- has the lawnmower been in long term storage
- how many hours has the lawnmower been cutting grass since it was last maintained
- is there any visible damage
- is there any vibration
- is there any smoke or fumes
- is there any heat
- does the lawnmower sound normal
- has the lawnmower hit something?

The manufacturer will specify a maintenance schedule and give you average **maintenance periods** that tell you how often each task should be done for average conditions.

Activity: Identify maintenance periods and make up a maintenance schedule

You are going to make up a maintenance schedule for your lawnmower – fill in the table with what you think you need to do and how often it should be done eg. weekly, monthly.

Maintenance Tasks	What Type of Maintenance	Maintenance Period
1		
2		
3		
4		
5		
6		
7		
8		

Unit Questionnaire

This questionnaire is designed to help your lecturer find out how you feel about this unit.

You don't need to put your name on this questionnaire.

Instructions: Please complete this form by placing ✓ in the most appropriate box.

Unit Title:				
Lecturer's Name:			**Date:**	
		Strongly Agree	**Agree**	**Disagree**
1	The induction to this unit was helpful.			
2	My teacher/lecturer helped me through this unit.			
3	The resources and equipment were suitable.			
4	All Health and Safety information and practices were effective.			
5	My teacher/lecturer prepared me well for assessments.			
6	I was given constructive feedback.			
7	I was kept informed of my progress regularly.			
8	I enjoyed this subject.			

Please add any comments you feel are important to make this subject better:

Thank you for completing this questionnaire.

Glossary of Terms

Term	Meaning
Assembly	when you put parts together
Bevel	when you cut or file an edge at an angle
Burr	a rough edge on metal caused by cutting or drilling
Disassembly	when you separate parts from each other
Drawings	a diagram or sketch of something
Equipment	a collection of parts that work together
Fastener	something that hold parts together
Filter	a part that stops or helps something to enter
Functionality	the way something works
Gauge	a tool to measure something
Instruction	the way you must do something
Insulated	protection by material to stop the flow of electricity
Insulator	a part that stops the flow of electricity
Maintenance	a part or equipment you care for and keep working
Manufacturer	the people who made something for you
Part	a small piece or bit of equipment
Period	the time when you have to do something
Procedure	a way of doing something
Repair	when you get something to work the way it should
Replace	when you take an old part out and put a new part in
Schedule	a timetable or plan of something that is going to be done
Spark plug	causes a spark to ignite the fuel
Specification	lists detail of equipment such as size, weight, type
Test	when you check something works correctly
Torque	when you make sure something is tight the way it should be

These boxes are for you to add any other terms that you use during the course:
