	Federal TVET Agency and Regional TVET Provider

Vehicle Body Repairing and Painting

NTQF Level II

Learning Guide -#23

Unit of Competence: - Carry-out Panel Repairs to Pre-paint Condition

Module Title: - Carrying-out Panel Repairs to Pre-paint Condition

LG Code: EIS VRP2 M08 LO1-23

TTLM Code: EIS VRP2 TTLM 0919v1

LO 1: Prepare to Repair Body Panel

Instruction Sheet	Learning Guide - #23

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

- Interpreting task instruction and Identifying body panels
- Sourcing and Interpreting specification and workplace procedures
- Sourcing and Interpreting safety and **environmental** requirement
- Identifying and reporting potential hazard/risk
- Identifying and checking **Tools** and equipment

This guide 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 task instructions and identify vehicle body panel to be work.
- Source and interpret Manufacturer specifications and workplace procedures for repairing body panel.
- Source and interpret Safety and ***environmental requirements***
- Identify and report potential hazards and risks associated with task to supervisor.
- Identify and check ***tools and equipment*** serviceability required for repairing body.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 25.
3. Read the information written in the "**Information Sheets 1**". Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the "Self-check 1" **in page 16.**
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to "**Information Sheet 2**". However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning "**Information Sheets 1**".
7. Read the information written in the "**Information Sheets 2**". Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
8. Accomplish the "Self-check 2" **in page 21**.
9. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 2).

10. If you earned a satisfactory evaluation proceed to "**Information Sheet 3**". However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning "Information Sheets 2".
11. Read the information written in the "**Information Sheets 3**". Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
12. Accomplish the "Self-check 3" **in page 31.**
13. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 3).
14. If you earned a satisfactory evaluation proceed to "**Information Sheet 4**". However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning "**Information Sheets 3**".
15. Read the information written in the "**Information Sheets 4**". Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
16. Accomplish the "Self-check 4" in **page 35.**
17. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 4).
18. If you earned a satisfactory evaluation proceed to "**Information Sheet 5**". However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning "**Information Sheets 4**".
19. Read the information written in the "**Information Sheets 5**". Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
20. Accomplish the "Self-check 5" in **page 51.**
21. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 5).
22. If you earned a satisfactory evaluation proceed to "**Operation Sheet-1 up to 3**". However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning "**Information Sheets 5**".
23. Read and understand the information written in the "Information Sheets 5". Try to understand what are being discussed and make a practice with the help of the teacher. Ask you teacher for assistance if you have hard time understanding when doing a practical.
24. Accomplish the "LAP test" in **page 56.**
25. Submit your accomplished Self-check. This will form part of your training portfolio.

Information Sheet-1	Interpreting task instruction and Identifying body panels

1.1. Interpreting Task Instruction

More than nine out of 10 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 gun
- Rivets (3/16th size)
- AC welder
- Welding rods
- Tack hammer
- Electric Drill
- Drill bits (3/16th)
- Sander
- Hand block sander
- Various grit sandpapers for each sander (rang from 36 to 1600 grit)
- Tack cloth
- General use body filler with reactor
- Putty Knife
- Screw driver
- Chalk or sharpie
- Tape measure

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

Figure 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.
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. Make sure it's equipped with the cut off wheel.
3. Cut out selected area on car.
4. 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

Picture of 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

Figure 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

Figure 3: Attaching the Panel bottom part.

1. Now it's time to rivet the remaining edges of the new panels to the car. This method is done because some of the areas of the car cannot be welded on successfully. If yours is feel free to weld those areas and skip this step.
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.
8. After this is complete load your Rivet gun with a 3/16" rivet and begin to fill all the newly drilled holes with rivets.
9. The entire replacement panel should now be completely attached to the car.

Step 9: Body Filler

Figure 4: Body filler and hardener to mix together

1. Now with the panel intact completely it is now time to make it blend in with the original panels of the car.
2. Open your body filler and put a golf ball size amount onto your clean mixing surface.
3. With your wooden mixing stick ready, open up your reactor and squeeze an inch's worth of reactor onto the body filler.
4. Immediately after doing so start mixing the two together using the mixing stick. (Don't 'whip' together, but rather a folding motion of the material).
5. 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.
6. Apply with your Plastic applicator evenly over welds on the panel. Trying your best to blend the two panels together evenly, only go over the body filler once or twice after applying it onto the car. Repeat these steps until a good buildup of material is on the car

Step 10: Sanding

Figure 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.

1.2. Identifying Body Panels

Body and Frame Construction

A. Body Construction

I. ***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.

II. ***Body Construction:*** The main body components are shown in figure. 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. They are the narrow sloping constructions at either side of the windshield opening. The cowl is sometimes referred to as the fire wall. The instrument panel is usually considered part of the cowl panel.

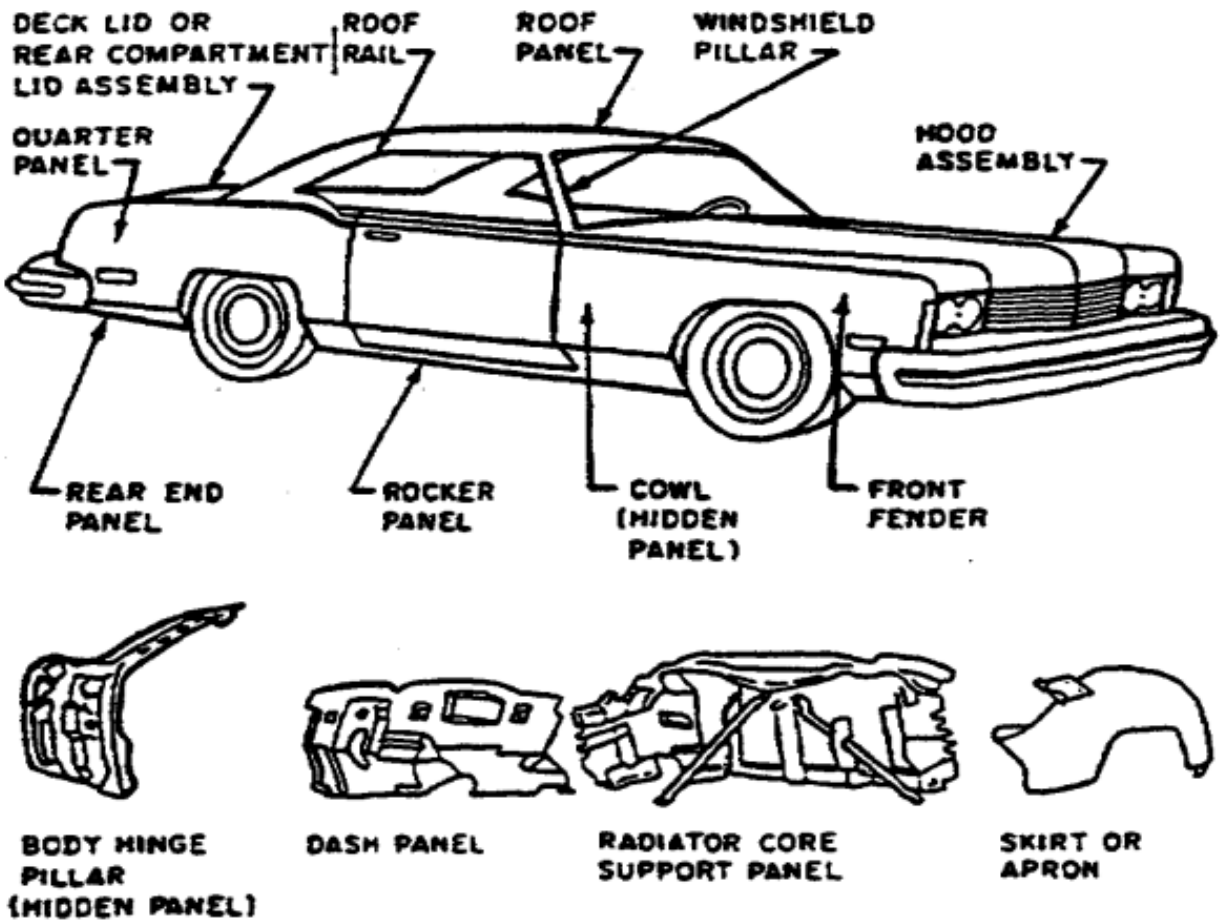


Figure 6: Major Sedan Body Components

III. **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. Some Army combat type wheeled vehicles have a canvas top.

IV. **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 7. Most floor pans are irregularly shaped. They are indented or formed into bends to give strength to the entire floor structure.

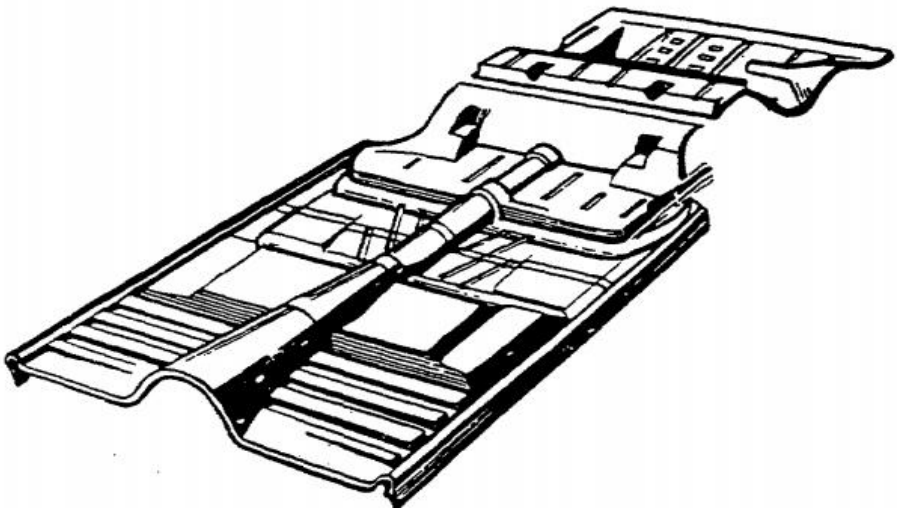


Figure 7: Floor Pan Assembly

V. ***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.

VI. **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.

VII. **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, I-beam, angle, Tstock, 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** welds 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.

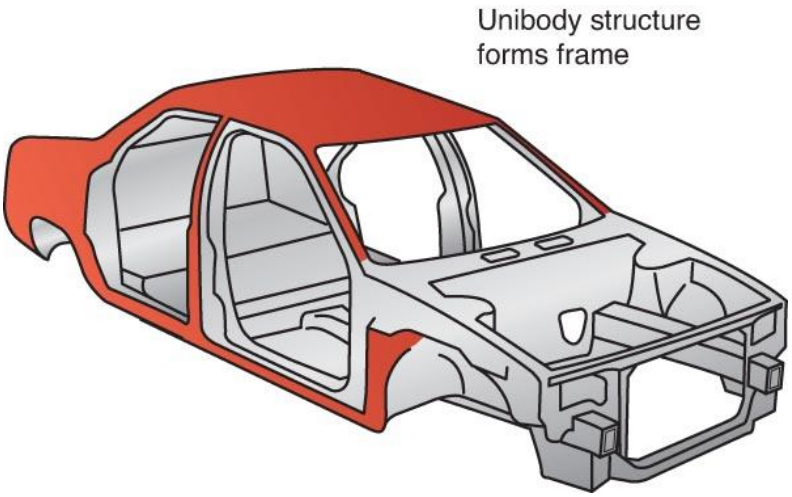


Figure 8: Uni-body Construction forms frame

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 9-4. Two very different methods used to construct modern vehicles: unibody and body-over-frame construction

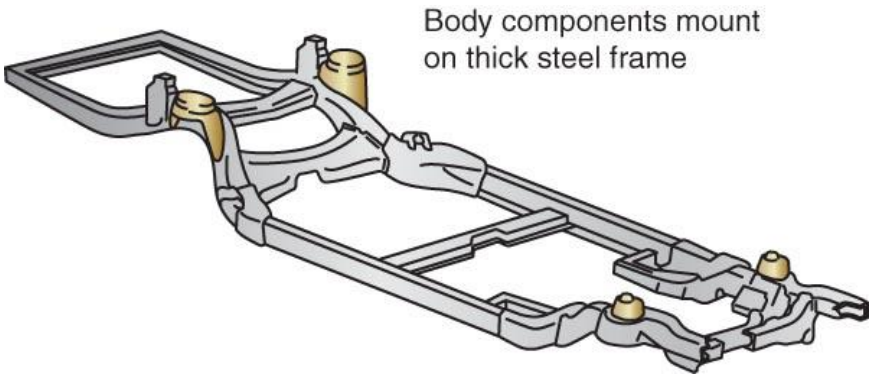


Figure 9: Body-over-frame construction

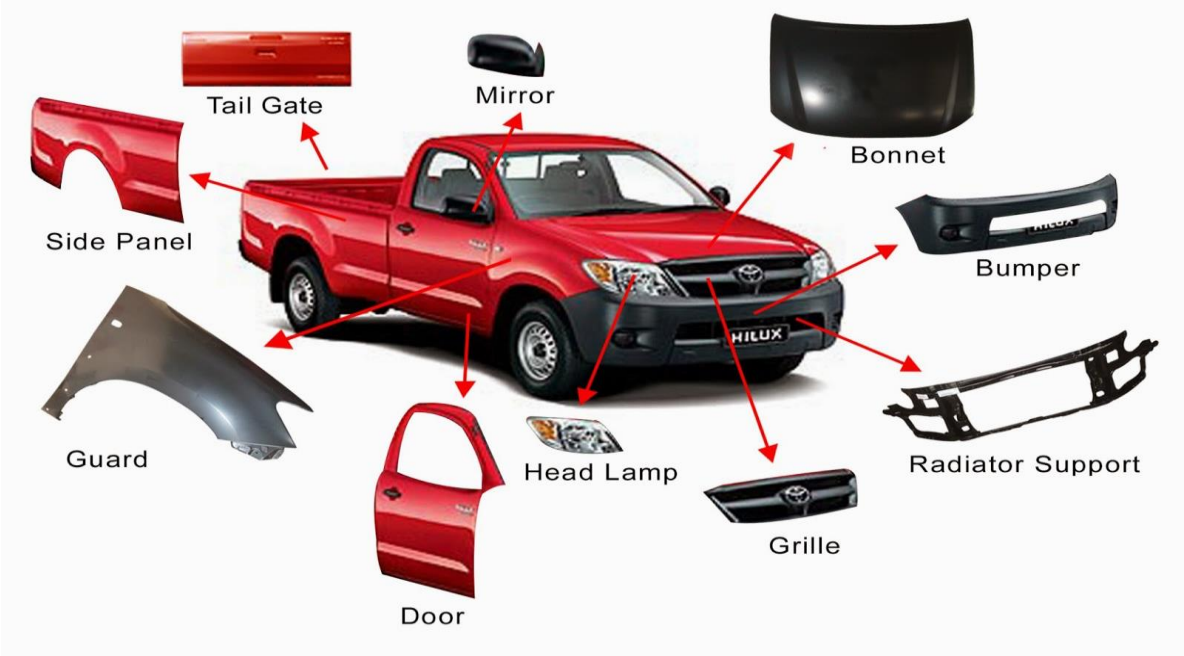


Figure 10: Truck Body Parts Diagram with part names

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 panel.

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.

1.3. Read and Interpret Job Sheets

A Job Sheet is a document that contains essential project information. It's a document that allows you to collect and organize information that you will need to fill out other documentation required to preserve your lien rights and get paid.

A job sheet is a tool used by workers to document key tasks performed onsite and obtain the required client sign-off upon completion. Job sheets are commonly used across engineering, manufacturing, and trade services businesses.

Job sheet templates vary by industry but generally follow this job sheet format:

- Customer information
- Description of fault and works carried out
- Additional works required
- Costing and materials used
- Worker and client sign-off

Powerful Mobile Job Sheet App

Digitizing your job sheet reports can streamline your productivity, save significant worker hours, and help uncover actionable business insights. iAuditor is the world's #1 cloud-based inspection platform and can be used to perform paperless job sheet reporting. Complete your job sheets while on-site, take photo evidence, capture digital client signatures and generate PDF reports instantly. Save and analyze all your business records securely online.

Sample Job Sheet for Auto Body Repair

AUTO BODY REPAIR ORDER

RIGGINS COLLISION REPAIR AND PAINTING
1550 South 20 West, Kanab, UT 84741
644-3288

DATE _____ 20 _____

NAME	ADDRESS	CITY

HOME PHONE	BUS PHONE	YEAR	MAKE	MODEL	BODY STYLE	I.D.

INS. CO.	ADJUSTER	PHONE NO.

CLAIM NO.	LICENSE NO.	MILEAGE	FAX

Deductible:

Rental Car:

Checks Issued:

	REPAIR	REPLACE	ESTIMATE OF REPAIR COSTS	PAINT	LABOR HRS.	PARTS	NET SUBLET
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
			TOTAL				

This estimate is based on our inspection and does not cover additional parts or labor which may be required after the work has been started. After the work has started worn or damaged parts which are not evident on first inspection may be discovered naturally this estimate cannot cover such contingencies. Parts prices subject to change without notice. This estimate is for immediate acceptance. Full payment for repairs is due upon release of the vehicle. A finance charge of 1 1/2 % per month (18% per annum) will be charged on all past due accounts. Riggins Collision Repair is not responsible for personal items left in vehicle.

ESTIMATE GOOD FOR 30 DAYS

The undersigned authorizes the above repairs for $ _____
Of this amount the above named insured is to pay $ _____
Insurance Deductible.
By _____

PAINT	**HRS @**	
LABOR	**HRS @**	
PARTS (Subject to Invoice)		
PAINT / MATERIALS		
SUBLET ITEMS		
TOWING / STORAGE		
SUB TOTAL		
SALES TAX		
	TOTAL	

1.4. Calculate area of damage

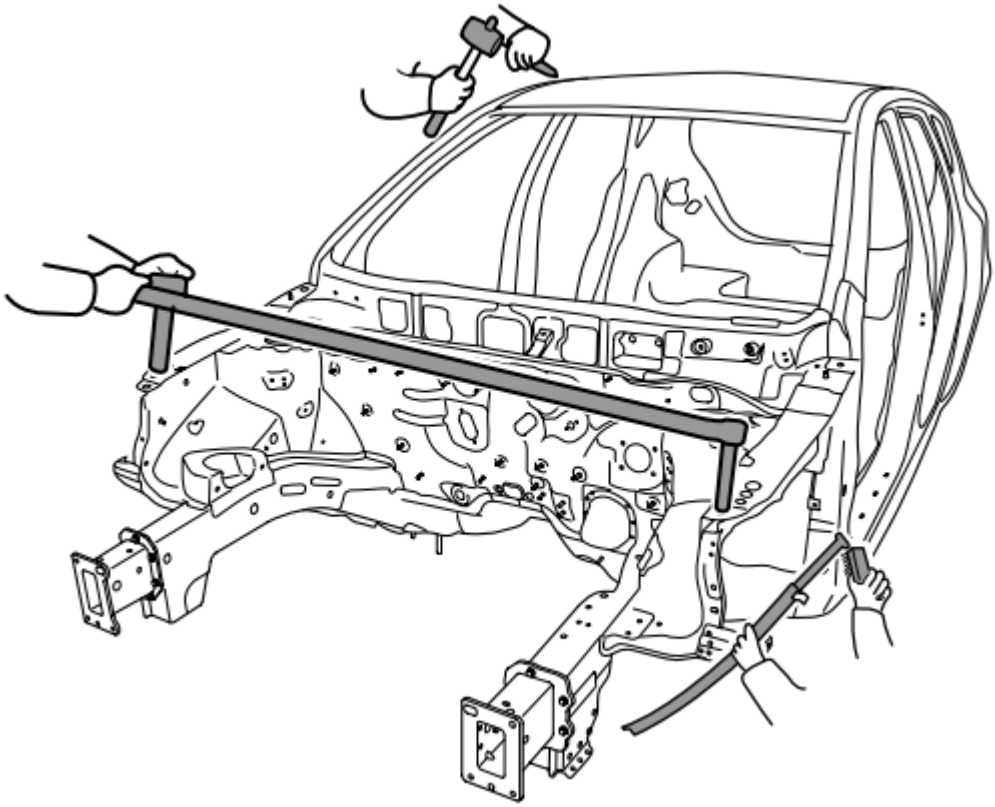
Determining Dent Size:

When using the sizing coin/magnet, the edges of the dent must be inclusive of the size of the measured circles to be considered that specific size. If the edges of the dent damage exceed the size of the circle on the magnet, then the dent is counted as being the next size up and will not be estimated at the size down or smaller than the actual damage. The affected area is to be determined by the PDR Technician and may include surface area greater than that of the measured indentation.

- **Dents/Panels That Should Not Be Subject To Standard Pricing:** the following items can be added to an estimate and may incur additional repair costs. Additional items should not be limited to one per panel since each item independently adds to the time and difficulty of the repair. The vehicle and vehicle damage will be inspected to determine access and repair technique/ difficulty. Items that may result in a longer, and/or more difficult repair and may incur additional repair costs include but are not limited to:
- **Tall Vehicles**: vehicle panels that require a technician to use the assistance of a bench/ladder in order to gain access to perform the repair
- **Panels with Laminated Glass:** laminated glass is especially susceptible to damage. Special caution must be taken in order to properly perform a repair on panels containing laminated glass.
- **Extended Roof**: extra time and advanced techniques/tools can be required to properly repair an extended roof.
- **Double Panels/Heavily Braced Panels**: this should not be limited to roof rails, doors, and deck lids. This includes areas that are not typically involved in the discussion of double paneled areas. Front of hoods, tops of doors, door area underneath belt molding, quarter panels at front and deck lids are often heavily braced. A panel is considered a heavily braced / and or a double panel when there is little to no direct access to the damaged area.
- **Material of Body:** High Strength Steel (HSS) and Ultra High Strength Steel (UHSS) have a higher Tensile Strength (MPa), resulting in a more challenging and time consuming repair. Aluminum has less metal memory, resulting in a more challenging and time consuming repair. Extra thin metal results in a more challenging and time consuming repair.
- **Deep Dents**: Dent depth can be assessed visually by qualified technicians, or measured in mm using a depth gauge.

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 by 30~50 mm (1.2~2.0 in)
- Protecting body from damage



Self-Check -1	Written Test

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

1. Write work instruction steps. (4 point)

2. Explain detail the types of Vehicle Chassis Construction. (3 point)

3. What elements include on job sheet format? (3 point)

4. Describe Roof Panel Assembly and Floor Pan Assembly. (2 point)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

1. _____

_____

_____

_____

.2. _____

_____

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_____

_____

_____.

3. _____

_____

_____

_____

4. _____

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Information Sheet-2	Sourcing and Interpreting Specification and Workplace Procedures

2. Sourcing and Interpreting Specification and Workplace Procedures

2.1. 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, I'll side with the majority and say that a "procedure" is a list of detailed instructions for completing a given objective. However, that's not to say that they can't also be called "processes".

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 – they let you consistently carry out tasks, limit human error, and make it easy for newer team members to complete their work to the same accuracy (if not standard) as veterans.

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.

Warning: This indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury. The sign is usually in black text with an orange background.

Sample workshop safety sign

3. **Identify exits**

Find out where every door, window and gate is, and whether they are usually open or locked. Plan your escape route, should you need to exit in a hurry.

4. **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.

5. **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.

6. **Identify flammable hazards**

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

7. **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.

8. **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.

9. **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.

10. **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.

2.2. Source of specification and workplace procedures

Information Source

An Information Source is a source of information for somebody, i.e. anything that might inform a person about something on provide 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. It is important to understand these types and to know what type is appropriate for your coursework prior to searching for information.

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.
    - Abstracts – summarize the primary or secondary sources,
    - Databases – are online indexes that usually include abstracts for each primary or secondary resource, and may also include a digital copy of the resource

Self-Check -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

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

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

1. _____

_____

_____

_____

.2. _____

_____

_____

_____

_____

_____.

3. A. _____

B._____

C._____

D. _____

4. _____

_____

_____

Information Sheet-3	Sourcing and Interpreting Safety and Environmental Requirement

3. Sourcing and Interpreting Safety and Environmental Requirement

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.

4.1. 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 floors
- Auto body repair products

Pollutants can include:

- Heavy metals (copper, lead, nickel, especially zinc)
- Hydrocarbons (oil and grease)
- Toxic chemicals (solvents, chlorinated compounds)
- Paints

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.
- Place a pan under the car panel being sanded to catch drips. Pour the collected water back into the wet sanding bucket.
- Clean up drips with a rag, or let the drips dry, and then sweep or vacuum up the dust.

4.2. Select PPE

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

These will protect your hands from burns when welding and heating or handling hot components. You should also use them when removing steel from a storage rack and when handling sharp objects.

C. Leather jacket for welding and Leather trousers with belt

Always wear appropriate work clothing. Whether this is a one piece coverall/overall, or a separate shirt and pants, the clothes you work in should be comfortable enough to allow you. The material must be flame retardant and strong enough that it is not easily torn.

E. Arm protector pair

Provides good protection during welding, especially when the welder has to work close to the work piece, or where movement is limited.

F. 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.

G. Safety Shoe

Always wear safety shoes that comply with the relevant standards for your area. The soles must be acid and slip resistant, the uppers made from a puncture proof material such as leather and the toes protected by a steel cap. Industrial safety shoes must be worn at all times in the workshop

H. 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. The light from a welding arc is very bright and contains high levels of ultraviolet radiation.

I. Gas welding goggles

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 11: 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

4.3. 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. With the rapidly increasing volume of vehicles, there is a parallel need to increase waste management initiatives by governments across the world and also of modern facilities for reuse and recycling of waste materials like metal, solvents, batteries, plastics etc. when the vehicle reaches its end of life. Waste recycling can help eliminate and thus minimize wastes.

Several initiatives in many counties have been proposed and are used for management of solid waste all over the world. Experts initiated and proffered strategies to reduce the volume of waste generation Reduction, prevention, recovering, repackaging, composting, recycling, reused, landfill, incineration, etc. are some of the major ways currently used to manage wastes generally. Reuse or recycling has been used interchangeably while discussing about waste management. Waste recycling can help eliminate and thus minimize wastes.

One aspect of body shops waste management has to deal with is sanding debris, namely bondo dust & debris. Bondo is a staple in automotive body repair and has been for years, but with changing environmental regulations it can be hard to stay on top of what is expected when it comes to disposal.

When it comes to sanding excess bondo from a car, it's important that the dust is handled correctly. Along with the bondo dust, there are also metal particulates that can be hazardous to air quality, so the general rule of thumb is that it is: better to be safe than sorry. According to the Western Sustainability & Pollution Prevention Network, the following are best practices for collecting and disposing of all sanding waste:

- Sand inside only and in designated areas to avoid spreading waste around the shop and outdoors.
- Maintain written guidelines for sanding paint waste cleanup and disposal procedures.
- Use "dry clean-up" methods such as high-intensity particulate arrestor (HEPA) filtered vacuum systems for sanding/paint dust. Avoid excess sweeping of floors which will send small sanding dust particles into the air. Only mop once floors have been vacuumed and are free of liquid spills.

- Contain all sanding dust and collect as sanding tasks are completed, to prevent tracking to areas inside and outside the shop.
- When wet sanding is required, use a spray bottle on the panel being sanded to minimize wastewater as well as drips and spills. Wring out sanding rags/sponges and collect in a shallow tray or sanding wastewater settling container.
- Operate a closed wet-sanding system where water is reused instead of discharged.
- Settle out sanding wastewater or transfer to separate settling unit. The unit should be able to hold double or triple the daily volume, including mop water.
- Dispose of wet sanding waste/sludge offsite with other waste collections or as hazardous wastes. Only dispose of in the garbage if you have profiled the waste as non-hazardous.
- Label and appropriately locate settling buckets/units and inform employees to avoid disturbance during settling periods.
- Remove settled sludge before it exceeds ¼ of the container's height (use a valve or spigot located no lower than halfway down the side of the unit.

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
- Paint Soaked Masking Paper / Plastic
- Empty Body Filler tins
- Paint Stripping material waste
- Residue from wet sanding
- Paint Filters / Strainers
- Solvent, Paint, or dust polluted water
- Solid Paint / Solvent Sludge

Non Toxic / Non Hazardous waste may include

- Paper
- Cardboard
- Empty Paint and Hardener tins (cleaned and dry)
- Rags or Wipes (dry)
- Weld materials
- General waste

Whilst damaged or waste parts resulting from Collision Repair are generally not categorized toxic or non-toxic, they can be put into **recyclable categories.**

- Steel or metal
- Polymer / Plastics
- Aluminum / non ferrous
- Battery
- Radiators
- Glass

4.4. 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 and breathing rate indicate that noise (and vibration) causes stress.

Noise is measured in decibels (dB). An increase of 3 dB doubles the noise, so what might seem a small difference in noise level may be a large difference in exposure. If the noise is so loud that you have to raise your voice to speak to someone 2 meters away, it may be loud enough to damage your hearing.

Removing and repairing body panels using pneumatic tools can be noisy work: air saws and chisels can typically produce levels as high as 107 dB(A) and grinders and orbital sanders 97 dB(A). Noise levels from panel beating and other repair operations using hand tools are variable but generally high; noise from work with sheet metal is often around 93 dB(A). Welding and flame cutting can also be noisy, and paint spraying has been measured at 93 dB(A). If workers were exposed to these noise levels through the day they would be well in excess of the specified Action Levels in the Control of Noise.

Any employee's exposure is likely be at or above 80 dB(A) throughout the day. If it is, then an assessment needs to be carried out by a competent person. When exposure exceeds 85 dB(A), you will have to take increased action to eliminate and/or control exposure.

The 80 dB(A) and 85 dB(A) exposure action values are likely to be exceeded where bodywork is a regular daily activity and where pneumatic tools are used even for short periods. Using an air saw to remove panels for as little as six minutes can mean the user's total daily personal noise exposure will exceed 85 dB(A). Using an air sander for 45 minutes can give the user a daily personal noise exposure of more than 90 dB(A), as well as causing significant exposure to others nearby.

Roles and responsibilities

Department Heads and Service Chiefs as officers of the Person Conducting a Business or Undertaking are responsible for allocating sufficient resources to effectively manage noise related risks.

1. **Managers** and **supervisors** must take all practicable steps to protect the health and safety of workers. They have a responsibility to:
   1.1. Understand how noise affects their workers and the work being performed;
   1.2. Consult with workers to identify, assess and control noise related hazards and risks;
   1.3. Ensure appropriate risk management is conducted for activities so that noise exposure does not exceed the exposure standard;
   1.4. Provide all workers with appropriate information, education, training, instruction and supervision;
   1.5. Implement improvements to reduce noise related risks so far as is reasonably practicable;
   1.6. Provide audiometric testing to all workers who are required by Defence to use personal protective equipment (hearing protection); and
   1.7. Analyze event reports for which exposure to noise was the cause or a contributing factor.
2. All **workers** have a responsibility to:
   2.1. Take all reasonably practicable steps to safeguard their own health and safety, and the safety of others in the workplace;
   2.2. 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;
   2.3. Wear personal protective equipment provided, as directed;
   2.4. Advise supervisors of any perceived risk that could increase exposure to injury or illness;
   2.5. Monitor themselves and their fellow workers and take action when they observe elevated risks to themselves or others; and
   2.6. Report events that caused, or could have caused, hearing-related injury or illness.

Noise and hearing loss

a. Hazardous noise affects the inner ear and may cause temporary hearing loss. After a period of time away from noise, hearing may be restored. With further exposure to hazardous noise, the ear will gradually lose its ability to recover and hearing loss can become permanent.

b. Permanent hearing loss can also occur suddenly if a person is exposed to very loud impact or explosive sounds.
c. The degree of hearing loss that occurs depends on how loud the noise is, how long someone is exposed to the noise and individual susceptibility. The frequency or pitch can also have some effect on hearing loss as high-pitched sounds are more damaging than low-pitched ones.
d. Workers exposed to hazardous noise may also experience tinnitus (ringing in the ears or head) which could become permanent.

Excessive noise exposure

a) Noise levels are measured in decibels (dB) and levels normally vary during the work day. Noise exposure is the average noise level to which a person is exposed over a period of time. The legislated exposure standard is 85 dB(A) averaged over eight hours. This standard can be exceeded if the noise level is too high and/or if workers are exposed to noise for too long.
b) A worker who is exposed to 85 dB(A) for 8 hours receives the same noise energy as someone exposed to 88 dB(A) for 4 hours with the balance of the day in a very quiet environment. In both cases the exposure standard is not being exceeded. However, being exposed to 88 dB(A) for more than 4 hours would exceed the exposure standard. Similarly, for a worker using a machine that generates 121 dB(A) the exposure standard would be exceeded after only 7.2 seconds.
c) Impacts such as sledge-hammering or peak noises (gun shots) cause peak noise levels greater than 140 dB(C). Exposure above this peak can create almost instant damage to hearing.

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

Note: **Satisfactory rating - 18 points** **Unsatisfactory - below 18 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

1. _____

_____

.2. _____

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3. _____

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4. _____

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5. _____

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6. _____

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7. _____

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Information Sheet-4	Identifying and reporting potential hazard/risk

4.1. Identifying Potential Hazard/Risk

4.1.1. 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.

4.1.2. 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. **Psychosocial**: Conditions that can affect the thoughts, behavior and mental well-being of workers. Examples include stress from using equipment without proper training or instruction or from being coerced into using defective tools or materials; etc.
5. **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.

4.1.3. 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)

4.2. Reporting Potential Hazard/Risk

Reporting Procedure

Note: the Office of Risk Management can be consulted at any stage of this procedure.

1) Report hazards to your supervisor, unless there is an immediate threat to life, safety, property or the environment. For physical hazards that you detect,
   - You may report non-urgent hazards orally or in writing to your supervisor.
   - For written reports use the ***Hazard Report Form***. (see form on operation sheet)
   - For hazards requiring immediate attention provide immediate oral notice, followed by written report when needed.
   - In the event that the situation is resolved without your supervisor's involvement, be sure to inform him / her about the hazard and the action taken, especially if the area involved is under the supervisor's direct responsibility.
2) If you are not satisfied with the supervisor's follow-up, raise the matter again or ask your organization manager with following organizational hierarchy.
   - Document your concerns on the Hazard Report Form.
   - The team investigates and then recommends the best action to the supervisor.

Supervisor – means a person who has charge of a workplace or authority over a worker or another person. Depending on the workplace relationship, a supervisor may include, for example, the president, vice-presidents, directors, deans, managers or principle investigators.

Self-Check –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. _____ Conditions where living organisms can pose a threat to human health.
5. _____ a situation that results in a chance of harm to people, of damage to property or of other loss.
6. _____ is the process of identifying all hazards in the workplace.
7. _____ Conditions that can lead to contamination by harmful or potentially harmful substances.
8. _____Conditions that can affect the thoughts, behavior and mental well-being of workers.
9. Hazards may be identified in_____ , _____ and _____
10. _____are the main cause of occupational health and safety problems.

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

1. _____
2. _____

   _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____ . _____ and _____
10. _____

Information Sheet-5	Identifying and Checking Tools and Equipment

5.1. Identifying Tools and equipment

Body Panel Repair Tools

1. Hammers

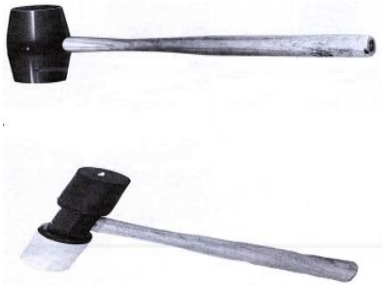
A number of different hammers are useful in the body shop. Many are specially shaped for a specific metal shaping operation.

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

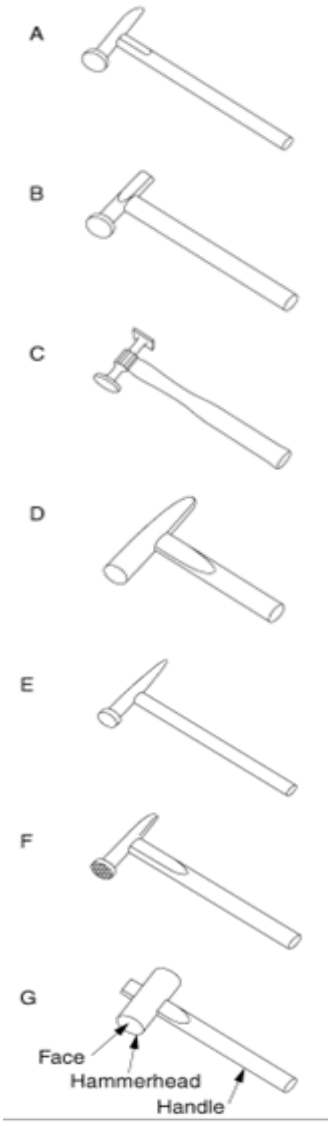
A light sledgehammer is an essential tool for the first stages of re-forming damaged sheet metal. It should weigh 3 to 5 pounds and have a short handle so that it can be used in tight places. The sledgehammer can be used to knock damaged metal roughly back in to shape and to clear away damaged metal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

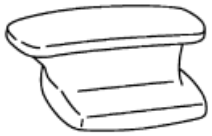
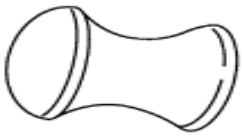
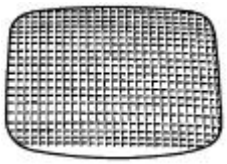
	A	Cross peen hammer	For shaping the panel together with dollies and spoons
	B	Straight peen hammer	For shaping the panel together with dollies and spoons
	C	Bumping hammer	For shaping the panel together with dollies and spoons
	D	Roughing hammer	For rough-shaping the panel in combination with straightening 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

1. 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.

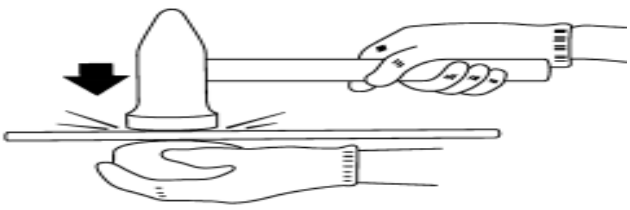
Generally speaking, four types of dollies (general purpose, utility, heel and toe dollies) are sufficient for ordinary panel work. However a special dolly can be designed for unique shaping.
The size and weight of the dolly must be easy to handle. The maintenance procedures and cautions described for 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.

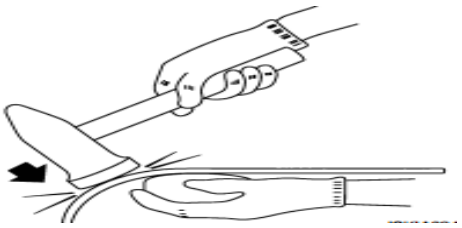
Dollies are used in combination with a hammer. They are a 1 kg - 2 kg (2 lb - 4 lb) steel blocks, heavier than a hammer, with various curves and planes.

Use of Dollies

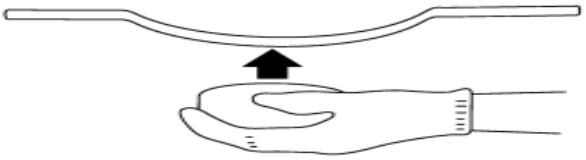
(a) Place the dolly on the underside of the deformed sheet metal. Strike the deformed section of the sheet metal with the hammer to stretch it.



(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.



2. 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

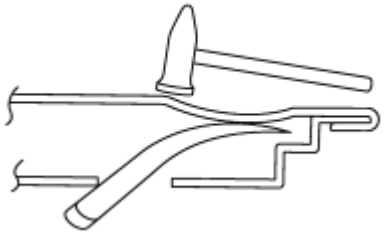
	General purpose spoon	This spoon has a gently curved surface and sharply curved ends. It is widely used in automobile body repair work.
	Long spoon	This spoon has a long handle and thin, rigid faces. It is used primarily for prying.
	Curved spoon	The handle of this spoon is comparatively short. It has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

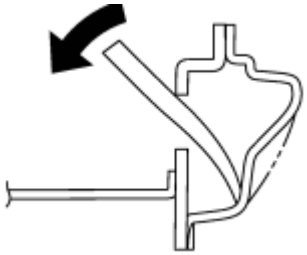
Select spoons suitable for the particular panel shape and internal structure. Spoons can be made from leaf springs. Cut the leaf spring to the desired shape. Heat it with a gas torch and shape it into a spoon by bending or stretching with a hammer. Then grind and polish. (See Hammer Maintenance Operation 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

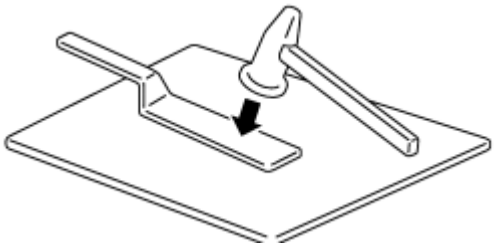
(a) Insert the spoon into tight spaces such as inside of door, and use as a dolly.



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

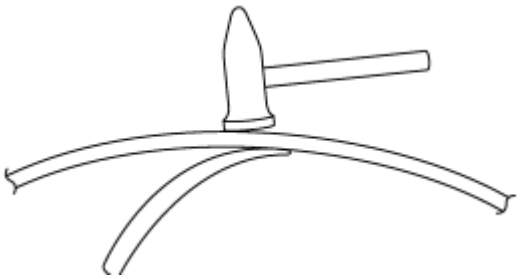


(c) Hammer directly on the spoon to disperse the force of the hammer blows



(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.



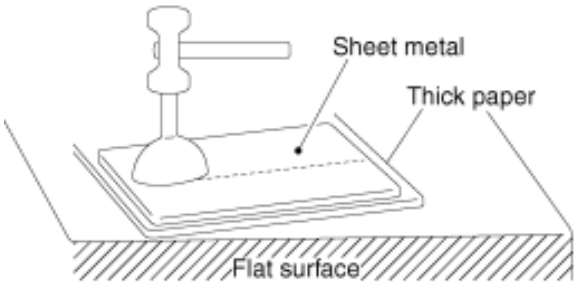
3. Scribing Chisels

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.

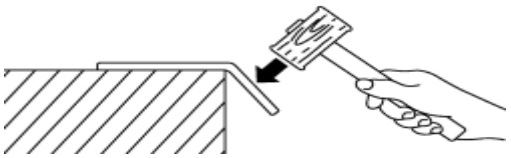
How to Use Scribing Chisels

(a) For bending sheet metal

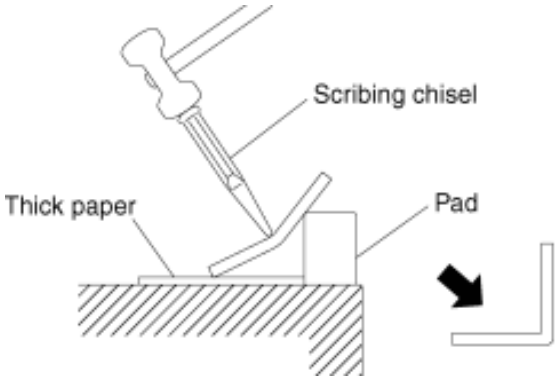
- First scribe a line on the sheet metal. Place thick paper or cardboard under the sheet metal.
- Place the scribing chisel on the line and hammer it.



- Place the sheet metal on a flat, angled surface scribed-side down, and bend the sheet metal with a wooden hammer.

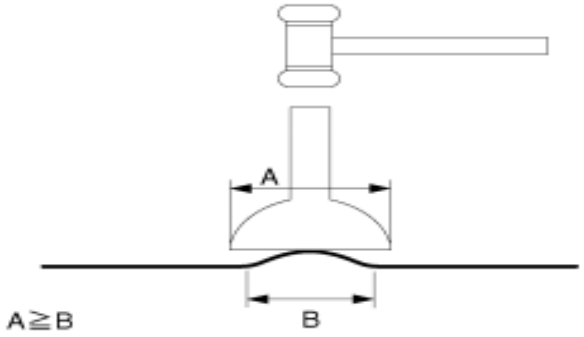


- Using a hammer and the scribing chisel, neatly bend the sheet metal squarely. Do not bend all at once.
- Bend the sheet metal gradually by gently hammering against the chisel head.

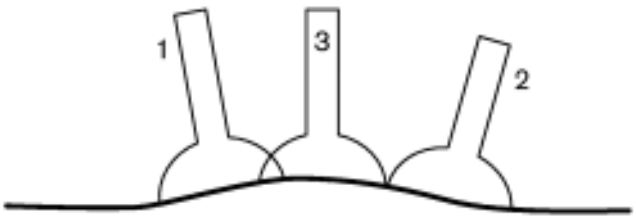


(b) Shaping the press line

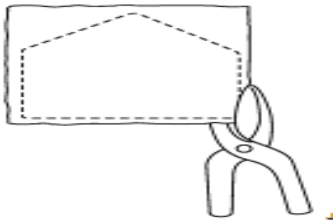
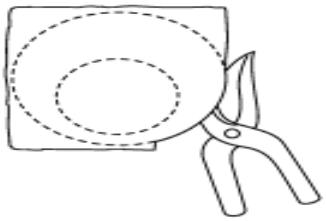
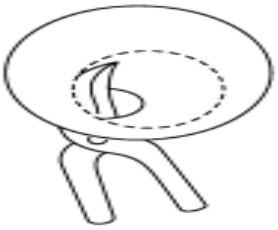
- If the dent in the press line is smaller than the width of the chisel, apply the chisel to the center of the dent. Hammer to flatten.
- Hammer gently so that the dent can be removed gradually.



- 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 Tinman's Shears

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

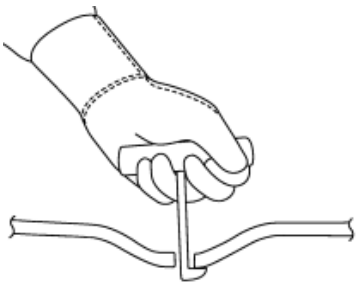
4. Tools for Pulling

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

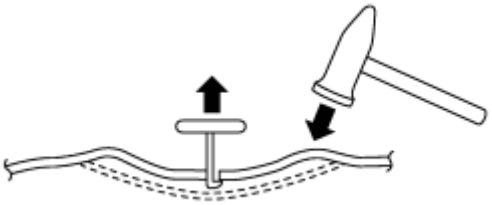
(1) Hand Hook

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.



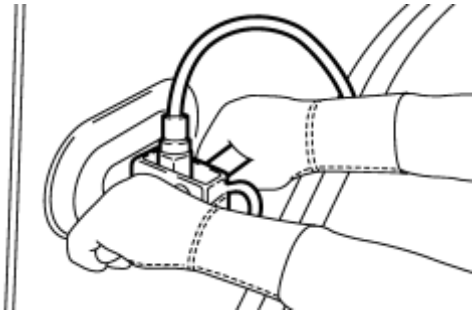
- When using a hand hook, fit the end snugly against the panel. Do not pry up or use too much force. Pull the hook lightly while tapping with a hammer at the edge of the dent.
- The drilled hole must be refilled with body putty after completing the work.



(2) Vacuum Puller

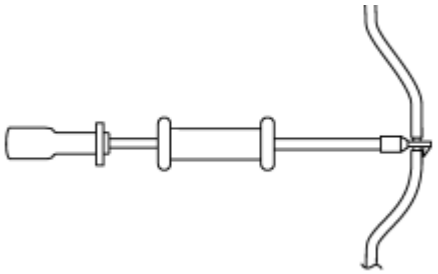
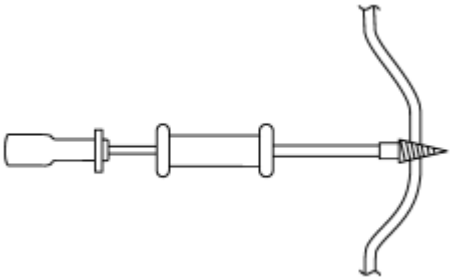
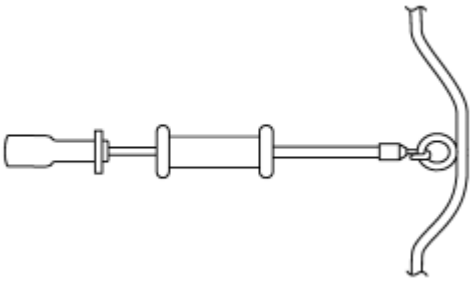
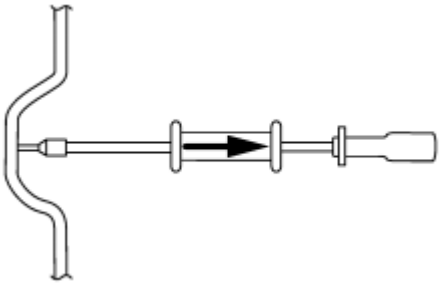
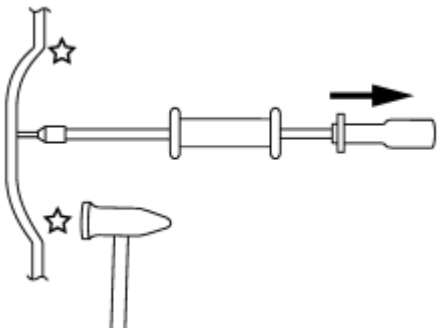
Vacuum Puller

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

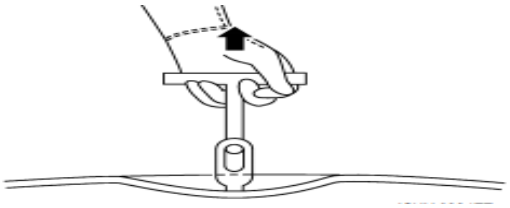
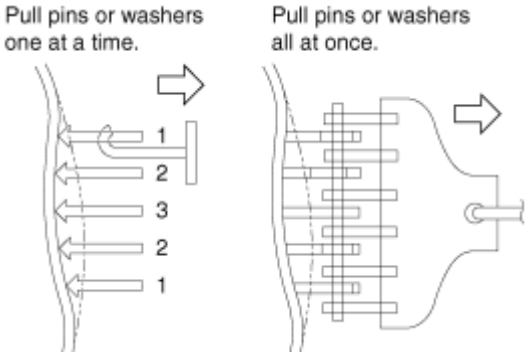


(3) Sliding Hammer

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.

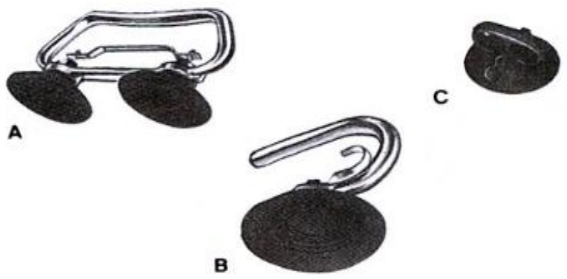
(a) A hook similar to the hand hook is attached to the end of the sliding hammer. Pulling holes are drilled in the panel. A limited force is allowed for pulling. The panel must be pulled carefully to avoid tearing.	
(b) A tapping screw is attached to the end of the sliding hammer. It is then screwed into the panel. A greater pulling force is possible than with the hook.	
(c) Instead of a hole, a metal pin or washer is welded to the panel. Great force can be used for pulling.	
(d) When the dent is deep and narrow, pull it with a single blow.	
(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.	

(4) Welded Pin or Washer

A pin or washer is welded to the dent without drilling. It is then pulled to repair the dent.	
Several pins or washers are welded to the dent. They are then pulled together or separately to repair the dent	

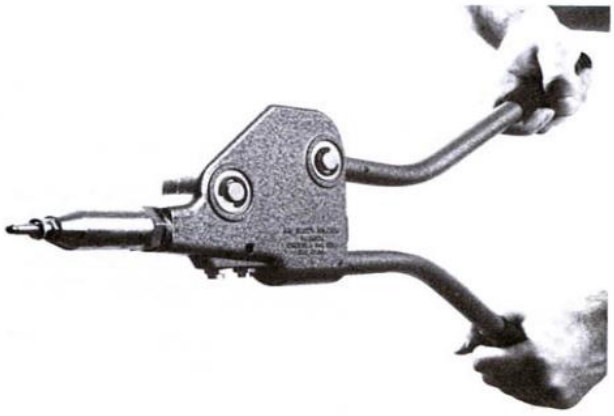
(5) Suction Cups

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.



5. 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.



6. 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 put: 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	

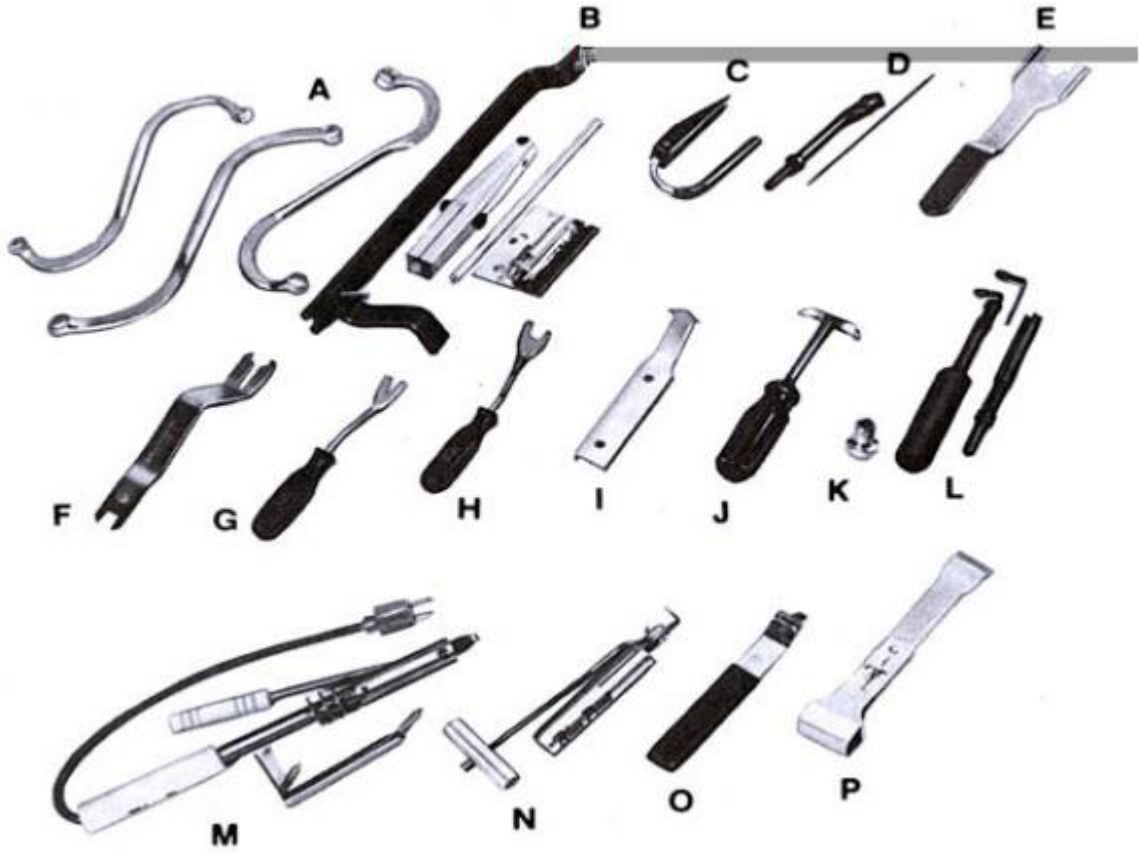


Figure 12: Different Door Handle Tool

5.2. Welding and Heating Equipment

Shielded metal arc welding (SMAW) machine

SMAW (shielded metal arc welding) is welding process which source of heat coming from the 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. With 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.

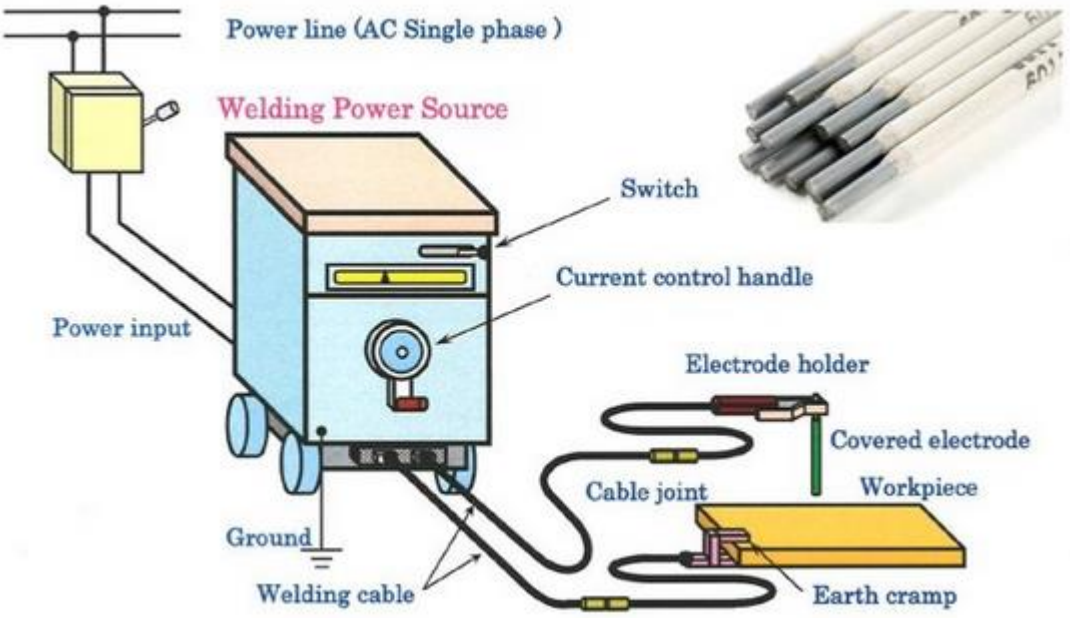


Figure 13: Shielded metal arc welding (SMAW) machine with Accessories

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

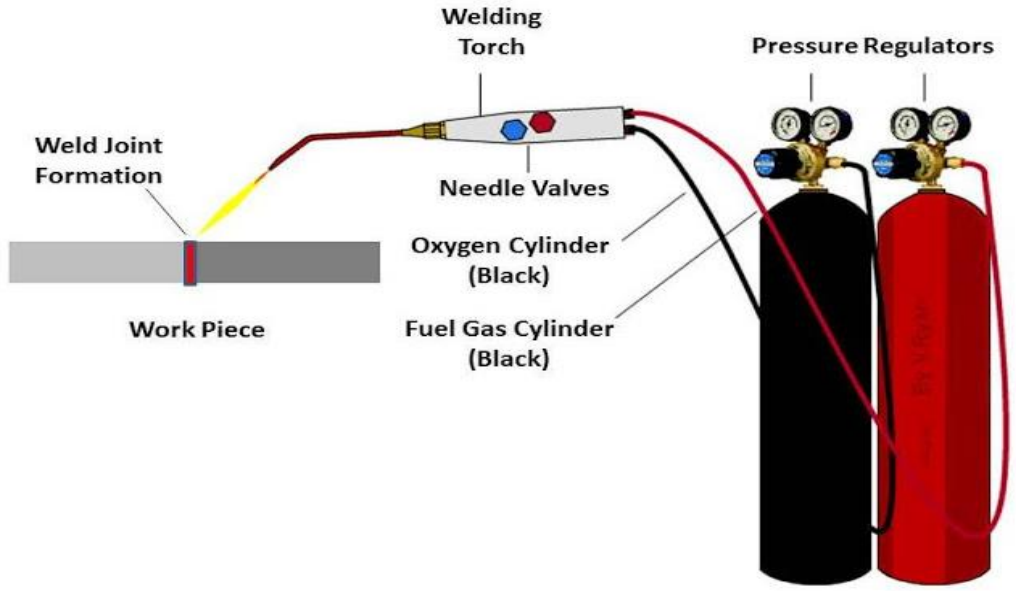


Figure 14: Gas Welding Cylinder with Accessories

Note: The operation of welding refer “Carryout Welding Procedures” module

5.3. Special Tools and Lifting Equipment

Using a Four-Post Hoist

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.
- The hoist should be raised so you can comfortably work under it. Lock the lift in place before moving underneath or working on the vehicle.

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.

2. 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. At the back there will be ramps that allow the vehicle to be driven up and on to the hoist. These will lift up when the hoist is raised and prevent the vehicle from rolling off.

3. Position the vehicle

Drive the vehicle slowly and carefully onto the hoist and position it centrally. If the vehicle has front wheel restraints, drive the vehicle forward until the wheels lock into the brackets. Get out of the vehicle and check that it's correctly positioned on the platform. If it is, apply the emergency brake and select first gear or park.

4. 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.

5. Lock safety device

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.

6. 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. Once the hoist is fully lowered you can drive the vehicle off the hoist. Other non-fixed equipment deserves special mention.

Note: - Special tools discuss on Body Panel Repair Tools

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

Electronic Parts

- To protect computers and other sensitive parts from damage:
- Follow the vehicle maker's recommendations for recording and resetting electronic memories.
- Ensure that the ignition switch is in the LOCK position, and the key is removed.
- Disconnect and isolate the negative battery cable, and disarm the passive restraint system. Follow the vehicle maker's recommendations.
- Carefully remove computer modules when welding or heating within 300 mm (12"), or a greater distance when recommended by the vehicle maker.
- Protect computer modules, connectors, and wiring from dirt, heat, static electricity, and moisture.
- Loosen or remove any wiring harnesses or electrical parts that could be damaged during the repair process. .

Adjacent Areas

- Protect glass, upholstery, and other cosmetic surfaces from welding, grinding, or cutting sparks. Remove interior trim and adjacent parts that cannot be protected.
- Check the fuel system for leakage it have a leak may be explode the vehicle because of welding or grinding spark
- Remove fuel tank clean the area when weld or grind panel of vehicle around the fuel tank. Always safety first.

Work site protection when perform arc welding

- Welding Curtain is to avoid other personnel being harmed by the welding work taking place. The curtain blocks out all hazardous ultraviolet and infrared light from the welding arc, but still enables one to see through the curtain. It is made of self-extinguishing material, but is not heat resistant to direct exposure to hot slag/iron spatter from the arc. Size: 2 m high and 1.3 m wide.
- Avoid any flammable liquid such as thinner, gasoline, kerosene, diesel, etc from welding, grinding or cutting area

Self-Check -5	Written Test

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

A. Matching

A	B
1. General purpose spoon	A. two flat surfaces and a connecting curved surface.
2. Ox-acetylene	B. Welding process which source of heat coming from the electrical current.
3. Vehicle Protection	C. For shaping the panel together with dollies and spoons
4. Curved spoon	D. suction cup is a simple tool that makes short work of shallow dents
5. Flat spoon	E. used to repair small panel dents
6. Shrinking hammer	F. For shaping the panel together with dollies and spoons
7. Hand Hook	G. spoon has a short handle and a wide, flat blade.
8. Heel dolly	H. The surface is like a file and used in combination with a shrinking hammer
9. Toe dolly	I. used for repairing large, deep dents.
10. Shrinking dolly	J. One side is flat and the other side is curved slightly.
11. Mallets	K. The rubber mallet gently bumps sheet metal without damaging the painted finish.
12. Cross peen hammer	L. For Shrinking stretched panels
13. Bumping hammer	M. Cover all glasses, seats and mats
14. sliding hammer	N. It has a wide curved blade and used for smoothing.
15. SMAW	O. a gently curved surface and sharply curved ends. It is widely used in automobile body repair work.
	P. has two purposes for welding process and heating the metal

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

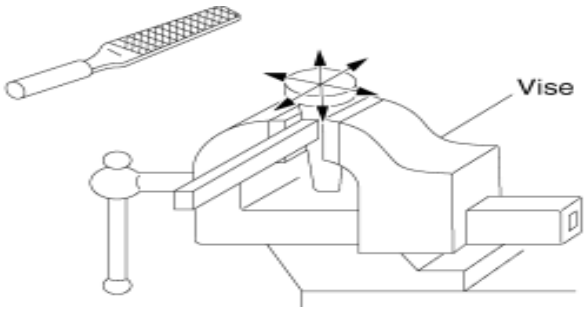
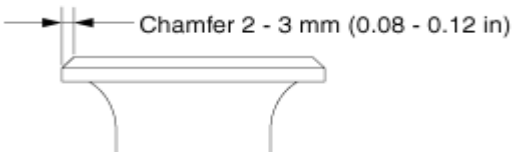
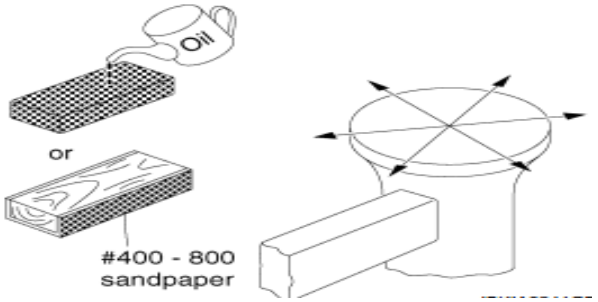
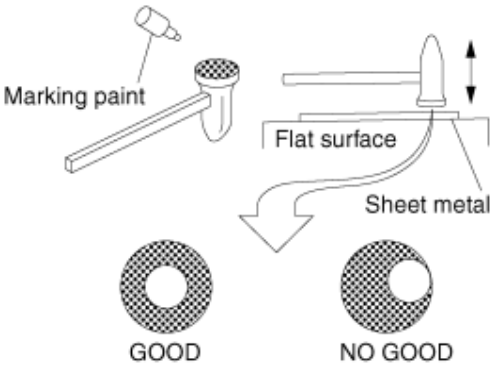
Short Answer Questions

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____

Operation Sheet-1	Maintain Hammers

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. In particular, the hammer face must always be kept clean. A distorted or damaged hammer face will lead to distorted panels.

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.	
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. **GOOD:** The paint comes off the center to the face. **NO GOOD:** The paint comes off at a section other than the center or the face. Grind the surface again.	

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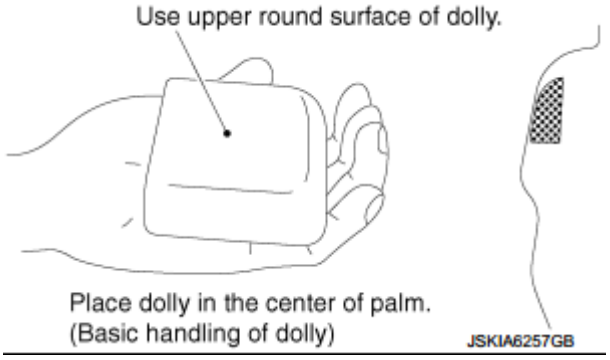
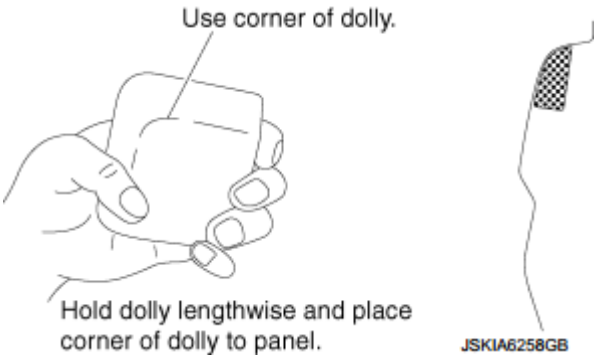
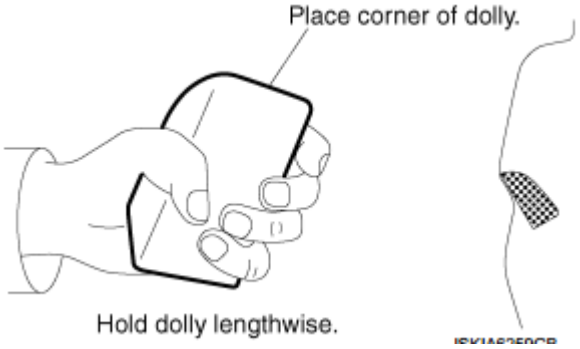
Operation Sheet-2	Holding techniques of Dolly

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

(a) Top Place the dolly in the palm of your hand. Holding it lightly, place the curved surface against the curved surface of the panel.	
(b) Corner Hold the dolly lengthwise, and place the corner in the sharply bent portion of the panel.	
(c) Edge Hold the dolly so that the edge faces upward. Place this edge to the press line of the panel.	
(d) Correcting the Press Line 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	

Operation Sheet-3	Health and Safety Hazard Report Form

Hazard Report Form

This form is for reporting hazards, complete this form if you notice a hazardous situation. Rectify the hazard immediately if you are able to do so and report what action you have taken. If unable to rectify the hazard, state what action you recommend and give this report to <insert title of person who form goes to>.

1. Details of person reporting hazard

First Name:	Family Name:	
Centre/Program :		
Position:	Phone (w):	Phone (h or m):
Supervisor/Manager:		

❑ Employee ❑ Contractor /Volunteer ❑ Visitor ❑ Agency Casual

2. Identify the hazard

Date hazard identified: Time hazard identified: am/pm

Location of hazard – if external give the nearest room:

Level: Room: Playground:

Other:

Describe the Hazard:

Why/How is it a Hazard:

3. Assess the Risk

The risk rating of a hazard is based on the combination of likelihood, consequence and amount of exposure to a hazard.

Risk Assessment Matrix

How serious could the injury be?	How likely is it to be that serious?			
	Very likely	Likely	Unlikely	Very unlikely
Death or permanent disability	1	1	2	3
Long term illness or serious injury	1	2	3	4
Medical attention and several days off	2	3	4	5
First aid needed	3	4	5	6

Severity – is a measure of an injury, illness, incidents, or disease occurring. When assessing severity, the most severe category that would be most reasonably expected should be selected.

Likelihood – is defined as the potential that an accident will happen that may cause injury or harm to a person. When making assessment of likelihood, you must establish which of the categories most closely describes the probability of the hazardous incident occurring.

Consequences Table

1 and 2	Extreme risk; consider elimination of the activity. Otherwise determine controls that are reasonably practicable to minimise the risk.
3 and 4	Moderate risk; determine controls that are reasonably practicable to minimise the risk.
5 and 6	Low risk; manage by routine procedures.

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LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 1hour. All tasks perform according to standard or workplace procedure.

Task 1: Maintain Hammers, dollies and Spoon

Task 2: Demonstrate holding techniques of Dolly

Task 3: Prepare health and safety hazard report

List of Reference Materials

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