

## Automotive Body Repair and Paint Work

### Level-II

Based on August 2022, Curriculum Version 1



**Module Title: - Carry-out Basic Panel Repairs**

**Module code: EIS BRP2 MO8 0322**

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**Prepared By: Ministry Of Labor and Skill**

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Addis Ababa Ethiopia**

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## ACKNOWLEDGMENT

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## Introduction to the module

In automotive body work measurement and quantity estimation of body work project helps to know the quantity of work; to estimate the quantity of material required; to determine the cost of the work; to estimate the expect project completion time and to know the amount of material supplied for body work. This module describes the performance outcomes required to carry out basic repairs to vehicle body panels. It involves planning and preparing for the task, identifying and using abrasives, body fillers, and heat shrink and metal finishing procedures, selecting and using tools and equipment, and maintaining the work area, tools and equipment..

### This module covers the units:

- Prepare to Repair Body Panel
- Carry Out Basic Panel Repairs
- Complete Work Processes

### Learning Objective of the Module

- Prepare to Repair Body Panel
- Perform Carry Out Basic Panel Repairs
- Complete Work Processes

### Module Instruction

For effective use this modules trainees are expected to follow the following module instruction:

1. Read the information written in each unit
2. Accomplish the Self-checks at the end of each unit
3. Perform Operation Sheets which were provided at the end of units
4. Do the “LAP test” giver at the end of each unit and
5. Read the identify reference book for Examples and exercise

## UNIT ONE: Prepare to Repair Body Panel

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This unit is developed to provide you the necessary information regarding the following content coverage and topics –

- interpreting manufacturer specifications
- Environmental requirements
- Identifying hazards and risks
- Identifying and checking tools and equipment

This unit will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Interpret Manufacturer Specifications
- Identify Environmental requirements
- Identify hazards and risks
- Identify and check tools and equipment

### 1.1. Interpreting Task Instruction

Most of workplace accidents are due to human error. These result in serious injuries and cost industry billions of birr every year. Yet much of this could be avoided by implementing better, clearer work instructions.

Work instructions are also called work guides, Standard Operating Procedures (SOPs), job aids or user manuals, depending on the situation. In any case, the purpose of work instructions is to clearly explain how a particular work task is performed. They’re like the step-by-step instructions we receive when we learn to drive a car: check gear stick is in neutral, start ignition, press clutch, change to first gear and so forth. This information sheet will show you how to performing body work repair step by step:

#### Step 1: Gather Tools Needed/Recommended

- Replacement panels
- Acetylene Torch’s
- Safety gloves
- Angle Grinder
- Rivet gu
- AC welder

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- Welding rods
- Tack hammer
- Electric Drill
- Various grit sandpapers for each sander (rang from 36 to 1600 grit)
- Tack cloth
- Putty Knife

### Step 2: Preparation

1. Before doing any work make sure all materials and tools are gathered and organized.
2. Have a clean and well-lit workspace.
3. Be sure to be wearing protective clothing when necessary. (Work gloves, steel toe boots, long sleeve shirt, pants).
4. Read through instructions prior to doing the work, will make work easier and more understandable.

### Step 3: Selecting Area to Cut / Repair



Figure1. 1: Selecting the Vehicle damaged part need to be repair

1. Take replacement piece of metal and size it up against the car. Making sure its flush against the car
2. Trace the outline of this piece onto the car. Grab your Chalk/Sharpie and make a line on the body of where you want to cut. (The area inside the cut will be removed and replaced).

Note: - If the damage possible to repair by beat with dolly and hammer not need to cut to replace the damaged parts

### Step 4: Cutting Out the Area to Be Replaced

Using Acetylene Torch (wears hand and eye protection)

1. Open acetylene tank valve ¼ turn. (Keep between 5-8 psi)
2. Open oxygen tank valve all the way. (Keep between 25- 40 psi)
3. Open acetylene valve on torch until you can hear gas escaping.

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4. Place striker in front of torch and lite.
5. Open oxygen valve on torch until acquired flame is reached.
6. Cut out selected area on car.
7. After the area is cut out, using the angle grinder remove any access paint from the area you are working on, this clean metal surface will allow welding to occur later on.

Using an Angle Grinder (wear hand and eye protection)

1. Get electric angle grinder out.
2. Cut out selected area on car.
3. After the area is cut out, using the angle grinder remove any access paint from the area you are working on, this clean metal surface will allow welding to occur later on.

#### **Step 5: Fitting Replacement Piece**

1. The replacement piece should be the same size as the piece you just cut out.
2. When adding the new piece, make sure it is flush with the original body.

#### **Step 6: Adding Replacement Piece**

1. With the new panels now in place, it's time to permanently join them to the car.
2. First start with the first of the two replacement panels, the one located closer to the front of the car.
3. Position this piece precisely where you want it, trying to match the original position of the old piece on the car.
4. When you are satisfied with the position of the panel, use a few pairs of vice grips and lock the new panel in place.
5. After the piece is in place be certain to check that everything is lined up correctly; making sure all body lines and moldings are correct.
6. Now it is time to permanently attach the replacement panel. This can be accomplished using an Ox-Acetylene or Arc welder, Drill, Drill bits, Rivet gun, and Rivets.

#### **Step 7: Welding?**

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Figure1. 2: Welding prepared panel with vehicle body

1. Before beginning welding make sure you are wearing the proper protective clothes for welding, Pants, long sleeves, welding gloves, and eye/face protection.
2. Go ahead and make your welds along that top edge, making sure to control speed, spacing, and movement.
3. After successfully completing your welds, go ahead and grind the welds down with your angle grinder; this should make the welds flush with the body.

### Step 8: Riveting



Figure1. 3: Attaching the Panel bottom part.

1. Now it's time to rivet the remaining edges of the new panels to the car.
2. For this you will need your Drill, Drill bits, Rivet gun, and rivets.
3. Rivets will be spaced 2" away from each other.
4. They will run along the bottom edge of the replacement panel, and in the inner wheel well area of the panel.
5. First mark where u wants the rivets to be.
6. Equip your drill with a 3/16" Drill bit.
7. Pre-drill every place you want a rivet to be at.

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8. The entire replacement panel should now be completely attached to the car.

### Step 9: Body Filler



Figure 1. 4: Body filler and hardener to mix together

1. Open your body filler and put a golf ball size amount onto your clean mixing surface.
2. With your wooden mixing stick ready, open up your reactor and squeeze an inch's worth of reactor onto the body filler.
3. Mix until a uniform color is reached. At this point you have about 3-5 minutes of time with the material before it's no good to use.
4. Apply with your Plastic applicator evenly over welds on the panel.

### Step 10: Sanding



Figure1. 5: Sanding the Panel after applying putty

1. Now with a good buildup of material on the car, it's now time to sand it down to make it fully blend in.
2. Go ahead and grab a various amount of sandpapers, ranging from 36 to 1600 grit.
3. Also it might be necessary to use sanders, block and hand sanders. For this particular job the sanding will be done in that order.
4. While using the bar air sanders apply a horizontal force pushing the sander into the car. Move the sander in mini X motions while doing the sanding.

5. Repeat this step using higher grit sandpaper.
6. After each pass with higher grit sandpapers the surface should be getting smoother and smoother.

## Identifying Body Panels

### Body and Frame Construction

#### A. Body Construction

Bodies: Passenger cars and truck bodies differ a great deal in construction because of the different purposes for which they are intended. However, each has an inner and outer construction. Outer construction is considered that portion of a panel or panels which is visible from the outside of the vehicle. Included in the inner construction are all braces, brackets, panels, etc. that are used to strengthen the vehicle body. A general assumption is that inner construction cannot be seen from the outside of the vehicle.

#### Body Construction:

The main body components are shown in figure 1.6. Cowl or dash panel assemblies for the front end of the body are usually formed by assembling several smaller panels. These are the cowl upper panel and the cowl side panels that are joined by welds into one solid unit. The cowl extends upward around the entire windshield opening with the upper edge of the cowl panel forming the front edge of the roof panel. Windshield pillars are part of the cowl panel.

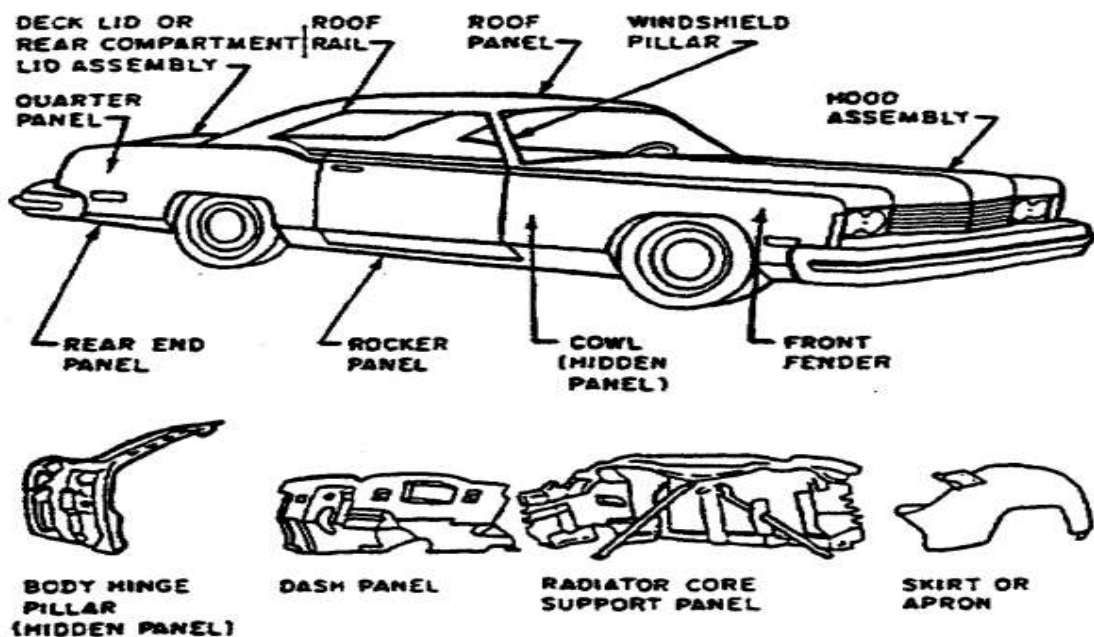


Figure 1. 6: Major Sedan Body Components

- I. Roof Panel Assembly. The roof panel is one of the largest body panels, but it is also one of the simplest in construction. Usually, the roof is a one piece steel construction

II. Floor Pan Assembly: The floor pan(refers to a floor-related component) is composed of several smaller panels that are welded together or secured to one another by bolts to form one single unit, as shown in figure 1. 7. Most floor plans are irregularly shaped. They are indented or formed into bends to give strength to the entire floor structure.

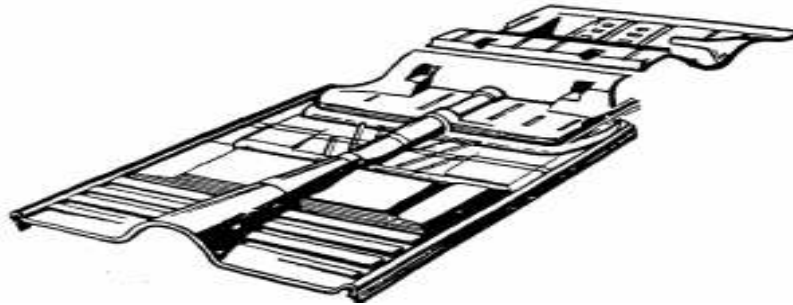


Figure 1. 7: Floor Pan Assembly

- III. *Rear Quarter Panel.* The rear quarter panel is an integral part of the fender. The rear quarter panel has both inner and outer construction. The outer construction or outer panel is smooth, except for the breaks caused by the design of the vehicle. The inner construction of a rear quarter panel is made up of many strong reinforcement brackets welded or bolted together to form a single unit.
- IV. **Doors:** Doors are composed of two main panels: outer and inner. Both panels are normally of all steel construction. Doors derive most of their strength from the inner panel. The inner panel acts as a frame for the door. It is made with offsets and holes for the attachment of inner door hardware. The outer panel flanges over the inner panel edges to form a single unit. It also provides an opening through which the outside handle protrudes. In some instances, a separate opening is provided for the lock.
- V. **Deck Lid:** The deck lid is another door that allows access to the luggage compartment. It consists of an outer and inner panel. These panels are spot welded together along their flanged edges to form a single unit.

**B. Frame (Chassis) Construction.**

An understanding of the construction of the frame is extremely important, since it is the foundation on which the vehicle is built. Frames can be constructed from channel stock, Ibeam, angle, Zstock, tubing, flat plates, or a combination of any two or more of these stocks. Frame/Chassis includes everything under the body, consisting of the mechanical systems that support and power the car. In general there two types of frame construction for light duty vehicle

I Uni-body construction weld major body panels together to form the frame for attaching the engine, drivetrain, suspension, and other parts. This type of construction is commonly used on cars. Uni-body construction uses body parts welded and bolted together uses lighter; thinner, high-strength steel alloys Body shell is formed by welding sheet metal into a box- or egg-like configuration.

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Unibody structure  
 forms frame

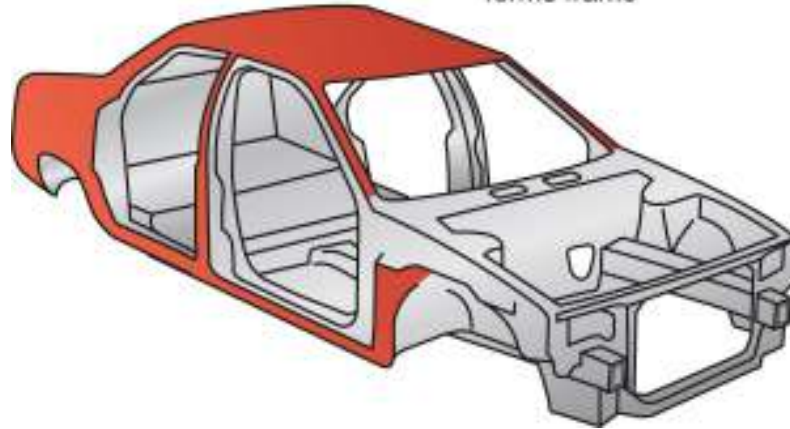


Figure 1. 8: Uni-body Construction forms frame

ii .Body-over-frame construction, a thick gauge steel frame provides the foundation for holding other parts. This type of construction is commonly used on large trucks and SUVs. Body-over-frame vehicles have separate body and chassis parts bolted to the frame Full frame vehicle is heavier - high amounts of energy are absorbed by the frame in a collision Figure 1. 9. Two very different methods used to construct modern vehicles:

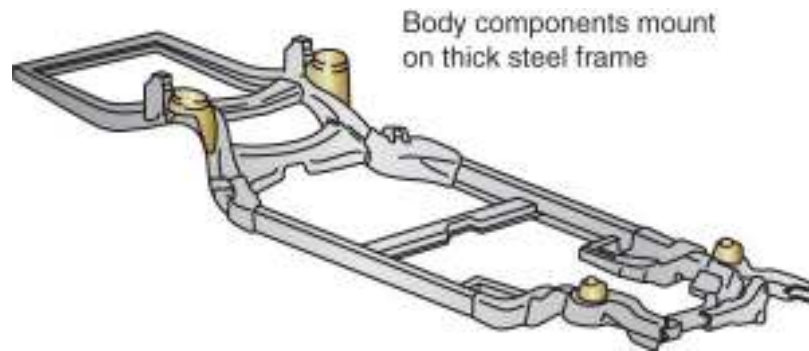


Figure 1, 9: Body-over-frame construction

- Unibody and body-over-frame construction

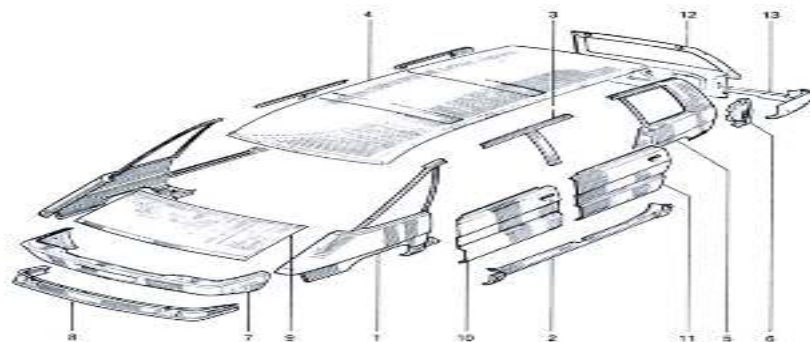


Figure 1.10a: Body Shapes and Parts

1) Fender

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- 2) Rocker panel
- 3) Roof side rail with centre body pillar
- 4) Roof panel
- 5) Quarter panel
- 6) Tail lamp holder
- 7) Front bumper sheet
- 8) Deflector
- 9) Hood panel
- 10) Drivers Door assembly
- 11) Left rear Door assembly
- 12) Back door panel (Trunk or Deck Lid)
- 13) Rear Bumpe



Figure 1. 11b: Truck Body Parts Diagram with part names

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### 1. Bonnet (Hood)

The hood protects your engine and other essential components of your truck. Whether you have a rusted or damaged hood, repairing/replacing it is often relatively easy.

### 2. Bumper / Energy Absorber / Cover

Bumpers are located at the front of the vehicle, below the front grille. They're intended to be the first thing to hit an object in front of them (such as another vehicle) and to minimize the impact and damage to the rest of the vehicle, minimizing repair costs.

### 3. Radiator Support/ Header panels

Header panels are an important part of the body that provides support and mounting locations for grille assemblies, radiator and headlights.

### 4. Grille

The front-end of the *vehicle* has seen considerable developments over the past few years. The principal function of the grille is to admit cooling air to the car's radiator.

### 5. Head lamp

Headlamp Automotive lighting keeps our families safer. In a moment, drivers must gauge a vehicle's position, size, and direction of travel.

### 6. Door

The complete truck door is made of several components, but this term refers to the largest panel and shell. A vehicle's door panel provides attachment points for handles and often side-view mirrors as well. Areas at the bottom of doors can trap water, dirt and debris — especially when drain holes get clogged.

### 7. Guard (Fender)

Fenders typically form an arch — made either of plastic or metal — on the side of the vehicle body, around each of the wheel cutouts. Rotating tires can throw lots of water, snow or pieces of debris while driving, so fenders help mitigate some of this matter.

### 8. Side Panel (Wheel arch panels)

Wheel arch panels receive abuse from grime and salt. These are the panels that sit above and around the truck wheels. They protect the rest of the body from moisture and debris thrown by your tires, so they often need to be replaced after years of use. Manufacturers tend to put foam in between the wheel arch and the inner wheelhouse, to help limit vibration and noise, but this foam holds moisture and causes both panels to rust.

## 9 Tail Gate

Located at the very back of your truck, there is no end to the ways you can damage a tailgate.

Whether you back into a post in a parking lot or get rear-ended while sitting in traffic, tailgates are a commonly damaged component of your vehicle.

## 10 Mirror

A rear-view mirror (or rearview mirror) is a flat mirror in automobiles and other vehicles, designed to allow the driver to see rearward through the vehicle's rear window

## 11 Roof Panel

The roof panel covers the cab of your truck, and you likely don't give it much thought most days. Because it is often out of site, you may not notice rust or other damage to this panel. Even direct sunlight over prolonged periods can damage your roof pa

12. Truck Bed Floor  
Your truck bed floor takes a beating – from payloads going in and out, to salt, water and debris that accumulates in it. Your floor is likely made up of several different panels. Depending on the damage you may be able to only replace parts of it or certain panels or supports.

### 1.1.3 Removal of Damaged part

- Measuring dimensions before beginning
- Measure the dimensions of the damaged area according to the body dimension drawings before removing and repairing.
- Adjust dimensions with body frame adjuster if deformed.
- Selecting cutting area
- Select a cutting area that is easily accessible and that is prone to the least amount of distortion when welding.
- Select an area that would allow the new part to overlap repair area
- Protecting body from damage

### 1.1.4 .Workplace Procedures

The idea of what a procedure is changes depending on who you ask. To many, a procedure is a set of detailed instructions which tell the reader how to complete a task. Others consider policies and procedures to be interchangeable terms, meaning a list of tasks to complete a goal, whether those are detailed, simple, in a basic list, or set out as a flowchart.

For the sake of simplicity,

A procedure is a list of detailed instructions to achieve any given objective. These instructions remain consistent from one project that uses them to the next, but they can be tweaked and improved if the procedure itself is behind under-performance.



Procedures are important for many of the same reasons as processes.

## Step-by-Step Instruction

### 1. Workshop Layout

Familiarize yourself with your workshop. There are special work areas that are defined by painted lines. These show the hazardous zone around certain machines and areas. If you are not working specifically on the machines, you should stay outside the marked area.

### 2. Observe warning signs

Study the various warning signs around your workshop. Understand the meaning of the Signal Word, the colors, the text and the symbols or pictures on each sign. Ask your instructor if you do not fully understand any part of the sign.

### 3. Check air quality

Check for air quality. There should be good ventilation and very little chemical fumes or smell. Locate the extractor fans or ventilation outlets and make sure they aren't obstructed in any way.

### 4. Identify firefighting equipment

Check the location and types of fire extinguishers in your workshop. Be sure you know when to use each type, and how.

### 5. Identify flammable hazards

Find out where flammable materials are kept, and make sure they're stored properly.

### 6. Identify hazards – Compressed air

Check the hoses and fittings on the air compressor for any damage or excessive wear. You have to be particularly careful when troubleshooting air guns. Never pull the trigger while inspecting it—severe eye damage can result.

### 7. Identify hazards – Corrosives

Find out which liquids will burn or corrode parts, metals or skin. Identify caustic chemicals and acids associated with activities in your workshop.

### 8. Personal protection

Be aware that YOU could be a hazard in the workshop, if you don't wear mandatory protective gear when working on hazardous machines.

## 9. Equipment hazards

Ask your instructor for information on any special hazards in your particular workshop and any special avoidance procedures, which may apply to you and your working environment.

|                      |                     |
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| <b>Self-Check -1</b> | <b>Written Test</b> |
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Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Write Work Instruction Steps.
2. Explain Detail The Types Of Vehicle Chassis Construction.
3. Describe Roof Panel Assembly And Floor Pan Assembly.
4. What Are The Recommended Tools Of Vehicles?
- 5, Write The Components Of Body Parts

## 1.2. Environmental requirements

An Information Source is a source of information for somebody, i.e. anything that might inform a person about something or provides knowledge to somebody. Information sources may be observations, people speeches, documents, pictures, organizations etc

In general, there are three types of resources or sources of information: primary, secondary, and tertiary.

1. Primary sources are original materials on which other research is based, including:
  - original written works –repair/service manual, poems, diaries, court records, interviews, surveys, and original research/fieldwork, and
  - research published in scholarly/academic journals.
2. Secondary sources are those that describe or analyze primary sources, including:
  - reference materials – dictionaries, encyclopedias, textbooks, and
  - books and articles that interpret, review, or synthesize original research/fieldwork.
3. Tertiary sources are those used to organize and locate secondary and primary sources.
  - Indexes – provide citations that fully identify a work with information such as author, titles of a book, article, and/or journal, publisher and publication date, volume and issue number and page numbers.

**Self-Check – 1.2**

Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is workplace procedure? (2 point)
2. Write step-by-step instruction of workplace procedure. (5 point)
3. Identify the following safety sign(4 point)



A

B

C

D

1. What are the sources of information? (3 point)

### 1.3. Identifying hazards and risks

Vehicle repair facilities that conduct auto body repair, painting, detailing and car washing contribute to water pollution. Auto body repair business owners/managers as well as its employees may become unaware of the harmful effects of water pollution to our local beaches. To assist the automotive repair facilities with requirements for reducing pollution and protecting water quality, this information sheet describes the Best Management Practices (BMPs) and pollution prevention tips to you should follow. Please review this information and incorporate these practices into your daily activities.

#### 1.3.1 Safe operating procedure

- Select and use the proper personal safety equipment for body panel repair, hammer, dollies and related equipment operation, paint mixing, matching and application, paint defects, and detailing (gloves, suits, hoods, eye and ear protection, etc.).
- An understanding of basic hazardous materials terms Know how to perform basic control, containment and/or confinement operations within the capabilities of the resources and personal protective equipment available with their unit
- Minimize exposure of rain and runoff to auto body repair and painting areas by using cover and containment. In and around these areas, use good housekeeping to minimize the generation of pollutants.
- Make water pollution prevention BMPs a part of standard operating procedures.
- Auto body repair products, such as body filler, primers, paints, and sandpaper often contain significant amounts of zinc. The original paint on a customer's car may also contain high concentrations of zinc. The following practices should help reduce or eliminate the amount of zinc and other pollutants in wastewater discharges.

#### Pollutant Sources

The following are sources of pollutants:

- Wet and dry sanding
- Painting
- Washing cars and other vehicles
- Cleaning floor
- Hydrocarbons (oil and grease)
- Toxic chemicals (solvents, chlorinated compounds)
- Paints

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## Dry Sanding

- Conduct all sanding indoors.
- Sweep, vacuum, or use other dry cleanup methods routinely to pick up dust from dry sanding of primer, metal or body filler.
- Use vacuum sanding equipment whenever possible in order to reduce the amount of airborne dust.

- **Wet Sanding**

- Conduct all sanding indoors.
- Do not wet sand in a wash rack or in an area with a floor drain.
- If possible, reduce or eliminate need for a sand bucket:
- Use dent repair tools whenever practical for small dents.
- Use vacuum sanding equipment whenever practical (for larger panels) in order to minimize the amount of wastewater.
- Use spray bottle to squirt water onto the panel being sanded. This eliminates sanding bucket wastewater and also minimizes drips and spills.
- Clean up drips with a rag, or let the drips dry, and then sweep or vacuum up the dust.
  - Selecting Personal protective equipment

To be used by technician for each of the workshop tasks and operations being conducted as required by the personal protective equipment Know how to select and use proper personal protective equipment provided to the first responder operational level.

- A. Welders gloves for electric arc welding
- B. Working gloves / Hand Protection
- C. Leather jacket for welding and Leather trousers with belt Always wear appropriate work clothing.
- D. Leather Apron

The use of aprons whether made from traditional cowhides or unique pigskins provide a high level of protection when any welding task is involved.

- F. Safety Shoe

Always wear safety shoes that comply with the relevant standards for your area.

- E. Arc welding faces shields and glasses

A welder should bear in mind that proper protection is absolutely necessary to guard him-self against the danger of electric shocks, burns, ultra-violet rays and bits of welding slag in the eye. Wear a welding mask when using, or assisting a person using, an electric welder..

- F. Gas welding goggles

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Gas welding goggles can be worn instead of a welding mask when using, or assisting a person using, an oxyacetylene welder. The eyepieces are heavily tinted, but not as much as those in an electric welding mask, allowing you to see the welding task.

#### J. Ear Protection

Ear Protection should be worn once sound levels exceed 85 dB, when working around operating machinery for any period of time or when the equipment you or others nearby are using produces loud noise.



- A. Welders gloves for electric arc welding
- B. TIG and gas welding gloves Working gloves
- C. Leather jacket for welding
- D. Leather trousers with belt
- E. Arm protector pair
- F. Leather apron
- G. Safety Shoe
- H. Arc welding face shields and glasse
- I. Gas welding goggles
- J. Ear Protection

Figure 3.1: Personal Protective Equipment

Select personal protective equipment (PPE) that is:

- Suitable for the nature of the work and the hazard (e.g. eye and ear protection, high visibility clothing)
- Comfortable to wear, and of a suitable size and fit
- Maintained, repaired or replaced when required

#### 1.3.2 Waste/dust management

Waste management is one of the most emerging issues all over the world. This is because of the large amount of waste that is being generated daily and the impact of such waste is hazardous for the environment and living beings. Waste management is the organized way of managing the waste through pathways to guarantee that they are disposed of with attention to least negative impact to the environment..

Toxic / Hazardous waste may include

- Waste Paint materials



- Waste Solvent (Thinners)
- Empty Paint and Hardener containers (wet)
- Body Filler waste or dust
- Paint / Thinner Soaked Rags or Wipes

### Noise Management

Prolonged and excessive exposure to noise results in long term harm to your hearing. This is irreversible, once you lose your hearing that's it - it's gone! It accelerates the normal hearing loss we get as we grow older and can cause a permanent sensation of ringing in the ears, known as tinnitus. Less-obvious side effects such as increased pulse rate, blood pressure. Managers and supervisors must take all practicable steps to protect the health and safety of workers.

#### 1. They have a responsibility to:

- Understand how noise affects their workers and the work being performed;
- Consult with workers to identify, assess and control noise related hazards and risks;
- Provide all workers with appropriate information, education, training, instruction and supervision;
- Implement improvements to reduce noise related risks so far as is reasonably practicable;

#### 2. All workers have a responsibility to:

- Take all reasonably practicable steps to safeguard their own health and safety, and the safety of others in the workplace;
- understand and follow established safe work practices and procedures, participate in appropriate training and hazard identification, and control risks arising from noise related hazards in accordance with guidance;
- Wear personal protective equipment provided, as directed; Advise supervisors of any perceived risk that could increase exposure to injury or illness;
- Report events that caused, or could have caused, hearing-related injury or illness.

|                        |              |
|------------------------|--------------|
| <b>Self-Check –1.3</b> | Written Test |
|------------------------|--------------|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the sources of pollutant? ( point)
2. Discusses the pollutant material of Auto body workshop. ( point)
3. Explain the PPE equipment used for body panel repair. ( point)
4. List at least five best practices for collecting and disposing of sanding waste. ( point)
5. Write the six toxic and non-toxic wastes in automotive body and painting workshop. ( point)
6. Which materials reuse again from collision repair waste? ( point)
7. Explain briefly the roles and responsibilities of manager and worker to manage the noise. ( point)

## 1.4. Identifying and checking tools and equipment

Hazards are the main cause of occupational health and safety problems. Therefore, finding ways of eliminating hazards or controlling the risks is the best way to reduce workplace injury and illness.

Hazard is a substance or situation that can cause injury or illness, damage to property, damage to the workplace environment, or any combination of these. A hazard is simply a condition or set of circumstances that presents a potential for harm. Hazards are divided into two:

- I. Health hazards (cause occupational illnesses)
- II. Safety hazards (cause physical harm – injuries)

High-risk hazard – a substance or situation that’s potential for causing injury or illness, damage to property and damage to the workplace environment is especially acute.

Risk – a situation that results in a chance of harm to people, of damage to property or of other loss; or the potential for such a situation occurring.

Accident – means an unexpected event causing injury, illness or even death (see also critical injury), or involving a person’s exposure to harmful substances.

### 1.4.1 TYPES OF HAZARDS

- 1) Physical: Conditions in which objects, materials or structures can cause material or bodily damage. Examples include flammability, explosiveness, noise, electric shock, heat and cold extremes, radiation, slippery surfaces, etc.
- 2) Chemical: Conditions that can lead to contamination by harmful or potentially harmful substances. Examples include toxic gases, corrosive liquids or powders, etc.
- 3) Biomechanical: Conditions that give workers biomechanical stress (body and movement). Examples include workbench height, chair design, workstation set-up, etc.
- 4) Biological: Conditions where living organisms can pose a threat to human health. Examples include syringes carrying potentially infected blood, specimen containers with potentially infected materials, etc.

Hazard Identification is the process of identifying all hazards in the workplace. Most automotive workshop hazards overlap into different hazard categories.

- Electrical systems
- Car operation
- Guarding of other power transmission and functional components
- Hazardous energy control while performing servicing and maintenance
- Noise of knock when repair body, engine, grinder, Air compressor etc.

Hazards may be identified in:

- Environments (light, noise, rain, heat, sun, cold)
- Substances (putty, paint, thinner, hardener, fuels, dusts)
- Workplace layout (store and working area design, vehicle parking, place of machine)
- Work organization (design of workflow)
- Equipment (welding machine, grinder, sheet metal cutter, etc.)
- Heights (roofs, vertical and horizontal shelf, workbench)
- Electricity (switches, cables, leads, power tools, connections)
- Finally we should Reporting Potential Hazard/Risk

Report hazards to your supervisor, unless there is an immediate threat to life, safety, property

**Self-Check –1.4**

**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Fill the space provide by correct word (1 point for each)

1. \_\_\_\_\_ Conditions that give workers biomechanical stress
2. Hazards are divided into two:
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_
3. \_\_\_\_\_ Conditions in which objects, materials or structures can cause material or bodily damage.
4. \_\_\_\_\_ a situation that results in a chance of harm to people, of damage to property or of other loss.
5. \_\_\_\_\_ is the process of identifying all hazards in the workplace.
6. \_\_\_\_\_ Conditions that can affect the thoughts, behavior and mental well-being of workers.
7. Hazards may be identified in \_\_\_\_\_ , \_\_\_\_\_ and \_\_\_\_\_

## Hammers

A number of different hammers are useful in the body shop. Many are specially shaped for a specific metal shaping operation.

### ➤ Ball Peen Hammers



The ball peen hammer is a useful multipurpose tool for all kinds of work with sheet metal. Heavier than the body hammer, it is used for straightening bent underpinnings, smoothing heavy gauge parts, and roughly shaping body parts before work with a body

hammer and dolly begins.

### ➤ Mallets

The rubber mallet gently bumps sheet metal without damaging the painted finish. Its most frequent use is with the suction cup on soft "cave-in" type dents.

While pulling upward on the cup, the mallet is used to top lightly all around the surrounding high spots. A popping sound occurs as the high spots drop and the low spot springs back to its original contour.

A steel hammer with rubber tips is another mallet useful in bodywork. The hammer shown in Figure has both hard and soft replaceable rubber heads. The soft-faced hammer, as it is sometimes called, is used to work chrome trim and other delicate parts without marking the finish.



### ➤ Sledge hammer



A light sledgehammer is an essential tool for the first stages of re-forming damaged sheet metal. It should weigh 3 to 5 pounds and have a short handle so that it can be used in tight places.

The sledgehammer can be used to knock damaged metal roughly back in to shape and to clear away damaged metal when replacing a panel.







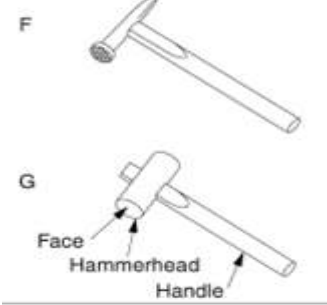
### ➤ Body Hammers

Body hammers are the basic tools for pounding sheet metal backs in to shape. They come in many different designs. Some have flat, square heads; some have rounded heads; and some,

called picking hammers, have pointed heads. Every style is designed for a special use for which it is ideal.

A hammer is used to correct dents, projections or other deformations. Various shapes have been designed according to their purposes.

### Types and Features of body Hammers

|   |   |                      |   |
|---|---|----------------------|---|
|    | A | Cross peen hammer    | For shaping the panel together with dollies and spoons  |
|    | B | Straight peen hammer | For shaping the panel together with dollies and spoons  |
|   | C | Bumping hammer       | For shaping the panel together with dollies and spoons  |
|  | D | Roughing hammer      | For rough-shaping the panel in combination with straightening equipment, or when great force is required. |
|  | E | Pick hammer          | For correcting small dents  |
|  | F | Shrinking hammer     | For Shrinking stretched panels  |
|  | G | Wooden hammer        | For shrinking or correcting the panel without stretching  |

- Dollies





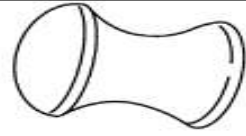

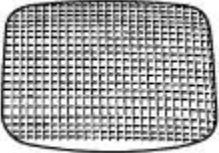
#### Types and Features of Dollies

Ideally, a dolly whose curved surface just fits the curvature of the panel should be used.

However, this is often difficult. In most cases, a dolly whose curvature is slightly smaller than that of the panel should be selected.

Generally speaking, four types of dollies (general purpose, utility, heel and toe dollies) are sufficient for ordinary panel work. However a special dolly can be designed for unique shaping.

The size and weight of the dolly must be easy to handle. The maintenance procedures and cautions described for the hammer also apply to the dolly. The entire surface of the dolly must be free from damage.

|   |                       |  |
|---|-----------------------|--|
|    | General purpose dolly | This is also called a rail dolly. It has both wide and narrow curved faces.  |
|    | Utility dolly         | This type of dolly features various curved surfaces and has wide applicability to automobile body repairs work. It can be handled easily in narrow space |
|  | Heel dolly            | One side is flat and the other side is curved slightly. This is suitable for correcting flat and slightly curved surfaces.                               |
|  | Toe dolly             | This dolly is formed by two flat surfaces and a connecting curved surface. It can be used in narrow places.  |
|  | Round dolly           | Both sides are curved. This dolly is used for repairing small dents.   |
|  | Wedge/Comma dolly     | This dolly has a curved surface which changes gradually from sharp to gentle. Its sharp end can be inserted into narrow portions.                        |
|  | Shrinking dolly       | The surface is like a file. This dolly is used in combination with a shrinking hammer.   |



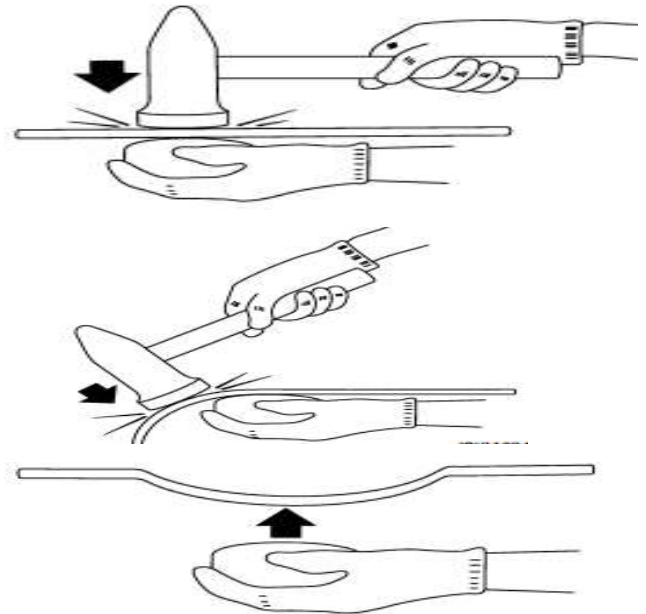
Dollies are used in combination with a hammer. They are a 1 kg - 2 kg (2 lb - 4 lb) steel blocks, heavier than a hammer, with various curves and planes.

#### Use of Dollies

(a) Place the dolly on the underside of the deformed sheet metal. Strike the deformed section of the sheet metal with the hammer to stretch it.

(b) Move the hammer and dolly as necessary, and direct the hammer blows so as to bend the sheet metal.




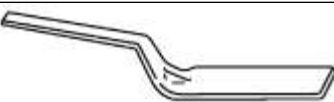
(c) If ordinary hammering is impossible due to limited space, substitute a dolly for the hammer, and strike the dented portion with the dolly.





- Spoons

Spoons are made of steel, and one or both ends are flat. Spoons are used as dollies in narrow spaces or as pry bars.

#### Types and Features of Spoons

|   |                       |   |
|---|-----------------------|---|
|  | General purpose spoon | This spoon has a gently curved surface and sharply curved ends. It is widely used in automobile body repair work. |
|  | Long spoon            | This spoon has a long handle and thin, rigid faces. It is used primarily for prying.                              |
|  | Curved spoon          | The handle of this spoon is comparatively short. It has a wide curved blade. This spoon is used for smoothing.    |
|  | Flat spoon            | This spoon has a short handle and a wide, flat blade. When  |

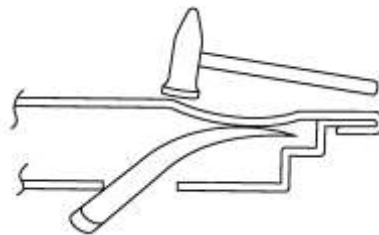
|   |                      |   |
|---|----------------------|---|
|   |                      | the spoon is placed on the panel and hammered, the force disperses over a wide area.                                      |
|  | High crown spoon     | This spoon has a wide hooked blade. It is used for repairing narrow body panel spaces such as inside of outer sill panel. |
|  | Sickle-shaped spoon. | This spoon has a wide, gently curved surface with a thin end. It can be inserted into very narrow gaps between panels     |

- Selection and Maintenance of Spoons

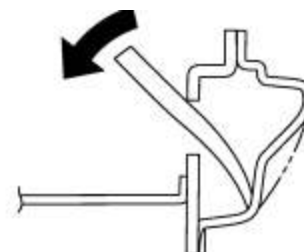
Select spoons suitable for the particular panel shape and internal structure. Spoons can be made from leaf springs. Cut the leaf spring to the desired shape. Heat it with a gas torch and shape it into a spoon by bending or stretching with a hammer. Then grind and polish. (See Hammer Maintenance Operation Sheet) The precautions described for the hammer and dolly also applies to spoons. Do not damage the surface which comes into direct contact with the panel during repair work.

#### How to Use Spoons

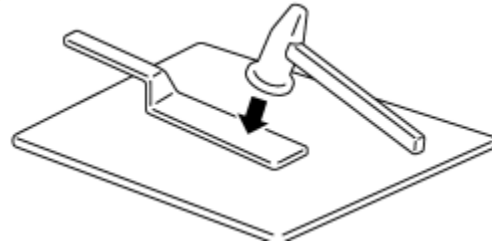
(a) Insert the spoon into tight spaces such as inside of door, and use as a dolly.



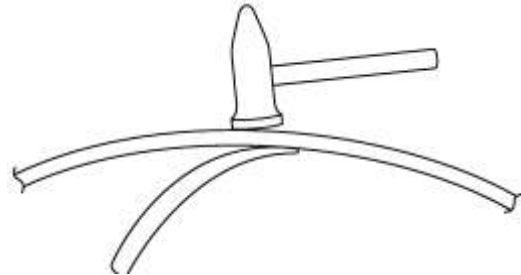
(b) Place a spoon between two panels and pry out the concave portion.



(c) Hammer directly on the spoon to disperse the force of the hammer blows



(d) The figure to shows an example of incorrect spoon usage. There is no fulcrum point for the spoon.



If a spoon is used in this way, insufficient force is applied to the mating face, and the spoon cannot act as a dolly.

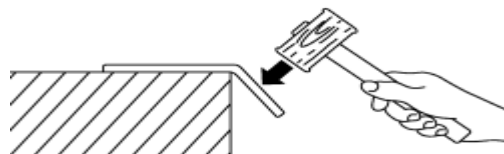
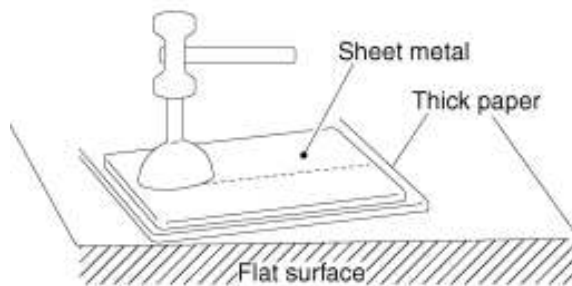
- **Scribing Chisels**

Chisels are generally used to cut sheet metal. They are also used in body repair work. There are numerous types of chisels. This section, however, describes scribing chisels used exclusively for bending sheet metal or for shaping panel press lines. This type of chisel must have a smoothly rounded edge as shown in the figure. If the edge is sharp, the body panel will be nicked.

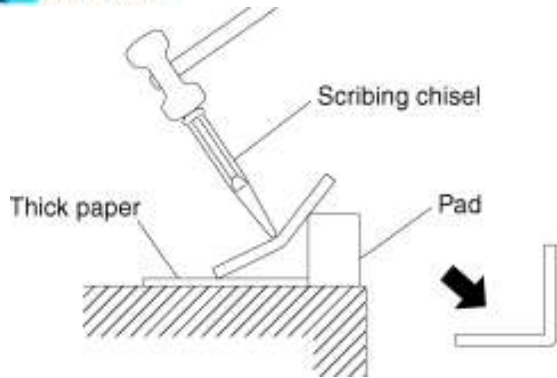
#### How to Use Scribing Chisels

(a) For bending sheet metal

- First scribe a line on the sheet metal. Place thick paper or cardboard under the sheet metal.
- Place the scribing chisel on the line and hammer it.
- Place the sheet metal on a flat, angled surface scribed-side down, and bend the sheet metal with a wooden hammer.

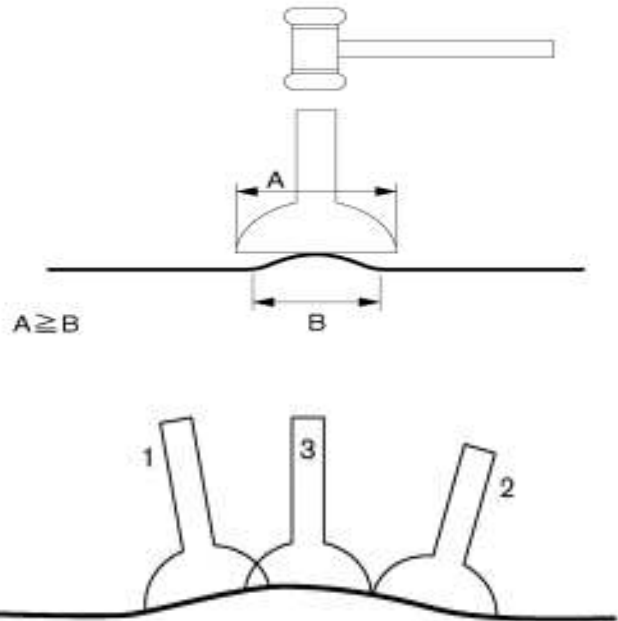


- Using a hammer and the scribing chisel, neatly bend the sheet metal squarely. Do not bend all at once.
- Bend the sheet metal gradually by gently hammering against the chisel head.

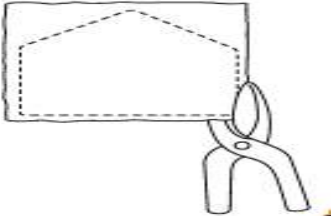
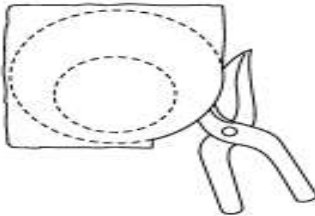
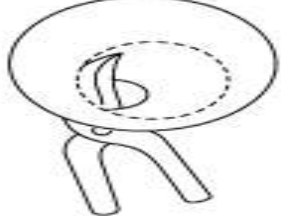


(b) Shaping the press line

- If the dent in the press line is smaller than the width of the chisel, apply the chisel to the center of the dent. Hammer to flatten.
- Hammer gently so that the dent can be removed gradually.
- If the dent is larger than the width of the chisel, do not strike the dent in the center.
- Apply the chisel at the edges of the dent.



Types and Uses of Tin man's Shears

|   |   |  |
|---|---|--|
| <p>(1) Straight Blade Shears<br/>For cutting straight lines.</p>                    | <p>(2) Curved Blade Shears<br/>The blades are smoothly curved. Suitable for straight or curved cutting.</p> | <p>(3) Scooped Blade Shears<br/>The entire blade is bent to one side. Suitable for cutting along a sharply curved line</p> |
|  |                         |                                       |

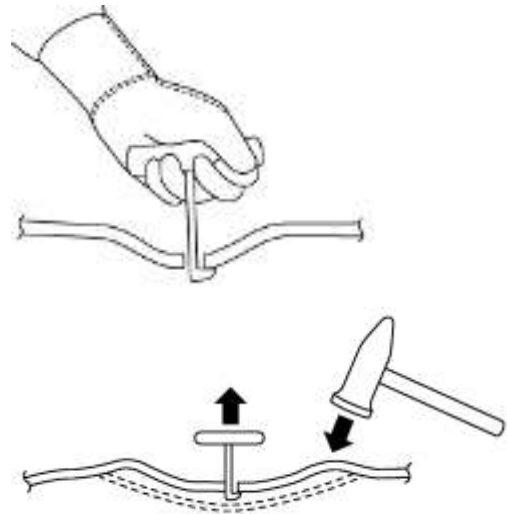
- Tools for Pulling

If it is impossible to gain access to the damaged area, dents can be pulled out and repaired.

### (1) Hand Hook

#### Hand Hook

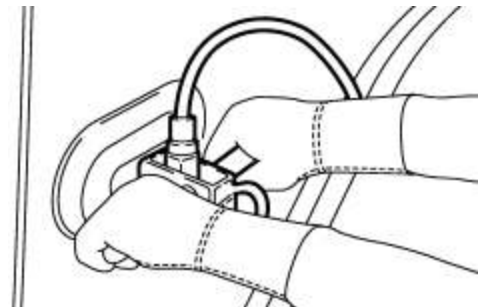
- Small holes are drilled in the dented portion, and a hand hook is inserted into the hole.
- The dented panel is pulled out with the hook. This method is used to repair small panel dents.
- When using a hand hook, fit the end snugly against the panel. Do not pry up or use too much force. Pull the hook lightly while tapping with a hammer at the edge of the dent.
- The drilled hole must be refilled with body putty after completing the work.



### (2) Vacuum Puller

#### Vacuum Puller

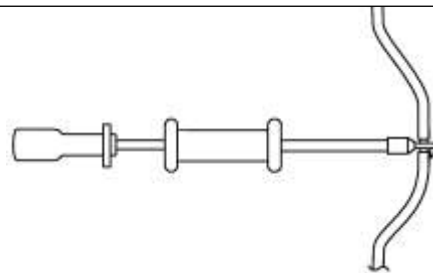
- The vacuum puller is suitable for pulling out large dents if the dented surface is comparatively smooth.

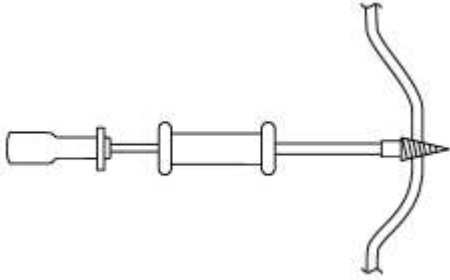
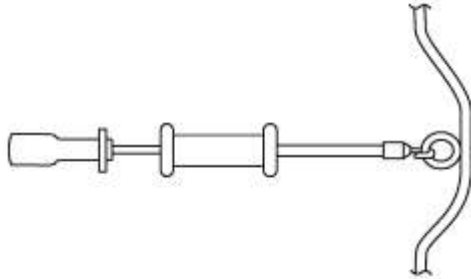
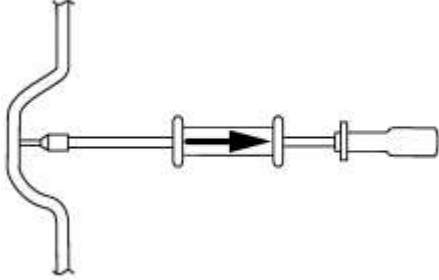
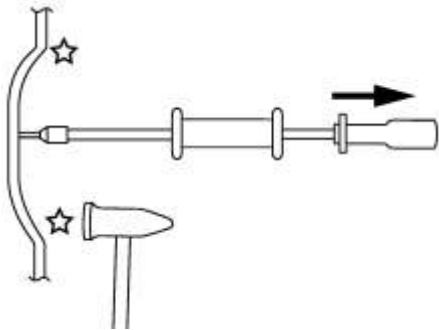


### (3) Sliding Hammer

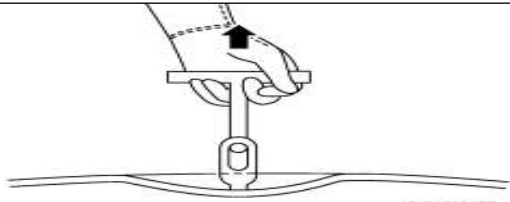
The sliding hammer is used for repairing large, deep dents. Since it provides greater force than an ordinary hammer, it is used to repair dents in thick panels.

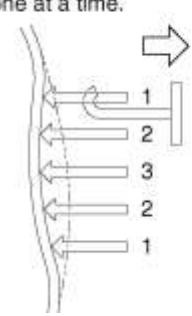
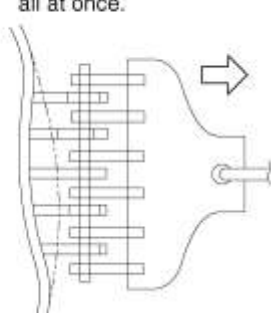
(a) A hook similar to the hand hook is attached to the end of the sliding hammer. Pulling holes are drilled in the panel. A limited force is allowed for pulling. The panel must be pulled carefully to avoid tearing.



|   |  |
|---|--|
| <p>(b) A tapping screw is attached to the end of the sliding hammer. It is then screwed into the panel. A greater pulling force is possible than with the hook.</p> |    |
| <p>(c) Instead of a hole, a metal pin or washer is welded to the panel. Great force can be used for pulling.</p>  |    |
| <p>(d) When the dent is deep and narrow, pull it with a single blow.</p>  |   |
| <p>(e) When the panel dent is shallow and wide, hold the end of the sliding handle. Repair the dent by gradually tapping the edge of the dent.</p>                  |  |

#### (4) Welded Pin or Washer

|  |  |
|--|--|
| <p>A pin or washer is welded to the dent without drilling. It is then pulled to repair the dent.</p> |  |
|--|--|

|   |   |
|---|---|
| <p>Several pins or washers are welded to the dent. They are then pulled together or separately to repair the dent</p> | <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Pull pins or washers one at a time.</p>  </div> <div style="text-align: center;"> <p>Pull pins or washers all at once.</p>  </div> </div> |
|---|---|

### (5) Suction Cups

The suction cup is a simple tool that makes short work of shallow dents if they are not locked in by a crease in the metal. Simply attach the suction cup to the center of the dent and pull. The dent might come right out with no damage to the paint and no refinishing required. It is an easy tool to use and can make a simple repair. However, once a dent is locked in, some hammer and dolly work will be necessary to smooth the metal.



- Rivet Gun

Pop rivets are one of the handiest inventions for auto bodywork. They can be inserted in to a blind hole through two pieces of metal and then drawn up with a riveting tool, locking the pieces of metal together. There is no need to have access to the back of the rivets, and if enough rivets are used, the joint created is extremely strong. For any kind of sheet metal replacement such as rust hole repair, the pop rivet is by far the easiest and least expensive joining system available. In fact, most body shops use rivets extensively, either as a permanent repair or as temporary fasteners. They are used as temporary fasteners before the replacement sheet metal is welded in places where extreme heat would distort the metal or create a safety hazard (such as around the gas tank). The most commonly used rivets in bodywork are 1/8- and 3/16 inch. A few others of assorted sizes might be needed for special jobs.



- Door Handle Tool

Interior door handles are often secured to the door panel by wire spring clips. Shaped like horseshoes, fit over the handle shaft and hold handle tightly against the interior panel trim.

Clip pullers or door handle tools are needed to reach inside the door and remove the clip. Some door handle tools pull the clip out: Others push the clip off the shaft.

|   |                                   |
|---|-----------------------------------|
| A) door hinge bolt wrenches                   | K) window sash nut spanner socket |
| B) door removal kit                           | L) windshield remover             |
| C & D) door panel remover                     | M) hot-tip windshield remover kit |
| E & F) door handle tool                       | N) windshield wiper removal tool  |
| G & H) Trim pad remover                       | O) windshield wiper tool          |
| I) window moldings release tool               | P) all-purpose window scraper     |
| J) windshield locking strip installation tool |                                   |

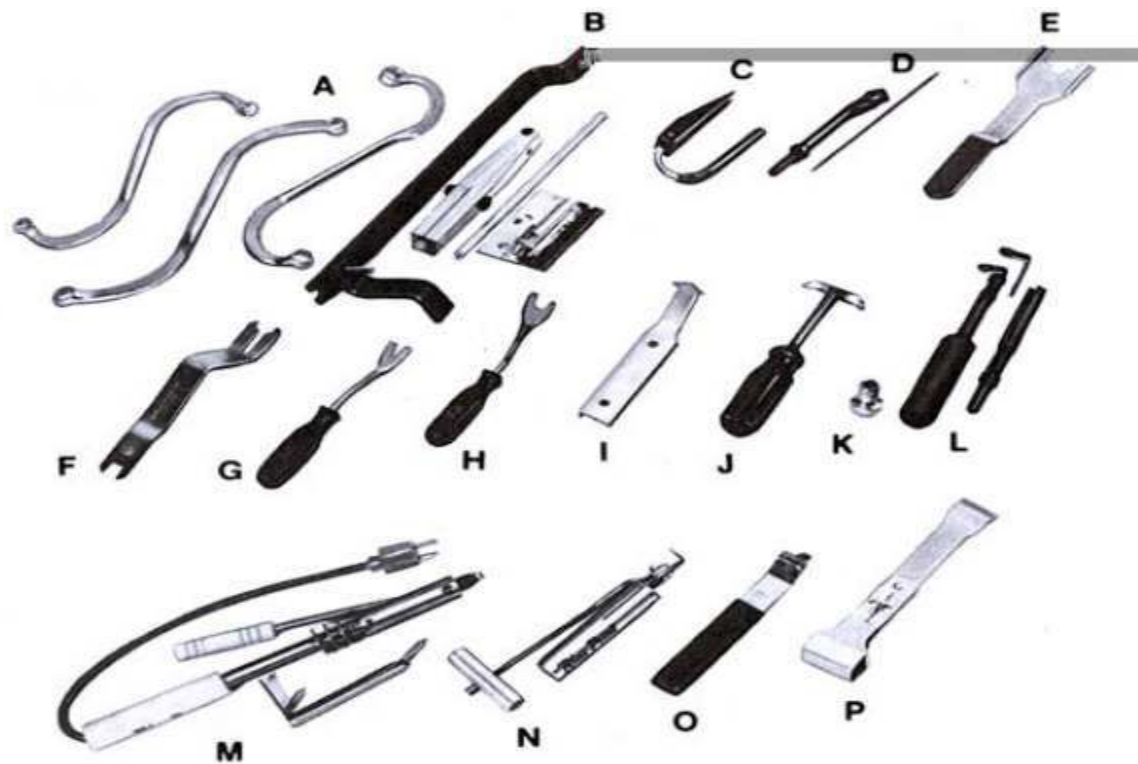


Figure 12: Different Door Handle Tool

## Welding and Heating Equipment

Shielded metal arc welding (SMAW) machine

SMAW (shielded metal arc welding) is a welding process where the source of heat comes from an electrical current. This heat is the result of the conversion of electric power that is converted into heat when the electrode is attached to the base metal. The meeting between the electrode and the base metal will cause ion exchange.



SMAW Welding can use for anything weld joint or welding position. Other side we use this process for underwater welding, but the tools must be complete again suitable for underwater welding procedure. If we do not follow the procedure then can cause our accident, for example, electric shock or other accident types.

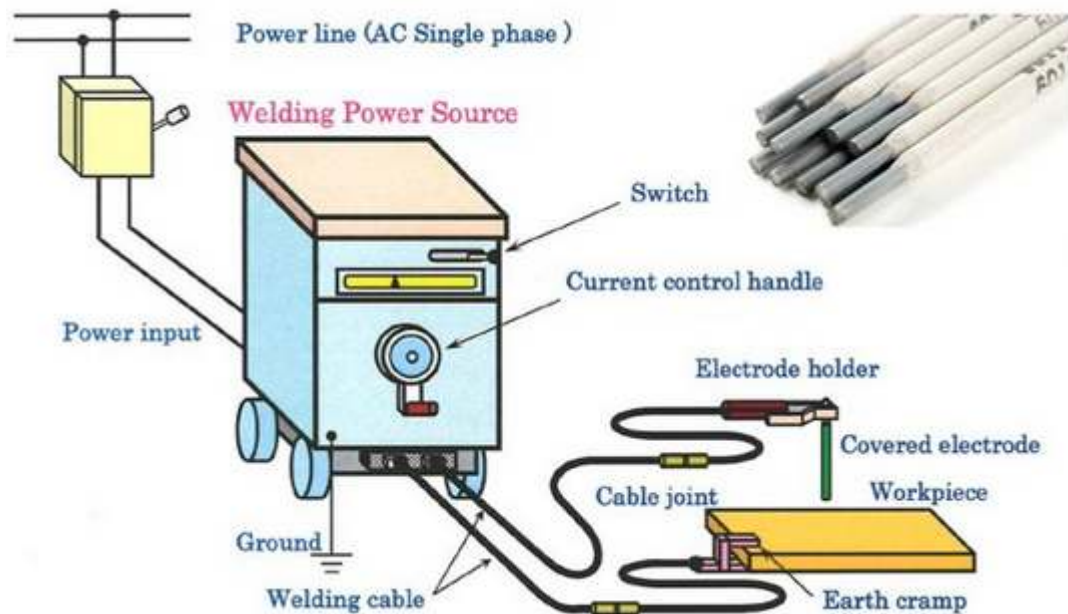


Figure 5.1: Shielded metal arc welding (SMAW) machine with Accessories

### Ox-acetylene Gas Cylinder

Ox-acetylene has two purposes for welding process and heating the metal. Gas welding is a most important type of welding process. It is done by burning of fuel gases with the help of oxygen which forms a concentrated flame of high temperature. This flame directly strikes the weld area and melts the weld surface and filler material. The melted part of welding plates diffused in one another and creates a weld joint after cooling. This welding method can be used to join most of common metals used in daily life

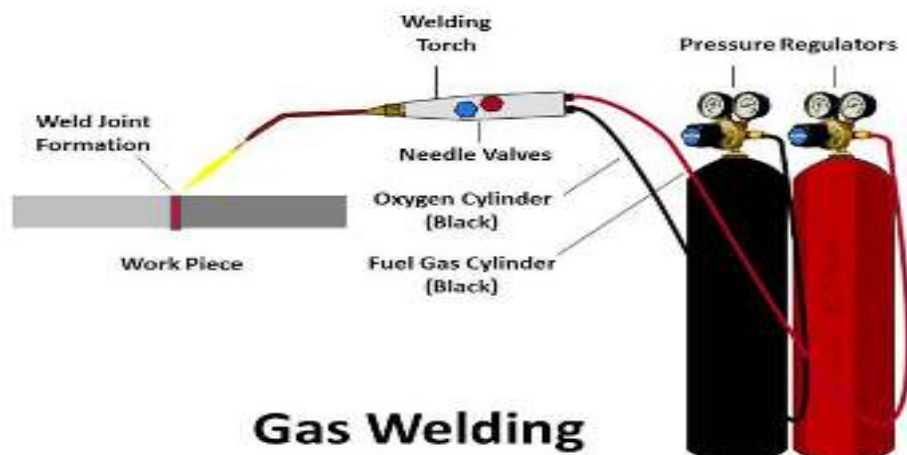


Figure 5.2: Gas Welding Linder with Accessories

## Special Tools and Lifting Equipment

### ➤ Safety Check

Make sure that you understand and observe all legislative and personal safety procedures when carrying out the following tasks. If you are unsure of what these are, ask your instructor.

Points to note

- Four-post hoists allow the vehicle to be positioned and lifted easily. They are often used to lift a vehicle for wheel alignment services, and bottom panel repairs.
- Some four-post hoists are fitted with attachments that allow the vehicle to be raised in a "wheels free" position. Refer to the operations manual for the correct operational procedure.
- The lifting capacity of the hoist you are using must be rated for a vehicle weight greater than that of the vehicle you are intending to lift. Check the hoist rating and compare it with the weight given in the vehicle service manual.
- Make sure you know exactly how to operate the hoist, taking particular care to know exactly where the stop control is so that you can use it quickly in an emergency. Refer to the operations manual for the correct procedure for stopping the hoist.
- Make sure that there will be adequate headroom above the vehicle after it has been raised. Taller vehicles, especially those fitted with roof racks, may need more headroom than you think.

### Step-by-Step Instruction

#### 1. Read instructions

Read the safety instructions that are provided with the hoist. They should be displayed near the lift operating controls. Check the hydraulic system for any leaks, and the steel cables for any sign of damage. Make sure there are no oil spills around or under the hoist.

#### 1. Prepare the hoist

The hoist should be completely down before you attempt to drive the car on to it. The platform may have built in wheel restraints, or attachments for wheel alignment equipment. A set of bars is mounted at the front of each ramp to prevent the vehicle from being driven off the front of the hoist. Position the vehicle

#### 2. Raise the vehicle

Make sure the hoist area is clear. Move to the controls and lift the vehicle until it's reached the appropriate work height.

#### 3. Lock safety device

|              |  |                               |                               |
|--------------|--|-------------------------------|-------------------------------|
| Page42 of 82 | Ministry of Labor and Skills<br>Author/Copyright | Carry-out Basic Panel Repairs | Version -1<br>September, 2022 |
|--------------|--|-------------------------------|-------------------------------|

Most 4 -post hoists will have an automatic locking mechanism. If the hoist has a manual safety mechanism you should lock it in place to engage whatever safety device is used.

## 5. Lower the vehicle

Before the hoist is lowered, remove all tools and equipment from the hoist area, and wipe up any spilled fluids. Remove the safety device or unlock the lift before lowering it. Make sure that nobody is near the vehicle or the hoist.

### 5.4 Vehicle Protection

- 1) Cover the seats before performing any procedure to keep them from getting dirty.
- 2) Cover all glasses, seats and mats with a heat resistant cover when welding.
- 3) Protect moldings, garnishes and ornaments

### Safety Factors

- A. Disconnect the negative (-) battery cable before performing any work on the vehicle.
- B. Protect yourself by wearing goggles, earplugs, respirators, gloves, safety shoes, caps, etc. when working on a vehicle.
- C. Safely support the vehicle before any work is done. Block the front or rear wheels if the vehicle is not lifted off of the ground.
- D. When welding or performing other procedures that require the use of an open flame near the fuel tank, disconnect and remove the tank and fuel pipe, and cap the pipe to prevent fuel leakage.
- E. Insure proper ventilation of your working area. Some paint and sealant can generate toxic gases when heated. Use an air chisel or saw to remove damaged panels instead of a gas torch.
- F. Observe all local and national safety regulations when performing any work.
- G. Cover interior with heat-resistant cover to insure safety when welding.
- H. Take care when using gas or cutting torches so as not to burn body sealer or interior.  
Extinguish immediately if they should catch fire

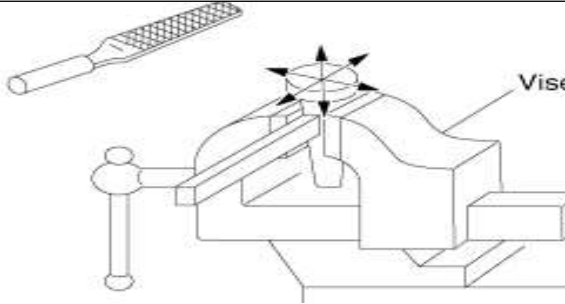
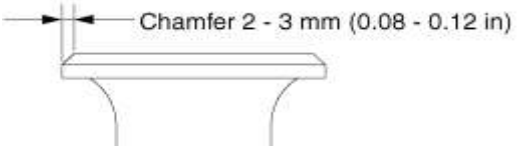
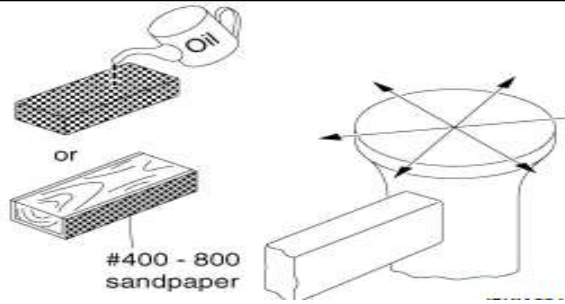
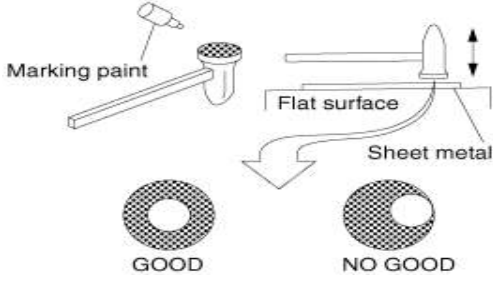
|                            |                         |
|----------------------------|-------------------------|
| <b>Operation Sheet-1.1</b> | <b>Maintain Hammers</b> |
|----------------------------|-------------------------|

It is necessary to choose lighter or heavier hammers according to application or purpose.

Hammer weight should be selected according to the user's physical strength. Hammer maintenance is important.

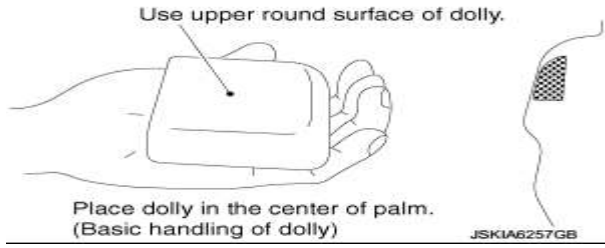
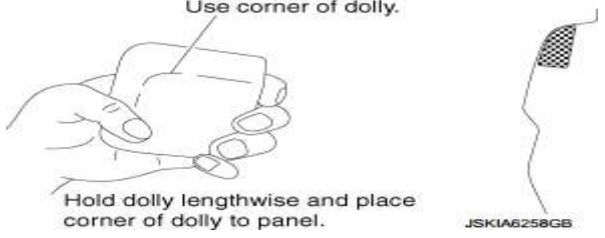
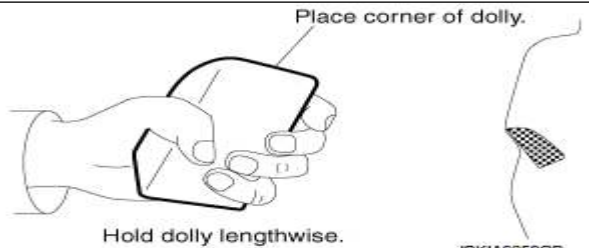

Accordingly, hammers for sheet metal work must not be used to hit other objects such as a chisel.

Do not mix sheet metal hammers with ordinary hammers. Repairing the face of a sheet metal hammer is explained below.

|        |  |   |
|--------|--|---|
| Step-1 | Clamp the hammer in a vise with the hammer face up. If the hammer face is deformed, use a hand file to smooth it.  |   |
| Step-2 | File the face in all directions. Do not file in only one direction.  |   |
| Step-3 | Chamfer the edge of the face to prevent it from nicking or distorting the sheet metal.   |  <p style="text-align: center;">Chamfer 2 - 3 mm (0.08 - 0.12 in)</p> |
| Step-4 | After smoothing the hammer face, polish it with an oil stone or #400 - #800 abrasive paper wrapped around a wooden block. Polish the face in all directions. |   |
| Step-5 | To check the finish, apply marking paint to the hammer face. Hit a piece of flat sheet metal on a flat surface.  |   |

|                            |                                |
|----------------------------|--------------------------------|
| <b>Operation Sheet-1.2</b> | Holding techniques of<br>Dolly |
|----------------------------|--------------------------------|

Techniques of Basic handling of the dolly based on needs of repair body parts

|  |  |
|--|--|
| <p>(a) Top</p> <p>Place the dolly in the palm of your hand.</p> <p>Holding it lightly, place the curved surface against the curved surface of the panel.</p>                                 |    |
| <p>(b) Corner</p> <p>Hold the dolly lengthwise, and place the corner in the sharply bent portion of the panel.</p>   |    |
| <p>(c) Edge</p> <p>Hold the dolly so that the edge faces upward.</p> <p>Place this edge to the press line of the panel.</p>  |   |
| <p>(d) Correcting the Press Line</p> <p>To correct a concave press line in a narrow space on the back of the panel, use a dolly as shown in the figure and strike the press line with it</p> |  |

## Unit Two: Carry Out Basic Panel Repairs

This unit to provide you the necessary information regarding the following content coverage and topics:

- Selecting Materials.
- Shaping and repair damaged panel
- Carrying out body filling and metal finishing.

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Use common Selecting Materials.
- Identify Shaping and repair damaged panel
- Apply Carrying out body filling and metal finishing.

### 2.1. Selection of Materials

One of the most challenging tasks of materials selection is the proper selection of the material for a particular job, e.g., a particular component of a machine or structure. Selector must be in a position to choose the optimum combination of properties in a material at the lowest possible cost without compromising the quality.

Roles & Responsibilities of Materials selection:

Some of Materials selector responsibilities are:

1) Design Process:

a) Drawing the basic design.

b) Proper selection of materials:

*Selection according to different parameters such as :*

- Mechanical loads,
- Wear,
- Electrical insulation,
- Thermal properties
- Availability & cost.

. This includes:

- 1 Selection of the proper manufacturing processes,
- 2) Proper choice (selecting) of substitute (alternative) materials when needed.
- 3) Contributing and evaluating materials tests results,
- 4) Studying and composing materials data sheets before placing an order,

Factors affecting the selection of materials:

(i) Component shape:

The shape and size of a component has great effect on the choice of the processing unit Which ultimately affects the choice of the material? To make it more clear, we consider an Example, let the best possible production method is selected, under given conditions, it is *Die casting*; obviously, now the choice of the material becomes limited, i.e. one can only Choose materials with lower melting points, e.g. *aluminum, zinc, magnesium* and *Thermoplastics*.

(ii) Dimensional tolerance:

There are some materials which can be finished to close tolerance while others cannot. Obviously, the required dimensional tolerance for finished components will, influence the choice of materials.

### **Cost of the material:**

In most of the cases, the cost of raw material accounts about 50 % of the finished cost. Obviously, the cost of the material is a major factor which influences the choice of the Material or process. We must note that the use of cheaper material will not always reduce the final cost of the component or product. Use of cheaper material may be associated with higher processing cost due to large number of operations to be performed and also more scrap. We can easily see that this sometimes makes the overall cost more than that of expensive raw material in combination with low processing cost due to lesser number of operations and lesser scrap. The type of material affects the detailed aspect of design and hence the choice of material as well as the process is selected at the early design state *e.g.* Whether the material is to be joined by spot welding, screws or rivets, must be decided at the design state.

|                         |              |
|-------------------------|--------------|
| <b>Self-Check -2.1.</b> | Written Test |
|-------------------------|--------------|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Explain about the Proper selection of materials:
2. What are the election of material Service requirements:
3. Discus about the Selection of according to different parameters



## 2.2. Shaping and repair damaged panel

### 2.2.1. Repairs part of accident damaged and dents

#### Correcting a Deformed Panel (Panel Replacements and Adjustment) And Replacing body panels

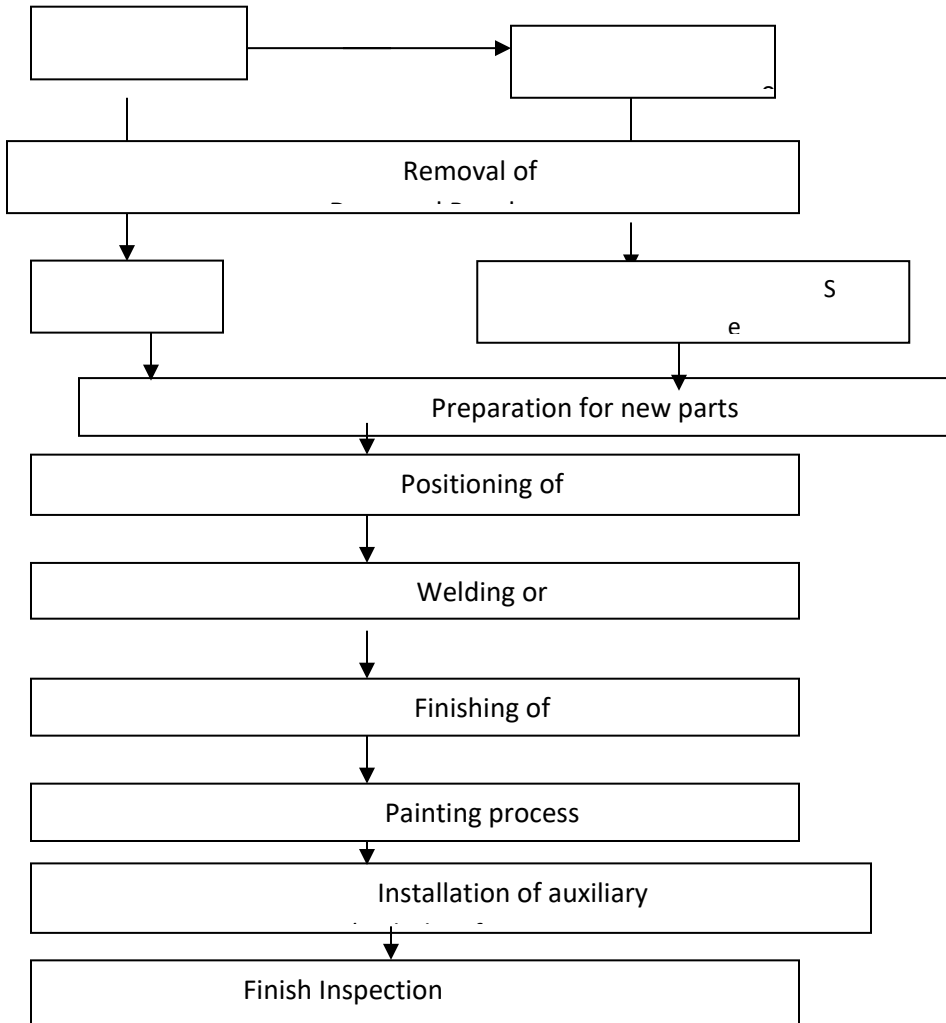
A vehicle that sustains extensive damage in a collision will require a variety of repair operations.

- Bent structural panels will have to be pulled and realigned by power straightening (Anchored and portable)
- Bulges, dents, and creases must be eliminated using the metal working techniques
- Some panels, however, might be so badly damaged that replacing the panel is the only practical and effective procedure.
- Panel replacement is often the only permanent remedy for corrosion damage.

The repair is made by cutting the rusty metal away and welding new partial panels in place.

Table below shows the general procedure for replacing both bolted and welded panels.

Table:2.1 - Typical Panel Replacement Procedure



Non-structural panels such as fenders, hoods, or quarter panels can be attached with bolts, rivets, and screws, among others. Bumpers and selected hard ware are also usually bolted to the frame.

- Replacing these panels requires removing the fasteners. It is simple and fast. It is a matter of bolting the new panel in place and adjusting the fit.

#### Replacing welded panels

Structural body panels are joined together in the factory by spot welding.

Therefore removing panels mainly involves the separation of spot welds.

\* Spot welds can be:

- Drilled Out
- Blown out with a plasma torch
- Chiselled out or
- Ground out with a high speed-grinding wheel

The best method for removing a spot welded panel is determined by the number and arrangement of mating panels and the accessibility of the weld.

Procedures:

#### 1. Determining spot weld position

Remove the paint film, under coat, or other coatings covering the joint area to find the location of spot welds.

#### 2. Separating spot welds

After the spot welds have been located, the welds can be removed with the appropriate cutting tools.

- Drilling
- Chiselling

#### 3. Separating continuous welds

In some vehicles, panels are joined by continuous MIG welding. Since the welding bead is long, use a grinding wheel (high speed grinder) to separate the panels. After grinding through the weld, use a hammer and chisel to separate the panels.

#### 4. Prepare the vehicle for installation of the new panel

- Grind off the welding marks from the spot welding areas and clean
- Smooth the dents and bumps in the mating flanges with a hammer and dolly
- Apply antirust to joining surfaces and exposed bare metals

#### 5. Replacement panel preparation

- The primer must be removed from the mating flanges of new replacement panels to allow the welding current to flow properly doing spot welding
- Drill holes for plug welds where spot welding is not possible

#### 6. Positioning new panels

- Align new panel with the existing body
- Dimensional measurement method

- Visual by looking the surrounding panel

7. Fitting the panel (with clamps temporarily)




8. Cutting the over lapping panel

9. Welding.

### 2.2.2 Damage diagnoses

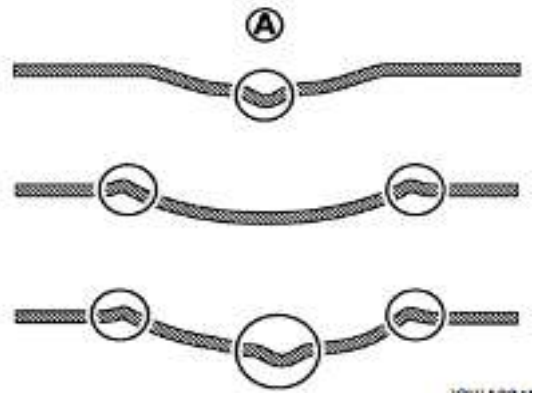
- Determine the direction and force of impact, and whether damage is confined to the body
- Inspect the parts along the path of impact, measure the major parts and check body height, suspension and body damage Impact Effects
- In body-over-frame construction, the passenger area is enclosed with panels of steel attached in the uni-body construction, the metal body panels are welded together to make a unit. Damage assessment and repair also differs.

### Level of Vehicle Damage


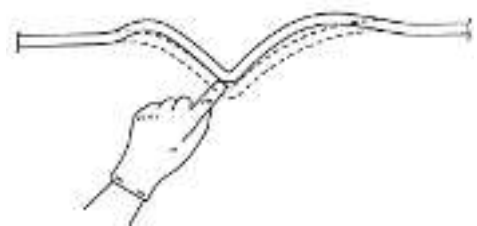
|    |   |  |
|----|---|--|
| 1. | Minor damage typically means scratches, scrapes or dings. Example, a cracked headlight or small dent in your hood |   |
| 2. | Moderate damage usually means large dents in the hood, fender or door of your car.                                |  |
| 2. | Severe damage (very heavy damage) this includes broken axles and bent or twisted frames                           |  |

### Top Basic Types of Damage

- Plastic deformation forms at the center of portion (A) of the dent. The surrounding area remains in elastic deformation.
- Plastic deformation occurs at one or several portions around the dent. Other areas remain in elastic deformation.
- Both plastic and elastic deformations are generated throughout the damaged panel.



### Elastic VS Plastic Deformation

|   |   |
|---|---|
|   | <p>Elastic deformation: If pressed, the deformed portion will move or further deform.</p>                         |
|  | <p>Plastic deformation: If pressed, the deformed portion will remain unchanged, and other portions will move.</p> |

### 2.2.3 Panel and trim removal

Typically, the technician begins by removing trim components, body hardware, and accessories in order to gain access to the damaged metal by a process called bumping, using dolly blocks and special hammers.

If damage is more extreme, hydraulic jacking equipment may be used to align a damaged area. Tiny nicks and dents are usually removed with special pick tools.

#### Metal Body Trim and Hardware

a. *General.* In the vehicle body, window openings are unsightly when viewed from the inside. They must have decorative trim to give them a finished appearance. In the vehicle body, finishing touches which are put on the outside as well as the inside are called either trim or hardware. On sedans, in addition to providing eye appeal, some trim is functional as well as decorative and contributes to the comfort and convenience of the passengers.

b. *Trim*. Moldings, floor mats, armrests, head linings, door trim pads, and weather stripping are known as trim.

c. *Hardware*. Door handles, window regulator handles, locks and window regulators, latches, hinges, seats, and seat adjustments are known as hardware.

d. *Grilles*. Grilles are sometimes referred to as trim. This would make it the largest single unit of trim. Grilles are usually made from several pieces of steel which are fastened together by nuts and bolts or by welding.

In some cases, grilles are made from cast aluminum, white metal alloy, stainless steel, and steel stampings. On combat type vehicles, the grille is referred to as a brush guard. This grille (3/4 ton and over) is made from low carbon steel stock and welded in place to form one single unit. The 1/4 ton vehicle grille is a one piece steel stamping bolted in place. Grilles are usually fastened in place by bolts which attach it to the front fenders. Brackets and supports are also provided which anchor it to the frame. Grilles are also fabricated from fiberglass and laminated material.

**Self-Check -2.2.**

**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

- 1 Discuss the level vehicle damage.
- 2 What is the difference between elastic and plastic deformation?

## 2.3. Carrying-out Body Filling and Metal Finishing

### 2. 3.1. Filling and Metal Finishing

#### ➤ . Filing Techniques

Filing is one of the most important aspects of finishing a body panel. It is carried out using an adjustable file holder, fitted with flexible blades which can be adjusted concave or convex to suit most contours on the average vehicle body. Initially the file was used for smoothing off panels prior to sanding and locating high and low spots. With the introduction of body solder and later metal and plastic fillers, filing took on an even greater importance in the finishing of repairs on body panels. Filing indicates any irregularities in the repaired surface of a panel and is carried out as the panel is plan shed. First of all fasten the correct blade to the file holder with the cutting edges of the teeth facing away from the handle or operator. Adjust the contour of the file holder so that it is almost, but not quite, matching the contour of the surface on which you intend to work.

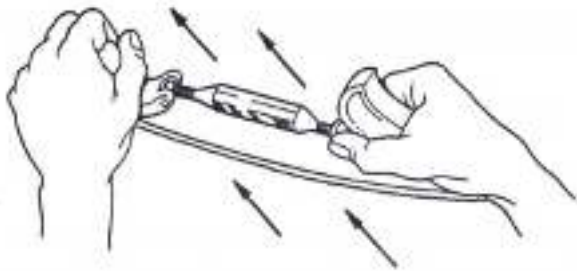


Figure 2. 3. 13: Removes High and Low Spots on Metal Surface

One hand is used to hold the file handle, while the other grasps the knob at the opposite end. The file should be applied with long, straight strokes, pushing it away from you along the length of the panel. Short, jabbing strokes should never be used, as these will only scratch the panel and will not indicate low spots. If the file digs in, too much pressure is being applied and hence a need for reduction is essential. At the end of the first stroke, raise the file and without dragging it over the metal, bring it back to the starting position and make a second stroke.

Repeat this procedure until the area has been covered, making the file marks parallel to one another. This is termed line filing and indicates the levelness of the panel in the direction in which it has been filed. At this point both the high and low areas will show up. The high spots can be corrected by spring hammering and the low spots by direct hammering, pick hammering, or in some cases by using the corner of the dolly block. Line filing indicates curvature in one direction only and as most panels are double curved the panel surface must be cross filed to give an accurate contour check. Cross filing means a change in the direction of the file strokes so that the file is moved at an angle between 45° and 90° over the previous file strokes, thus checking the accuracy of the curvature in that direction. After filing, and prior to refinishing

the panel, the damaged area is sanded using a fine-grit sanding disc which leaves a smooth, even surface ideally suited for painting.

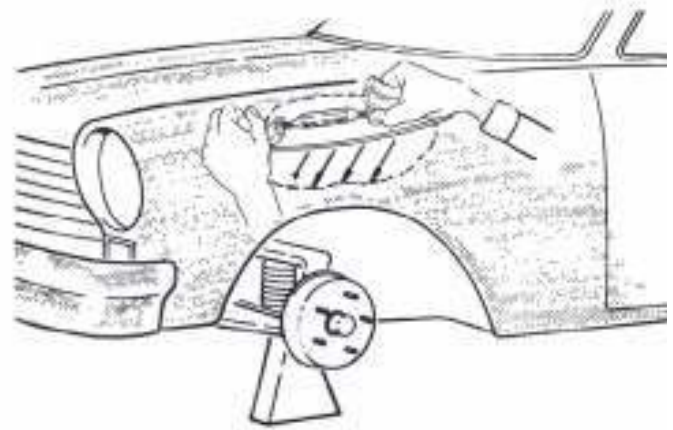
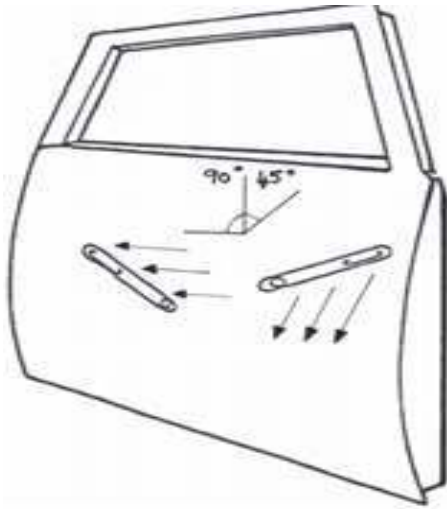


Figure 2.3. 2: Filing a Door Panel

Figure 2. 3:3 Cross Filing at 45°

### 3.1.2. Grinding Techniques

Several general rules govern the use of the disc grinder. If these are observed they will enable the operator to become proficient very quickly in the use of the grinder. The rules are considered good shop practice and are directed towards the safety of the operator. In the first instance, if the device is electrically operated see that it is properly connected and earthed. Shop floors are usually of cement, they are generally moist and therefore, relatively good conductors of electricity. If the grinder is not properly earthed it is possible to receive a fatal electric shock when the machine is in use.

#### Summary

Metal finishing is a skilled job and perfection can only be achieved by plenty of practice. The correct selection and use of tools for the job in hand is vital to produce the perfect finish. Metal finishing is a hand craft that still retains its place in body work and as yet is irreplaceable by more modern methods, in spite of mechanical methods of repairing panels.





### 2.3.4.. Metal Finishing

Filing is a means of metal finishing a damaged panel prior to sanding operations for paint spraying. Essentially, panel beating is a hand method of producing hollow or double-curvature shapes by means of hammering and metal finishing nevertheless the panel beater's craft still retains its place in body work and as yet is irreplaceable by more modern methods, in spite of the tremendous developments in recent years of mechanical methods of forming, panel beating remains as essential means of fabrication of special parts

#### ➤ Metal Finishing Safety

When filing metal panels care should be taken with the edges of the panels as they become very sharp from the filing. Always use gloves and goggles to protect your eyes from flying sparks and paint debris. Fireproof overalls, safety boots and ear muffs are also essential.



Figure 2.3.5 Grinding/Filing a Door Panel

#### ➤ Body Filing

- (1) A body file is used for many things: to remove paint, smooth metal, find low spots, remove excess solder, quickly remove aluminum, and to form the correct contour of areas that have been built up with solder. The gauge of metal on sedan bodies is as light as practical, and every precaution must be taken not to file or grind away any

metal unnecessarily. When removing high spots by grinding or filing, care must be taken not to cut through or weaken the part.

- (2) Using the file is a two hand job. One hand is used to hold the file handle; the other is used to grasp the file around the saddle at the opposite end of the handle.

➤ Body File

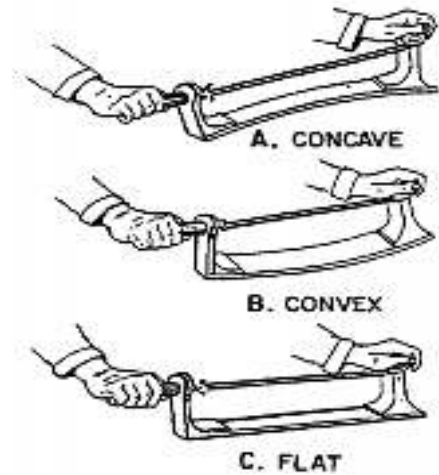
(a) The file blade is fastened to the holder with the cutting edges of the teeth facing away from the handle. Adjust the contour of the file holder so that it almost, but not quite, matches the contour of the surface.

(b) Place the file on the work. With a straight stroke, push the file away from you, holding it at an angle of 30 degrees in relation to its line of travel. If the file digs in, you are putting too much pressure on it. At the end of the first stroke, raise the file and bring it back to

where you started and make a second stroke. Remember to raise the file at the end of each stroke. It should not be pulled back over the metal because dragging will tend to dull the file blade.

(c) By filing in the above manner, the file marks are parallel and have removed all of the paint, and probably some of the metal, from the work in the filed area. This type of filing is referred to as line filing. The term "line filing" means all the strokes, and consequently, all of the file marks, are in the same direction.

- (3) Now change the direction of your file strokes so they are about a 45 degree angle from the previous direction. This is referred to as X-filing. When the file is moved so that you are X-filing, you may find that the contour of the area differs slightly. If this is true, adjust the file holder again to nearly, but not quite, match the contour. When using body files on epoxy fillers, ensure that the fillers are thoroughly cured or the file will clog and gouge the surface.



➤ Foaming Agent Filling Operation Procedure

1. Fill procedures after installation of service part.

a. Eliminate foam material remaining on vehicle side.

b. Clean area after eliminating form insulator and foam material.

c. Install service part.

d. Insert nozzle into hole near fill area and fill foam material or fill enough to close gap with the service part.

2. Fill procedures before installation of service part.

a. Eliminate foam material remaining on vehicle side.

b. Clean area after eliminating foam insulator and foam material.

c. Fill foam material on wheelhouse outer side.

NOTE: Fill enough to close gap with service part while avoiding flange area.

d. Install service part.

NOTE: Refer to label for information on working times

### 2.3. Types of Filler and Putty

| Type (Standard thickness limits)   |                                     | Characteristics   |
|--|-------------------------------------|---|
| Body Filler Putty<br>(For repairing of large dents or scratches)<br>[10 mm (0.39 in)]      | Surform type                        | <ul style="list-style-type: none"> <li>This type of filler requires reforming, (rough grinding). It will clog sandpaper if it is sanded only.</li> <li>Can be thickly applied to panel.</li> <li>After drying, grind ability is poor as it is harder than other types.</li> </ul> |
|  | Light Type                          | <ul style="list-style-type: none"> <li>This type of filler contains tiny hollow beads. It feels gritty when applied with a spatula.</li> <li>Suitable for thick application to panel</li> <li>Superior grindability after application</li> <li>Forms blowholes easily</li> </ul>  |
|  | Glass Fiber or Aluminum Powder Type | <ul style="list-style-type: none"> <li>Excellent thick application to panel</li> <li>Superior corrosion prevention and durability</li> <li>Suitable for repairing rusty holes in panel</li> </ul>   |
| Intermediate Filler Putty [10 mm (0.39 in)]<br>(For repairing of large dents or scratches) |                                     | <ul style="list-style-type: none"> <li>Good sanding characteristics.</li> <li>It is difficult for fine grain pores to form in it, so poly putty can be eliminated and surfacer can be applied directly over intermediate filler.</li> </ul>                                       |
| Polyester Putty<br>(For filling pores and sand scratches in body filler)                   | Spatula Type<br>[3 mm (0.12 in)]    | <ul style="list-style-type: none"> <li>Not very much thickness can be built up.</li> <li>It has fine grain and good flexibility.</li> <li>Since no volatile content remains, there is no depletion after baking.</li> <li>Sanding characteristics are good.</li> </ul>            |
|  | Spray Type<br>[1 mm (0.04 in)]      | <ul style="list-style-type: none"> <li>Not very much thickness can be built-up.</li> <li>Since a spray gun is used, it can be applied easily to any location.</li> </ul>  |

|   |  |   |
|---|--|---|
|   |  | <ul style="list-style-type: none"> <li>• Drying time is approximately two times as long as putty applied with a spatula.</li> </ul>   |
| Lacquer Putty [0.1 mm (0.004 in)]<br>(Detail putty) |  | <ul style="list-style-type: none"> <li>• It is soft and flexible.</li> <li>• It cannot be used to build up low areas.</li> <li>• Standing characteristics are extremely good.</li> <li>• The thicker the built-up, the longer the drying time.</li> </ul> |
|   |  | <ul style="list-style-type: none"> <li>•</li> </ul>   |

NOTE: Putty film thickness limits should be decided with putty manufacturer because limits vary from maker to maker.

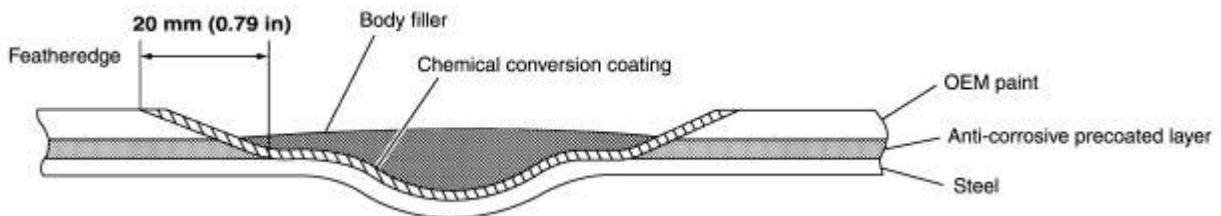
### Procedure for Applying Body Filler

#### (1) Removal of Paint

Using an air sander, remove old paint from the panel surface for better filler adhesion. Form a featheredge on the panel surface approximately 20 mm (0.79 in) wider than the correction area in order to eliminate traces of body filler application.

#### (2) Chemical Conversion Coating

Body skin panels of NISSAN vehicles use anti-corrosive steel. These panels should be coated with chemical conversion coating before applying common body filler.



If body filler has been developed for anti-corrosive steel, chemical conversion coating will not be needed. (Please confirm this with the body filler supplier.)

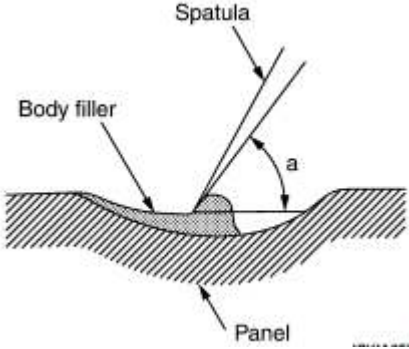
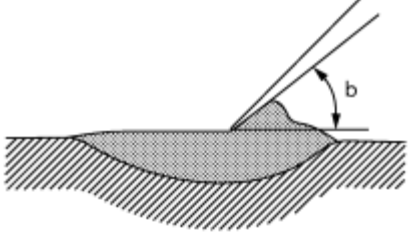
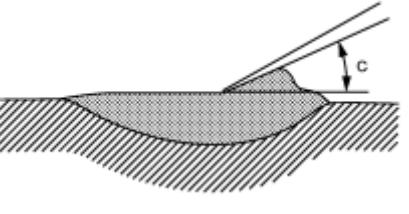
#### (3) Spatula Movement

Move the spatula lengthwise when applying to an oval shaped area. If applying to a round area, move the spatula in many directions as shown in the fig



(4) Applying Technique

Apply body filler in several thin layers.

|   |   |
|---|---|
| <p>(a) Hold spatula well balanced and hold slightly standing position, then squeeze putty into scratches.<br/>a : 60° - 90°</p>   |   |
| <p>(b) Put a large amount of filler on the spatula. Hold spatula slightly lean, then apply several times (do not put much in once) until covered above datum level.<br/>b : 30° - 45°</p>               |   |
| <p>(c) Use the spatula to smooth the applied filler. Perform finishing work for smoothening the surface. The filler surface should be slightly higher than the panel surface.<br/>c : Less than 30°</p> |  |

**Self-Check -2.3**

Written Test

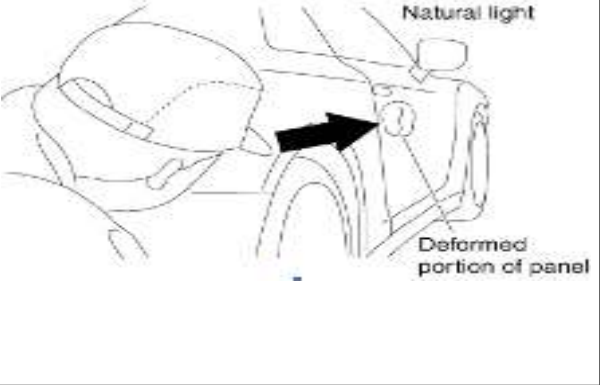
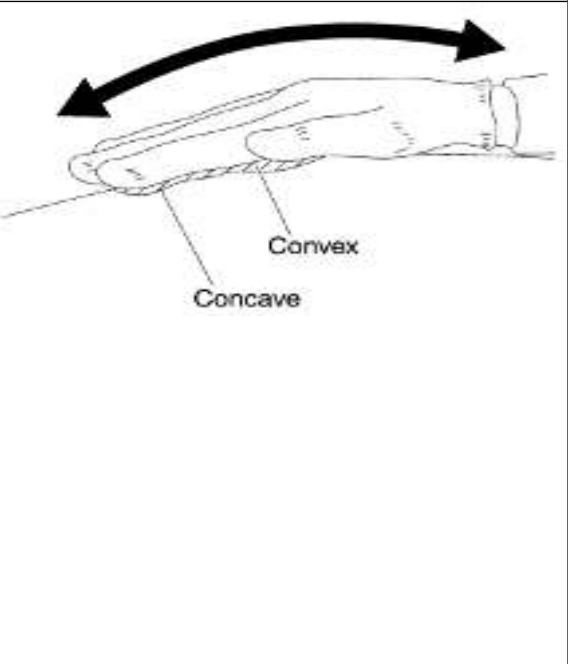
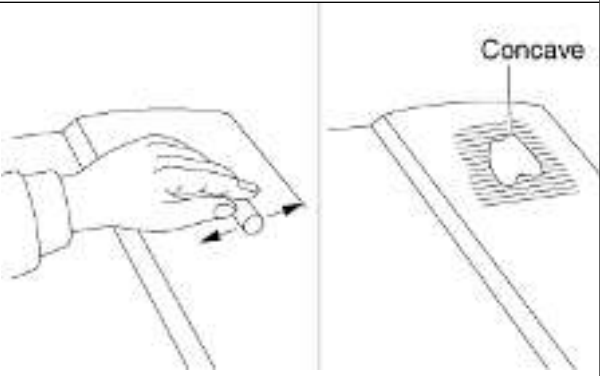
Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

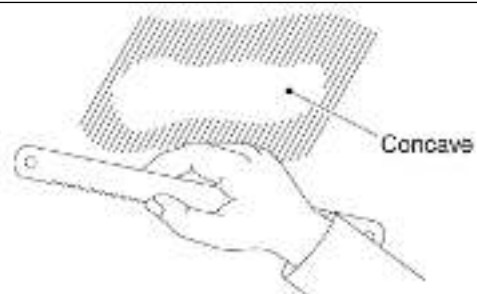
1. What is filling and metal finishing? (2 point)
2. What solid blow and elastic blow? (2 point)
3. Why we perform body filling? (3 point)
4. Describe types of body filler (Putty). (4 point)
5. Write the procedure of body filler. (4 point)

**Operation Sheet-2.1**

**Examination of Panel Damage**

It is difficult to find minor deformation or panel irregularity, particularly, at the final stage of repair. This section explains how to determine if a vehicle has minor panel deformation.

|                 |   |  |
|-----------------|---|--|
| <p>Method-1</p> | <p>(1) Visual Check<br/>Check the affected portion of the panel by carefully examining the deformation in the light reflected on the surface.</p>   |    |
| <p>Method-2</p> | <p>(2) Touch Check<br/>Lightly place a hand on the surface of the panel and move it forward/backward and right/left to judge by touch with the palm of a hand. Slide and move a hand from an undamaged surface to a damaged part, all the way to the undamaged surface on the other side.</p> |   |
| <p>Method-3</p> | <p>(3) Check with Tools</p> <ul style="list-style-type: none"> <li>• Use of chalk: Rub the panel surface with a piece of chalk held lengthwise. Dents or concave areas in the panel will remain uncolored.</li> </ul>   |  |


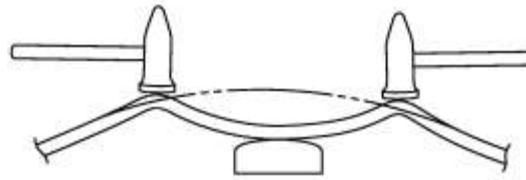
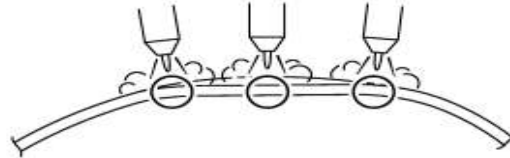
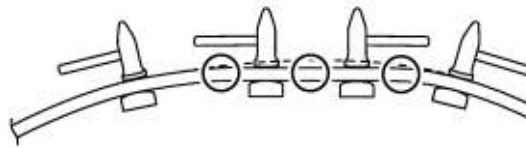
|  |  |  |
|--|--|--|
|  | <ul style="list-style-type: none"> <li>• Use of hacksaw blade:<br/>Scrape the panel surface with the blade teeth. Dents or concave areas will not be scratched.</li> <li>• Use of body file: Scrape a body file lightly on the panel. Dents or concave areas will not be scratched. The body file should not be used for grinding. Thickness and strength of the panel will be reduced.</li> </ul> |  |
|--|--|--|



|                             |                                 |
|-----------------------------|---------------------------------|
| <b>Operation Sheet-2.2.</b> | <b>Shaping a Deformed Panel</b> |
|-----------------------------|---------------------------------|

Basic Panel Repair Procedure

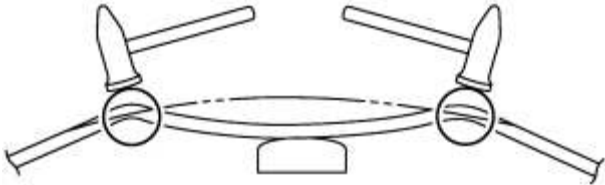
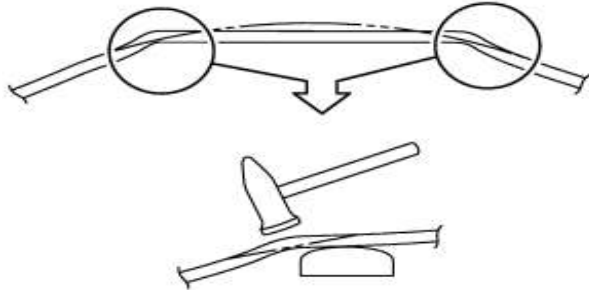
(1) When plastic deformation occurs at the center of the damaged portion

|        |   |   |
|--------|---|---|
| Step-1 | (a) Using a hammer or dolly, strike the lowest portion of the dent from behind until it becomes flat.   |    |
| Step-2 | (b) Using the hammer-off-dolly method as shown in the figure, raise the concave portion and lower the convex portion. Then smooth the surface a little lower than the original. Using a wooden hammer and dolly, correct the irregularities in the panel.                                   |     |
| Step-3 | (c) Existence of plastic deformation can be determined by the stretched panel. The original surface can be restored by shrinking that portion with a gas welding torch.   |  |
| Step-4 | (d) Use a hammer and dolly by the hammer-on-dolly method. Stretch the panel while striking the outer area of the damaged portion. The entire panel surface should be formed somewhat higher than the original surface. Note that, in this case, the stretched portion of the panel must not |   |

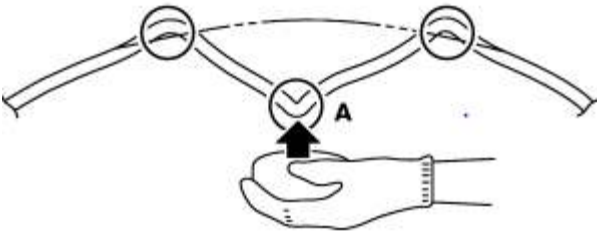
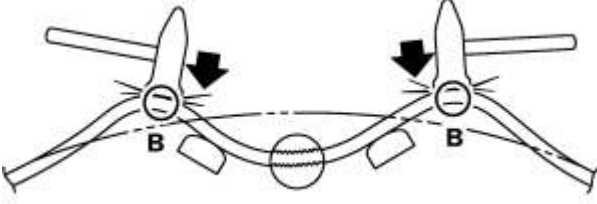
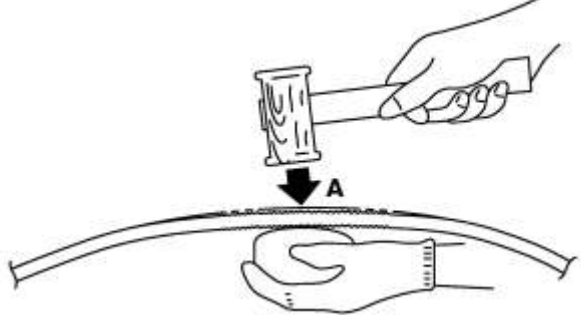
|  |                         |  |
|--|-------------------------|--|
|  | be hit with the hammer. |  |
|--|-------------------------|--|

If the concave portion is shallow and if the working face of the wooden hammer matches it, the repair work can be completed quickly by directly shrinking the portion with a gas welding torch.

(2) When plastic deformation exists around the damaged portion

|  |   |
|--|---|
| <p>(a) Apply the dolly to the elastic deformation area behind the panel.<br/>Hit the plastic deformation area with a hammer so that the elastic deformation area is lower than the original surface.</p> |   |
| <p>(b) Repair the plastic deformed portion using the hammer-off-dolly method. If a shrinking hammer is available, the stretched portion can be easily shrunk.</p>  |  |

(3) When plastic deformation exists at the center and around the damaged portion

|   |  |
|---|--|
| <p>(a) Using a hammer and dolly, flatten the lowest portion (A) where the plastic deformation exists, so that the flattened surface is not higher than the original surface.</p>                                |  |
| <p>(b) Flatten the highest points (B) where plastic deformation exists.</p>   |  |
| <p>(c) Flatten portion (A) so that the panel surface is not higher than the original surface. Correct irregularities using a wooden hammer and dolly. If the panel has been stretched, repair by shrinking.</p> |  |



|             |                         |
|-------------|-------------------------|
| LAP Test -2 | Practical Demonstration |
|-------------|-------------------------|

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Time started: \_\_\_\_\_ Time finished: \_\_\_\_\_

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 3 hour. The tasks perform according to standard and workplace procedure.

Task 1: Examining body damage

Task 2: Shaping a Deformed Panel

Task 3: Correcting Panel Distortion

Task 4: Apply Body Filler (Putty)

## Unit Three: Complete Work Processes

This unit to provide you the necessary information regarding the following content coverage and topics:

- Presenting final inspection
- Cleaning work area
- Checking and storing tools and equipment
- Processing workplace documentation

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Present final inspection
- Cleaning work area
- Checking and storing tools and equipment
- Processing workplace documentation

### 3.1 Presenting final inspection

#### Final Inspection

Vehicles which have been in accidents should have a Post Repair inspection to insure that the repairs were done correctly. This evaluation is performed by a qualified third-party who is tasked with examining the repairs to ensure that the proper parts were used and the proper procedures were followed. During a post repair inspection the vehicle is assessed to ensure that no safety problems exist.

Post Repair Inspections are an important component in vehicle safety. They add a second layer of protection to vehicle repairs which can save time, money and human life.

As more and more insurance companies engage in Direct Repair Programs, auto body repair shops are evaluated on how quickly and inexpensively repairs can be made. Rushing through a repair or using aftermarket parts on repairs can jeopardize a vehicle's performance and the safety of drivers and passengers.

#### Inspect Your Car's Repaired Area

Let's say for illustration purposes that your car sustained some major front-end damage. That means not only were body panel replacements and painting required, but also repairs to the suspension, frame and engine components.

Inspect the following:

- The body panel seams for uneven gaps
- Open and close the doors, hood and trunk to notice the fit while listening for strange rubbing sounds. Make sure they open easily and close securely.

- If an air bag was deployed was it replaced?
- Check the distance between the tires and fenders and compare those from side to side
- Ensure that all hoses and wires are connected
- Turn on your headlights and inspect the beam alignment
- If the frame needed straightening request a copy of the frame spec printout and have the before and after numbers explained to you

Vehicle inspection and delivery is the last step in the long, careful process of getting your car back to like-new condition after it has been involved in a collision.

Inspect the vehicle thoroughly post-repair to make sure that it is properly put-together and everything works as it should. Often, we'll take your vehicle for a test drive just to make sure that everything is functioning properly, there are no squeaks or rattles, and all trim pieces and body panels are properly assembled and joined.

**Self-Check -3.1.**

Written Test

Directions: Answer all the questions listed below.

Use the Answer sheet provided in the next page:

1. What is Post Repair Inspection and why it is Necessary?(2 point)
2. What are you inspecting after body repaired? (4 point)
3. What condition consider when repair/replace a rear body panel? (4 point)

### 3.2. Cleaning Work Area

#### 1. Removing Body Shop Dust

The light dust is created from sanding away at the body filler during the repairs and even if the body shop does wash the car before returning it, the chances are there will still be dust deposits in a number of areas in and around the car. Body shop dust will accumulate in door shuts, on all interior surfaces if a door or window has been left open slightly during the repairs and even in and around the engine bay.

Door shuts can be pre sprayed with a diluted all-purpose cleaner or simply cleaned with a wash mitt and normal shampoo solution then lightly rinsed off, being careful not to wet the interior by aiming the flow of water away from the car. Soft bristled detailing brushes can be used to access tight, awkward areas and to help remove more stubborn accumulated dust.

To remove body shop dust that has settled in the interior all surfaces must first be thoroughly vacuumed. Carpets and upholstery should be lightly pre sprayed with either designated upholstery cleaning product or a diluted all-purpose cleaner and then vacuumed off. It is important to do this as the body shop dust can smell quite strongly and pre spraying before vacuuming will help to eliminate the smell.

#### 2, Shop Floor Maintenance

Proper procedures for keeping your store clean.

We all know that a clean facility is better than a dirty one. Clean facilities generate more repeat traffic as well as providing a safer working environment.

Taking the few seconds to do this will save hours a month while limiting the possibility of these soils being tracked through your shop or onto your customer's vehicle. Having a clean facility and presenting a customer with a staff well trained in shop maintenance will drive customers back to your facility. If you are following "Clean as You Go" at your facility, floor mopping should only need to be done once or twice a day, usually at the end of each shift.

Equipment needed: (All equipment should be clean to start every day)



- Broom.
- Dustpan.
- Putty Knife.
- Shop rags.
- Mops. Using a linen service to rent your shop towels & mops.
- Wet Floor Signs.
- A spill kit, such as the Oil Eater Spill Kit.

**Self-Check -3.2.**

Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What equipment needed for shop floor cleaning?
2. What is oil eater?
3. What Cintas recommends maintaining a clean auto shop?
4. Explain the ratio of water and oil eater for painting floor.

### 3.3. Checking and storing tools and equipment

#### 3.1. Keeping of Equipment and Tools

- a) Equip the workshop with all necessary equipment and facilities required for the workshop's services and always keep them in safe working condition.
- b) Equipment and tools should be stored in clearly designated places.
- c) Properly plan the placement of hand tools. To avoid hazard, all sharp edges and tips should face down or put into protective sleeves.
- d) Lifting appliances, pneumatic tools and devices should be properly stored, maintained and inspected regularly by those competent.
- e) All equipment for analysis and testing instruments should be maintained and calibrated in accordance with the manufacturer's instructions

#### 3.2. Store the tools

##### List of Recommended Equipment and Facilities# for Vehicle Maintenance Workshops

The equipment and facilities listed below are for general guidance and are not meant to be exhaustive. The workshop-in-charge shall provide all necessary equipment and facilities in accordance with relevant legislations and guidelines. The tool lists are organized into three basic categories:

- i. Hand Tools,
- ii. General Lab/Shop Equipment
- iii. Specialty Tools and Equipment.

The specialty tools and equipment section is further separated into the four Collision Repair & Refinish Accreditation task categories (see table-1). When referring to the tools and equipment list, please note the following:

- A. The organization of the tool list is not intended to dictate how a program organizes its tool crib or student tool sets (i.e., which tools should be in a student set, if utilized, and which should be in the tool crib or shop area).
- B. Quantities for each tool or piece of equipment are determined by the program needs; however, sufficient quantities to provide quality instruction should be on hand.
- C. For *Specialty Tools and Equipment by Area*, the program need only have those tools for the areas being accredited.
- D. Programs may meet the equipment requirements by borrowing special equipment or providing for off-site instruction (e.g., in a dealership or independent repair shop). Use of borrowed or off-site equipment *must* be appropriately documented.
- E. No specific brand names for tools and equipment are specified or required.

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F. Although the Program Standards recommend that programs encourage students to begin to build their own tool sets, this is not a requirement. However, many employers require an entry-level technician to provide his/her own basic hand tool set.

Table3. 1: Four Collision Repair & Refinish Accreditation task categories

| Body Repair  | Body Painting   | Body Building Work  | Vehicle Accessories Work   |
|--|---|---|--|
| <ul style="list-style-type: none"> <li>• Vehicle Frame Alignment Bench</li> <li>• Transmission Jack</li> <li>• Oxy-acetylene</li> <li>• Welding Machine</li> <li>• Tungsten Inert Gas</li> <li>• Welding Machine</li> <li>• Metal Inert Gas</li> <li>• Welding Machine</li> <li>• Hydraulic Crane</li> <li>• Hydraulic Jacks</li> <li>• Ventilation and</li> <li>• Exhaust System</li> </ul> | <ul style="list-style-type: none"> <li>• Paint Mixing Machine</li> <li>• Spray Guns</li> <li>• Spray Booth or (with air filtering and heating facilities)</li> <li>• Spray Gun Cleaner</li> <li>• Hydraulic Jacks</li> <li>• Ventilation</li> <li>• Exhaust System</li> </ul> | <ul style="list-style-type: none"> <li>• Full Set of Hand Tools</li> <li>• Protective Clothing and Gloves</li> <li>• Sheet Metal Bending/Roll Forming/Cutting Machines*</li> <li>• Jack Stands</li> </ul> | <ul style="list-style-type: none"> <li>• Full Set of Hand Tools</li> <li>• Necessary Tools for Work (depending on the case)</li> </ul> |

**Self-Check -3.3**

Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Describe three tool list categories. (3 point)
2. How to perform Keeping Equipment and Tools? (3 point)

### 3.4. Processing workplace documentation

In order to understand what Process Documentation is, we also need to understand what is Process? A Process is a series of steps and interrelated work activities, characterized by specific inputs and tasks which add value, and make up a procedure for a set of specific outputs. Thus the word 'Process' refers to the steps and work activities a transaction follows through an organization's systems, applications, and people.

The word Documentation – refers to a narrative, or some description of the way the process works. Process Documentation is a systematic way of capturing what happens in a process of change and how it happens, to reflect and analyze why it happens and to organize and disseminate the findings. It helps to reflect, analyze and discover patterns that help or hinder change.

- It analyses significant concerns, questions and issues articulated and addressed at different stages of the study
- It serves as a tool for decision making
- It helps identify problems and bottle necks, identify deviations to tackle corrective action and industry learning.

➤ Discussion Notes Major steps in Process Documentation

Step 1: Documentation prior to the start of any task: involves documenting the objective of the activity and approach; steps to be taken; why; who will be involved

Step 2: Documenting immediately following the Process task: what was actually done; modifications made on the approach and why; successes; what worked well;

Step 3: Synthesis of findings and insights. Feedback may be obtained from stakeholders involved in the activities to find out factors which determined success; factors leading to failure;

Step 4: Communication of findings and insights to stakeholders for obtaining feedback.

➤ Manage Process Documentation

A problem with process documentation is that processes tend to change while the documentation remains. One way to maintain a high level of documentation is to evaluate it frequently.. The model consists of ten characteristics of quality and five characteristics of value. The characteristics of quality are:

- Ownership: Rates which degree the three key ownership roles are identified, understood and supported. The three roles are process owner, documentation custodian and technical writer. One person can have all roles, the issue is that every role must be identified.

- **Readability:** This characteristic rates how well the text in the document is written. How well matches the material the audience?
- **Accuracy:** Rates the technical accuracy of the material.
- **Thoroughness:** Is all relevant material included in the documentation?
- **Format:** Rates the overall organization of the material. How well it keeps a consistent level of technical depth, how easy it is to follow.
- **Accessibility:** Rates the ease of accessibility.
- **Currency:** Rates to what degree the documentation is up-to-date and the frequency with which it is kept current.
- **Ease of update:** Rates the ease of updating the documentation, including revision dates and distribution of new version.
- **Effectiveness:** Rates the usability of the documentation including examples, graphics, color-coding, use on multiple platforms, compliance with existing standards, etc.
- **Accountability:** Rates how well the documentation is being used by all appropriate users.

### 4.3 Documentary Records

- Properly keep and update all technical reference materials and maintenance Waste rubber tires are classified as special waste.
- Promptly record and update all customer complaints and their handling methods.
- A record of all feedback from staff to the management through the established mechanism and how they have been handled should be kept and updated as soon as possible.
- Record in detail information about the services provided and the parts replaced. Keep the records for at least three years or based on industry requirement.

Here are some other best practices of document maintenance. Documents should possess the following qualities:

- Be public and visible
- Be centrally stored
- Be easy to edit and searchable
- Include adequate feedback
- Use flowcharts
- Use templates when possible
- Use simple formatting
- Each represents different processes
- Include the date of an update
- Be locally backed up
- Include software documentation
- Have a search feature
- Have an assigned numbering system

**Self-Check -3.4**

Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Describe the process and documentation. (4 point)
2. What are Major steps in Process Documentation? (3 point)
3. What quality fulfill a document?(at least write five) (5 point)



## Operation Sheet – 3.1

### Method of final inspection

Step by Step Guide to Post Repair Inspections:

- 1) Vehicle is evaluated to determine whether a post repair inspection is needed.
- 2) Obtain a copy of insurance estimate and/or collision shop estimate to compare estimate with actual work performed.
- 3) Visually check all the repair gaps to see if the car lines up.
- 4) Check all paint surfaces using a paint thickness meter to ensure an even finish and to mark any problem areas for correction later.
- 5) Pull back any rugs and unclip panels to inspect for hidden incorrect repairs. Elements such as covered over unrepaired structural panels, open welds which were not properly protected against corrosion, bare metal, missing spot welds, misaligned structural panels and damaged parts that should have been changed are often hidden by rugs and panels. These repair shortcuts can cause vehicle breakdown and jeopardize driver safety.
- 6) If the initial inspection uncovers cause for concern, we recommend that the customer allow us to do a full post repair inspection.
- 7) Not every car will require a full post repair inspection, but when one is necessary, we contact the insurance company and provide them the necessary information in order to have them pay for the work that needs to be done in order for the vehicle to be properly repaired.
- 8) There is no cost to the customer for post repair inspection or repairs resulting from the inspection. The costs of those repairs are borne by the insurance company who has a contractual obligation with the insured to pay for vehicle repairs that are a result of a car accident.

|              |  |                               |                               |
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Name: \_\_\_\_\_ Date: \_\_\_\_\_

Time started: \_\_\_\_\_ Time finished: \_\_\_\_\_

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 1:30 hour.

Task 1: Perform Post Repair Inspections

Task 2: Cleaning workplace