M6-EN.4 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 wounded 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 that 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 ^{o}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 150ºC. 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 3000ºC) 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 lose 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 valenting area is highly recommended for the control of exposure to vapours
- Keep the valenting 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:

Hand protection (when handling solvents, paints, oils) 	Eyes protection (when using solvents) 
Body protection (spray painting) 	Respirators/ masks (during spray painting/ mixing paints)