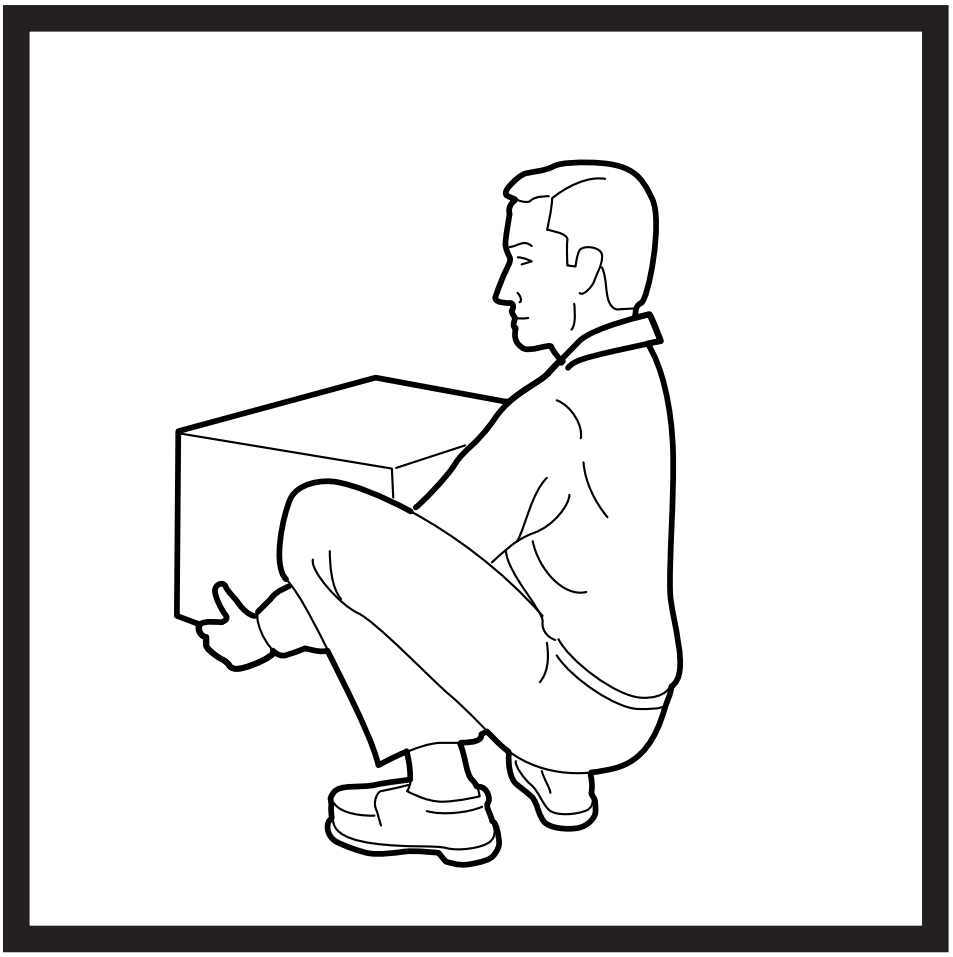
Technical Service Training

Global Fundamentals

Curriculum Training – TF10010016S

Shop Practices



Student Information

Ford Motor Company

FCS-13202-REF

CG7972/S en 12/2001

Global fundamentals training overview

The goal of the Global Fundamentals Training is to provide students with a common knowledge base of the theory and operation of automotive systems and components. The Global Fundamentals Training Curriculum (FCS-13203-REF) consists of nine self-study books. A brief listing of the topics covered in each of the self-study books appears below.

- Shop Practices (FCS-13202-REF) explains how to prepare for work and describes procedures for lifting materials and vehicles, handling substances safely, and performing potentially hazardous activities (such as welding). Understanding hazard labels, using protective equipment, the importance of environmental policy, and using technical resources are also covered.
- Brake Systems (FCS-13201-REF) describes the function and operation of drum brakes, disc brakes, master cylinder and brake lines, power-assist brakes, and anti-lock braking systems.
- Steering and Suspension Systems (FCS-13196-REF) describes the function and operation of the power-assisted steering system, tires and wheels, the suspension system, and steering alignment.
- Climate Control (FCS-13198-REF) explains the theories behind climate control systems, such as heat transfer and the relationship of temperature to pressure. The self-study also describes the function and operation of the refrigeration systems, the air distribution system, the ventilation system, and the electrical control system.
- Electrical Systems (FCS-13197-REF) explains the theories related to electricity, including the characteristics of electricity and basic circuits. The self-study also describes the function and operation of common automotive electrical and electronic devices.
- Manual Transmission and Drivetrain (FCS-13199-REF) explains the theory and operation of gears. The self-study also describes the function and operation of the drivetrain, the clutch, manual transmissions and transaxles, the driveshaft, the rear axle and differential, the transfer case, and the 4x4 system.
- Automatic Transmissions (FCS-13200-REF) explains the function and operation of the transmission and transaxle, the mechanical system, the hydraulic control system, the electronic control system, and the transaxle final drive. The self-study also describes the theory behind automatic transmissions including mechanical powerflow and electro-hydraulic operation.
- Engine Operation (FCS-13195-REF) explains the four-stroke process and the function and operation of the engine block assembly and the valve train. Also described are the lubrication system, the intake air system, the exhaust system, and the cooling system. Diesel engine function and operation are covered also.
- Engine Performance (FCS-13194-REF) explains the combustion process and the resulting emissions. The self-study book also describes the function and operation of the powertrain control system, the fuel injection system, the ignition system, emissions control devices, the forced induction systems, and diesel engine fuel injection. Read Engine Operation before completing Engine Performance.

To order curriculum or individual self-study books, contact Helm Inc.

Toll Free: 1-800-782-4356 (8:00 am – 6:00 pm EST)
Mail: 14310 Hamilton Ave., Highland Park, MI 48203 USA
Internet: www.helminc.com (24 hours a day, 7 days a week)

Introduction

Proper work preparation is essential to perform work tasks and create a safe working environment. Tools and safety equipment are necessary to perform and complete many aspects of automotive shop work. Personal safety must remain paramount to every technician. Practicing proper work preparation prevents accidents from occurring to yourself or to those around you.

Objectives

Upon completion of this lesson, you will be able to:

- Describe potential hazards and accidents that can occur in the workplace and how to prevent them.
- Describe proper lifting methods.

Hazards and accidents

A vehicle workshop is potentially a dangerous environment. For this reason it is important that you be familiar with some of the common accidents that can occur in a workshop and what causes them. All of the accidents listed below can, and do, happen in workshops:

ACCIDENTS	POSSIBLE CAUSES
Cuts and skin abrasion	Defective or misused hand tools
Impact injuries	Being caught in machinery
	Heavy objects falling from above
	Falling over things left lying around, or on slippery substances
	Air bags deploying incorrectly inside vehicles
	Particles of hard substances from grinding work flying into eyes
	Explosion, CNG or LPG
Heart attack	Air forced into the bloodstream by compressed air machine
Back strains	Hand lifting
Poisoning	Chemicals (for example: air conditioning refrigerant, exhaust fumes, fuels, solvents, mineral oils, paints, adhesives and sealers) entering blood through lungs, stomach or skin
Asphyxia	Carbon monoxide (contained in exhaust fumes)
Lung damage	Dusts and powders, especially asbestos dust
Burns	Fires (compressed gases), molten metal, hot splashes
Chemical burns	Strong acids and alkalis – “corrosive” substances
Frost bite	Contact with air conditioning refrigerant
Skin irritation	Contact with fiber insulation, brake fluids, gasoline, solvents, mineral oil
Eye damage	High level of UV radiation (arc welding)
Ear damage	High level of noise
Electric shock	The human body closing an electrical circuit

Health and safety responsibilities

As an employee you have three general health and safety responsibilities:

1. Take reasonable care for your own health and safety and that of others who may be affected by what you do (or fail to do).
2. Cooperate with your employer on health and safety.
3. Don’t interfere with or misuse anything provided for your health, safety or welfare.

Prevention

Prevention means anticipating in order to stop dangerous events from happening. Once started, a dangerous event can get out of control quickly, so the safe thing is not to let it start.

Most dangerous events can be prevented if you:

- stay aware of what is happening around you.
- do not rush.
- avoid distraction.
- think ahead.
- use machinery and chemicals according to the instructions.
- never take short cuts on safety.

Protection

Protection means guarding against the bad effects of an event which you can't prevent. When prevention fails, protection takes over in preserving your safety.

Protection is necessary when a particular hazard can't be prevented. For example, you can't prevent an air chisel from making noise, therefore you have to protect yourself against the noise by wearing ear muffs.

Protection is also needed to cover completely unpredictable hazards. For example, you can't be absolutely sure that nothing hits your head while working under a car (even if you took preventive actions), so it is safer to wear a safety hat.

Most importantly, remember that nothing is too much trouble when it comes to your safety! Use both prevention and protection to reduce risk.

Keeping a clean shop

Many accidents are caused by untidiness. Injuries caused by tripping, falling or slipping on things left lying around are all too common in an untidy work area.

It is our responsibility to protect ourselves, and fellow workers, by ensuring that all equipment, components and vehicles are kept in a safe place and in proper condition.

Features of a clean workshop include:

- Floor is clean and not slippery.
- Fire escape routes are not blocked.
- Easy access to all equipment without having to climb over items not being used.
- Tool storage is safe and easily reached.
- Power outlets such as electricity and compressed air are clearly labeled and regularly checked.
- Extension cables or hoses are put away after use or are suspended from the roof.
- Adequate lighting for the work to be undertaken.
- Good air quality to maintain a comfortable working environment.
- Fixed equipment or plant is maintained and in a safe condition.
- All personnel working in the area have been trained to use the equipment and are aware of safety procedures.

Dressing appropriately

Safety at work often begins before you arrive. When you leave home for work, are you properly equipped? Think about the type of clothing suitable for the task ahead. Remember – safety is your responsibility, too. Here are some things to avoid:

- Loose cuffs
- Necklaces
- Bracelets
- Flared trousers
- Fashion shoes
- Tight skirts
- Loose ties
- Long hair
- Watches
- Rings
- Laces undone
- Rags hanging out of pockets

Here is a list of things you should do:

- Remove jewelry.
- Wear the approved type of work wear, overalls, etc.
- Wear safety footwear with toe crush preventers.
- Tie up long hair.
- Use the correct eye/hand/ear protection where necessary.
- Do not rush into preparations for work. Give yourself enough time to be safe.

Using hand tools

Many cuts and abrasions are caused by defective or misused hand tools. Keep tools in a clean condition. Never use a tool you know to be defective. Most hand tools require some force to be applied by the operator such as pulling, pushing or twisting – always ensure you have stable footing. Make sure that your hand will not be trapped if the tool should slip or give way.

- Always use the correct size tool for the job.
- Protect the edges of sharp tools when not in use.
- Do not use a tool with a loose handle.
- Do not use tools for inappropriate jobs.
- Do not use a punch or chisel with a “mushroomed” head.
- Always use a vise to hold loose items when using screwdrivers or knives.
- Never use cracked sockets.
- Never extend a tool to gain extra leverage.
- Never use power tools to drive “hand use” sockets.
- Do not leave tools under the hood – use a tool table.
- Remember – “Look after your tools and they will look after you.”

Using compressed air

In many workshops a compressed air supply provides a convenient source of power to drive tools. It is safe if used correctly but misuse can be very dangerous, causing serious injury or death. Do not use compressed air to:

- blow filings or swarf off a work bench.
- remove dust from your clothing.
- give someone a shock as a “joke”.
- clean out partially sealed objects such as light units.
- remove dust from brake units.

Remember, compressed air is not a toy. The pressure in a typical workshop may be over 700 kPa (100 psi or 6.9 bar). This is more than enough to force air through clothing and into the bloodstream, which may cause death. Fooling around with an air line may seem like fun, but it can have tragic consequences.

Behaving appropriately

Many people suffer serious injury through fooling around at work. Accidents happen when you are distracted, or through lack of concentration. You owe it to yourself and your colleagues to act responsibly at all times in the workplace. When in the workplace:

- Walk, do not run.
- Do not wear personal stereos or “walkmans”.
- Be aware of what is happening around you.
- Drive carefully.
- Operate machinery safely.
- Never “cut corners” on safety.

If you are unsure about whether you are fit for work, consult your supervisor or medical adviser. Never work when unfit due to alcohol or drugs; you are putting yourself and others at risk.

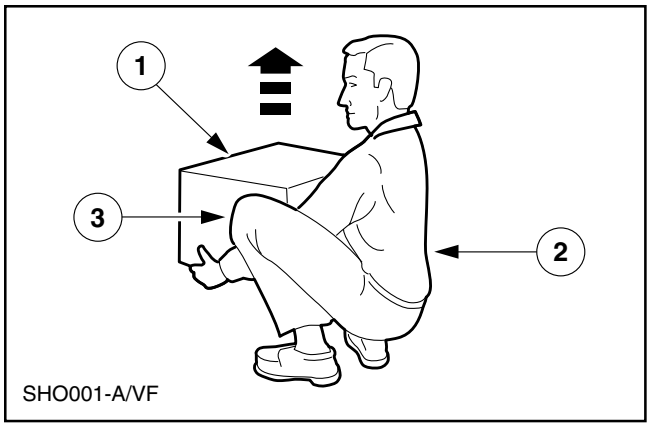
Methods for lifting materials

It is necessary to lift tools, items, and materials while working in the shop. It is important to adhere to proper safe lifting procedures.

Manual lifting

It is part of everyday life to lift objects from the floor or workbench. The method used when lifting is important to help reduce the risk of back injury. The key elements:

- Do not try to lift too much weight. 20 kg is a safe limit for one person.
- When lifting from the floor keep the feet slightly apart, knees bent, and back straight. Your leg muscles should provide the power to raise the load.
- Do not jerk objects.
- When carrying a load, keep it close to your body.



Method for proper lifting

1 Object not more than 20 kg held close to body
2 Back straight
3 Knees bent

Lifts and cranes

For objects of more than 20 kg it is recommended to use a lifting device such as a mobile crane, or jack. Specific training should be given for each piece of equipment, but there are several rules which are common sense.

- Never exceed the safe working load (SWL) of the equipment you are using.
- Always support vehicles with axle stands before working underneath them.
- There is always a danger when loads are lifted or suspended. Never work under an unsupported, suspended or raised load such as a suspended engine.
- Always ensure that lifting equipment such as jacks, hoists, axle stands, slings, etc. are adequate and suitable for the job, in good condition and regularly maintained.
- Never improvise lifting tackle.

Objective

Upon completion of this lesson, you will be able to:

- Explain the various methods of safely handling hazardous materials.

Handling substances

For health and safety reasons it is necessary to handle substances safely using the appropriate equipment. Mishandling substances can result in health and environmental hazards.

Handling chemicals

The production and maintenance of motor vehicles involves the use of some potentially hazardous substances. This is a brief guide to some of the materials which might be encountered during work on a vehicle.

Chemical materials such as solvents, sealers, adhesives, paints, resin foams, battery acids, antifreeze, brake fluids, fuels, oils and grease should always be used with caution and stored and handled with care. They may be toxic, harmful, corrosive, an irritant, highly flammable or give rise to hazardous fumes and dusts.

The effects of excessive exposure to chemicals may be immediate or delayed, briefly experienced or permanent, cumulative, life threatening, or may reduce life expectancy.

Chemical materials “don’ts”

- Do not mix chemical materials except under the manufacturer’s instructions; some chemicals can form other toxic or harmful chemicals, give off toxic or harmful fumes or become explosive when mixed together.
- Do not spray chemical materials, particularly those based on solvents, in confined spaces, such as when people are inside a vehicle.
- Do not apply heat or flame to chemical materials except under the manufacturer’s instructions. Some materials are highly flammable and some may release toxic or harmful fumes.
- Do not leave containers open. Fumes given off can build up to toxic, harmful or explosive concentrations. Some fumes are heavier than air and accumulate in confined areas, pits, etc.
- Do not transfer chemical materials to unlabeled containers.
- Do not clean hands or clothing with chemicals. Chemicals, particularly solvents and fuels, dry the skin and may cause irritation leading to dermatitis or be absorbed through the skin in toxic or harmful quantities.
- Do not use emptied containers for other materials except when they have been cleaned under supervised conditions.
- Do not sniff or smell chemical materials. Brief exposure to high concentrations of fumes can be toxic or harmful.

Handling substances (continued)

Chemical materials "do's"

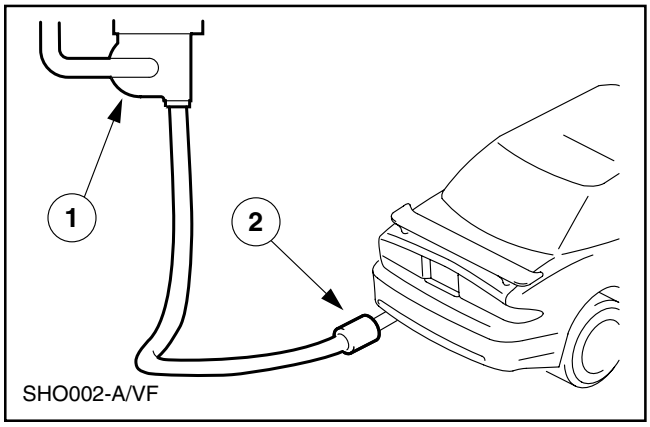
- Do carefully read and observe hazard and precaution warnings given on material containers (labels) and in any accompanying leaflets, posters or other instructions. Material health and safety data sheets can be obtained from manufacturers.
- Do remove chemical materials from the skin and clothing as soon as practicable after soiling. Change heavily soiled clothing and have it cleaned.
- Do organize work practices and protective clothing to avoid soiling of the skin and eyes; breathing vapors, aerosols, dusts or fumes; inadequate container labeling; fire and explosion hazards.
- Do wash before job breaks, before eating, smoking, drinking or using the toilet facilities when handling chemical materials.
- Do keep work areas clean, uncluttered and free of spills.
- Do store chemical materials according to national and local regulations.
- Do keep chemical materials out of reach of children.

Handling exhaust fumes

Exhaust fumes contain asphyxiating, harmful and toxic chemicals and particles such as carbon oxides, nitrogen oxides, aldehydes, lead and aromatic hydrocarbons. Engines should be run only under conditions of adequate exhaust extraction or general ventilation and not in confined spaces.

With gasoline engines, there may not be adequate warning of odor or irritation before toxic or harmful effects arise. These may be immediate or delayed.

With diesel engines, soot, discomfort and irritation usually give adequate warning of hazardous fume concentrations.



Exhaust fume extraction

1 Roof-mounted extraction fan
2 Exhaust fume extraction hose attached to outlet of vehicle

Handling air conditioning refrigerant

Air conditioning refrigerant is highly flammable and combustible. Always observe “no smoking” policies. Any skin contact may result in frostbite. Instructions given by the manufacturer must be followed. Avoid naked lights, wear suitable protective gloves and goggles. If refrigerant comes into contact with the skin or eyes, rinse the affected areas with water immediately. Eyes should also be rinsed with an appropriate irrigation solution and should not be rubbed. Seek medical assistance if necessary.

Local regulations may require that technicians be certified to repair or handle air conditioning refrigerant.

Air conditioning fluid “do not’s”

- Do not expose refrigerant bottles to sunlight or heat.
- When filling, follow manufacturer’s recommendations.
- Do not expose refrigerant bottles to frost.
- Do not drop refrigerant bottles.
- Do not vent refrigerant to the atmosphere under any circumstances.
- Do not mix refrigerants (R12 and R134A).

Handling fuels

Avoid skin contact with fuel. Should contact occur, wash the affected skin with soap and water. Fuel is highly flammable. Always observe “no smoking” signs.

Swallowing fuel can result in mouth and throat irritation and absorption from the stomach can result in drowsiness and unconsciousness. Small amounts can be fatal to children. Aspiration of liquid into the lungs through vomiting, for example, is a very serious hazard.

Gasoline dries the skin and can cause irritation and dermatitis on prolonged or repeated contact. Liquid gasoline in the eye causes severe irritation.

Gasoline may contain appreciable quantities of benzene, which is toxic upon inhalation, and the concentration of gasoline vapors must be kept very low. High concentrations cause eye, nose and throat irritation, nausea, headache, depression and symptoms of drunkenness. Very high concentrations result in rapid loss of consciousness. Long term exposure to high concentrations can cause cancer.

Observe strict fire safety precautions when storing and handling flammable materials or solvents, particularly near electrical equipment or welding processes.

Before using electrical or welding equipment, ensure that there is no fire hazard present.

Have a suitable fire extinguisher available when using welding or heating equipment.

Handling solvents

Solvents include acetone, white spirit, toluene, xylene, and trichloroethane. Solvents are primarily used in cleaning and dewaxing materials, paints, plastics, resins, thinners, etc. Some may be highly flammable. Skin contact degreases the skin and may result in irritation and dermatitis following repeated or prolonged contact. Some solvents can be absorbed through the skin in toxic or harmful quantities. Splashes in the eye may cause severe irritation and could lead to loss of vision.

Brief exposure to high concentrations of vapors or mists causes eye and throat irritation, drowsiness, dizziness, headaches and, in the worst circumstances, unconsciousness. Repeated or prolonged exposure to excessive but lower concentrations of vapors or mists, for which there might not be adequate warning indications, can cause more serious toxic or harmful effects.

Handling lubricants and greases

Avoid all prolonged and repeated contact with mineral oils. All lubricants and greases may be irritating to the eyes and skin.

Prolonged and repeated contact with mineral oil can result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis.

Used engine oil precautions

In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer. Adequate means of skin protection and washing facilities must be provided.

Do not employ used engine oils as lubricants or for any application where appreciable skin contact is likely to occur. Dispose of used oil and used filters through authorized waste disposal sites, or to the waste oil reclamation trade. If in doubt, contact the relevant local authority for advice on disposal facilities.

It is illegal to pour used oil onto the ground, down sewers or drains, or into water courses. If oil finds its way into a river, the effects can be devastating to fish and other creatures. If the river provides fresh water for human consumption, the supply may be contaminated for a considerable time. One liter (0.26 gallon) of oil can contaminate five million liters (1,320,000 gallons) of water!

Health protection precautions

- Avoid prolonged and repeated contact with oils, particularly used engine oils.
- Wear protective clothing, including impervious gloves when practicable.
- Do not put oily rags into pockets.
- Avoid oil-contaminated clothes, particularly underpants and footwear.
- First aid treatment should be obtained immediately for open cuts and wounds.
- Use barrier creams, applying them before each work period, to help the removal of oil from the skin.
- Wash with soap and water to ensure all oil is removed (skin cleansers and nail brushes help). Preparations containing lanolin replace the natural skin oils which have been removed.
- Do not use gasoline, kerosene, diesel fuel, thinners or solvents for cleaning skin.
- If skin disorders develop, obtain medical advice without delay.
- Where practical, degrease components prior to handling.
- Where there is a risk of eye contact, eye protection such as chemical goggles or face shields should be worn. In addition, an eye wash facility should be provided.

Handling chlorinated fluorocarbons (CFC)

There is concern in the scientific community that CFCs and Halons are depleting the upper ozone layer, which filters out harmful ultraviolet radiation. Decreased filtration of ultraviolet radiation may result in increases in skin cancer, cataracts and immune system suppression in humans, as well as decreased productivity of crops and aquatic systems.

CFCs are used primarily as refrigerants (R12) in vehicle air conditioning systems and as aerosol propellants. Halons are used as fire extinguishers. Automotive manufacturers support worldwide elimination of CFC usage and its use is being phased out as acceptable substitutes are commercially available.

Handling Viton

Some components fitted to vehicles have O-rings, seals or gaskets which contain a material known as Viton. Viton is a fluoroelastomer, a synthetic rubber type which contains fluorine. It is commonly used for O-rings, gaskets and seals of all types. Although Viton is the most well known fluoroelastomer, there are others, including Fluorel and Tecmoflon.

When used under design conditions, fluoroelastomers are perfectly safe. If, however, they are exposed to temperatures in excess of 400° C (752° F), the material does not burn, but decomposes, and one of the products formed is hydrofluoric acid.

Inquiries should be made to determine whether Viton or any other fluoroelastomer has been used in the affected O-ring, seal or gasket. If they are of natural rubber or nitrile there is no hazard. If in doubt, be cautious and assume that the material may be Viton or any fluoroelastomer.

If Viton or any other fluoroelastomer has been used, the affected area should be decontaminated before the start of work.

Disposable heavy duty plastic gloves should be worn at all times, and the affected area washed down using wire wool and a limewater (calcium hydroxide) solution to neutralize the acid before disposing of the decomposed Viton residue and final cleaning of the area. After use, the plastic gloves should be discarded carefully and safely.

Handling dusts

Powder, dusts or clouds may be irritating, harmful or toxic. Avoid breathing dusts from powdery chemical materials or those arising from dry abrasion operations. Wear respiratory protection if ventilation is inadequate. Fine dusts of combustible material are present an explosion hazard. Avoid explosive limits and sources of ignition. Do not use compressed air to remove dust from surfaces or fabrics.

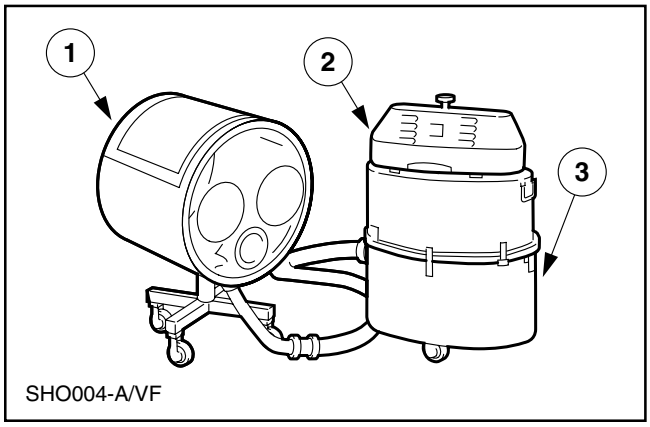
Handling asbestos

Breathing asbestos dust may cause lung damage or, in some cases, cancer. Asbestos is used in brake and clutch linings, transmission brake bands and gaskets. Most original production and replacement items today, however, are asbestos-free.

The use of drum cleaning units, vacuum cleaning or damp wiping is preferred. Asbestos dust waste should be dampened, placed in a sealed container and marked to ensure safe disposal. If any cutting or drilling is attempted on materials containing asbestos, the item should be dampened and only hand tools or low speed power tools used.

Handling fiber insulation

Fiber insulation is used in noise and sound insulation. The fibrous nature of surfaces and cut edges can cause skin irritation. This is usually a physical and not a chemical effect. Precautions should be taken to avoid excessive skin contact through careful organization of work practices and the use of gloves.



Asbestos handling equipment

1 Brake cleaning hood which contains integrated gloves and vacuum hose
2 Vacuum pump powered by electrical supply
3 Filter/trap assembly

Handling antifreeze

Antifreeze is highly flammable and combustible. Antifreeze is used in vehicle cooling systems, brake air pressure systems, and screenwash solutions. Vapors may be given off from coolant (antifreeze) when heated. Avoid breathing these vapors.

Antifreeze may be absorbed through the skin in toxic or harmful quantities. Antifreeze, if swallowed, can be fatal and medical attention should be sought immediately. Antifreeze must not be used in any cooling or industrial water system which is connected or linked to general food preparation or drinking water supplies.

Handling acids and alkalis

Acids and alkalis include caustic soda or sulfuric acid and are used in batteries and cleaning materials. Acids and alkalis are irritating and corrosive to the skin, eyes, nose and throat and can cause burns and destroy ordinary protective clothing.

You should avoid splashes to the skin, eyes and clothing. Wear a suitable protective impervious apron, gloves and goggles. Do not breathe mists. Ensure that eyewash bottles, shower and soap are readily available for splashing accidents. “Eye Hazard” signs should also be displayed where appropriate.

Handling battery acids

Gases released during battery charging are explosive. Never use naked flames or allow sparks near charging or recently charged batteries. Always ensure adequate ventilation. Always follow local regulations and policies when charging or handling batteries.

Handling brake fluid

Splashes to the skin and eyes are slightly irritating. Avoid skin and eye contact. Vapor inhalation hazards do not arise at ambient temperatures because of the very low vapor pressure.

Handling corrosion protection materials

Corrosion protection materials are varied, and the manufacturer’s instructions should be followed. They may contain solvents, resins, petroleum products, etc. They are usually highly flammable and any “no smoking” policies should be observed. Skin and eye contact should be avoided. They should only be sprayed in conditions of adequate ventilation and not in confined spaces.

Handling paints

Paints can contain harmful or toxic pigments, dryers and other components as well as solvents. The manufacturer’s instructions should be followed.

Any spraying should preferably be carried out in exhausted ventilated booths removing vapor and spray mists from the breathing zone. Individuals working in booths should wear appropriate respiratory protection. Those doing small scale repair work in the open workshop should wear air-fed respirators.

Handling adhesives and sealers

Adhesives and sealers should generally be stored in "no smoking" areas. Cleanliness and tidiness in use should be observed, for example: disposable paper covering benches; adhesives and sealers should be dispensed from applicators where possible; containers, including secondary containers, should be labeled appropriately.

Water-based adhesives/sealers

Water-based adhesives and sealers that are based on polymer emulsions and rubber latexes may contain small amounts of volatile, toxic and harmful chemicals. Skin and eye contact should be avoided and adequate ventilation provided during use.

Isocyanate (polyurethane) adhesives/sealers

Individuals suffering from asthma or respiratory allergies should not work with or near these materials as sensitivity reactions can occur.

Overexposure to isocyanate adhesives and sealers is irritating to the eyes and respiratory system. Excessive concentrations may produce effects on the nervous system, including drowsiness. In extreme cases, loss of consciousness may result. Long term exposure to vapor concentrations may result in adverse health effects. Prolonged contact with the skin may have a defatting effect which may lead to skin irritation and, in some cases, dermatitis.

Anaerobic and cyanoacrylate (super-glues)

Many acrylic adhesives are irritating, sensitizing or harmful to the skin and the respiratory tract. Some are eye irritants. Skin and eye contact should be avoided and the manufacturer's instructions followed.

Cyanoacrylate adhesives (super-glues) must not contact the skin or eyes. If skin or eye tissue is bonded, cover with a clean moist pad and seek immediate medical attention. Do not attempt to pull tissue apart. Use in well ventilated areas, as vapors can cause irritation to the nose and eyes.

Resin-based adhesives and sealers

Resin-based adhesives and sealers include epoxide and formaldehyde resin-based adhesives and sealers. Mixing should be carried out in well ventilated areas, as harmful or toxic volatile chemicals may be released.

Handling foams

Foams are used for sound and noise insulation. Cured foams are used in seat and trim cushioning.

Cured components are irritating and may be harmful to the skin and eyes. Individuals with chronic respiratory diseases, asthma, bronchial medical problems, or histories of allergic diseases should not work with or near uncured materials.

Always wear gloves and goggles. Skin contact with uncured resins and hardeners can result in irritation, dermatitis, and absorption of toxic or harmful chemicals through the skin. Splashes can damage the eyes.

Any spraying should preferably be carried out in exhaust ventilated booths, removing vapors and spray droplets from the breathing zone.

Hot melt adhesives

In the solid state, hot melt adhesives are safe. In the molten state they may cause burns, and health hazards may arise from the inhalation of toxic fumes. Use appropriate protective clothing and a thermostat-controlled heater with a thermal cut-out and adequate extraction. The components, vapors or spray mists can cause direct irritation, sensitivity reactions and may be toxic or harmful.

Vapors and spray mists must not be inhaled. These materials must be applied with adequate ventilation and respiratory protection. Do not remove the respirator immediately after spraying. Wait until the vapors/mists have cleared.

Burning of the uncured components and the cured foams can generate toxic and harmful fumes. Smoking, naked flames or the use of electrical equipment during foaming operations before vapors/mists have cleared should not be allowed.

Any heat cutting of cured foams or partially cured foams should be conducted with extraction ventilation.

Passive restraint systems

Follow manufacturer's recommendations when handling passive restraint system components.

Objectives

Upon completion of this lesson, you will be able to:

- Explain how to correctly perform potentially hazardous activities.
- Explain the purpose of hazard labels.
- Explain the purpose of the environmental policy.

Performing potentially hazardous activities

In order to accomplish certain repair tasks, it may be necessary to perform potentially hazardous activities. Proper safety equipment must be used when performing potentially hazardous activities.

Welding

Welding processes include resistance welding (spot welding), arc welding and gas welding.

Resistance welding

Resistance welding may cause particles of molten metal to be emitted at a high velocity, and the eyes and skin must be protected.

Arc welding

Arc welding emits a high level of ultraviolet radiation which may cause arc-eye and skin burns to the operator and to people nearby. Gas-shielded welding processes are particularly hazardous in this respect. Personal protection must be worn, and screens must be used to shield other people.

Contact lens wearers are advised to revert to ordinary spectacles when arc welding as the arc spectrum is believed to emit microwaves which dry out the fluid between the lens and the eye. This may result in blindness when the lens is removed from the eye.

Metal splatter may also occur and appropriate eye and skin protection is necessary.

The heat of the welding arc produces fumes and gases from the metals being welded, the rods and any applied coatings or contamination on the surfaces being worked on. These gases and fumes may be toxic and inhalation should be avoided.

The use of extraction ventilation to remove the fumes from the working area may be necessary, particularly in cases where the general ventilation is poor, or where considerable welding work is anticipated. In extreme cases or confined spaces where adequate ventilation cannot be provided, air-fed respirators may be necessary.

Oxy-acetylene torches may be used for welding and cutting, and special care must be taken to prevent the risk of fire and explosion. The welding process produces metal splatter and eye and skin protection is necessary. The flame is bright, and eye protection should be used. But the ultraviolet emission is much less than from arc welding, and lighter filters may be used.

The welding process itself produces few toxic fumes, but such fumes and gases may be produced from coatings on the work, particularly during cutting away of damaged body parts. Inhalation of the fumes should be avoided.

In brazing, toxic fumes may be produced from the metals in the brazing rod, and a severe hazard may arise if brazing rods containing cadmium are used. If rods containing cadmium are used, particular care must be taken to avoid inhalation of fumes and expert advice may be required.

Special precautions must be taken before any welding or cutting takes place on vessels which have contained combustible materials (for example, boiling or steaming out of fuel tanks).

Soldering

Solders are mixtures of metals with the melting point of the mixture below that of the constituent metals (normally lead and tin). Solder application does not normally produce toxic fumes, provided a gas/air flame is used. Oxy-acetylene flames should not be used, as they are much hotter and will cause lead fumes to be produced.

Fumes may be produced by the application of a flame to surfaces coated with grease, etc. Inhalation of these fumes should be avoided.

Removal of excess solder should be undertaken with care to ensure that fine lead dust is not produced, which can have toxic effects if inhaled. Respiratory protection may be necessary.

Solder spillage and filings should be collected and removed promptly to prevent general air contamination by lead. High standards of personal hygiene are necessary to avoid ingestion of lead or inhalation of solder dust from clothing.

Electrical work

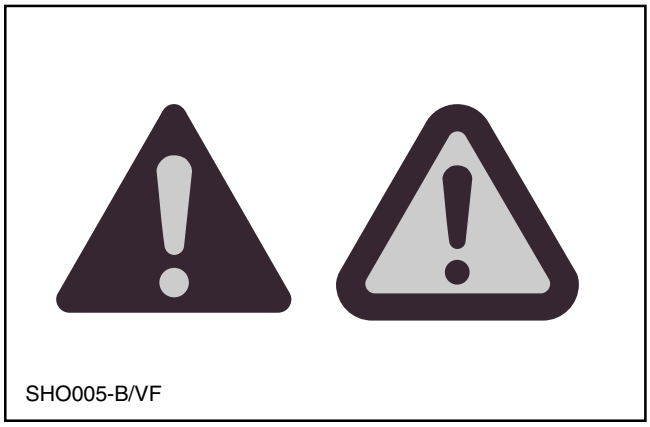
To prevent electric shock when working on automotive electrical systems, always check all wires, cables and connectors for cuts, corrosion or scrapes in the insulation. Due to the risk of electric shock, when working with automotive electrical equipment always refer to the appropriate workshop manual for the vehicle that you are working on.

Hazard symbol

Decals showing warning symbols can be found on various vehicle components, fluid containers, workshop areas, and on most hazardous areas or materials. These symbols are warnings which must be carefully followed.

Interpreting some basic warning symbols

Components or assemblies displaying either version of the safety alert symbol indicates a potential injury hazard.



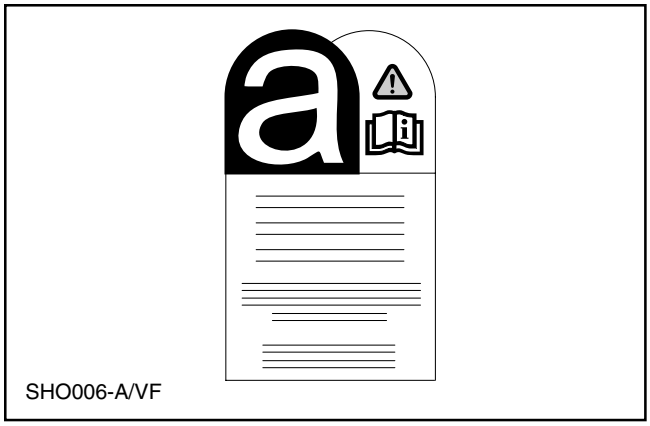
Safety alert symbol – alternate versions

An open book symbol means to consult the relevant section of the owner handbook before touching or attempting adjustments of any kind.

Owner handbook reference symbol

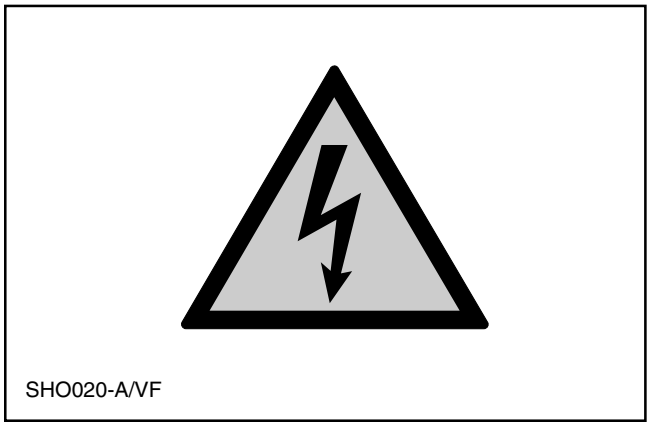
Hazard symbols (continued)

Vehicles and replacement parts which contain asbestos are identified by this symbol.



Asbestos warning symbol

Components or assemblies displaying the warning triangle with the electrified arrow and open book symbol give warning of inherent high voltages. Never touch these with the engine running or the ignition switched on.

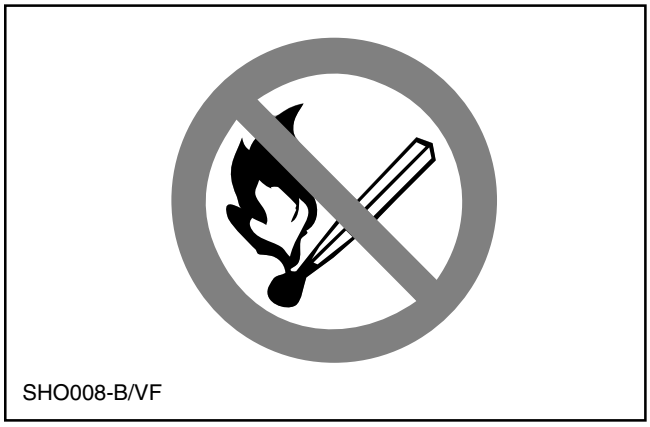


High voltage symbol

Components or assemblies displaying this symbol give warning that the component contains a corrosive substance.

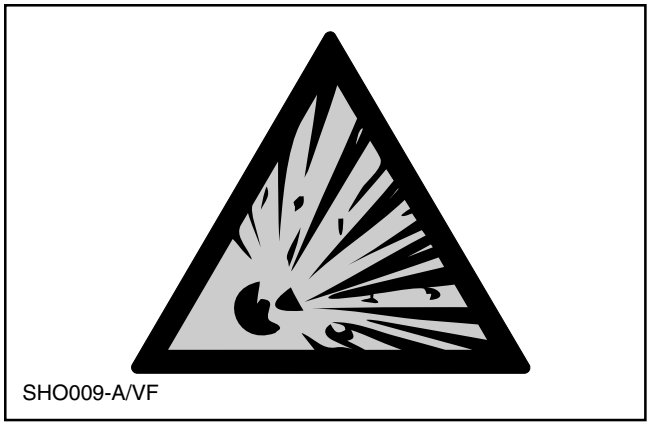
Corrosive substance symbol

Vehicles displaying the prohibition symbol (red circle and slash) with lighted match symbol caution against the use of naked lights or flames within the immediate vicinity, due to the presence of highly flammable or explosive liquids or vapors.



Fire hazard symbol

Vehicles displaying this symbol (normally in conjunction with the above symbol) warn of the presence of potentially explosive matter within the immediate vicinity.



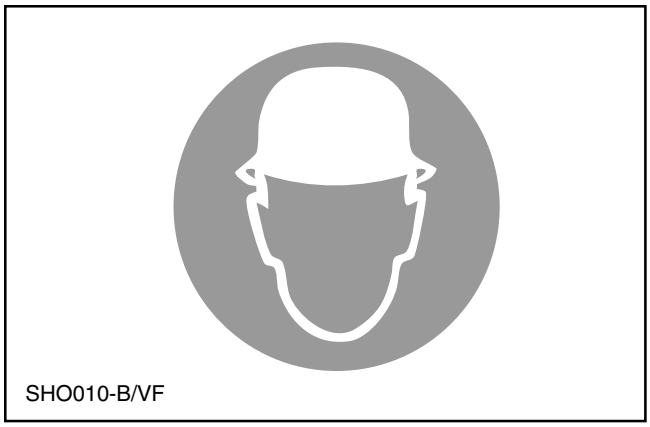
Explosive hazard symbol

Protective equipment

Whatever you need to do your job safely can be obtained. All you have to do is wear it or use it correctly. In some regions, you are legally obliged to do so.

Head protection

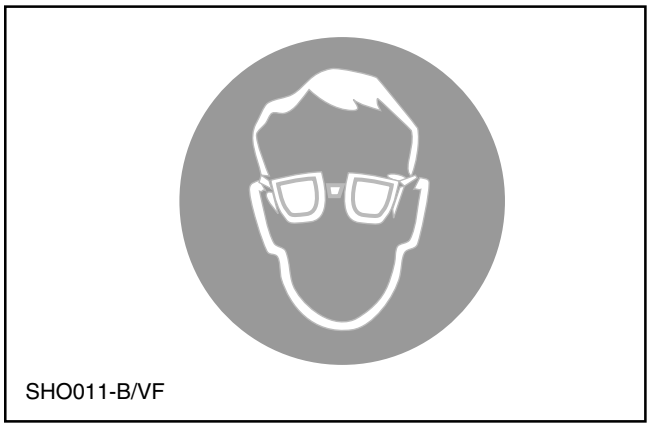
Head protection is advisable when working under a vehicle on a ramp. Head protection prevents injury from falling tools or objects.



Head protection symbol

Eye protection

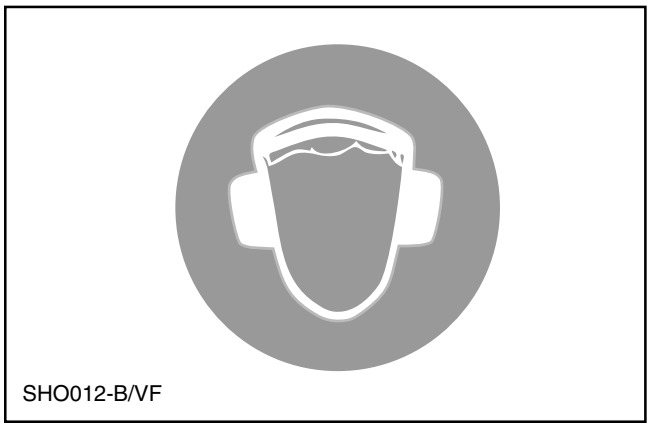
Eye protection is advisable when working in an area with flying sparks or dust from grinding/drilling operations.



Eye protection symbol

Ear protection

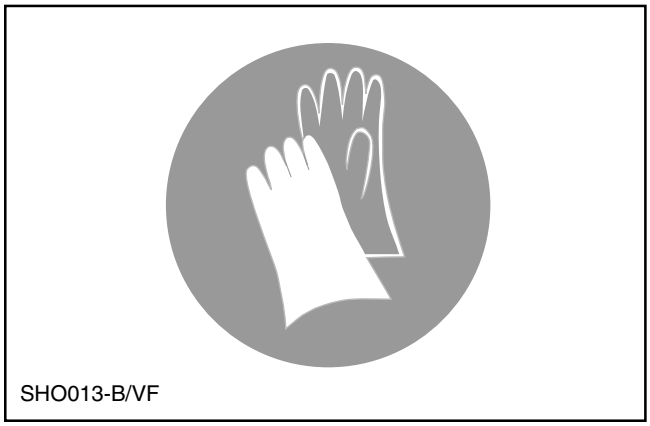
Use of ear protection is advisable when working in a noisy environment. If you have to shout to be heard by someone standing three meters away, it may be too noisy for unprotected ears.



Ear protection symbol

Hand protection

Use the correct type of glove to prevent cuts or burns when handling materials which are sharp, hot, cold or chemical substances.



Hand protection symbol

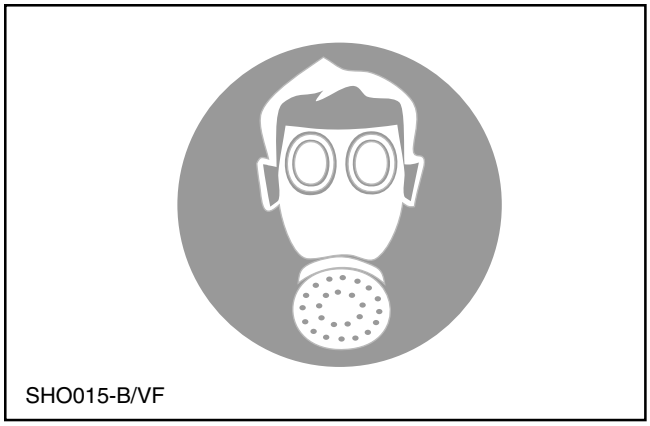
Foot protection

Footwear should be practical for the type of work being undertaken. The soles should be non-slip and the toes should be protected by an anti-crush cap.

Foot protection symbol

Respiratory protection

Some work creates dust or involves the use of materials giving off fumes. The correct type of face mask should be used to prevent the dust or fumes from being inhaled.



Respiratory protection symbol

Environmental policies

Automobiles are designed to have minimal impact on the environment. The vehicle itself must be fuel efficient, able to operate within the specified limits for emission of pollutants, and able to deliver driving satisfaction to the user.

Consideration is not only given to specific assembly or production sites, but also to the external environment. The community and surrounding landscape are important parts of the facility in any operation.

Strategies to minimize impact on environment

It is important that automobile manufacturing operations, products, and services accomplish their functions in a manner that provides responsibility for protection of health and for the care of our environment. All products, services, processes and facilities are planned and operated to avoid or minimize the production of waste. Any waste which is produced should have the minimum impact on health and environment.

To prevent the waste of resources manufacturers have, several initiatives have been taken where savings are produced by cutting out waste and at the same time helping to stop pollution. These initiatives include reducing waste water and energy waste.

Standards to meet and exceed legal requirements

Health and environment should be considered in every business decision. Potential effects on health and environment as well as future legislation must be a part of the planning process.

Shared responsibility

The protection of health and environment is the responsibility of everyone. All employees have to carry out their own assignments within the general policy outline. The adoption of laws and good practice is in the company’s interest. Everyone concerned must be kept informed as new ideas or information is made available.

Objective

Upon completion of this lesson, you will be able to:

- Explain the purpose of using technical resources.

Technical resources

Technical resources provide the technician with the information about vehicles and vehicle systems. Technical resources assist in the diagnosis and completion of the repair process.

Wiring diagrams

Wiring diagrams are available to technicians for assistance in diagnosis and repair of automotive electrical systems. Wiring diagrams provide the following:

- Fuse and relay information
- Power distribution
- Fuse details
- Ground distribution
- Component location charts
- Component location views
- Connector views

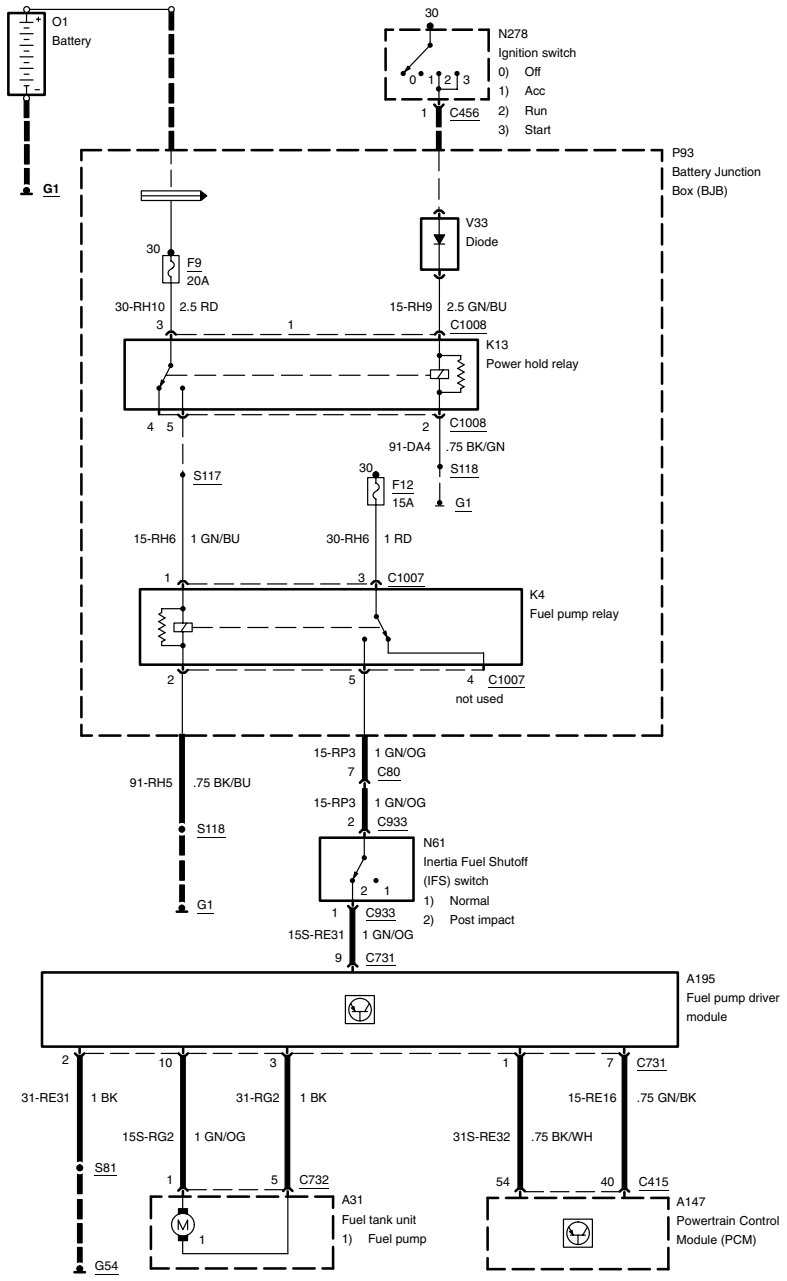
Wiring diagrams are provided in several different formats, depending on manufacturer:

- Workshop manual
- On-line (internet)
- Microfiche
- CD-Rom

In general, wiring diagrams are presented in the following format:

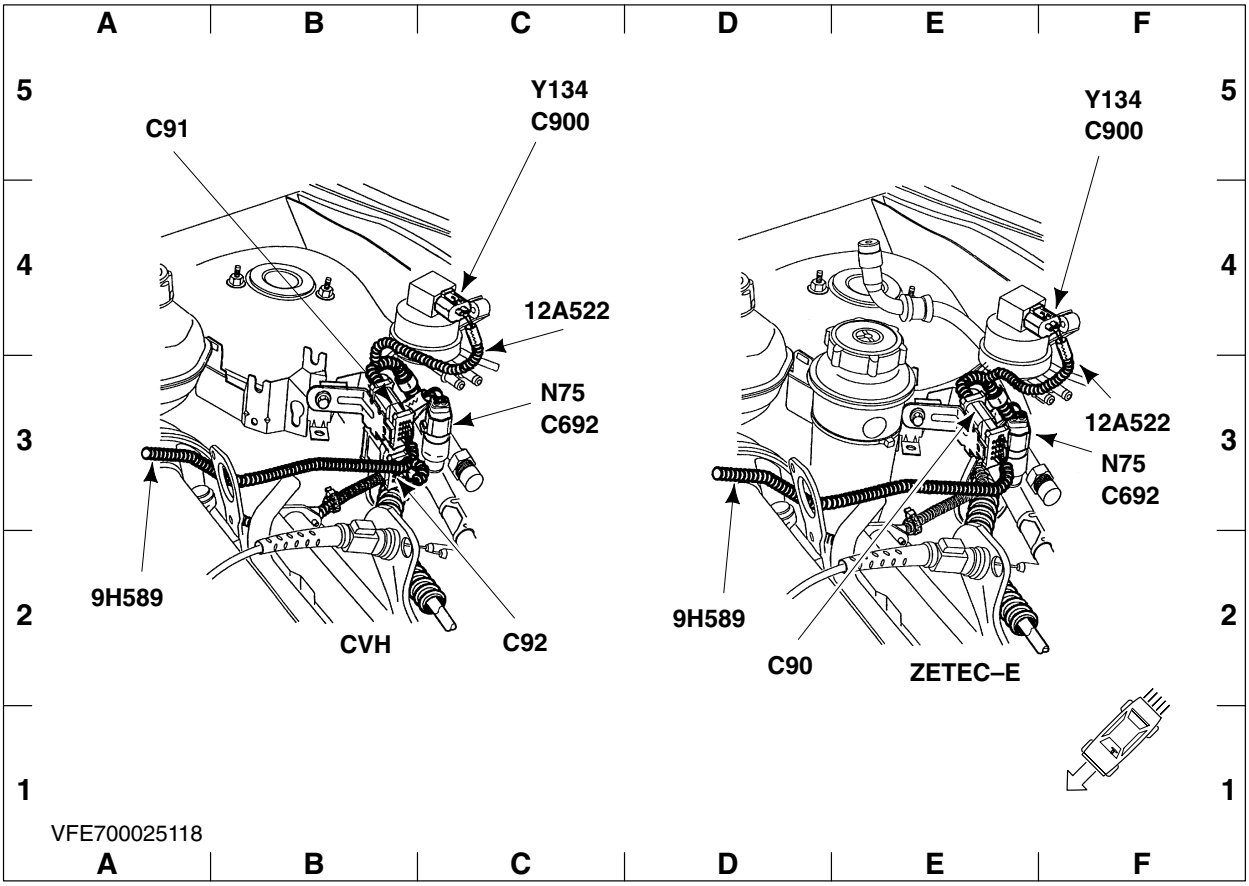
- Components that work together are shown together.
- All components used in a specific system are shown in one diagram.
- Circuit breakers, fuses, etc., are shown at the top of the page.
- All wires, connectors, components, and splices are shown in the flow of current to ground.
- Ground is shown at the bottom of the page.
- If a component is used in several systems, it is shown in several places.
- Schematic pages contain references to full-view illustrations and description notes for various components.
- If the power supply or ground connection is represented by a dashed line, the full representation can be found in one of the following sections:
  - Power distribution
  - Fuse details
  - Ground distribution

Wiring diagrams (continued)



SHO017-A/VF

Sample wiring diagram



Engine compartment, RH–side, rear

12A522	C 4	C692	F 3
12A522	F 3	C900	C 5
9H589	A 2	C900	F 5
9H589	D 2	N75 . . A/C compressor cycling switch	C 3
C90	D 2	N75 . . A/C compressor cycling switch	F 3
C91	A 5	Y134 . EVAP canister purge valve	C 5
C92	C 2	Y134 . EVAP canister purge valve	F 5
C692	C 3		

SHO018-A/VF

Sample of component location information

Location indexes are usually provided to help locate the following items:

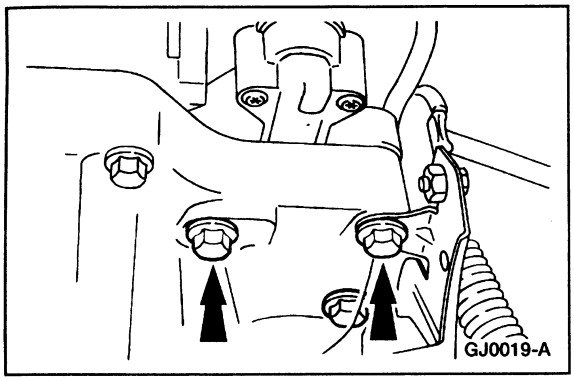
- Components
- Connectors
- Splices
- Grounds

Workshop manuals

The workshop manual is a step-by-step guide that may be available in print form, CD-Rom, DVD or microfiche, that assists the technician in performing the following activities to service customers' vehicles and components:

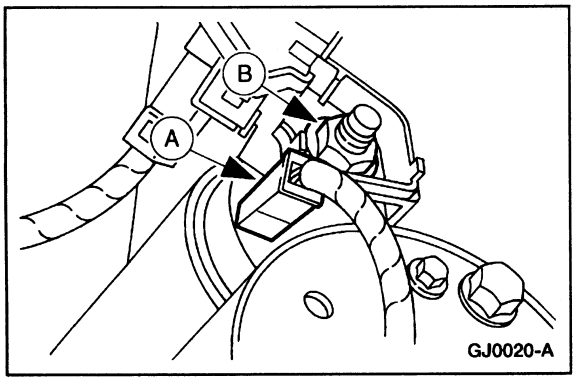
- Diagnosis and testing
- Removal and installation
- Disassembly and assembly
- Cleaning and inspection
- Adjustments
- Specifications
- Special service tools/equipment
- Individual components general procedures and description and operation

REMOVAL AND INSTALLATION (Continued)



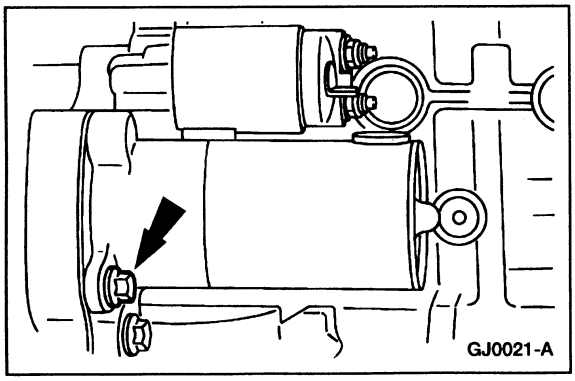
3. Remove the top two starter motor bolts.

4. Raise and support the vehicle. For additional information, refer to Section 100-02.



5. **NOTE**: A protective cap is installed over the B-terminal and must be replaced after servicing the starter motor and solenoid assembly.

   Disconnect the (A) S-terminal wire, and the (B) B-terminal nut and cable from the starter motor.



6. Remove the lower starter motor bolt and remove the starter motor and solenoid assembly.

Sample of component removal procedures

Workshop manuals (continued)

The following section provides a typical example of how a workshop manual can be used to assist in diagnosing and repairing a vehicle:

1. Review the repair order received with the vehicle.
2. Obtain the vehicle workshop manual.
3. Go to the Table of Contents at the beginning of the manual.
4. Select the appropriate group based on the symptom.
5. From the Group Table of Contents choose the appropriate section.
6. Conduct the Inspection and Verification procedures:
   - If inspection reveals concern, service as required.
   - If inspection does not reveal concern, proceed with next step.
7. Determine symptom of concern and go to the Symptom Chart.
8. If the Symptom Chart directs it, go to the Pinpoint Tests.

Diagnostic and testing manuals

Diagnostic and testing manuals cover vehicle system diagnosis, testing procedures, component illustrations, technical illustrations, and details of special tools and equipment that may be used. Some manuals may be divided into subsections such as:

- General information
- Chassis
- Powertrain
- Electrical
- Body and paint

1. Use the information about the vehicle driveability or emission concern, from the service write-up, to verify/recreate the symptom.
2. Diagnosis and testing manuals can be consulted to aid in diagnosis.
3. Locate the diagnosis and testing manual volume for your vehicle from the workshop's reference area.
4. Locate the subsection number in the Table of Contents.
5. Locate the suspected category from the index at the beginning of each subsection.
6. Locate the specific diagnosis and testing page by using the subsection index.
7. Conduct an inspection and verification. The visual inspection charts help identify system components.
8. If inspection reveals a concern, service as required. If inspection does not reveal a concern, proceed to the symptom chart. This leads the diagnosis from condition, to possible sources, to action.
9. Go to pinpoint test if directed from the symptom chart. Pinpoint tests are used to identify the source of an electrical concern in a logical, step-by-step manner.
10. Go to component test if directed from a pinpoint test. Component tests are used to test a complete component, as opposed to a portion of a component or wiring.

Technical service hotline

Some manufacturer's may have a technical service hotline. A hotline is a telephone and fax communication that connects the user to technical assistance with hotline engineering staff to assist in solving difficult diagnostic and repair concerns.

1. Perform all applicable procedures described in manuals before contacting the technical service hotline.
2. Have all of the previous diagnosis and testing results and readings available when contacting the hotline.
3. Assistance should be requested via telephone communication whenever possible. Fax communication should only be used when phone access is not available.
4. Determine the hotline location that matches your time zone.
5. Place your call to the hotline. Follow the specific instructions included within each hotline location.
6. Discuss the condition with the hotline engineer.
7. If condition still exists after all hotline recommendations have been completed, re-contact the technical service hotline.