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TRAINING MATERIAL

FOR ASSESSING THE RISK IN

CARS REPAIR WORKSHOPS



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M6-EN.1 INTRODUCTION

M6-EN.1.1 Scope and structure of the training module

M6-EN.1.1 Scope and structure of the training module

Scope of the present module is the training of the employees in a motor vehicle repair workshop on the identification of the main hazards related to their operations and the provision of “Safety Precautions” for the establishment of a safe and healthy work environment.

The module presents the different hazards in the main activities that take place in a motor vehicle repair workshop. At the same time, an effort is made to keep the main categorization of hazards, as follows:

Electrical hazards: Injuries from electrical shocks in garages occur mainly due to poor electrical standards, not appropriate electrical installations, false equipment, weak inspection and maintenance.

Electrical hazards may exist in all sections of a motor vehicle repair workshop and can either result in an even fatal electrical shock of operators, or become source of ignition (spark) leading to fire or explosion.

Mechanical hazards: These are related to the use of mechanical equipment, during operations such as lifting, wheel alignment and balancing, cutting and welding, use of compressed air, etc. The consequences of the mechanical hazards vary from small injuries to fatal accidents. Regular maintenance of the mechanical equipment from competent personnel and use of the equipment from appropriately trained operators minimize the probability of the related risks.

Work in inspection pits is also included within the present category of hazards.

Chemical hazards: These are related to: **(a)** the products being used in a motor vehicle repair workshop, such as paints and thinners, body fillers and hardeners, petrol, used engine oils, cleaning solvents for vehicles' valenting, and **(b)** the chemicals being released during different processes, such as running engines (exhaust fumes), welding, charging of batteries (hydrogen), body filling, paint spraying (isocyanates), brake and clutch lining (asbestos). Exposure to chemical hazards affects the worker's health and may have both short and long-term effects. The installation of effective ventilation systems, the implementation of safety procedures in the handling of chemical hazards and the use of appropriate PPEs reduce the risks from the chemical hazards. In addition to the health effects, the accumulation of vapours emitted from products being used may create explosive atmosphere, while other products, such as petrol and engine oils are flammable. The presence of ignition sources in these cases may lead to explosion and fires. Therefore, special safety precautions need to be taken.

Noise and Vibration: They are both serious health hazards. Noise is a hazard present in most of a motor vehicle's repair workshop sections, while vibration mostly affect operators working in the body repair section. Both, noise and vibration may be reduced with the proper installation, maintenance and use of the equipment.

Electromagnetic Radiation: This is a hazard present during the flame cutting and welding processes

Other hazards: These are hazards related to the general working environment. The working conditions, such as housekeeping, hygiene and welfare, lighting and comfort include all different types of hazards that affect both the safety and health of the workers and need to be assessed.

Explosions and Fire Fighting: Most of the chemicals found in a motor vehicle repair workshop, such as petrol, engine oils, paints, solvents, hydrogen and grinding dusts are at one hand flammable, but at the other hand create an explosive atmosphere due to emitted vapours and dusts. At the same time the existence of ignition sources, such as sparks, static electricity, vehicle's exhaust, require the establishment of both safety procedures against explosions and fire fighting procedures. Therefore a separate chapter is attributed to explosive atmospheres and the key elements of fire fighting procedures that should exist in a workshop.

Given that several activities in a motor vehicle repair workshop include many of the above hazards, special reference is given to specific activities and an effect/hazard-activity matrix is provided. At the end of the module a relatively detailed checklist is included, that is separated into different parts: a) the general one that applies to all activities b) the specific ones adjusted to the main sections found in a motor vehicle repair workshop, meaning the servicing and mechanical repair section, the body repair section (activities: cutting, welding), and the painting section, and c) the one related to the working conditions. This checklist is not exhausted, but it can be used from the employees in order to perform an initial risk assessment of their workplace and to be in position to provide accurate and well-justified feedback to their employers in order corrective actions to be taken. It is essential to point-out that the present module does not get into in-depth analysis of the possible effects of all hazards, since such an analysis is beyond the scope of the current effort and these effects are expected to be managed by qualified safety engineers and not by the workers themselves.

M6-EN.2 ELECTRICAL HAZARDS

M6-EN.2.1 Introduction

M6-EN.2.2 General Safety Precautions

M6-EN.2.3 Electrical Panel

M6-EN.2.4 Overloaded Circuits and Extension Cords

M6-EN.2.1 Introduction

Electricity is one of the main causes of injuries, fatal accidents and fires. Accidents can happen when people touch part of a unit carrying live current. If the insulation becomes faulty, even contact with part of a unit, which does not normally carry live current can lead to serious accidents. Electric current can also cause burns. Again, if the insulation is faulty and there is a short circuit, intense heat can develop, leading to the possibility of a serious fire.

The main **electrical hazards** are:

- contact with live parts causing electric shock and burns (normal mains voltage, 230 volts AC, can cause death)
- faults which could cause fires
- fire or explosion where electricity could be the source of ignition in a potentially flammable or explosive atmosphere, (e.g. in a spray paint booth, during welding, if there is spilt petrol or flammable liquids)

Most incidents related to electricity result in from:

- unsafe work practices
- improper equipment use
- faulty equipment

An electrical system consists of the electrical panel, the electrical circuits and wiring, and the electrical equipment being connected to the system. The following sections provide some general safety precautions against electrical hazards in a workplace, as well as safety tips for the electrical panel, the overloaded circuits and the extension cords that can be found extensively in vehicle repair workshops.

M6-EN.2.2 General Safety Precautions

- Use electrical equipment according to the established safety rules and the manufacturer's instructions
- Report any failure and/or problem of the equipment being used. Require to be repaired by a competent electrician
- Any damaged or suspect electrical cord must be repaired or replaced
- Never use temporal and unsafe electrical connections (**M6.2.1.jpg**)

- Plugs and lamps must have properly connected cables. The cable restraint or grip should effectively fasten the sheath of the cable in order to prevent the cable cores from pulling free of terminal posts
- Install all electrical equipment and wiring properly and with certain circuit protection
- Before using a component, it should be evaluated to determine whether it could tolerate the environment to which it will be exposed. Physical abuse and stress on any component should be minimized by the selection of a safe location and by the use of stress/strain relief devices
- Electrical machine installations should be equipped with relays that trip when the current is too low or when there is a power cut. The relay has to reset before the machine restarts when the current has reached its normal level
- Be aware that sparks from electrical equipment can serve as ignition source for flammable or explosive vapours or combustible materials
- In workshops, all parts of the fixed electrical installation should be at least one metre above floor level (**M6.2.2.jpg, M6.2.3.jpg**) to remove the risk of igniting spilt petrol or flammable liquids
- Portable 240-volt tools and hand lamps and their plugs, sockets and flexible leads are often sources of electric shock and burn accidents, some of which are fatal. Therefore, air-operated hand tools are recommended

Employers are required to:

- Arrange the inspection, testing and maintenance of wiring and all electrical equipment by a competent person, periodically. Fixed electrical installations is recommended to be tested every five years by a qualified electrician
- Keep a record of all inspections, testing and maintenance work carried out
- Arrange inspection of portable and flexible leads and connected plugs as often as once a week by a competent person
- Ensure that the safety system of all machines and tools is performing correctly

Good practices

- Consider the use of air tools or cordless or low-voltage (110 or 50 V) equipment when possible, since poorly maintained portable 240-volts electrical equipment and hand lamps are of major concern in motor vehicle repair
- Install a Residual Current Device (RCD) protection for each electrical socket

M6-EN.2.3 Electrical Panel

Electrical panel (or breaker box) is an insulated panel on which electrical wires are mounted. It consists of a) the Main Breaker, on which the maximum amperage that a service panel may deliver at one time is marked, and b) the Branch Circuit Breakers, that control individual areas / devices. (**M6.2.4.jpg, M6.2.5.jpg**)

Circuit breakers are protective devices controlling the power going to a particular route of wiring. A circuit breaker should be a switch that must be tripped automatically by a failure in the electrical system, usually an overload that could cause the wires to heat up or even

catch fire. According to the regulations, the maximum amperage that a **circuit breaker** is allowed to deliver is set to be **30 mA**.

Safety Recommendations

- Do not disconnect or tape circuit switches, in order to keep a breaker from tripping
- If a fuse, blows or circuit breaker trips repeatedly while in normal use (not overloaded), a check is essential for shorts and other faults in the line or devices. Its use must not be resumed until the trouble is identified and fixed by competent personnel
- Breaker circuits must have accurate labels within the panel box, indicating what equipment or power source they control
- Panel box must have doors attached with secure. Only authorized personnel should have access to it
- Never block panel boxes. There should be a clear space around it at all times to permit ready and safe operation and maintenance
- Employees must know the location of electrical panels in order to disconnect switches in or near their work area so that power can be quickly shut down in the event of a fire or electrical accident. To enhance safety, it is better to post the location of the electrical panel on the equipment it services
- Electrical panels must have warning labels, as the following:



M6-EN.2.4 Overloaded Circuits and Extension Cords

Overloading circuits by hooking on more electrical devices than they were designed to handle is a common problem. Overloading the electrical circuits by using extension cords and multi-plug outlets is hazardous. Some symptoms of an overloaded circuit can be dimmed lights, reduced output from heaters, poor monitor pictures, or even overheating of electrical equipment and possible fire hazard. In order to avoid overloading, employers must take care to provide a generous number of socket outlets on pillars and walls above bench level to reduce the number and length of trailing leads. The total load at any time must be kept safely below maximum capacity.

Safety Precautions

- Do not create an ‘octopus’ by inserting several plugs into a multi-plug outlet connected to a single wall outlet (M6.2.6.jpg, M6.2.7.jpg)
- Use extension cords only when necessary and only on a temporary basis. Improper use could result in a fire or shock hazard.

If an extension cord has to be used then:

- Select the size of the cord in order to be large enough for carrying the electricity necessary to operate the tool or appliance

- Use polarized extension cords with polarized appliances
- Make sure that extensions cords in use do not hang down from the counter or table tops where they can be pulled down or tripped over
- Replace cracked or worn extension cords with new
- With cords lacking safety closures, cover any unused outlets with electrical tape or with plastic caps to prevent the chance of making contact with the live circuit.
- Insert plugs fully so that no parts of prongs are exposed when using the extension cord
- When disconnecting cords, pull the plug rather than the cord itself
- Use only three-wire extension cords for appliances with three-prong plugs. Never remove the third (round or U-shaped) prong, which is a safety feature designed to reduce the risk of shock and electrocution
- Check the plug and the body of the extension cord while the cord is in use. Noticeable warming of these plastic parts is expected when cords are being used at their maximum rating, however, if the cord feels hot or if there is a softening of the plastic, this is a warning that the plug wires or connections are failing and that the extension cord should be discarded and replaced
- Never use an extension cord while it is coiled or looped. Never cover any part of an extension cord with newspapers, clothing, rugs, or any objects while you use it
- Never place an extension cord where it is likely to be damaged by heavy equipment or foot traffic (**M6.2.8.jpg**)
- Avoid placing extension cords along walkways and corridors
- Do not use staples or nails to attach extension cords to a baseboard or to another surface. This could damage the cord and present a shock or fire hazard
- Do not overload extension cords by plugging in appliances that draw a total of more watts than the rating of the cord. Overloading causes them to overheat creating a fire hazard
- Use special, heavy-duty extension cords for high wattage appliances
- When using outdoors tools and appliances, use only extension cords labelled for outdoor use

M6-EN.3 MECHANICAL HAZARDS

M6-EN.3.1 Introduction

M6-EN.3.2 Lifting Equipment

M6-EN.3.3 Vehicle Inspection Pits

M6-EN.3.4 Wheel Alignment and Balancing

M6-EN.3.5 Rolling Roads and Brake Testing Equipment

M6-EN.3.6 Vehicles Testing

M6-EN.3.7 Compressed Air Equipment

M6-EN.3.8 Steam and Water Pressure Cleaners

M6-EN.3.1 Introduction

Mechanical hazards are related to the machinery being used in the workshop. In any case the machinery or equipment being purchased must meet safety requirements, and preferably be CE marked. All protection/guards, maintenance and safety instructions must be included and no extra protection should be needed for the operator. During the installation of a machine, care must be taken ensuring that all guards are properly fixed and used. It is important the safety device not to constitute an obstacle to work, and not to hamper the maintenance services of the machine. Often, accidents happen when machines are accidentally started during maintenance and repair work. Therefore, careful servicing of machines is most important when it comes to work safety.

In a motor vehicle repair workshop the main mechanical hazards are related to the:

- Lifting equipment
- Vehicle inspection pits
- Wheel alignment and balancing
- Rolling roads and brake testing equipment
- Vehicle testing
- Compressed air equipment
- Cutting and welding processes (due to the nature of the hazards related to these processes these processes they will be discussed in the Chemical hazards section)
- Grinding machines and grinding wheels (**M6.3.1.jpg, M6.3.2.jpg**)

M6-EN.3.2 Lifting Equipment

Lifting equipment being used in a motor vehicle workshop is mainly:

- Hoists (Used for raising a vehicle to an ergonomic working position)
- Lifting platforms
- Jacks in conjunction with axle stands

For safety reasons **lifting equipment must not be overloaded**. If specific parts are stressed beyond rated capacities, vital parts may become worn and finally break.

Therefore, the manufacturer's recommendations have to be respected and followed. In order to avoid worn parts **a trained operator must inspect the lifting equipment on a regular basis.**

Lifting operation involving lifting appliances always put the worker at risk. The most frequent accidents are related to:

- malfunction of the lifting apparatus
- accidental detached of the load, and
- foot injury.

Safety Precautions

When **hoists** are being used, accidents occur due to bad maintenance and the misuse of the hoists. Collapse of hoists in use leads to the fall of the vehicle under repair, and the related accident may become fatal for the mechanics near the collapsed structure. Therefore, regular inspections with established routines must be carried out at prearranged intervals. The inspections should include check of the structural soundness of the hoists, tests for the determination of the hoists' tolerance, lubrication and adjustments of the brakes and the locking positions.

A hoists' system should be equipped with:

- Two hand operation. Both hands must be used at the same time to start the machine and keep it running, below a safety position, set by the manufacturer
- Toe protection (to avoid injury of the operator standing very close to the vehicle big lowered down), and
- Automatic locking. The hoists' system must be locked at the different positions. The existence of double locks is highly recommended

Lifting platforms (M6.3.3.jpg, M6.3.4.jpg) are used to raise a vehicle. They must:

- Never be used as working areas unless proper working balconies or platforms with barrier rails are provided. An operator should never be standing on the platform be designed for a vehicle under inspection/repair
- Either include a two-hands-operation used during the lowering onto the floor, or be equipped with light beams (photoelectric cell devices). These light beams in front of a danger zone can be used for automatic cut out (the machine stops when someone or something enters the danger-zone, e.g. when the lifting platform is lowering onto the floor for the avoidance of foot injury)

Jacks (M6.5.jpg – M6.3.7.jpg) are used for raising a vehicle at a small height from the ground. However they must:

- Be used only on level and undamaged floors, with a trolley or bottle jack appropriate to lift the vehicle weight safely
- Only be used when they are kept in good condition
- Be used in conjunction with axle stands to support the vehicle weight

Mechanics must have in mind to:

- Lift the vehicle only from its correct jacking points that they can easily identify

- Keep **axle stands** in good condition and properly positioned
- Keep the correct support pins in good condition and use them for the extendible columns of axle stands
- Never get beneath a vehicle supported only by a trolley jack or jacks

M6-EN.3.3 Vehicle Inspection Pits

Inspection pits are found in most car repair workshops where no lifting platforms exist for the repair of vehicles (**M6.3.8.jpg**).

The main **hazards** occurring at the inspection pits are related to:

- Injuries from falling into an unfenced inspection pit not in use, either of people not familiar with the premises, or of employees who instantly forget the presence of the pit
- Creation of a hazardous atmosphere inside the inspection pit, due to the concentration of flammable vapours from petrol, paints and solvents which are heavier than air and can be collected in pits in ignitable and explosive concentrations
- Injuries from fall of tools being left at the edges of the inspection pit

Safety Precautions

- Cover pits when not in use, and line paint them for direct space identification
- Place temporary barriers around exposed sections of pits in use to prevent falls
- Never leave tools or parts close to the edge of a pit since they can be accidentally fallen in the pit injuring the person working in it
- Cover the steps in the inspection pit with on-slippery material to avoid injury from slips
- Never step into closed inspection pit in a service station, to avoid possible poisoning from accumulated vapours
- Use electrical equipment that is explosion protected, since an explosive atmosphere might be created inside the inspection pit. This type of equipment is bulky and expensive, therefore, air powered portable tools are recommended
- Lighting must be placed **one meter** from the pit floor, must be sealed lights glazed with toughened plastic (polycarbonate), or wire armoured, laminated or toughened glass
- Lighting should be placed flush with the pit walls to avoid damages from falling objects, and/or obstruction of the operator's work, or injury of the worker
- It is essential that pits have two clear access/exit routes to enable employees to get out in case of an emergency
- Pits should have enough width for the worker to work easily and for the car to move without hitting the edges (0,8-1m)
- The pit wall is recommended to be glazed with white tiles and to be kept clean. This way the need for additional lighting will be avoided
- Use portable tools, including hand lamps, in the pit that are strong enough to survive drops from a height and of an explosion-protected type. Low voltage hand lamps do not offer protection from the risk of igniting flammable vapours

M6-EN.3.4 Wheel Alignment and Balancing

Wheel alignment and balancing are important for safety and maximum mileage from the tires. However, these operations include several hazards: contact with rotating wheels during wheel balancing may cause friction burns or other injuries, while air blasts from the over-inflation of car tyres can also cause injuries.

Safety Precautions

- Raise and support vehicles safely
- Remove the valve core from tyre to be repaired to ensure it is fully deflated
- Use the right tools for removing wheel nuts and levering tyres off wheels
- Protect against back injuries by using good lifting techniques to lift tyres and wheels from vehicles (**M6.3.9.jpg**)
- Inflate tyres to the correct pressure, as indicated on the tyre itself
- Use a well-maintained accurate pressure gauge with at least two meters of air line between gauge and clip-on chuck
- Stand clear of tyres during inflation
- Never weld or flame-cut a wheel to which a tyre is still fitted

For the proper mounting of tires, it is recommended for a worker to take some basic precautions, such as:

- Ensure that the wheel is securely seated on the hub face
- All lugs have proper torque
- No build-up of dirt exists between the hub and the wheel
- Never bend the wheel
- Ensure that both tire beads are securely seated on the rim

M6-EN.3.5 Rolling Roads and Brake Testing Equipment

Rolling road is a standard “tool” in a vehicle repair workshop and the way to be used should be straightforward. However serious injuries may occur when it is not maintained properly, or when other adjustments are being made while in operation. Therefore:

- Do not make other testing or adjustments to a vehicle while the rolling road is moving
- Ensure that the rolling road is equipped with a “dead man’s” control system and that it is working appropriately
- Prevent unauthorized personnel to access the area where the testing is taking place. If access cannot be prevented fit guards at the sides of the rolls

M6-EN.3.6 Vehicles Testing

Accidents can occur during the movement of vehicles on the site and inside the workshop, and as well during the vehicles’ testing on road. Very often, this happens due to the involvement of unqualified, inexperienced and unauthorised drivers.

Safety Precautions

- Never allow non-competent persons to test a vehicle. Only licensed drivers can move vehicles
- Mark clearly the routes in and out the workshop
- Supervise vehicle movements near blind corners and when reversing
- It is advisable not to keep the keys on the engine while the vehicles are not in use, in order to avoid accidental start of the engine
- Never allow non authorized personnel or customers to move around the repair workshop, to avoid accidents with moving vehicles

M6-EN.3.7 Compressed Air Equipment

Compressed air is being used in a vehicle repair workshop either to power tools or to apply materials, such as oil, grease and paints to vehicles. The accidental injection of compressed air or of material either through the skin or into a body orifice can cause injuries or be fatal, since the compressed air equipment injects material at very high pressures (e.g. a painting gun inject paint at 3000 – 7000psi). Ordinary working clothes do not restrict the penetration of compressed air into the body.

Safety Precautions

- A competent technician must examine compressed air equipment regularly
- Be very careful and alert when compressed air equipment is being used in confined spaces such as the inspection pit or inside a vehicle, or in awkward situations, such as beneath vehicles
- Be careful when clearing or cleaning guns being used in conjunction with compressed air equipment
- Compressed air guns should be directed away from face and goggles should be used to protect operator's eyes from flying dust particles.
- If compressed air is used as a source of breathing air for respirators or breathing apparatus then ensure that the air meets the necessary standards and passes through the appropriate filters
- Ask for medical advice in cases of accidental compressed air penetration, since the degree of injury is not always apparent immediately
- Keep in mind that you need to be aware of the hazards related to the compressed air equipment

M6-EN.3.8 Steam and Water Pressure Cleaners

Safety Precautions

- Keep all air and high pressure hoses properly coiled, when not in use
- Ensure the good repair of couplings and valves. The ends must be tightly clamped in order for not to be pulled loose, allowing the lines to whip around dangerously
- Do not point high pressure spray wand at another person.

- Always wear rubber boots, thick gloves and face protection to protect from burns, while working near steam cleaning operations
- Always wear eye protection during use
- In order to avoid any electrical hazards when using steam/water cleaners:
 - Use a residual current device or an earth monitoring device, with cleaners that have flexible cables, and check that it is working daily
 - Check flexible cables and plugs daily for visible signs of damage and do not use them if they look damaged or faulty

M6-EN.4 CHEMICAL HAZARDS

M6-EN.4.1 Introduction

M6-EN.4.2 Exhaust Fumes from Running Engine

M6-EN.4.3 Petrol

M6-EN.4.4 Used engine oils

M6-EN.4.5 Painting

M6-EN.4.5.1 Paints and thinners: Health effects and Safety Precautions

M6-EN.4.5.2 Storage and Mixing of Paints

M6-EN.4.5.3 Paint spraying

M6-EN.4.6 Isocyanates

M6-EN.4.7 Body Filling and Preparation

M6-EN.4.8 Asbestos – Brake and Clutch Lining

M6-EN.4.9 Hydrogen – Batteries charging

M6-EN.4.10 Welding and Metal Cutting Fumes

M6-EN.4.11 Sanding Dust

M6-EN.4.12 Cleaners for Vehicle Valeting

M6-EN.4.13 Postings for chemical hazards

M6-EN.4.1 Introduction

Chemical hazards include compounds or mixtures of them that can produce adverse **health effects** under some conditions of exposure. The effects may be: (a) acute toxic (develop soon after exposure, rapidly reach a climax and usual recover quickly when exposures ceases. These effects include eye nose, and throat irritation, skin injuries and certain lung injuries), (b) sub-acute (or short-term: develop more gradually, usually on prolonged exposure, and tend to recover when exposure ceases), and (c) chronic (or long term: develop gradually over a prolonged period of exposure, and tend to recover extremely slowly. These effects include kidney damage, foetal damage, and chemically induced cancers). Inhalation is the most common route of entry of aerial (gas, dust, vapour) chemical hazards into the body in a workplace, followed by absorption through the skin (usually in case of liquids) and by ingestion. The later route is the least important, provided that the rules of personal hygiene, such as eating at workplace, washing hands before eating, etc are followed.

In addition to their toxicity and health effects, several chemical hazards present in a motor vehicle repair workshop are flammable (e.g. petrol, engine oils, paints, solvents, etc) and accumulation of gases, vapours and/or dust results in an **explosive atmosphere**. The accumulated substances mixed with air have the possibility to catch fire or explode. An explosive atmosphere does not always result in an explosion, but if it catches fire, the flames will quickly travel through it and if this happens in a confined space (e.g. in inspection pits), the rapid spread of the flames or rise in pressure could also cause an explosion. Explosions are responsible for many lives lost, serious injuries and significant damage. Reduction of the related risks can only be achieved through:

- Minimisation of the dangerous substances being used, through substitution, if possible
- Minimisation of the releases of substances that can create explosive atmospheres (e.g. keep containers closed during work in closed booths while painting or spraying, etc)
- Elimination of the accumulation of gases, vapours and dusts (through e.g. appropriate ventilation and handling)
- Elimination of ignition sources (e.g. cigarette, matches, sparks, vehicle's exhaust)

As in all cases of identified risks and in consistence with the risk assessment, mitigation measures are necessary. These measures include:

- Prevention of fires and explosions from spreading to other sections of the workplace
- Reduction of the number of employees being exposed to a minimum

The measures for the elimination and/or reduction of risk of explosion should be taken into account during the design, construction and maintenance of the workplace.

The following sections include the main chemical hazards present in a motor vehicle repair workshop, and refer to activities that are mostly related to these hazards:

- Exhaust fumes from running engine
- Petrol
- Used engine oils
- Painting (paints and thinners, storage and mixing of paints, paint-spraying)
- Isocyanates
- Body fillers
- Asbestos - brake and clutch linings
- Hydrogen emitted from batteries
- Welding and cutting fumes
- Cleaners for valenting

M6-EN.4.2 Exhaust Fumes from Running Engine

Exhaust fumes from diesel or petrol fuelled engines are toxic, with both short- and long-term effects on human health (**M6.4.1.jpg**). When diesel fuel burns in an engine, the resulting exhaust is a combination of gases (e.g. carbon monoxide, nitrogen dioxide, volatile organic compounds, sulphur dioxide, benzene, etc), vapours, liquid aerosols and substances made up of particles, which contain thousands of different chemical substances. The very small particles of the fumes are inhaled and deposited in the lungs. Diesel exhausts contain 20-100 times more particles and produce less carbon monoxide than petrol exhaust. These particles carry cancer-causing substances known as polynuclear aromatic hydrocarbons (PAHs). The carbon particle or soot content varies from 60% to 80% depending on the fuel used and the type of engine. Most of the contaminants are adsorbed onto the soot.

While engine running in a motor vehicle workshop high concentrations of fumes are emitted. During these tests the vehicle engine is cold, resulting in emission of fumes in much higher concentrations than during normal operation. Exposure of workers to high

concentrations of exhaust fumes has short-term health effects, also called acute effects, as well as long-term effects. Short-term effects include irritation of eyes and nose or of the respiratory track, light-headedness, weakness and numbness. These effects tend to disappear when the effected worker is away from the source of exposure. However, prolonged exposure to exhaust fumes can cause long-term effects.

A number of studies showed that workers exposed to exhaust fumes are more likely to have chronic respiratory symptoms (such as persistent cough and mucous), chestiness and breathlessness bronchitis, and reduced lung capacity than unexposed workers. In accordance, the United States National Institute for Occupational Safety and Health (NIOSH) studies showed that diesel exhaust should be treated as a human carcinogen (cancer-causing substance). Exposure to exhaust fumes in combination with other cancer causing substances may increase the risk of developing lung cancer. Other exposures known to cause lung cancer include cigarette smoke, welding fumes and asbestos. All of these exposures may interact with diesel exhaust to magnify the risk of lung cancer, and it is advisable to be kept to a minimum. In addition, people with pre-existing diseases, such as emphysema, asthma, and heart disease, may be more vulnerable to the effects of the exhaust fumes. Also, many of the individual components of the exhaust fumes are known to be hazardous. For example, nitrogen oxides can damage the lungs, and carbon monoxide can aggravate heart disease and affect coordination. Furthermore, skin contact with cold diesel fuel may cause dermatitis.

Good practices – Ventilation

The installation of an appropriate ventilation system is required in every vehicle repair workshop. When it comes to general ventilation, roof vents, open doors and windows, roof or floor fans can be used to move air through the workplace. The fans and the openings should be placed at appropriate height so that the resulting air streams are not directly affecting operators. However, the general ventilation is not appropriate in removing exhaust fumes from a running engine inside a workshop. In contrary, it may spread the fumes around the workplace. Therefore, the use of: a) a local system for the removal of fumes, or b) a filtering system is recommended.

Local Ventilation System

The system for the local removal of exhaust fumes is based on the uptake of the fumes directly from the vehicle's exhaust and their emission to the ambient air outside the workshop. The system consists of an electronic air-extractor, a flexible plastic pipe, one end of which is attached to the air-extractor and the other, being equipped with a hose, is attached to the vehicles' exhaust system (M6.4.21.jpg), and a pipe that ventilates the gases into the ambient atmosphere (M6.4.3.jpg). This system has the disadvantage that the flexible pipe is placed on the floor of the workshop and sometimes obstructs the passage of operators, tool trolleys and vehicles. Furthermore, the shifting of the flexible pipe from one vehicle to another is difficult since the pipe is pretty heavy. The flexible pipe to be used must be made of strong material, not to be destroyed when is run over a vehicle and to tolerate the high temperatures of the exhaust fumes.

The above system can be improved by the installation of a central air-extractor system, on which several flexible pipes are attached. The advantages of such a configuration are:

- Exhaust fumes are not ventilated just out of the workplace, but through a central system, in order to minimise the possibility of re-entering the workplace. Additionally,

the air-extractor is placed outside the workshop (M6.4.4.jpg), eliminating the corresponding noise

- The flexible pipe is either wound around a rundle that is attached to the roof or the wall of the workshop or is sliding along a track that is also attached to the roof of the workshop (M6.4.5.jpg). This way, the flexible tube is not left down on the floor obstructing the operator's work, and no lifting is required.

Attention should be given to the type of air-extractor to be used. The choice depends on the type of vehicles to be served in the workshop. In any case, the capacity of the air-extractor has to be at least double the amount of emitted fumes.

Filtering System

With this system the exhaust fumes are filtered and most of the pollutants are removed. Small catalyst filters that have been treated thermally are fixed at the vehicle's exhaust. The system consists of the main filter of catalyst, where full combustion of the products of the incomplete combustion takes place, and a particulate filter, where soot is withheld. The exhaust fumes, such as carbon monoxide, hydrocarbons, aldehydes and other poisonous substances react catalytically on the filter and give inert products. The advantages of such a system are: a) the vehicle can move independently, b) there is no need for a central installation, the system is completely portable, and c) the temperature of the ambient air does not decrease as in the case of the hot fumes' extraction. The main disadvantage of the system is that the removal of the exhaust's fumes is not complete.

Consequently, **the installation of a system involving intake and exhaust fans (fumes-extraction system) that will release the fumes of the vehicle's exhaust to the ambient air outside the workshop is recommended**, if there is no need for continuous change of the vehicles' position.

Safety Precautions

- Never keep running a vehicle's engine inside a workshop more than is needed to get the vehicle in and out the workshop
- When an engine is kept running (during repairs, tuning adjustments or testing) use a fume extraction system directly coupled to the vehicle's exhaust, to lead the fumes outside the workshop
- Ventilate the fumes to the open air (outside the workshop), but be careful the fumes not to be drawn back in the workshop or affect other premises or people nearby
- Keep the flexible pipes and the connecting hoses into good condition to prevent leaks
- Report immediately any faults in the fumes-extraction system, in order to be repaired

Employers are required to provide the necessary information on the risks of exposure to exhaust fumes to their employees as well as training on the correct use of the installed fumes-extraction system

M6-EN.4.3 Petrol

Petrol is a highly flammable liquid and any spillage will evaporate to form a flammable, heavier-than-air vapour, which disperses over considerable areas, and can easily ignite (sometimes even at some distance from the spillage). Petrol fires in garages are relatively frequent incidents and result in serious burns or even deaths.

Most petrol spills occur when:

- Petrol is being removed from the fuel tank
- Petrol is drained in unsuitable containers
- Fuel systems are being checked
- Fuel lines are damaged

Common ignition sources are:

- Cigarettes and lighted matches (never smoke close to a fuel tank and/or container)
- Welding, cutting equipment, or any type of hot work (never perform hot work close to a fuel tank not totally emptied)
- Vehicle's exhaust (always place a park arrestor at the exhaust of the vehicle)
- Electrical equipment, unless it is designed for use in a flammable atmosphere
- Heaters with naked flames or glowing electric elements (being used to dry clothing onto which petrol has been spilled)

The use of a **fuel retriever** ((**M6.4.6.jpg** - **M6.4.7.jpg**) is the safest and most strongly recommended method for draining petrol, since it eliminates fuel spillages, minimizes fugitive petrol vapour emissions, eliminates the risks related to static discharge, provides a suitable and stable container into which petrol can be drained, and allows subsequent transfer to another container. A fuel retriever system incorporates the following features:

- One or more containers for temporary storage of the different fuels (in some models a level gauge and a flashback arrestor are placed on each container)
- A hand-operated pump for transfer of fuel to and from the retriever
- Flexible hose(s) for access through the fuel filler neck
- A vapour recovery pipe to prevent much of the displaced petrol vapour escaping into the atmosphere
- Earthing straps for the elimination of dangerous static discharge (always read carefully the manufacturer's instructions for correct use and maintenance of the earthing straps)

Using the correct adaptor, it should be possible to remove the fuel through the filler neck, though some vehicles may have types of 'anti-theft' or 'rollover safety devices', which may make it very difficult. Removal by way of fuel lines can usually be carried out safely provided the appropriate adaptors are used and the recommended method in the vehicle workshop manual is followed.

Where a fuel retriever is not used, the hazards must be totally addressed. A hand-operated siphon or independent manual pump may be acceptable if transfer pipe-work is securely positioned at both ends and the vehicle chassis and the container are grounded by the use of earthing straps.

When not being used, the fuel retriever should be stored in a clearly designated area in the workshop without ignition sources and combustible materials. It should not be kept on an escape route and a fire extinguisher suitable for dealing with flammable liquid fires should be nearby.

Safety Precautions

- Always drain petrol into a stable, metal container large enough to hold the content of the fuel tank
- Keep the top of the container securely closed all the time
- Make sure that the petrol containers cannot be knocked over (keep them away from pathways and/or keep them held within a stable framework)
- Store drained petrol in a designated lockable, well-ventilated area, preferably outside the workshop, unless it is to be returned to the vehicle immediately
- Never add drained petrol to the waste-oil tank and vice versa. The establishment of a system with colour designated drainage containers is a good practice (**M6.4.8.jpg** – **M6.4.10.jpg**)
- Treat any contaminated petrol or petrol/diesel mixtures as waste, giving a clear description of the nature of the material
- Never remove petrol from a vehicle while it is over an inspection pit
- Work in a level, well ventilated area, from where all ignition sources have been removed, preferably in the open air and well away from pits or other openings in the ground, even when using a fuel retriever
- Never perform hot work, such as welding, close to a fuel line of the vehicle
- Disconnect the vehicle's battery
- Use a fuel retriever, to minimise risks of gross petrol spillages and to provide means to eliminate static electricity (highly recommended)
- Only fully trained personnel can carry out fuel removal

M6-EN.4.4 Used engine oils

Engine oil can be used as:

- Lubricant (reduces friction and damage occurring when parts move against each other, for example between the cylinder liner and piston ring)
- Coolant (absorbs the heat produced in the engine combustion chambers and piston under crown area, cooling the engine and helping to prevent overheating)
- Sealant (seals the space between the piston ring and the cylinder liner to prevent combustion pressure from escaping)
- Detergent (prevents waste matter resulting from combustion and impurities produced by oxidation from sticking to the engine interior, helping to keep it clean)
- Rust inhibitor (neutralizes acids produced by combustion gases, preventing rusting and corrosion)

Risks related with used engine oils:

Used engine oil contains a variety of toxins, such as heavy metals (lead, chromium, and cadmium), naphthalene, chlorinated hydrocarbons, etc. During the combustion process at the internal parts of engines, large amounts of lead and other heavy metals, accumulate in the oil. Frequent and prolonged contact with used engine oils may cause dermatitis and

other skin disorders, including skin cancer. The longer the oil has been used, the more carcinogens it contains. Engine oils are flammable and must be handled accordingly. Oil spills are responsible for injuries due to slips (see also paragraph 9.1.3).

Safety Precautions

- Dispose all waste oils safely in lidded metal containers, which are in good condition. Never leave waste oil containers open (M6.4.11.jpg)
- Use a colour designated system for the oil storage containers not to confuse the containers to be used for the engine oils with those for the petrol
- The oil storage containers must be leaking free and have labels such as “Used oil”. No special labels are necessary, if the words “Used oil” are visible all the time (M6.4.12.jpg). Used motor oil may be mixed with other used oils (hydraulic oils, transmission fluids, brake fluids), and stored in the same container
- Wear protective clothing (gloves, overall, etc) when dealing with engine oils (M6.4.13.jpg)
- Use a drip or screen table while changing oil, to collect oil dripping off parts
- Never keep containers with engine oil that is not in use in the workplace or near it. Keep these in a separate storage room
- Storage room for engine oils must be well ventilated, have doors with louvers (M6.4.14.jpg), and be equipped with sprinklers above the containers in case of fire (M6.4.15.jpg)
- If the size of the repair workshop permits it, an engine oil distribution system should be established. The containers with the engine oils are stored in a separate room and pipes are transferring the oil to the workshop. This way the presence of large oil containers in the workshop is avoided

M6-EN.4.5 Painting

Paints are a mix of pigment and binder, thinned with a solvent (called thinner) to form a liquid. Many paints and solvents used in vehicles finishing give off vapour, which is readily ignited and often toxic. In motor vehicle workshops painting takes place in the form of spraying, which gives rise to fine aerosol mists and droplets of toxic and flammable liquid. The following sections include information on the health effects from exposure to thinners and refer to different activities related to these hazards, such as storage, mixing of paints, and paint spraying.

M6-EN.4.5.1 Paints and thinners: Health effects and Safety Precautions

Solvents being used in paints as thinners include: toluene, xylene, methyl ethyl ketone, methyl isobutyl ketone, ethyl benzene, ethyl acetate, and butyl acetate, which are volatile organic compounds (VOCs) and hazardous air pollutants (HAPs).

Exposure to solvents is perhaps one of the most common chemical health hazards at workplace. When a solvent evaporates, the vapour becomes part of the air and the inhaled quantity travels through the blood to the internal organs, such as brain and liver. Due to the fact that solvents can dissolve substances, they can also affect mucous membranes and the skin. Some solvents can even be absorbed through the skin. Symptoms from short exposure

to solvents may be dizziness, headaches, tiredness, and reduced comprehension as well as prolong reaction time. Although these effects might disappear quickly, they increase the risk of accident. Furthermore, paints and thinners are flammable material.

The ability of a solvent to cause injury depends on the viscosity of the solvent (low viscosity solvents spread more rapidly in enclosed air), the concentration of the solvent in the air, and the exposure time (the longer the exposure the greater the risks of injury). Many solvents evaporate and form vapour in the air when their containers are kept open. Then, these vapours can be breathed in and lead to health problems. Therefore, they must be stored in strong sealed containers. In addition, ventilation/extraction systems can reduce the vapour concentrations.

Safety Precautions

- Assess the Safety Data Sheets (provided by the supplier) and choose the least harmful paint and thinner for each particular application
- Reduce the volume of flammable solvents present in a workplace as much as possible
- Use water-diluted paints when possible
- Keep paints and thinners away from any ignition source, such as naked lights, unsuitable electric equipment, static electricity, hot surfaces and mechanical friction
- When solvents are used for the cleaning of parts, then the washing baths have to be equipped with a hood for the extraction of the release vapours (**M6.4.16.jpg**)

M6-EN.4.5.2 Storage and Mixing of Paints

Paints should be **stored** in dedicated enclosure, preferably outside the workshop. The enclosure should be well ventilated, having two diametrically opposite openings that will ensure appropriate air circulation, while the entrance door should be constructed with louvers. Attention should be given to the temperature inside the storage room, since increased air temperature may increase evaporation of solvents and consequently increase of vapour concentrations creating a potential source of fire. The walls and the ceiling of the storage room should be made of fire resisting material.

When **mixing** takes place, vapours are released creating a potentially explosive atmosphere. Therefore, the mixing should take place under an appropriately designed hood that would lead the poisonous vapours away from the workplace. In addition, the mixing room should have appropriate ventilation (at least two openings that would circulate air effectively). Explosion-protected lighting and electrical equipment should be installed and used in the paint-storage room as well as in the vicinity (at least 2m around) of the paint-mixing place.

Safety Precautions

- Keep only small quantities of paints and solvents for immediate use in a workshop
- Keep larger stocks of paints and solvents in specially designed storage room (paint-storage unit), with fire resisting walls, good ventilation (at least two openings and louvered entrance door)
- Keep paints and solvents in their original labelled containers well closed, to eliminate vapour escaping

- Treat empty containers of solvents and/or dissolved paints the same way as full ones, since they are often full of vapours
- Never use plastic containers not designed to hold paints or solvents, since they can become brittle or crack over time (solvents can attack many containers)
- Locate both, the paint-storage unit and the paint-mixing unit in a fire-resistant, well-ventilated rooms, separate from the workshop
- Install explosion-protected lighting in the paint-storage and the paint-mixing units
- In case of spillage of paint use immediately absorbent material (rugs) to soak it up. Have the rugs readily available every time you are using a paint
- While working, always keep waste rugs and material being contaminated with paint or solvent in a metal bin, with its lid always on, and dispose them safely as soon as you complete the job
- Never smoke where paints are stored or mixed
- Store containers in a planned and orderly manner that does not endanger employees' safety

M6-EN.4.5.3 Paint spraying

Spraying gives rise to fine aerosols, mists and droplets of toxic and flammable liquid, as well as to high vapour concentrations. Therefore, special safety precautions are necessary for the safety of the spray painter's health and for the elimination of the risk for explosion. Overall, safe spraying requires:

- a) Adequate ventilation
- b) Efficient personal protection, and
- c) Prevention of sources of ignition

Safety Precautions

- Spray only in booths (**M6.4.17.jpg** – **M6.4.18.jpg**), enclosures or controlled spray spaces, to control exposure and risks from flammable vapour
- Check and maintain regularly the spraying booths and keep records
- Never start spraying unless the extraction/ventilation is switched on and is adequate. Ensure that exhaust is a non-circulating one
- The installation of down-draught ventilation system (**M6.4.19.jpg**) is highly recommended in a spray booth or area. In such a system, fresh air passing through dust filters comes down from the roof (**M6.4.20.jpg**), while the exhaust filters are placed on the floor of the booth (**M6.4.21.jpg**)
- Wear proper breathing mask with filter appropriate for organic vapours, rubber gloves, water proof overall, earmuffs and head cover (**M6.4.22.jpg**). It is important that all operators are trained in the proper use of the respirators
- While spraying, stand upstream of the vehicle being sprayed. This can be easily achieved with down-draught booths

- Never spray above your head in a down-draught booth, since the spray will be carried out downwards by the air flow
- Use a suitable platform when spraying a high-sided vehicle in a down-draught booth, in order to ensure the correct orientation of the air flow
- If more than one sprayer is working on the same vehicle simultaneously, work in the same direction, in order to avoid spraying against one another
- Spraying booths or controlled spray areas must be illuminated with explosion-proof lighting. Portable lights are not allowed in body shop spray area
- Repair damaged spray booth panels to maintain the fire resistance of the unit
- Spraying within 20 feet of flames, sparks, operating electrical motors and other ignition sources is forbidden
- Remove all combustible material from the spray area
- Use properly grounded electrical equipment in spray areas
- “NO SMOKING” signs must be placed at the workplace

M6-EN.4.6 Isocyanates

Isocyanates are a group of chemicals, which have been used in industry for many years now, mainly in the manufacture of polyurethane plastics (PUR). PUR is found in foam plastics, thermoplastics, fibbers and adhesives and in paints, foils and insulation materials. When PUR is heated, it is thermally decomposed and many different toxic compounds such as isocyanates are formed. The decomposition products are in both gas and particle phase and the composition depends on the formulation of the actual polyurethane polymer.

Work in a motor vehicle workshop that involves exposure to isocyanates includes:

- Body painting with 2-pack spray paints that contain isocyanates. If paint is discoloured or starts to bubble, isocyanates are formed. However, hazardous levels of isocyanates are formed even if the paint looks undamaged
- Bonding of windscreens and sheet metal
- Applying body filler and working with under sealing compounds which contain isocyanates (the operators should refer to the safety data sheets)
- Welding, shrinking, aligning, hard soldering or when working on bumpers containing PUR damping material. If PUR material is heated to temperatures over 150-200 °C, the material decomposes and isocyanates are formed (as isocyanate acid). The hotter it gets the more isocyanates are formed.
- Grinding or cutting of material containing PUR. The exposure may be high, especially if the air stream from the tool is directed towards the repair worker.

Materials being used in a motor vehicle workshop that may contain isocyanates include:

- Paints and varnishes, e.g. two-component and hardening types, and those that are intended to be durable, including water-based paints
- Products for surface treatment (coating, filling)
- Adhesives, particularly hardening ones and those designed to withstand high stresses

- Joint sealing compounds and sealing foams
- Damping material used for the bumpers

Exposure to high concentrations of isocyanates may:

- Harm the respiratory system and give rise to a range of symptoms such as nasal congestion, runny nose, dry cough or nose bleeding, heavy breathing, in combination with physical exertion or loss of energy. Diffuse symptoms such as eye irritation, headaches or feeling of heavy headed can also occur. The symptoms may begin at work, but they may also only be noticeable many hours after work
- Involve asthma, which is life-long. Exposure to isocyanates can result in an asthma attack, but at the same time asthma may mean that the airways become more sensitive to dust and odours, meaning that asthma may be triggered by things such as perfume, exhaust emissions or solvents
- Cause dermatitis upon contact with the skin

EU Directive 91/155/EEG applies for isocyanates and specifies the information to be shown on safety data sheets. When a product contains isocyanates must carry the following warning on the packaging: “Contains isocyanates. See information from manufacturer”.

Those involved with the vehicle body repair, and their supervisors must have special training regarding the risks related to work with isocyanates. Anybody working with vehicle body repair should have a regularly medical examination, in order to discover the signs of isocyanate injury quickly.

Employees must know if the products they work with contain isocyanates. **In case of uncertainty, they must assume that the raw materials do contain isocyanates.**

The best preventive measures against isocyanates are to prevent isocyanates from being formed, or to catch them as close as possible to the source, where substitution should always be the first choice of preventive measures. A good example is the use of a non-isocyanates containing glue for the windscreen assembly.

Safety Precautions

If it is not possible to avoid products containing isocyanates, or if isocyanates are formed by heating, the following measures must be taken:

- Isolated handling from other activities, in a separate area with lower atmospheric pressure than in adjacent premises (best method), in well-designed separate (but not shielded) areas. The separate area should have no large openings so isocyanates are not spread to surrounding work places
- Use a local exhaust to reduce the spread of smoke in the premises
- Have access to high vacuum system, so tools can be provided with integrated exhausts
- Keep good working posture, work standing upright, without having to lean in or over the work site, which may result in high exposures to isocyanates. Avoid work below waist level. Use easily operated car hoists to find an ergonomic working position
- Use gloves, goggles and protective clothing to protect from contact with isocyanates, which quickly penetrate ordinary plastic gloves. Changes of clothes and good hygiene

are necessary. If there is any risk of splashing, an emergency shower should be available nearby

- Scrap away any paint, adhesive, plastic, etc, prior start working (sanding down) in order to remove completely materials emitting isocyanates before heating. If there is no paint on the panel no isocyanates can be formed. The paint should be removed at least 30 mm and preferably 50 mm from each side of the work site.
- Use an orbital sander with integrated air extraction connected to the high-vacuum system when sanding large, relatively flat surfaces. Breathing protection is then not needed
- Use a small belt sander or a small rotating sander with a “Scotch Brite” wheel when sanding paint away before welding (sanding down much smaller surfaces) or when grinding down the weld bead after welding. A tool with integrated exhaust could be used to suck up as much dust as possible
- Never saw through a bumper containing PUR damping material
- If a product containing PUR must be used, then is advisable to avoid heating it to more than 150°C. This also applies to occasional jobs such as repair and maintenance and when dealing with spillage.
- The ceiling of the workplace should be high in order to make it easier to ventilate the premises. Both, the general and the local ventilation systems must be regularly checked.

When performing any kind of hot work:

- Use a local exhaust whenever work causes smoke or dust. Position the local exhaust as close as possible to the hot work. Ensure that you cannot put your head between the local exhaust and the extraction device.
- Use a welding gun with integrated fume capture nozzle for the welding process. The integrated exhaust in combination with sanding down gives a good protection against isocyanates
- For cutting use tools which do not produce much heat. Prefer using a circular saw with rotating blade or a jigsaw instead of high-speed machines. **(M6.4.23.jpg, M6.4.24.jpg)** If these tools are used it is not necessary to sand down the metal or use breathing protection
- Use high-speed cutting machines equipped with a hood connected to a high vacuum installation
- Never use hot air gun when working with PUR plastics material
- Instead of heating with a heat gun in order to remove spillage containing isocyanates or PUR, scrape or cut is preferred

When breathing protection needs to be used, then:

- Use a breathing mask with compressed air supply or a fan-supplied respirator with combined filter containing a particle trap and active carbon filter. The latter PPE provides some but not enough protection

- Wear the breathing equipment throughout work and not removed until the vapours have been extracted. Caution is needed because the levels of isocyanates are often elevated for some time after work has been completed
- Change the filters regularly (expensive solution to be used in the long run)

M6-EN.4.7 Body Filling and Preparation

Body fillers and under sealing compounds contain **isocyanates**. The majority of fillers are reinforced with glass fibre or metal and consist of thermosetting unsaturated polyester in a solvent, which is then hardened by a catalyst. The **catalysts** being used are often corrosive irritants and some of them sensitise the skin causing dermatitis.

The body filling process, meaning the mixing and the application of the filler (preparation) and the finishing process, generate toxic fume and dust.

Alloys containing lead are sometimes being used during the preparation process, but they do not usually introduce serious hazards since the working temperatures are low and no generation of harmful fumes takes place. However the finishing process performed with the use of powered discs and sanding machines releases high concentrations of **fine dust**, which is a serious health hazard.

Safety Precautions

- Separate the body filling and preparation area from other work in order to minimize the number of people exposed to dust and fume
- Perform body filling only in a mechanically ventilated booth
- Fit dust-tight lighting in the body filling area/booth
- Keep dust to a minimum by removing the large excesses of filling using coarse hand files and not sanding machines
- Use powered sanding machines only for the final finish
- Use only tools being equipped with built-in extraction or local exhaust ventilation
- Always wear protective clothing (overall, gloves) and respiratory protection (masks appropriate for organic vapours)
- Never smoke, eat or drink in the workroom while working with lead
- Use separate changing areas for clean and contaminated clothing

M6-EN.4.8 Asbestos – Brake and Clutch Lining

Asbestos is a material with excellent properties that include mechanical strength, chemical resistance, thermal insulation, incombustibility and low cost. However, inhalation of asbestos fibres is directly related to high health risks, such as asbestosis and mesothelioma, a form of cancer. Exposure to asbestos may occur during manufacture, use, machining, removal and disposal of asbestos containing materials.

Some vehicle's parts do contain asbestos, meaning that working with those parts can release to the air asbestos fibres, which if inhaled are harmful. A large number of cases of asbestos-related cancer have been reported in garage workers. The most common activities dealing with asbestos are:

- Cleaning of the brake assemblies and the clutch housings
- Grinding the brake linings
- Sweeping floors

In several cases, brake and clutch linings as well as disc pads contain asbestos (M6.4.25.jpg – M6.4.27). Therefore, the establishment of preventive procedures for asbestos fibres to get into the air are necessary. In the cases of doubt for the presence of asbestos in different parts, it must always be assumed that they do.

Safety Precautions

- Always use properly designed drums cleaning equipment, which prevent dust escaping or use clean wet rags to clean out drums or housings.
- Always dispose used rags in a plastic waste bag while still wet
- Always use special vacuum cleaner to remove dust, or wet dust thoroughly and scrape it up if there's no vacuum
- Always wear the protective clothing, such as overalls (to be provided by the employer)
- Never blow dust out of brake drums or clutch housings with an air line
- Never grind or drill linings unless the machine has exhaust ventilation or there is a ventilated booth to do the work in
- Never use brushes to sweep up dust
- Never take the protective clothing home, it should be cleaned by the employer

M6-EN.4.9 Hydrogen – Batteries charging

During and after charging, batteries give off hydrogen, an easily ignited and explosive gas. Connecting or disconnecting batteries or charger connections to battery terminals when batteries are gassing creates sparks. If these sparks ignite the emitted hydrogen, then batteries will explode, rupturing the battery case and spraying people nearby with acidic electrolyte. The following section gives recommendations for the safe handling of batteries and chargers in order to reduce the possibility of explosion.

Furthermore, if metal gets in contact with the battery terminals heavy short circuit currents are created leading to rapid heating of the metal in contact. Consequently, if the jewellery that an operator wears gets in contact with the battery's terminals flash injuries and burns will occur.

Safety Precautions

- Charge batteries only in approved, ventilated battery-charging areas
- Check the electrolyte level before recharging. If the battery has been outside in cold weather, make sure that the battery is not frozen before recharging it
- If the electrolyte is covering the top of the plates, do not add more water. Recheck the fluid level after the battery has been recharged. If water is added, use distilled water, not tap water
- Never recharge batteries at rates greater than those recommended by the manufacturer

- Follow the recommendations of the charger’s manufacturer for attaching and removing cables and for operating the equipment properly.
- Unplug or turn off the battery charger before connecting or disconnecting the clamp connections
- Carefully attach the clamps to the battery with the proper polarity: positive [+] clamp, usually red, to the positive terminal and negative (-) clamp, usually black, to the negative terminal
- Keep the crocodile clamps clean and free from corrosion and insulated, except for the contact surfaces
- Clean battery terminals before fixing the charging clamps
- Do not use battery discharge testers immediately after charging
- If the battery becomes hot or if the electrolyte spits out from the vent, turn off the charger temporarily. Resume recharging using a lower current or charging rate
- When vent plugs may need adjustment, follow manufacturers' instructions carefully
- If the battery has sealed vents, do not recharge the battery with a current greater than 25 amps
- No smoking rule must be strictly applied during charging
- Always keep sparks, flames, burning cigarettes, and other sources of ignition away from the battery recharging area
- Never wear jewellery when working with batteries to avoid burns and flash injuries
- Wear protective eyewear when working near batteries
- A safety shower and an eyewash station in a battery-charging area must be installed

M6-EN.4.10 Welding and Metal Cutting Fumes

During **welding** harmful fumes and gases are generated including those from primer and paint layers, other surface coatings such as undercoat, and from lead in car bodies. The welding fumes may pose the risk of serious respiratory (such as dryness of the throat, tickling, coughing, tightness of the chest and difficulty in breathing), neurological and reproductive effects. Long- term changes in the lung are possible.

Flame cutting is a traditional method for cutting metals in a motor vehicle body repair workshop. The heat introduced into the material and the following thermal distortions are the main drawbacks of the process. A high temperature flame (about 3000°C) made from a mixture of fuel gas (e.g. acetylene) and pure oxygen heat the material in the cutting region resulting in a combination of rapid oxidation and melting. The gas pressure blows the oxides/the melt away (metal cutting fumes).

In addition to the emission of fumes other hazards related to the welding and cutting processes arise from:

- The misuse of welding gear and the use of wrong equipment for the job
- Failure in implementing the necessary precautions against electrical hazards

- Fires caused by the ignition of flammable material on or near cars such as trim, carpets and upholstery and petrol in tanks, fuel lines and nearby containers; often started by sparks or drips of molten metal
- Fires due to the flammable gas cylinders being used for the cutting flame
- Direct contact with heat generated
- Electromagnetic radiation

Local exhaust ventilation is essential during welding and cutting procedures. This can be done by mobile extraction unit with flexible exhaust hood wherever possible, and always in confined spaces.

Safety Precautions

- Move all fire hazards and combustibles at least 3 meters away from areas or objects to be welded
- Prohibit welding where flammable materials (such as paints) are used, or where heavy dust concentrations are present
- Make sure that fire extinguishing equipment is kept where welding or cutting takes place
- Ensure that when fuel tanks are weld or cut, they have been thoroughly cleaned to remove fuel, that when heated may cause fire, explosion and release of toxic substances
- Use suitable face, neck and ear protection to prevent direct radiant energy from the arc
- Use suitable eye protection (face shields, goggles, etc) (**M6.4.28.jpg, M6.4.29.jpg**)

Employees must always have in mind the precautions from electrical hazards as well, for example:

- The work cable must be connected to the work as close to the welding area as practical. Work cables connected to the building framework or at some distance from the welding area, increase the possibility of the welding current passing through lifting chains, crane cables, or other alternate circuits. This can create fire and shock hazards or overheat lifting chains or cables until they fail

M6-EN.4.11 Sanding Dust

During auto body repair, sanding removes paint from surfaces and smoothes body panels repaired with body filling compounds. Airborne dusts produced during these operations may contain hazardous substances, such as **lead** and **chromium** from surface coatings and abrasives from sanding discs that are harmful to the lungs and nervous system of workers. Therefore, sanding tools must be used with built-in extraction or local exhaust ventilation (**M6.4.30.jpg**). Increased cost of sanders equipped with high velocity, low volume (HVLV) ventilation is minor compared to the non-ventilated ones. The amount of air used in the ventilated systems is also relatively low. Although initial costs for this system including an air mover, air cleaners, and ductwork can be substantial, the system will help eliminate expensive repaints, shorten clean up time, and extend sandpaper life.

Safety Precautions

- Rotary/orbital and straight line/reciprocating sanders, equipped with high velocity, low volume (HVLV) local exhaust ventilation as part of the tool's design (**M6.4.31.jpg**), are recommended. These sanders are effective in reducing total dust concentrations during the sanding of body filling compounds. HVLV ventilated sanders have cut total dust concentrations to one-tenth the levels produced using unventilated ones
- Make the ventilated sanders convenient to use, for example by installing retractable, flexible hosing attached to a central vacuum system (**M6.4.32.jpg**)

M6-EN.4.12 Cleaners for Vehicle Valeting

Vehicle valeting involves the use of cleaners that contain toxic and flammable solvents, resulting in increased concentrations of hazardous organic compounds. These concentrations are even larger when the cleaners are being used inside the vehicles, or in a poorly ventilated workplace. Direct skin and eye contact with these cleaners is harmful. The general safety precautions applied for solvents are to be followed in case of valeting.

Safety Precautions

- Always look at the label and the safety data sheet of the products to be used, to get information on the potential hazards
- Substitute hazardous products with less hazardous ones, when possible
- Pour only a small amount of fluid onto a pad or applicator
- Keep only a small container with the cleaner close to the working area, and keep the container always closed when not in use
- When working inside a vehicle, leave all doors open for maximum ventilation
- Work only in a well ventilated area. The existence of ventilation in the valeting area is highly recommended for the control of exposure to vapours
- Keep the valeting area free of ignition sources
- Disconnect the vehicle battery
- Wear protecting clothing, including ant slippery shoes, natural rubber or nitrile rubber gloves to protect hands and forearms
- If cleaner is splashed on the clothes, remove it and dry it in a safe place in the open air

M6-EN.4.13 Postings for chemical hazards

Postings are a good practice that is essential to be implemented in all workplaces. These postings refer to the products under use, to the hazards related to the products/processes or to the recommended PPEs. The most common postings and signs related to chemical hazards are given below.






In paint mixing rooms, where chemicals and solvents exist the following signs and/or labels must be placed:



Where explosive materials exist, such as oil, petrol, paints, solvents, etc, the next signs can be used:



When it comes to the postings for Personal Protective Equipment, some examples follow for the use of PPEs:

<p>Hand protection (when handling solvents, paints, oils)</p>  <p>Wear gloves</p>	<p>Eyes protection (when using solvents)</p>  <p>Wear goggles</p>
<p>Body protection (spray painting)</p>  <p>Wear protective clothing</p>	<p>Respirators/ masks (during spray painting/ mixing paints)</p>  <p>Wear masks</p>  <p>Wear respirator</p>

M6-EN.5 EXPLOSIONS AND FIRE FIGHTING

M6-EN.5.1 Introduction

M6-EN.5.2 Ignition

M6-EN.5.3 Explosions

M6-EN.5.4 Fire Fighting

M6-EN.5.4.1 Removal of combustible material

M6-EN.5.1 Introduction

A variety of explosive materials exist in a motor vehicle repair workshop. These can be:

- Waste engine oil that is stored in drums/tanks
- Other flammable liquids storage/use of paints, solvents, cleaning materials
- Flammable gases welding/cutting equipment, LPG heaters, battery charging, LPG-fuelled vehicles, some aerosols
- Explosive dusts sanding organic fillers e.g. fibre-glass
- Other explosive materials air bags, seat belt parts
- Flammable materials in welding/cutting of diesel tanks, or near to special circumstances brake lines etc
- Gases in cylinders. They are often stored at very high pressures, and so their uncontrolled release can be physically dangerous. A small amount of released gas (such as Liquefied Petroleum Gases (LPGs)) can fill a large area with a potentially explosive mixture. Stored cylinders need to be suitably restrained and their valves protected from impact damage. In addition, gas cylinders may need special valves, fittings and hoses
- Fine flammable dusts, which if ignited, can cause violent explosion and damage
- Plastic foams, packaging materials, polyester wadding and textiles, which ignite easily and burn fiercely, giving off a lot of dense black smoke

M6-EN.5.2 Ignition

Ignition is the process whereby a material capable of reacting exothermically reached a state of rapid combustion. At atmospheric temperatures and pressures, flammable mixtures of hydrocarbons and air will not ignite unless they have a source of energy.

Certain characteristics of fuel and oxidant mixtures, such as minimum volume, minimum energy, auto ignition temperature and ignition lag time, give some indication of how 'easily' or how 'quickly' a specific mixture in a specific situation will ignite. For a particular mixture at a particular temperature and pressure there will be a minimum volume of flammable mixture required to sustain ignition. For a given flame volume, there is a balance between heat generated by the exothermic reaction and heat lost to the surroundings. The auto-ignition temperature is the lowest temperature to which an entire fuel and oxidant mixture must be raised before it spontaneously ignites.

Flammable liquids can give off large volumes of flammable vapours at room temperature. These vapours, when mixed with air, can ignite, often violently. Spilled flammable liquids

can, if not contained, flow a long way to an ignition source, and then flash back to the source of the leak. Ignition sources can be very varied and they include sparks from electrical equipment or welding and cutting tools, hot surfaces, open flames from heating equipment, smoking materials etc.

Safety Precautions

- Remove all obvious ignition sources from the storage and handling areas
- Smoking must be prohibited in the garage, especially near explosive, flammable, and combustible materials
- Never store combustible materials close to heaters or electrical equipment which could run hot and act as a local ignition source
- Keep passageways, exits and working areas clear of packaging materials, finished products containing flammable solids etc. (M6.5.1.jpg)

M6-EN.5.3 Explosions

Dealing with flammable substances is a hazardous activity. This is due to the risk of fire and explosion. Fuel, air and a source of ignition are the ingredients for starting a fire or explosion. By controlling or eliminating even one of these, fire can be prevented. A great variety of flammable substances exists in the workplace. They can be divided to the obvious (heating fuel, petrol, painting thinners, etc) and the less obvious (packaging materials, etc).

Safety Precautions

Those working with flammable dusts (during sanding, welding, etc) must remember to:

- keep plant dust-tight
- keep the working area dust-free by regular cleaning, and vacuuming spillages immediately

In addition to the precautions outlined above, when dealing with flammable gases:

- Never use oxygen instead of compressed air
- Never use oxygen for sweetening the air in a working area or confined space
- Never use grease or oil on equipment containing oxygen
- Always check manufacturers or suppliers' instructions and fit the correct equipment. Protect hoses from potential causes of damage that could cut, scuff or weaken them. Inspect them regularly and replace those that show signs of damage or wear that could give rise to a leak

M6-EN.5.4 Fire Fighting

Employers are responsible to ensure the health, safety and welfare of their employees and other that may have access to the workplace. These duties include among others, safety in relation to fire hazards, both from the work processes and activities, as well as general fire safety in the workplace. Employers must also carry out a fire risk assessment, although this can be done as part of the general risk assessment.

Safety Precautions

Employers are required to:

- Establish means of detecting and giving warning in case of fire
- Provide escape routes with clear indications
- Provide fire extinguishers in conspicuous positions on escape routes, preferably near exit doors (**M6.5.2.jpg**)

Provide fire-fighting equipment, ensure free access to it (bad practice: **M6.5.3.jpg**, **M6.5.6.jpg**), and good working condition

- Keep exit doors free of obstacles (**M6.5.7.jpg**, **M6.5.8.jpg**). No emergency exits should be placed in toilets, must be away from rooms containing hazardous materials, and should never exist in narrow passages
- Provide emergency lighting, which will indicate the escape routes clearly, will provide illumination along escape routes allowing safe movement towards final exits, and will ensure that the fire alarm call points and fire-fighting equipment can be readily located
- Provide training of employees in fire safety
- Provide suitable storage containers for flammable substances, ventilation systems to dilute or remove flammable gas, extraction systems to remove combustible materials, and equipment selected not to be a source of ignition are key elements for the elimination of fire
- Consider their fire characteristics when storing, handling, and piling materials
- Store non-compatible materials that may create a fire hazard at least 7.5m apart or separate them with a barrier having at least a 1-hour fire rating.
- Pile material in such a way to minimise internal fire spread and to provide convenient access for fire fighting. At least 1m clearance should exist between stored materials and unit heaters, radiant space heaters, duct furnaces, and flues or the clearances shown on the approval agency label.
- Provide appropriate fire fighting equipment for each floor separately, in case that the garage has more than one floor

For more information the trainee is addressed to the information provided in the introductory module, section M0-EN.6.

M6-EN.5.4.1 Removal of combustible material

Any combustible material (petrol, oil, solvents, etc) must be removed from the garage. If possible, move the work to a location well away from combustible materials. In case that another location cannot be found, then combustibles must be protected with a cover made of fire-resistant material.

Safety Precautions

- Remove all combustible materials 10m away from the garage
- Use fire-resistant material for covering or blocking all open doorways, windows, cracks, and other openings

- Enclose the storage room for these materials with portable fire-resistant screens
- Protect combustible walls, ceilings, floors, etc, from sparks and heat with fire-resistant covers
- When working on a car, move nearby combustibles to a safe location, to prevent their ignition
- In case that relocation of combustibles cannot be done, an employee can be designated to serve as a fire watch, equipped with a fire extinguisher, during the welding operation and for at least one half-hour after welding is completed
- No welding or cutting must take place, on material having a combustible coating or combustible internal structure, as car particles, or accessories, without an approved method for eliminating the hazard
- After welding or cutting, make a thorough examination for evidence of fire. It must be mentioned that easily visible smoke or flame may not be present for some time after the fire has started
- Avoid welding or cutting in atmospheres containing dangerously reactive or flammable gases, vapours, liquids, or dust (such as vapours from solvents, petrol, etc)
- Do not apply heat to a container that has held an unknown substance or a combustible material whose contents, when heated, can produce flammable or explosive vapours
- Never heat a car piece, when is covered by an unknown substance or whose coating can produce flammable, toxic, or reactive vapours when heated
- Develop adequate procedures and use proper equipment for doing the job safely
- Adequate ventilation must be provided by the employers, in the workplace in order to prevent accumulation of flammable gases, vapours, or dusts

M6-EN.6 NOISE

M6-EN.6.1 Brief Description

M6-EN.6.1 Brief Description

The material that follows is supplementary to the information provided in the Introductory Module (section M0-EN.5).

In case of exposure to excessive noise, noise levels have to be reduced or controlled or ear protection provided for workers has to be used.

Workers in vehicle repair workshops are exposed to excessive noise during different operations. For example:

- Operators using air saws and chisels may be exposed to noise levels as high as 107 dB, while those using air grinders and orbital sanders to 97 dB
- Noise levels from panel beating and other repair operations using hand tools are variable but generally high
- Noise from work with sheet metal is often around 93 dB, while welding and flame cutting can also be noisy
- Noise during paint spraying has been measured at 93 dB
- Much body repair work will expose operators and others to more than 85 dB
- Removing panels using an air saw for as little as six minutes can mean that the user's total daily personal noise exposure will exceed 85 dB
- Using an air sander for 45 minutes can give the user a daily personal noise exposure of more than 90 dB

The noise action levels (of 85 and 87 dB) are likely to be exceeded where bodywork is a regular daily activity and where pneumatic tools are used even for short periods.

Safety Precautions

Reduction of noise exposure by means other than the provision of hearing protection is preferable, when this is practicable. Therefore, employers must:

- Choose quiet machines and equipment, by requiring from the suppliers to provide information on noise levels at operators' positions
- Use silencers, for example on pneumatic exhausts
- Isolate the bodywork in separate room or fix ceiling high partitions, covered with noise absorbing material
- Fit sound absorbing materials to work areas
- Reduce the duration of exposure to noise by job rotation
- Identify noisy work with "ear protection zone" warning signs
- Impose the use of hearing protection within the "ear protection zones"

M6-EN.7 VIBRATION

M6-EN.7.1 Brief Description

M6-EN.7.1 Brief Description

Exposure to vibration at work can occur in two main ways:

- Hand-transmitted vibration (known as hand-arm vibration or HAV), and
- Vibration transmitted through the seat or feet (known as whole-body vibration or WBV). WBV is not common in a motor vehicle repair workshop (body repair section)

Hand-arm vibration (HAV) is the vibration transmitted into workers' hands and arms when they use hand-held powered work equipment. Too much exposure to hand-arm vibration can cause hand-arm vibration syndrome and carpal tunnel syndrome. The hand-arm vibration syndrome affects the nerves, blood vessels, muscles and joints of the hand, wrist and arm. If ignored, it can become severely disabling. HAV also results in the impaired blood supply to the fingers, a condition known as "Vibration White Finger", which can cause severe pain in the affected fingers. Carpal tunnel syndrome is a nerve disorder, which may involve pain, tingling, numbness in parts of the hand, and can be caused –among others- by exposure to vibration.

Workers in a vehicle body repair workshop are frequently using hand-vibrating tools that can damage bones and joints; therefore they must be informed to look out for early signs and symptoms, such as:

- Tingling and numbness in the fingers (which can cause sleep disturbance)
- Not being able to feel things with their fingers
- Loss of strength in their hands (they may be less able to pick up or hold heavy objects).
- In the cold and wet, the tips of the worker's fingers are going white then red and being painful on recovery (vibration white finger)

If no attention is paying to the above early signs and the use of high-vibration tools continues, then the following symptoms will get worse:

- numbness in workers' hands could become permanent and they won't be able to feel things at all
- the exposed worker will have difficulty picking up small objects such as screws or nails
- the vibration white finger could occur more frequently and affect more fingers

Operators working in a body repair workshop are the ones mostly exposed to vibrations due to regular use of hand-held or hand guided power tools and machines such as grinders, disc cutters, screw drivers, etc.

Safety Precautions

It is a responsibility for both employers and employees, to **reduce the risks of vibration, by:**

- Using suitable low-vibration tools and proper ones for each job
- Properly installing, maintaining and repairing tools to avoid increased vibration caused by faults or general wear, and to sustain their best vibration performance (employers

should monitor the use of vibrating tools to ensure that they are being used and maintained correctly)

- Fitting hand tools with vibration-absorbing handles
- Operating the vibrating tools only by appropriately trained workers
- Keeping cutting tools sharp so that they remain efficient
- Avoiding gripping or forcing a tool or work piece more than it should
- Storing tools in appropriate environment so that they do not have very cold handles when next used

Some simple things workers can do in order to ameliorate the effects of vibrations are:

- Encouraging good blood circulation, by keeping hands warm and dry (when necessary, wear gloves, waterproofs and use heating pads if available)
- Giving up or cutting down on smoking because smoking reduces blood flow
- Massaging and exercising their fingers during work breaks

Anti-vibration gloves generally provide small reduction of vibration. Tool suppliers should not recommend anti-vibration gloves as a means of attenuating the vibration from hand-held power tools unless models of anti-vibration gloves have been demonstrated to provide adequate protection. However, gloves may help prevent vibration injury by keeping hands warm and dry.

M6-EN.8 ELECTROMAGNETIC RADIATION

M6-EN.8.1 Brief Description

M6-EN.8.1 Brief Description

Welding operations are associated with the intense light that can cause serious and often permanent eye damage if operators do not wear proper eye protection. The intensity of light or radiant energy produced by welding, cutting or brazing operations varies according to a number of factors including the task producing the light, the electrode size and the arc current.

Safety Precautions

In order to prevent exposure to direct and reflected ultraviolet light and infrared rays, employees have to wear protective clothing, eye protection and use welding screens (M6.8.1.jpg, M6.8.2.jpg)

M6-EN.9 WORKING CONDITIONS

M6-EN.9.1 Housekeeping of the work area

M6-EN.9.1.1 Workshop and passageway floors (incomplete)

M6-EN.9.1.2 Stairs and ladders (incomplete)

M6-EN.9.1.3 Slips, Trips and Falls

M6-EN.9.2 Light levels

M6-EN.9.3 Warning and safety signs

M6-EN.9.4 Ventilation

M6-EN.9.5 Welfare

M6-EN.9.5.1 Ambient temperature and relevant humidity

M6-EN.9.5.2 Sanitary facilities

M6-EN.9.5.3 Coffee-break room

M6-EN.9.5.4 First Aid provisions

M6-EN.9.6 Car wash safety

M6-EN.9.1 Housekeeping of the work area

One essential component of good working conditions is good housekeeping. It helps to the prevention of occupational injuries and diseases. Housekeeping includes the proper organization and maintenance of buildings, plants, machinery and equipment; the upkeep of all the sanitary and welfare facilities; and the regular painting and cleaning of walls, ceilings and fixtures. Good housekeeping also includes everyday cleanliness, tidiness and good order in all parts of the workplace. Good housekeeping is important when it comes to good safety practice. Because housekeeping is a maintenance task, therefore it cannot be achieved without the goodwill and participation of everyone in the workplace.

Some important points in observing good housekeeping are given below:

- Layout to facilitate order and cleanliness
- Aisles, passageways, transport areas and exits must be marked. They must be kept clear from obstacles
- Storage areas must be set, for raw materials, finished products, tools and accessories (**M6.9.1.jpg, M6.9.2.jpg**)
- Racks for hand tools or implements above work tables
- Arrangements to remove wastes
- Clear assignment of duties for maintenance and repair of work premises, in particular stairs, walkways, walls, lights and sanitary facilities
- Receptacles for waste and debris in convenient locations
- Floor-covering materials suitable for the work and for cleaning
- Screening and simple devices to prevent deposits of oil, liquid wastes or water on the surrounding floors
- Drainage channels for waste water

- Special groups of persons to carry out daily cleaning and weekly or monthly cleaning

M6-EN.9.1.1 Workshop and passageway floors

Safety Precautions

- Keep all floors clean, dry and especially not slippery
- Wear suitable footwear in vehicle washing areas
- Keep the ramps dry and with non-skid surfaces
- Mark properly all passageways and roadways (e.g. marking with black and yellow diagonal stripes)
- Keep passageways clean, as well as steps, corners and fixed obstacles
- Spills must be reported and cleaned up immediately

Employers must ensure that:

- All surfaces are even, without holes or broken boards.
- Good drainage exist in wet processes
- Floor load capacities are posted in lofts, and spares storage areas

M6-EN.9.1.2 Stairs and ladders

During the use of ladders, one main hazard exists: falls (**M6.9.3.jpg**). A fall can happen because of several circumstances, such as:

- A ladder that is overloaded or damaged and fails,
- The employees slip or lose their balance while they climb on a ladder
- Existence of oil or grease on a ladder
- Ladders that are not set up securely with a possibility to shift

When it comes to falls on stairways, this can occur when employees slip or trip. Clutter, slippery surfaces, damage, poor lighting, and unsafe work practices can contribute to stairway fall hazards.

Safety Precautions

- Keep all stairs and ladders in good condition
- Keep stairways free of any clutter or slippery conditions
- Avoid to use a broken ladder or stair
- Inspect the ladder prior use
- Do not use ladders in uneven or unstable ground. Prefer a firm, solid surface
- Chose a ladder with adequate length and load limits
- Never tied ladders together to make them longer
- Avoid to use of metal ladders near electrical lines

Employers are required to:

- Inspect regularly the stairs and ladders and repair any damages immediately
- Provide a handrail for the prevention of falls

M6-EN.9.1.3 Slips, Trips and Falls

Many motor vehicle repair garages have a difficulty in maintaining good standards of housekeeping and storage. For many cases this is because to a general lack of space. As a result slips, trips and falls cause many non-fatal injuries. These can be effectively reduced through good health and safety arrangements. Injuries might be a result of:

- Slips of workers (due to oil spillages) (**M6.9.4.jpg**)
- Falls (mostly related to unfenced inspection pits) (see also paragraph 3.3)
- Trips of operators (due to unorganised workplace) (**M6.9.5.jpg - M6.9.10.jpg**)

Safety Precautions

- Isolate a leak of engine oils as soon as it is identified. Stop the flow and use inert absorbent material to contain the spill with
- Never leave oil spillages or grease on the floor; most probable a worker will step on it and slip. Clear them promptly
- Never leave an inspection pit open when not in use (for more safety precautions refer to the relevant paragraph (3.3))
- Always keep a trolley next to you with all necessary equipment on. Do not leave equipment or material on the floor, since someone may trip over them
- Always return the equipment being used to their storage place as soon as you finish your job
- Keep all tools in a tight form
- Store and stack materials and objects

Storage of materials and objects must be done in a way that there is no possibility to fall and cause injury (**M6.9.11.jpg - M6.9.12.jpg**). The racks and shelves used for the storage must be strong enough and stable for the loads to be placed on them. Usually, racking and shelving is made from lightweight materials and is limited to the amount of wear and tear it can withstand. In order to make sure that racking or shelving installations continue to be functional several actions can be taken, such as regular checks for the identification of damage, encouragement of the employees to report any damage, fix maximum load notices and adhere to them strictly.

Safety Precautions

- Stack material safely on sound pallets
- Give limits for the height of stacks to maintain stability
- Inspect regularly the stacks to detect and remedy any unsafe stacks
- Establish a storage system and instruct and train the employees in stacking
- Provide special arrangements for objects which may be difficult to store

M6-EN.9.2 Light levels

At a workshop, lighting, which consists of general lighting or a combination of general and local lighting, should be enough to allow employees to work and move safely. Adequate lighting is very significant at a workplace, for the following reasons:

- Focus: the human eye cannot focus at the same time on objects that are close and far away. When a person rapidly changes its focus on objects at different distances, the eye becomes tired. This is more often in inspection of an engine, and working on an engine. In such cases, plenty of light must be available, mainly at the area furthest away from the eye.
- Changes in the eyesight: everybody has different eyesight. Some people have weaker eyesight than others do. In addition, the ability of the eye to adjust rapidly to different distances declines, as people grow older. It is very important that older people have adequate lighting.

Daylight is much better than artificial lighting; however, daylight varies with the seasons and the weather conditions. Thus,

- Determine the amount of lighting required no matter the amount of daylight
- Get as much daylight as possible
- Make sure that stored material does not be piled up where it blocks daylight
- Keep windows clean both inside and outside
- In case of a window facing a wall, that wall should be painted white in order to reflect more daylight into the workplace
- It is better that most of the light to fall on the material or objects that employees handle
- The light source should be positioned behind and to the side of the left shoulder if the person is right-handed.

Some important factors for determining the quantity of the light are:

- The type of work (e.g. precision work needs more light)
- The size, form and light-reflecting properties of the material or object, and whether the object is easily distinguishable from the background
- The capability of the surrounding surfaces to reflect light
- Eyesight of the workers

Safety Precautions

- Always provide adequate general lighting as sunlight may become insufficient at different times of the day
- Adequate lighting should also reach every individual working place (e.g. during oil removal) without being shadowed by the employee or part of a machine.
- Use only explosion-proof lighting in spray areas and in paint storage rooms
- Portable lights are not allowed in body shop spray area.
- In case of sudden loss of light, automatic emergency lighting, powered by an independent source, should be provided immediately.

M6-EN.9.3 Warning and safety signs

Several regulations exist to cover various means of communicating health and safety information. These include the use of illuminated signs, hand and acoustic signals (e.g. fire alarms), spoken communication and the marking of pipe-work containing dangerous substances. These are in addition to traditional signboards such as prohibition and warning signs. Fire safety signs (i.e. signs for fire exits and fire-fighting equipment) are also covered. Some examples are given below:



Ear protection for engines testing



Gloves during washing



Shield used during welding



Eye protection for welding process



Mask and respirator during painting

Suitable illuminated signs and acoustic signals must be used at workplaces. Dangerous locations (e.g. where people may slip from spilled oils, fall into inspection pits) and traffic routes need to be marked.



No access for the pedestrians



Industrial vehicles

Areas containing significant quantities of dangerous substances (storage of oil, petrol, solvents, etc) have to be identified by the appropriate warning sign.



Placed at storage rooms

Warning signs represent a hazard level between Caution and Danger. A warning indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury. Regulations require that employers must provide specific safety signs whenever there is a risk that has not been avoided or controlled by other means, e.g. by engineering

controls and safe systems of work. Where a safety sign would not help to reduce that risk, or where the risk is not significant, there is no need to provide a sign.

Employers have to maintain the safety signs, which they provided, explain unfamiliar signs to their employees and advise them what they need to do when they see a safety sign.



Corrosive material (solvents, cleaning agents, etc)



Toxic material (solvents, paints, etc)



Flammable material (oil, solvents, etc)



Explosive material (petrol, etc)



Marking for dangerous locations (inspection pits, etc)

Warning signs very often have an orange body with a black panel at the top. Warning is written in orange on the black panel. Additional wording and pictograms are printed in black on the lower portion of the sign.

M6-EN.9.4 Ventilation

Employers should ensure that adequate ventilation system exists, and that the dangerous air can be extracted in the open air away from people, sources of ignition and nearby buildings and/or equipment. Although the most effective way of reducing the risks of atmospheric pollution is to enclose the entire process, this is not always possible.

Workplaces must have adequate ventilation. Resulting in fresh and clean air, uncontaminated by discharges from fuels or other process outlets, entering and circulating through the workrooms. Ventilation should also remove and dilute warm, humid air and provide air movement. When the workplace contains process or heating equipment or other sources of dust, fumes or vapours, more air will be needed to provide sufficient ventilation. In many cases, windows or other openings can provide sufficient ventilation, but where necessary, mechanical ventilation systems must be provided. The mechanical ventilation system could be general covering the entire workshop, local covering emissions from specific processes (e.g. booths, baths of dangerous liquids), or be installed on tools and some hand-operated machines (e.g. grinders) **(M6.9.13.jpg)**

The main areas in a vehicle repair workshop that adequate ventilation is necessary are:

- In the repair workshop, due to the exhaust fumes from running engines (see section M6-EN.4.2)
- In the paint spraying booths, due to the rise of fine aerosols, mists and droplets of toxic and flammable liquid (see section M6-EN.4.5)
- In the body filling and sanding booths, due to exposure to dust and fume (see sections M6-EN.4.7 and M6-EN.4.11)

- In the welding and metal cutting areas due to exposure to gases and fumes (see section M6-EN.4.10)
- In the bath area of dangerous liquids, where an air curtain system can be used (**M6.9.14.jpg**). In this system the air is blown in under pressure from one side and extracted from the other, thereby screening the worker from dangerous vapours.

Fresh air inlets must be adequate and access points for inspection and cleaning inside ducting should be provided. A booth should always have an outward-opening fire escape door in the end wall opposite the booth's entrance. (**M6.9.15pg – M6.9.16.jpg**)

All technical equipment should be well maintained and checked by competent personnel regularly. In order for any ventilation system to work effectively, the filters should be changed at a regular basis, the fans and ducts/pipes should be checked, gaskets/washers replaced and valves inspected.

M6-EN.9.5 Welfare

Employers must provide adequate and appropriate welfare facilities for their employees while they are at work. "Welfare facilities" are those essential for the well-being of the employees, such as washing, toilet, rest and changing facilities, and a clean place for eating and drinking during breaks.

If the work activity requires from the employees to change into and wear special clothing (overalls, a uniform, thermal clothing etc), then employers must provide enough changing rooms for the number of people expected to use them. Wherever a changing room is provided it should be readily accessible, contain, or lead directly to, clothing storage and washing facilities, provide seating, provide a means for hanging clothes (hook or peg), ensure the privacy of the user. The space for workers' clothing storage should be adequate, suitable and secure. All the facilities should be readily accessible from workrooms, washing, and eating facilities and should ensure the privacy of the user. In cases that a pregnant employee exists, employers may need to provide a room for the pregnant woman/nursing mother to rest or lie down.

Employers must ensure that the facilities are kept clean and in good condition, meaning that an effective system for maintenance needs to be put in place. The facilities should also be designed so to respect people with disabilities that might work at the workshop or visit the premises.

M6-EN.9.5.1 Ambient temperature and relative humidity

At a workplace, comfort depends on air temperature, radiant heat, air movement and humidity. The risk to the health of workers increases as environmental conditions become uncomfortable. For example, the risk of heat stress arises, from working in high air temperatures, exposure to high thermal radiation or high levels of humidity, while cold stress may arise from working in the open air during winter. If an assessment is undertaken, of the risk to workers' health, from working in either a hot or cold environment, it needs to consider both sets of factors - personal and environmental. Personal factors include body activity, the amount and type of clothing, and duration of exposure, while environmental factors include ambient temperature, and radiant heat; and if the work is outside, sunlight, wind velocity and the presence of rain or snow.

In a motor vehicle workshop, high temperatures can usually be observed at car wash areas and during welding processes. Inadequate ventilation and inefficient cooling systems can cause discomfort, incapability to concentrate, heat stroke, exhaustion, cramps and fainting.

Safety precautions

Employers should be aware of engineering and work practice controls providing:

- Good general ventilation avoiding draughts
- Mechanical ventilation (cooling fans and air conditioning) at areas of high heat production and where fresh air supply is insufficient
- Heating systems that do not give off fumes into the workplace
- Large quantities of cool drinking water
- Controls of radiant heat (especially near head level) and of local “hot spots”, arising for example from paint-drying lamps

M6-EN.9.5.2 Sanitary facilities

Adequate toilet and washing facilities must be provided for employees. 'Adequate' means that employers have to provide:

- sufficient toilets and washbasins for those expected to use them
- where possible, separate facilities for men and women
- clean facilities
- a supply of toilet paper, and for female employees means of disposing of sanitary dressings
- facilities that are well lit and ventilated
- facilities with hot and cold running water
- enough soap or other washing agents
- a basin large enough to wash hands and forearms if necessary
- a means for drying hands, e.g. paper towels or a hot air dryer

M6-EN.9.5.3 Drinking water and Coffee break room

Adequate supply of wholesome drinking water, with an upward drinking jet or suitable cups, should be provided. Water should only be provided in refillable enclosed containers where it cannot be obtained directly from a mains supply. The containers should be refilled at least daily. Bottled water/water dispensing systems may still be provided as a secondary source of drinking water.

Employers must ensure that the drinking water they provided is:

- free from contamination and is preferably from the public water supply
- easily accessible by all employees, but in areas where contamination is possible due to the work performed (**M6.9.17.jpg** – **M6.9.20.jpg**, bad examples)
- adequate supplied (taking into consideration the temperature of the working environment and types of work activity)
- equipped with cups or a drinking fountain
- equipped with taps and containers clearly and correctly labelled as drinking water

Rest facilities should also be provided, being suitable, sufficient, and readily accessible. Rest areas or rooms should be large enough, and have sufficient seats with backrests and tables, for the number of workers likely to use them at any time. They should include suitable facilities to eat meals where meals are regularly eaten in the workplace and the food would otherwise be likely to become contaminated. Where hot food cannot be obtained in, or reasonably near to the workplace, workers may need to be provided with a means for heating their own food. Canteens or restaurants may be used as rest facilities and no obligation must exist for purchasing food. Employers should provide a working environment where people can work without being irritated by tobacco smoke. This can be done by prohibiting smoking in all but a few designated rooms.

M6-EN.9.5.4 First Aid provisions

People at work may suffer injuries. It does not matter whether the injury or the illness is caused by the work they do or not. It is important that they receive immediate attention and that an ambulance is called in serious cases. A workplace should at least have a suitably stocked first-aid box and an appointed person to take charge of first-aid arrangements. There is no obligatory list of contents for first aid boxes. What to include in a first aid box, is based on the employer's assessment of first aid needs that has to be carried out. It is better not to keep tablets and medications in the first aid box. Although there is no specified review timetable, many items (especially sterile ones) are marked with 'Best before dates'. Items with these on should be replaced by the dates given. Any items that have passed their expiry date should be disposed of safely. In cases where sterile items have no dates, it would be advisable to check with the manufacturers as to how long they can be stored.

All first aid boxes must have a white cross on a green background. (**M6.9.21.jpg** – **M6.9.25.jpg**) Similarly, first aid rooms should be easily identifiable by white lettering or a white cross on a green background. All first aid signs should be placed where they can be seen (not obstructed from view) and easily identified.

If mains tap water is not readily available for eye irritation, at least one litre of sterile water or sterile normal saline (0.9%) in sealed, disposable containers should be provided. When the seal has been broken, the container should not be reused. The container should not be used beyond its expiry date.

Written emergency procedures should exist for cases of accidents, such as major spills and exposures, contact of skin and/or eyes with dangerous and toxic liquids.

M6-EN.9.6 Car wash safety

Safety Precautions

- Remove tools, materials or other objects lying on floors, driveways, in order to eliminate tripping hazards. Clean up all spills (oil, detergent, wax, etc.).
- Inspect tools and equipment before using them and think before starting every job. Search out hazards and take precautions to prevent accidents from happening. Use the protective equipment provided
- Report any unsafe conditions you observe in your work to the immediate supervisor.
- When lifting, be sure of your footing and grip. If the object is too heavy for you, get help from someone to help you

- Keep all oil rags or other flammable waste materials in closed metal containers, not indoors, and preferably be disposed of every day
- Caution labels and signs must be installed whenever necessary
- Vehicle washing can produce wash waters contaminated with dust, dirt, oil, grease, and other leaking vehicle fluids. Do not discharge these contaminated waters to gutters, streets or storm drains

M6-EN.9.6.1 Personal Protective Equipment for car washers

During **steam cleaning operations**, the employees should always wear boots, heavy gloves and face protection to protect from burns. A shot of steam inside a pair of shoes can raise blisters. Hands are burned, if touched by a hot coupling.

Some **car wash chemicals** are caustic and should not come in direct contact with bare skin or eyes (see also section M6-EN.4.12). Whenever handling such chemicals as acid, strong caustics or concentrated solve nets or waxes, employees must wear proper protective rubber gloves, boots and a face shield. (Bad practice in **M6.9.26.jpg**, **M6.9.27.jpg**). Employees must wear shoes with neoprene soles, which are resistant to chemicals. These shoes are also more slip-resistant on oily or soapy floors and usually incorporate steel caps for toe protection against falling objects.

M6-EN.10 RISK ASSESSMENT FORMS

Hazard		Who (type of worker)	Harm	Required Safety Measures
Source	Hazard description			
Electricity				
Electrical circuits	Contact with live parts	Worker using electrical equipment	<ul style="list-style-type: none"> • Electric shock • Burns • Death 	<ul style="list-style-type: none"> • Appropriate electrical equipment with circuit protection • Regular maintenance of the electrical equipment • Use of air tools, when possible • Use of low voltage equipment • Installation of a residual current device for each electrical socket • Replace cracked or worn extension cords • While disconnecting pull the plug and not the cord • For outdoors applications use only appropriate extension cords
	Overloading of circuits	Employees	<ul style="list-style-type: none"> • Reduced performance of equipment • Overheating of electrical equipment – Possible fire • Explosion when near to explosive materials • Injuries and burns 	<ul style="list-style-type: none"> • Do not create an “octopus” on a single wall outlet • Do not use looped or coiled cords • Select appropriate size of the cord to satisfy the needs of the tool or appliance
Ignition sources	Ignition leading to fire or explosion	During welding, in inspection pits, employee working around spills of flammable liquids	<ul style="list-style-type: none"> • Injuries from burns 	<ul style="list-style-type: none"> • Use of explosion protected electrical equipment • Placement of fixed electrical installations at least 1m above the ground

Extension cords	Trips and falls	Employees and visitors	Injuries from the trips and falls due to cords	<ul style="list-style-type: none"> Do not leave extension cords to hung from counters Do not place extension cords along walkways and corridors
	Overloading of extension causes overheating	Employees	Overloading leads to overheating, possible fire cause	
Lifting Equipment				
	Malfunction of the lifting equipment	Operators of lifting equipment	<ul style="list-style-type: none"> Injuries due to detached load Death 	<ul style="list-style-type: none"> Regular inspection of equipment by competent personnel
	Overloading	Operators	<ul style="list-style-type: none"> Injuries due to detached load Death 	<ul style="list-style-type: none"> Respect and follow the manufacturer's recommendations concerning the lifting capacities of the equipment
	Collapse of hoists, jacks	Worker under or near the car being repaired	Injuries sometimes fatal	<ul style="list-style-type: none"> Two hand operation machines Toe protection Automatic locking at different positions Use in level and undamaged floor Use equipment in good condition Use the correct jacking points Nobody must get underneath a vehicle supported only by a trolley jack or jacks
Inspection Pits				
Unsecured inspection pits	Falls into the pits	Workers or visitors unaware of the pits	Injuries such as broken legs, hands, etc	<ul style="list-style-type: none"> Pits must be covered when not in use Place temporary barriers
	Falls of tools left at the edge of an inspection pit	Workers inside a pit	Head injuries	<ul style="list-style-type: none"> Never leave tools near pit' edges
Flammable vapours	Explosions due to concentration of	Workers inside or near the pit	Burns, injuries sometimes fatal	<ul style="list-style-type: none"> Pits must have two clear access/exit routes Use only explosion protected electrical

	flammable vapours from petrol, paints and solvents			equipment or air powered portable tools when working into pits
Testing of Vehicles				
Movement of vehicles during testing, on the site or inside the workshop	Accidents due to incompetent driver	People inside or near the car; Visitors	Injuries from accidents (broken bones, etc)	<ul style="list-style-type: none"> • Forbid unauthorised personnel or customers to move around the repair workshop • Mark clearly the routes in and around the workshop • Non-competent persons must never test a vehicle. • Supervise vehicle movement near blind corners and when reversing
Rolling Roads and Brake Testing Equipment	Accidents due to damaged equipment or when adjustments are being made while in operation	Operator of the testing equipment	Injuries	<ul style="list-style-type: none"> • Never perform testing or adjustments to a vehicle while the rolling road is moving • The rolling road must be equipped with a “dead man’s” control system • No unauthorised personnel should have access to the area of testing
Wheel Alignment and Balancing	Contact with rotating wheels during balancing	Employees working with wheels	Rotating wheels can cause friction burns or other injuries	<ul style="list-style-type: none"> • Vehicles must be supported and raised safely
	Injuries during the lifting of tyres	Employees working with wheels	Back injuries	<ul style="list-style-type: none"> • Apply good lifting techniques
	Inflation of tyres	Employees working with wheels	Air blasts due to over-inflation of the tyres, causing injuries	<ul style="list-style-type: none"> • Fully deflate the tyres • Inflated the tyres to the correct pressure • Use proper pressure gauge
Compressed air equipment	Injection of compressed air or material at very high pressures	Operators	Injuries (even fatal) from the injection of the compressed air to the skin or body orifice	<ul style="list-style-type: none"> • Regular examination of the equipment by a competent technician • Direct compressed air guns away from the face • Always wear goggles • Ask for medical advice in cases of accidental compressed air penetration

				<ul style="list-style-type: none"> • Train the compressed air equipment's operators
Regular Service Work				
Fuel Work (Spillage of petrol)	<ul style="list-style-type: none"> • Spillage of petrol due to: removal from fuel tanks; checking of the fuel systems; drainage in unsuitable containers; damaged fuel lines • Evaporation of spilled petrol, and creation of a heavier-than-air vapour. 	Vehicle mechanic	Ignition of flammable vapours leading to explosion and fire, having as a result burns, sometimes fatal	<ul style="list-style-type: none"> • Fuel removal has to be carried out only by trained personnel • Remove fuel in a well-ventilated area, away from ignition sources • Use a fuel retriever system • If a hand-operated siphon or an independent manual pump is being used for fuel removal then the transfer pipe-work must be securely positioned at both ends and the vehicle chassis and the container must be grounded by the use of earthing straps • Petrol must always be drained into a stable, metal container large enough to hold the content of the fuel tank • The container must have a top securely closed all the time • Keep petrol containers away from pathways and held then within a stable framework • Store drained petrol in a designated lockable, well-ventilated area, unless it is to be returned to the vehicle immediately • Never add drained petrol to the waste-oil tank and vice versa. • Treat any contaminated petrol or petrol/diesel mixtures as waste • Never remove petrol from a vehicle while it is over an inspection pit • Hot work (e.g. welding) must never take place close to a fuel line of the vehicle

				<ul style="list-style-type: none"> Always disconnect vehicle's battery during fuel removal
Change of engine's oil	Used engine oils include a variety of toxins, such as heavy metals, naphthalene, chlorinated hydrocarbons, etc.	Workers dealing with used engine oils	Dermatitis and other skin disorders, including skin cancer; breathing health problems due to vapours	<ul style="list-style-type: none"> Dispose all waste oils in lidded metal containers Keep waste oil containers always closed The oil storage containers must be leak-free and have labels with the words "used oil". Apply a system (e.g. colour designation) to avoid confusion between the containers for the engine oils and those for the petrol. Always wear clean overalls and gloves
	Engine oils are flammable and can cause fire	Workers dealing with used engine oils	Burns caused by the fire	<ul style="list-style-type: none"> Never keep containers with engine oil in the workplace or near it Storage room for the engine oils must be well ventilated, and be equipped with sprinklers above the containers in case of fire Establish an engine oil distribution system, if possible
	Spillage of oil on floors	Workers dealing with engine oils and visitors	Injuries due to slips	<ul style="list-style-type: none"> Use a drip table or screen table to collect oil dripping off parts, while changing oil
Running engine (emission of exhaust's fumes)	Inhalation of the exhaust fumes from diesel or petrol fuelled engines, which are toxic, and deposition of the very small particles of the fumes on the lungs	Mechanics in a vehicle repair workshop	<ul style="list-style-type: none"> The particles contained in the fumes can also cause cancer. Short-term health effects, can be irritation of eyes and nose or of the respiratory track, light-headedness, weakness and numbness Long-term effects, can be chronic respiratory symptoms (e.g. persistent cough and mucous), chestiness and 	<ul style="list-style-type: none"> Install an appropriate ventilation system (general or local) Never keep a vehicle's engine running inside a workshop more that is needed to get the vehicle in and out the workshop Use a fume extraction system directly coupled to the vehicle's exhaust, when the engine is kept running, to lead the fumes outside the workshop Be cautious the fumes being ventilated to the open air (outside the workshop), not to be drawn back in the workshop or affect other premises or people nearby

			breathlessness bronchitis, and reduced lung capacity than unexposed workers	<ul style="list-style-type: none">• Keep the flexible pipes and the connecting hoses of the exhaust system in good condition to prevent leaks• Report immediately any faults in the fumes-extraction system, in order to be repaired• The employees must be informed on the risks of exposure to exhaust fumes, and be trained on the correct use of the installed fumes-extraction system
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Batteries charging	<ul style="list-style-type: none"> • Hydrogen being emitted during and after charging • Sparks generated while connecting or disconnecting batteries or charger connections to battery terminals 	Mechanics charging or repairing batteries	<ul style="list-style-type: none"> • Explosion if the created sparks ignite the emitted hydrogen • Injuries and burns from the acidic electrolyte being sprayed when a battery is exploded 	<ul style="list-style-type: none"> • Charge a battery only in an approved, ventilated battery-charging areas • Restrict smoking • Keep away any source of ignition from the battery recharging area • Wear protective eyewear • Install a safety shower and an eyewash station • Check the electrolyte level before recharging. • Never charge batteries at rates greater than those recommended by the manufacturer • Follow the recommendations of the charger's manufacturer for attaching and removing cables and for operating the equipment properly. • Unplug or turn off the battery charger before connecting or disconnecting the clamp connections • Be cautious of the battery's polarity • Keep the crocodile clamps clean, free from corrosion and insulated • Clean the battery terminals before fixing the charging clamps • Never use battery discharge testers immediately after charging • Turn off the charger temporarily, if the battery becomes hot or if the electrolyte spits out from the vent • If the battery has sealed vents, it must not be recharged with a current greater than 25 amps
	Rapid heating during contact of a metal with the battery terminals	Mechanics dealing with batteries	Flash injuries and burns	<ul style="list-style-type: none"> • Never wear jewellery when working with batteries to avoid burns and flash injuries

Brake and Clutch Linings (Asbestos)	Inhalation of asbestos fibres being released while working with those parts that do contain asbestos.	Mechanics working on brakes and clutch linings	Inhalation of asbestos fibres may cause asbestos-related cancer, or asbestosis	<ul style="list-style-type: none"> • Use properly designed drums cleaning equipment, which prevent dust escaping or use clean wet rags to clean out drums or housings • Dispose used rags in a plastic waste bag while still wet • Use special vacuum cleaner to remove dust, or wet dust thoroughly and scrape it up if there's no vacuum • Never blow dust out of brake drums or clutch housings with an air line • Never grind or drill linings unless the machine has exhaust ventilation or there is a ventilated booth to do the work in • Never use brushes to sweep up dust • Always wear overalls • Never take the overalls home, they should be cleaned by the employer
Body Repair Workshop				
Welding and flame cutting	<ul style="list-style-type: none"> • Generation of harmful fumes and gases during welding due to primer and paint layers, other surface coatings such as under seal, and to lead in car bodies • Emission of metal cutting fumes 	Mechanics dealing with welding and cutting	Risk of serious respiratory (such as dryness of the throat, tickling, coughing, tightness of the chest and difficulty in breathing), neurological and reproductive effects due to the fumes.	<ul style="list-style-type: none"> • Install local exhaust ventilation in the area where welding and cutting work take place (e.g. use a mobile extraction unit with flexible exhaust hood) • Ensure that ventilation is never blocked up to prevent draughts

	<ul style="list-style-type: none"> • Electrical hazards • Passing of the welding current passing through lifting chains, crane cables, or other alternate circuits 	Mechanics dealing with welding and cutting	<ul style="list-style-type: none"> • Electrical shock or fire • Injuries and burns • Overheating of lifting chains or cables 	<ul style="list-style-type: none"> • Always connect the work cable as close to the welding area as practical • Never connect the work cables to the building framework
	<ul style="list-style-type: none"> • Ignition of flammable material on or near cars due to sparks or drips of molten metal • Direct contact with the generated heat 	Mechanics dealing with welding and cutting	<ul style="list-style-type: none"> • Injuries and burns from fire • Release of toxic substances • Burns from the generated heat 	<ul style="list-style-type: none"> • Move all fire hazards and combustibles at least 3 m away from areas or objects to be welded • Prohibit welding in areas where flammable materials (such as paints) are used, or heavy dust is present • Always keep fire extinguishing equipment in good condition in the welding or cutting place • Clean thoroughly fuel tanks to be weld or cut • Be cautious of the generated heat
	<ul style="list-style-type: none"> • Electromagnetic radiation 	Mechanics dealing with welding and cutting	<ul style="list-style-type: none"> • Burns and injuries 	<ul style="list-style-type: none"> • Always wear suitable face, neck and ear protection to prevent direct radiant energy from the arc • Use suitable eye protection (e.g. face shields, goggles)
	<ul style="list-style-type: none"> • Use of acetylene and oxygen cylinders for the generation of the cutting flame • Explosion of flammable gas cylinders 	Mechanics dealing with welding and cutting	<ul style="list-style-type: none"> • Explosion • Fire 	<ul style="list-style-type: none"> • Store full and empty cylinders in a safe, well-ventilated place (e.g. outside the workshop) • Never keep cylinders in low-lying places (e.g. basements, next to drains, below ground level), since heavy gases do not disperse • Turn off cylinder's valve at the end of the day • Minimize welding flame "flash-back" into hoses or cylinders • Change cylinders away from ignition sources • Never use flame to test for leaks, use only soapy water solutions

Body filling and preparation	<ul style="list-style-type: none"> Emission of toxic fumes Generation of fine dust due to sanding Emission of isocyanates (for safety precautions refer to the information under “isocyanates” in this tool) 	Workers in the body repair workshop	<ul style="list-style-type: none"> Inhalation of fine dust The catalyst being used is corrosive irritant that may cause dermatitis 	<ul style="list-style-type: none"> Keep body filling and preparation area away from other works Perform body filling only in a ventilated booth Prefer using coarse hand files Use powered sanding machines only for the final finish Use tools being equipped with built-in extraction or local ventilation Use appropriate PPEs (overall, gloves, masks) Never smoke, eat or drink when working with lead
Work on bumpers – Bonding of windscreens (Isocyanates)	<ul style="list-style-type: none"> Exposure to isocyanates 	Workers in the body repair workshop	<ul style="list-style-type: none"> Harm of the respiratory system Result in asthma Cause dermatitis 	<ul style="list-style-type: none"> Use non-isocyanates containing glue for windscreens if possible Handle isocyanates in a separate area with negative pressure Use local exhaust to reduce the spread of smoke Use gloves, goggles and protective clothing Scrap away any paint, adhesive, plastic etc that may contain isocyanates before heating Never saw through a bumper containing PUR damping material Never use hot air gun with PUR plastic material Prefer scrapping or cutting over heating when working with PUR material Use tools that produce as little heat as possible
Sanding dusts	Production of airborne dusts during sanding that may contain hazardous substances, such as lead and chromium	Operator of sanding discs	Harm to the lungs and the nervous system of workers due to inhalation of airborne dusts	<ul style="list-style-type: none"> Prefer using sanding tools with built-in extraction or have local exhaust ventilation Rotary/orbital and straight line/reciprocating sanders, equipped with high velocity, low volume (HVLV) local exhaust ventilation as part of the tool's design are recommended.

Noise	<ul style="list-style-type: none"> • Use of pneumatic tools • Use of air grinders, orbital sanders, air saws • Work with metal sheets 	Workers in the body repair workshop	<ul style="list-style-type: none"> • Health problems • Loss of hearing • Stress • Increase pulse rate, blood pressure, breathing rate 	<ul style="list-style-type: none"> • Choose as quiet machines as possible • Isolate bodywork in separate rooms • Reduce the duration of exposure by job rotation • Identify the noisy areas • Impose the use of ear protection PPEs
Painting				
Storage and Mixing of Paints	<ul style="list-style-type: none"> • Evaporation of solvents and paints • Creation of explosive atmosphere 	Workers handling paints for storage and mixing	<ul style="list-style-type: none"> • Injuries from inhalation of organic vapours • Injuries from possible explosion and fire • Injuries from burns due to fire 	<ul style="list-style-type: none"> • Place paint-storage and paint-mixing units in fire-resistant, well-ventilated rooms, and separated from the workshop • Equip the storage room with fire fighting system • Install explosion-protected lighting in the paint-storage and the paint-mixing units • Keep paints and solvents in their original labelled containers well closed • Store containers in a planned and orderly manner • Never use plastic containers not designed to hold paints or solvents • Use an absorbent material (rugs) in case of paint spillage • Keep waste rugs and material being contaminated with paint or solvent in a metal bin, with its lid always on • Perform mixing only under an appropriately designed hood that would lead the vapours away from the workplace • Forbid smoking where paints are stored or mixed
Use of	<ul style="list-style-type: none"> • Evaporation of 		<ul style="list-style-type: none"> • Skin irritation and irritation 	<ul style="list-style-type: none"> • When solvents are used for the cleaning of parts, then the washing baths have to be

Solvents	solvents <ul style="list-style-type: none"> • Creation of explosive atmosphere 		of internal organs <ul style="list-style-type: none"> • Health problems from inhalation of organic vapours • Dizziness, headaches, reduced comprehension, tiredness • Explosion and fire 	equipped with a hood for the extraction of the release vapours <ul style="list-style-type: none"> • Be cautious of the empty containers of solvents and/or dissolved paints, since they are often full of vapours • Reduce the amount of solvents being used • Use water diluted-paints • Keep thinners away from ignition sources
Paint spraying	<ul style="list-style-type: none"> • Rise of fine aerosol mists and droplets of toxic liquids due to paints and solvents vapours • Exposure to isocyanates (for safety precautions refer to the information under “isocyanates” in this tool) 	Painters	<ul style="list-style-type: none"> • Inhalation of vapours leading to breathing problems • Absorption from the skin of paint 	<ul style="list-style-type: none"> • Spray only in booths or enclosures with adequate ventilation • Check and maintain the spraying booths regularly. • Install a downdraught ventilation system in the spray booth or area. • Spray painter must wear proper breathing mask with filter appropriate for organic vapours, rubber gloves; water proof overall, earmuffs and head cover • Train the painter for the proper use of respirator • Stand upstream of the sprayed area • Never spray above your head in a down-draught booth • Use suitable platform when spraying a high-sided vehicle in a down-draught booth • If more than one sprayer is working on the same vehicle simultaneously, they must work in the same direction, in order to avoid spraying against one another

	Rise of high vapour concentrations that may lead to an explosive atmosphere	Painters	Injuries and burns due to explosion or fire	<ul style="list-style-type: none"> • Illuminate spraying booths or controlled spray areas with explosion-proof lighting. • Never use portable lights in the spray area • Ensure the fire resistance of the spray booth panels • Never spray within 7m from flames, sparks, operating electrical motors and other ignition sources • Remove all combustible material from the spray area • Smoking is forbidden in the spray area
Valeting				
Cleaners	They contain toxic and flammable solvents	Workers dealing with car valeting	Injuries and burns due to direct skin and eye contact with the cleaners; Breathing problems due to inhalation of vapours	<ul style="list-style-type: none"> • Substitute hazardous products with less hazardous ones, when possible • Always look at the label of the products to be used, to get information on the potential hazards • Pour only a small amount of fluid onto a pad or applicator • Keep only a small container with the cleaner close to the working area, and keep the container always closed when not in use • Leave all doors open when working inside a vehicle, for maximum ventilation • Work only in a well ventilated area • Valeting area must be free of ignition sources • Disconnect the vehicle battery • Always wear protecting clothing, including ant slippery shoes, natural rubber or nitrile rubber gloves to protect hands and forearms • Removed and dry the clothes in a safe place

				in the open air is cleaners are splashed
Untidiness	Tools, materials and objects lying on floors	Workers dealing with car valeting	Trips, slips and falls	<ul style="list-style-type: none"> • Remove lying tools, materials and objects • Clean up all spills from oil, detergent, wax, etc
Steam cleaning	Use of steam and water pressure cleaners	Workers dealing with car valeting	Burns, electrical shocks	<ul style="list-style-type: none"> • Keep all air and high pressure hoses properly coiled, when not in use • Always wear rubber boots, thick gloves and face protection to protect from burns • Use a residual current device or an earth monitoring device with cleaners that have flexible cables
Electrical tools	Use of electrical tools while valeting	Workers dealing with car valeting	Electrical shocks	<ul style="list-style-type: none"> • Always wear dry, insulated shoes that cannot result in shock through the soles • Never stand over water while using electrical tools
Working Conditions				
Workshop and passageway floors	Untidy, slippery floor	Workers, visitors	Injuries due to slips, trips and falls	<ul style="list-style-type: none"> • Keep all floors clean, dry and especially not slippery • Wear suitable footwear in vehicle washing areas • Keep the ramps dry and with non-skid surfaces • Mark properly all passageways and roadways (e.g. marking with black and yellow diagonal stripes) • Keep passageways clean, as well as steps, corners and fixed obstacles • Spills must be reported and cleaned up immediately <p>Employers must ensure that:</p> <ul style="list-style-type: none"> • All surfaces are even, without holes or broken boards.

				<ul style="list-style-type: none"> • Good drainage exist in wet processes • Floor load capacities are posted in lofts, and spares storage areas
Stairs and ladders	<p>A fall can happen because of several circumstances, such as:</p> <ul style="list-style-type: none"> – A ladder that is overloaded or damaged and fails, – The employees slip or lose their balance while they climb on a ladder – Existence of oil or grease on a ladder – Ladders that are not set up securely with a possibility to shift <p>When it comes to falls on stairways, this can occur when employees slip or trip. Clutter, slippery surfaces, damage, poor lighting, and unsafe work practices can contribute to stairway fall hazards.</p>	Workers, visitors	Injuries due to slips, trips and falls	<ul style="list-style-type: none"> • Keep all stairs and ladders in good condition • Keep stairways free of any clutter or slippery conditions • Avoid to use a broken ladder or stair • Inspect the ladder prior use • Do not use ladders in uneven or unstable ground. Prefer a firm, solid surface • Chose a ladder with adequate length and load limits • Never tied ladders together to make them longer • Avoid to use of metal ladders near electrical lines <p>Employers are required to:</p> <ul style="list-style-type: none"> • Inspect regularly the stairs and ladders and repair any damages immediately • Provide a handrail for the prevention of falls
Slips, Trips and Falls	<p>Injuries might be a result of:</p> <ul style="list-style-type: none"> • Slips of workers (due 	Workers, visitors	Injuries due to slips, trips and falls	<ul style="list-style-type: none"> • Isolate a leak of engine oils as soon as it is identified. Stop the flow and use inert absorbent material to contain the spill with • Never leave oil spillages or grease on the floor;

	<p>to oil spillages)</p> <ul style="list-style-type: none"> • Falls (mostly related to unfenced inspection pits) • Trips of operators (due to unorganised workplace) 			<p>most probable a worker will step on it and slip. Clear them promptly</p> <ul style="list-style-type: none"> • Never leave an inspection pit open when not in use (for more safety precautions refer to the relevant paragraph (3.3)) • Always keep a trolley next to you with all necessary equipment on. Do not leave equipment or material on the floor, since someone may trip over them • Always return the equipment being used to their storage place as soon as you finish your job • Keep all tools in a tight form • Store and stack materials and objects
Αποθήκευση υλικών και αντικειμένων	Falls of unstable objects, collapse of overloaded stacks or pallets	Workers, visitors	Injuries due to falling objects	<ul style="list-style-type: none"> • Stack material safely on sound pallets • Give limits for the height of stacks to maintain stability • Inspect regularly the stacks to detect and remedy any unsafe stacks • Establish a storage system and instruct and train the employees in stacking • Provide special arrangements for objects which may be difficult to store
Light levels	Accidents and injuries due to insufficient lighting	Workers, visitors	Injuries	<ul style="list-style-type: none"> • Determine the amount of lighting required no matter the amount of daylight • Get as much daylight as possible • Make sure that stored material does not be piled up where it blocks daylight • Keep windows clean both inside and outside • In case of a window facing a wall, that wall should be painted white in order to reflect more daylight into the workplace

				<ul style="list-style-type: none"> • It is better that most of the light to fall on the material or objects that employees handle • The light source should be positioned behind and to the side of the left shoulder if the person is right-handed. • Always provide adequate general lighting as sunlight may become insufficient at different times of the day • Adequate lighting should also reach every individual working place (e.g. during oil removal) without being shadowed by the employee or part of a machine. • Use only explosion-proof lighting in spray areas and in paint storage rooms • Portable lights are not allowed in body shop spray area. • In case of sudden loss of light, automatic emergency lighting, powered by an independent source, should be provided immediately.
Ambient temperature and relative humidity	The risk of heat stress arises, from working in high air temperatures, exposure to high thermal radiation or high levels of humidity, while cold stress may arise from working in the open air during winter	Workers, visitors	<ul style="list-style-type: none"> • Discomfort • Incapability to concentrate • Heat stroke • Exhaustion • Cramps • Fainting 	<ul style="list-style-type: none"> • Provide mechanical ventilation (cooling fans and air conditioning) at areas of high heat production and where fresh air supply is insufficient • Provision of heating systems that do not give off fumes into the workplace • Large quantities of cool drinking water must exist in the workplace • Controls of radiant heat (especially near head level) and of local “hot spots”, arising for example from paint-drying lamps
Car wash safety				

Steam cleaning operations	Steam cleaning operations may cause burns	Workers in car wash	Burns	<ul style="list-style-type: none"> • Use of personal protective equipment (boots, heavy gloves and face protection)
Car wash chemical cleaners	Direct contact with bare skin or eyes	Workers in car wash	Injuries of skin and eyes	Use of proper personal protective equipment (rubber gloves, boots, face shield, shoes with neoprene soles, which are resistant to chemicals)
Working conditions at a car wash	Injuries due to slips, trips, falls	Workers in car wash, visitors	Injuries due to slips, trips, falls	<ul style="list-style-type: none"> • Remove tools, materials or other objects lying on floors, driveways, in order to eliminate tripping hazards. Clean up all spills (oil, detergent, wax, etc.). • Inspect tools and equipment before using them and think before starting every job. Search out hazards and take precautions to prevent accidents from happening. Use the protective equipment provided • Report any unsafe conditions you observe in your work to the immediate supervisor. • Keep all oil rages or other flammable waste materials in closed metal containers, not indoors, and preferably be disposed of every day • Caution labels and signs must be installed whenever necessary • Vehicle washing can produce wash waters contaminated with dust, dirt, oil, grease, and other leaking vehicle fluids. Do not discharge these contaminated waters to gutters, streets or storm drains

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M6-EN.12 EVALUATION TESTS

In the following photos identify:

- Bad practices
- Good practices
- Hazardous situations
- Inappropriate equipment
- Proper personal protective equipment

