

Unit 27: Motorsport Workshop Practices

NQF level 3: BTEC National

Guided learning hours: 60

Unit abstract

This unit will give learners an understanding of the safe operating procedures of a trackside/temporary vehicle workshop and enable them to appreciate relevant health and safety issues in terms of risk to self and others. Learners will also develop the skills needed to use various tools, fasteners, materials and manufacturing processes when servicing, preparing and maintaining a motorsports vehicle.

The unit is designed to prepare learners for trackside operations and reinforce their understanding of the need for safe working practices. Learners will develop an understanding of the ways that actions can reduce the risk to employees, others and vehicles in a temporary workshop at an outdoor motorsport event. In addition, learners will gain an appreciation of the procedures required to deal with trackside incidents.

Learners will also develop the skills needed to use tools and equipment, including hand and power tools, through carrying out disassembly and reassembly tasks. This will involve an understanding of fasteners and materials used in motorsport vehicle construction, and their appropriate usage.

Finally, the unit introduces learners to the properties of engineering materials and their specific applications for motorsport engine and chassis components.

Learning outcomes

On completion of this unit a learner should:

- 1 Understand how to maintain good housekeeping and health and safety procedures at an outdoor motorsport event
- 2 Be able to select and use appropriate tools and equipment for the disassembly and reassembly of motorsport vehicle components
- 3 Understand how and why temporary and permanent fasteners are used for specific motorsport applications
- 4 Be able to select an appropriate material for specific motorsport applications.

Unit content

1 Understand how to maintain good housekeeping and health and safety procedures at an outdoor motorsport event

Actions to reduce risk: risk to employees eg correct use of personal protective equipment (PPE), safe use of tools and equipment, safe use of fuels and lubricants; others eg containment of hazardous substances, working areas clearly marked, warning signs correctly used and clearly visible; vehicles eg correct use of lifting and supporting equipment; housekeeping eg relevant regulations/codes of practice (Health and Safety at Work Act, Control of Substances Hazardous to Health (COSHH)), workshop areas kept separate from pedestrian areas at all times

Dealing with incidents: emergencies eg personal injury, fire, spillage, equipment failure, area evacuation, inhalation of noxious fumes; accidents eg slips, trips, falls, collision; immediate actions eg evacuate/cordon off area, report/fight fire, quarantine emergency; follow-up actions eg clear away spillage and dispose of waste, document incident, administer first aid, inform emergency services

Outdoor motorsport event: eg rallying, go-karting, closed-circuit competition, off-road racing, motocross, sprint, hill climbs

2 Be able to select and use appropriate tools and equipment for the disassembly and reassembly of motorsport vehicle components

Tools and equipment: hand tools eg spanners, screwdrivers, ratchets and sockets (metric and imperial); tool size recognition; power tools relevant to speed and efficiency at trackside eg pneumatic/electric ratchets, drills; measuring tools eg micrometer, vernier callipers, gauges; lifting and stabilising equipment eg hoists, trolley jacks, axle stands

Disassembly/reassembly: components eg body and chassis components in the event of a crash (panels and steering components), engine disassembly and reassembly; tasks eg maintenance, servicing consumable components at trackside, repair

3 Understand how and why temporary and permanent fasteners are used for specific motorsport applications

Temporary fasteners: for components requiring frequent maintenance or replacement eg 'R' clips, split pins, nuts and bolts, quick release fasteners

Permanent fasteners: for components that do not require regular replacement or removal for maintenance eg rivets, locking nuts, stretch bolts, shear bolts; alternative methods eg the bonding of polymers, glass fibre and carbon, plastic welding, glue

4 Be able to select an appropriate material for specific motorsport applications

Material selection: mechanical properties eg strength, hardness, ductility, durability, density and mass; performance versus weight; finish eg professional appearance for chassis components, weight and aerodynamic properties; aesthetic, ergonomic and durable properties; types of material eg metallic alloys and non-metallic materials used in engine tuning, Kevlar, glass fibre; special treatments to obtain required properties eg shot/laser peening, heat treatment, specialised coatings; effects of loading eg compressive/tensile stress, fatigue, stress corrosion

Motorsport engine component: eg pistons, connecting rods, crankshafts, camshafts, valves, engine mounting brackets

Motorsport chassis components: eg steering components (such as steering racks and uprights), braking components (such as callipers and discs), suspension components and body panels

Grading grid

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all of the learning outcomes for the unit. The criteria for a pass grade describe the level of achievement required to pass this unit.

Grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
<p>P1 explain the ways that actions can reduce the risk to employees, others and vehicles in a temporary workshop at an outdoor motorsport event</p> <p>P2 describe the immediate and follow-up actions to be taken to deal with two different types of incidents at an outdoor motorsport event</p> <p>P3 select and use the most appropriate tools and equipment to efficiently disassemble a motorsport vehicle component</p> <p>P4 select and use the most appropriate tools and equipment to efficiently reassemble a motorsport vehicle component</p> <p>P5 identify and describe the use of three different temporary fasteners with regard to suitability for purpose in motorsport applications</p>	<p>M1 take the necessary action to deal with an incident at an outdoor motorsports event</p> <p>M2 select and justify the use of two different fasteners for use in motorsport competition critical applications</p> <p>M3 explain and justify the differences in surface finishing techniques used for a motorsport engine compared to a mass produced engine.</p>	<p>D1 evaluate a temporary workshop at an outdoor motorsport event for potential hazards and recommend action to be taken</p> <p>D2 compare the differences in the material selection criteria for a specific vehicle component used on both production and motorsport vehicles.</p>

Grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
<p>P6 identify and describe the use of three different permanent fasteners with regard to suitability for purpose in motorsport applications</p> <p>P7 research and select a material for a given motorsport engine component application</p> <p>P8 research and select a material for a given motorsport chassis component application.</p>		

Essential guidance for tutors

Delivery

Delivery of this unit is likely to follow the sequential order of the learning outcomes.

Learning outcomes 1 and 2 cover workshop practice within the context of an outdoor event (ie working in a temporary/field workshop as opposed to a fixed permanent facility). *Unit 28: Motorsport Vehicle Preparation and Inspection* covers very similar ground but from the perspective of a permanent facility.

Learning outcomes 3 and 4 are more general and look specifically at temporary and permanent fastenings used for motorsport vehicles and also at material properties in terms of how materials are selected for motorsport vehicle applications.

Because of the very nature of motorsport events, delivery of learning outcome 1 must immerse learners in a wide range of health and safety issues. Many more people could potentially be involved in an incident at a motorsports event than within a confined automotive workshop. Therefore, learners must have a competent working knowledge of the required safety procedures to ensure the safety of personnel, spectators and vehicles.

Delivery must focus on ensuring learners understand the actions required to reduce risk to those directly involved with motorsports vehicles and others (eg spectators, guests, visitors). This will involve raising learners' awareness of the importance of tools, equipment and consumables being kept in their rightful place, so as not to cause hazard by way of obstacle, slips or trips. Also, that even in 'self-contained' temporary workspaces at events, it is still important that relevant codes of practice for safety and materials storage and handling (eg Health and Safety at Work Act, COSHH) are strictly adhered to in order to ensure minimum risk.

In particular, high-speed vehicles are a constant hazard to service and support crew unless health and safety procedures are rigidly observed. Service personnel must be aware of how to deal with an incident and the relevant safety procedures to be observed in the event of a collision (vehicle/vehicle or personnel/vehicle) or other incident. Delivery of the unit must ensure that learners are aware of the appropriate action to be taken in such incidents to ensure the safety of personnel, spectators and vehicles.

The delivery of the 'dealing with incidents' section of the unit must also ensure that learners are aware of the regulations regarding fire safety (eg which extinguisher to use on what type of fire, actions to be taken in the event of a fire). For example, motorsport vehicles may use materials that pose specific risks when burning (eg magnesium, fibre glass and other non-metallic materials), give off noxious fumes, or require specialist treatment (eg burns from burning rubber or plastic components). Post-incident procedures and effective incident documentation must also be effectively in place to ensure the continued safety of personnel and spectators (eg disposal of harmful waste, spillage control).

Learners must be made aware that for each individual motorsport event, there are specific and general risks which apply whether the event is tarmac-based, off-road, rallying, karting, or any other outdoor motorsport event. Centres should ensure that the methods of delivery are such that each learner has a working knowledge of the risks and how to deal with them irrespective of the type of event.

Learning outcome 2 considers tools and equipment and their use to disassemble and reassemble components. The focus of this unit is set within the context of

trackside work and this should be reflected in the delivery methods used for this section of the unit. During a motorsports event speed is vital and the vast majority of work is time-critical. However, this should not be at the expense of accuracy.

Delivery of this section must ensure that learners are able to select and use the correct tools to complete any job and without compromising either the tools or components. Hand tool selection should cover the range of tools listed in the unit content (eg spanners, screwdrivers, ratchets and sockets). Learners should be given sufficient practise with tools to ensure that they are able to recognise different tool sizes, as this can be a critical factor in the speed with which a job is completed. This section should also deal with the use of power tools, which are critical for speed at trackside and to complete service and disassembly/reassembly swiftly during events. Again, it is expected that delivery will introduce learners to tools such as air powered/electric ratchets and drilling machines.

In addition to the use of hand and power tools, it is expected that the range of measuring tools (eg micrometer, vernier callipers, gauges), lifting and stabilising equipment (eg hoists, trolley jacks, axle stands) will also need to be covered during delivery.

Learning outcome 3 focuses on the fasteners used for assembly and disassembly. For applications where service adjustments or component substitutions are made frequently, temporary fasteners must be used. There are many factors involved in the selection of such fasteners, such as the load placed on the fastener, the frequency and required ease of removal and replacement, the type of material to be joined, and the required joint strength of the fastener. During delivery learners should be encouraged to compare the relative merits, suitability and purpose of a variety of temporary fasteners and joining methods (such as nuts/bolts, r-clips, split pins, cable ties, push rivets and quick release fasteners).

For situations where components are removed and replaced infrequently, if at all, fastenings that are more permanent may be required. Once again, delivery should ensure that learners have the widest possible experience of such fastenings. For example, learners should gain experience with rivets, self-clinching fasteners, self-tapping screws, vibration-proof and self-locking fasteners, tamper-proof or shear bolts and screws. Some of the fasteners may overlap (such as nuts and bolts) but in such cases it is important to focus on the key aspects of the fastenings (eg thread size, pitch, material construction and properties such as tensile strength, shear strength and hardness) through workshop/classroom-based investigations.

Learners should also be given an opportunity to investigate and apply alternative permanent joining techniques for a variety of materials (such as polymers, glass fibre and carbon) which are now frequently used in modern motorsport vehicles.

Delivery of learning outcome 4 should focus on the materials used for motorsport components. Learners will need to develop their ability to select materials based upon the mechanical properties, required finish, the type of material and its suitability for a particular task. For most motorsport applications performance versus weight will always be an important factor in final choice. Providing learners with an opportunity to work with materials (eg cutting, bending, fabricating) would reinforce the theoretical aspects of material properties. There is also a link back to learning outcome 1 that could be reinforced here in terms of the health and safety issues surrounding the use of materials in an engineering environment (eg working with fibre glass, metals such as aluminium, steel, stainless steel and alloys).

Learners should also be given an opportunity to investigate the surface treatment of motorsports engine components. For example how shot peening, laser peening, heat treatment and the use of specialised coatings increase a component's ability

to withstand compressive stress and reduce the effects of fatigue or stress corrosion, and protect against oxidation.

The range of materials to be covered during delivery will very much depend upon the main motorsport focus in a centre. In general, when looking at how metals are used in motorsport vehicle construction, learners should investigate the types of alloys typically used (eg duralumin, Alclad and magnalium) and the various applications of these materials (eg use for body skins, spars and stiffeners). They should also look at applications where stronger more lightweight metals are required (eg magnesium, stainless steel and titanium alloys) and alternative non-metallic materials (eg carbon fibre, Kevlar and fibre glass).

The most important aspect about the delivery of learning outcome 4 will not be coverage of an extensive range of materials but that learners have a good grasp of the important features of material properties and their range of applications in motorsport engine and chassis components.

Assessment

Assessment of this unit is likely to be through the use of four assignments, one for each learning outcome.

The first assignment could cover learning outcome 1 and the related criteria (P1 and P2). The assignment could also be designed to provide an opportunity to work towards M1 and D1.

To achieve P1, learners must be able to explain the ways in which actions can reduce the risk to employees, others and vehicles in a temporary workshop at an outdoor motorsport event. The evidence for this criterion could be achieved through a time-constrained test. However, it is recommended that a much better approach would be for learners to produce their own observation record during one or more actual events. The record could be in the form of a logbook in which learners record their observations in such a way as to cover risks to employees, others and vehicles and housekeeping.

P2 could be dealt with in a similar way to P1. Although learners might have had experience of or witnessed an emergency/accident, the use of role play or a 'what if' scenario is a much more likely means of gathering evidence.

M1 can be linked to P1 and P2 and evidence is likely to be in the form of tutor observation of the learner's performance during a particular incident (which could be real or simulated). There is a further link through to D1, for which learners need to use their understanding from P1, P2 and M1 to carry out a risk assessment. It is important that the situation used provides learners with an opportunity to make recommendations for action to be taken (ie there needs to be some real or simulated problems in the temporary workshop). In order to gain D1, learners must attend a competition event and carry out the risk assessment. Centres must therefore make adequate provision for this to happen.

The two pass criteria associated with learning outcome 2 (P3 and P4) cover the disassembly and reassembly of components. For P3, learners will require a specific task to be set for them to disassemble a motorsport vehicle component. The tools that learners select and use will be determined by the task and therefore, not all the unit content is necessarily going to be covered. Centres should, however, ensure that the choice of component demands the use of a reasonable number of the items listed in the unit content (eg hand tools, power tools, measuring tools, lifting and stabilising equipment). The same would apply to P4 but for reassembly.

The evidence for P3 and P4 is likely to be in the form of a tutor observation record supported by the learner's own records of how they dealt with the tasks. This could be in the form of a technical report or logbook.

P5 and P6 relate to learning outcome 3, which covers temporary and permanent fasteners. Learners will need to identify and describe the use of three different temporary fasteners and three different permanent fasteners with regard to suitability for purpose in motorsport applications. Although it would be possible to assess these criteria using a written test, a more practical approach is recommended. There is an opportunity to link the work undertaken for P3 and P4 with this learning outcome, since it is likely that when disassembling and reassembling components learners will experience such fastenings.

Such an integrated approach could also be used to assess M3. An extension task could be built onto the work done for P3, P4, P5 and P6 requiring learners to select and justify fastening within a maintenance or repair task.

Learning outcome 4 is covered by P7 and P8, which also link to M3 and D2. In order to meet P7 and P8, evidence of independent research of the materials involved must be shown. For both P7 and P8, learners are expected to research and select a material for a given motorsport engine and chassis component application, respectively. The components selected for this task must enable learners to investigate the mechanical properties of a material, issues of performance versus weight, the material's finish, and any aesthetic, ergonomic and durable properties as appropriate to the component. The types of material investigated could be chosen from the list of examples in the content (eg metallic alloys and non-metallic materials used in engine tuning, Kevlar, glass fibre) or any other relevant material. It is expected that special treatments to obtain required properties and the effects of loading will be dealt with for at least one of the components (ie either for the engine component or chassis component). This could then be linked through to M3 and D2.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit contributes can contribute towards the underpinning knowledge and understanding in the Automotive Skills Level 3 National Occupational Standards in Vehicle Maintenance and Repair, particularly:

- Unit G1: Contribute to Workplace Good Housekeeping
- Unit G2: Ensure Your Own Actions Reduce Risks to Health and Safety
- Unit MR11: Overhaul Mechanical Units.

The unit also supports the SEMTA Level 3 National Occupational Standards in Automotive Engineering, particularly:

No 9: Assembling Vehicle Body Sub-Assemblies.

Essential resources

Learners will need access to outdoor motorsports events at which they can take an active part in field/temporary workshops. Centres will also need to have workshop facilities fitted with a range of the tools and equipment listed in the unit content. A range of fastenings and components (engine and chassis) will need to be available for demonstration purposes and for learner to work with. Learners will also need access to sufficient data and research resources to enable them to study and research different engineering materials for motorsports applications.

Indicative reading for learners

Health and Safety Executive — *Essentials of Health and Safety at Work, Third Edition* (HSE Books, 1994) ISBN 07170716X

Health and Safety Executive — *Five Steps to Risk Assessment* (HSE Books, 1998) ISBN 0717615650

Health and Safety Executive — *A Short Guide to Personal Protective Equipment at Work Regulations 1992* (HSE Books, 1995) ISBN 0717608891

Key skills

Achievement of key skills is not a requirement of this qualification but it is encouraged. Suggestions of opportunities for the generation of level 3 key skill evidence are given here. Staff should check that learners have produced all the evidence required by part B of the key skills specifications when assessing this evidence. Learners may need to develop additional evidence elsewhere to fully meet the requirements of the key skills specifications.

Communication Level 3	
When learners are:	They should be able to develop the following key skills evidence:
<ul style="list-style-type: none"> reading relevant regulations and codes of practice to establish guidelines for workshop housekeeping and health and safety preparing technical reports on health and safety issues, disassembly/reassembly tasks, fastenings and materials. 	<p>C3.2 Read and synthesise information from at least two documents about the same subject. Each document must be a minimum of 1000 words long.</p> <p>C3.3 Write two different types of documents each one giving different information about complex subjects. One document must be at least 1000 words long.</p>
Application of number Level 3	
When learners are:	They should be able to develop the following key skills evidence:
<ul style="list-style-type: none"> carrying out calculations on material properties and behaviour selecting materials based upon mechanical properties. 	<p>N3.1 Plan an activity and get relevant information from relevant sources.</p> <p>N3.2 Use this information to carry out multi-stage calculations to do with:</p> <ol style="list-style-type: none"> amounts or sizes scales or proportion handling statistics using formulae. <p>N3.3 Interpret the results of your calculations, present your findings and justify your methods.</p>

Information communication technology Level 3	
When learners are:	They should be able to develop the following key skills evidence:
<ul style="list-style-type: none"> searching for relevant information on regulations and codes of practice to establish guidelines for workshop housekeeping and health and safety searching for information and preparing technical reports on health and safety issues, disassembly/reassembly tasks, fastenings and materials. 	<p>ICT3.1 Search for information, using different sources, and multiple search criteria in at least one case.</p> <p>ICT3.2 Enter and develop the information and derive new information.</p> <p>ICT3.3 Present combined information such as text with image, text with number, image with number.</p>
Problem solving Level 3	
When learners are:	They should be able to develop the following key skills evidence:
<ul style="list-style-type: none"> researching and selecting a material for a motorsport engine/chassis component 	<p>PS3.1 Explore a problem and identify different ways of tackling it.</p> <p>PS3.2 Plan and implement at least one way of solving the problem.</p> <p>PS3.3 Check if the problem has been solved and review your approach to problem solving.</p>