Vehicle Body Repairing

Level-III

Based on November 2016, Version 2

Occupational standards (OS)

Module Title:Performing Body Parts Manufacturing

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LG #42	LO #1- Prepare for work

Instruction sheet

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

- Using work instructions to determine the job requirements, including method, materials and equipment.
- Reading and interpreting job specifications
- Observing OHS requirements, including dust and fume collection, breathing apparatus, eye and ear personal protection needs.
- Selecting materials for repair
- Identifying and checking equipment and tools
- Identifying procedures for maximizing energy efficiency.
- Determining procedures to minimize waste materials.

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

- Use work instructions to determine the job requirements, including method, materials and equipment.
- Read and interpreting job specifications
- Observe OHS requirements, including dust and fume collection, breathing apparatus, eye and ear personal protection needs.
- Select materials for repair
- Identify and check equipment and tools
- Identify procedures for maximizing energy efficiency.
- Determine procedures to minimize waste materials.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1-Using work instructions to determine the job requirements, including method, materials and equipment.

1.1. Introduction

Most of the damage resulting from everyday vehicle collisions can be repaired, and vehicles can be refinished to look and drive like new. This damage may be relatively minor, such as scraped paint or a dented panel, or major, requiring the complex replacement of parts. Such repair services are performed by trained workers by following work instruction.

1.2. Work instructions

Information about the work

- Describe what workers need to be able to do on the job
  - Work functions
  - Key activities of each work function
  - Performance indicators
- Describe what task to be done or work roles in a certain occupation

A Work Instruction is a document that provides specific instructions to carry out an Activity. It is also a document describing specific activities and tasks within the organization. It contains the greatest amount of detail. Work instruction is a step by step guide to perform a single instruction which contains more detail than a Procedure and is only created if detailed step-by-step instructions are needed. Work instruction is a description of the specific tasks and activities within an organization. A work instruction in a business will generally outline all of the different jobs needed for the operation of the firm in great detail and is a key element to running a business smoothly.

In other words it is a document containing detailed instructions that specify exactly what

steps to follow to carry out an activity.

It contains much more detail than a Procedure and is only created if very detailed instructions are needed. For example, describing precisely how a Request for Change record is created in the Change Management software support tool.

1.3. Difference Between Work Instructions and Procedures

Another way of looking at Work Instructions v Procedures is that:

Procedures describe:

- What is the activity
- Who performs it
- When it is performed

Work instructions describe:

- How the activity is performed.

Purpose of Work Instructions

A work instruction is a tool provided to help someone to do a job correctly. This simple statement implies that the purpose of the work instruction is quality and that the target user is the worker. Unfortunately, in many workplaces, today's work instructions have little connection with this fundamental focus. Factories have encumbered work instructions with content that has been added to satisfy auditors, lawyers, engineers, accountants and yes, even quality managers. We've piled on so much extraneous material that we've lost sight of the intended purpose of work instructions.

1.4. Determination of method, materials and equipment on body repair

Any person performing repairs must determine whether any suggested or recommended procedures or repairs are suitable or appropriate for the particular

vehicle being repaired. The repairer remains solely responsible for such determination, as well as for the proper completion of the repairs.

Automotive body and related repairers, often called collision repair technicians, straighten bent bodies, remove dents, and replace crumpled parts that cannot be fixed. Each damaged vehicle presents different challenges for repairers. Using their broad knowledge of automotive construction and repair techniques, automotive body repairers must decide how to handle each job based on what the vehicle is made of and what needs to be fixed. They must first determine the extent of the damage and decide which parts can be repaired or need to be replaced.

If the car is heavily damaged, an automotive body repairer might start by measuring the frame to determine if there has been structural damage.

1.4.1.Repair methods change

As design innovations and the construction of vehicles have changed over the years, so too has the collision repair profession. The job of repairing vehicles has also become more complex. When a car was brought in for repair, the damaged part was usually removed and replaced with a new one that was either forged from steel or cut from wood. This method was expensive and time-consuming. Many times there was a long wait for parts and to complete repairs. Most of the early body/frame technicians were carpenters or blacksmiths.

Self-check - 1	Written test

Name…… ID…… Date…….

Test write true if the statement is correct and write false if the statement is in correct (2pts for each)

1. Work instruction is a tool provided to help someone to do a job correctly.

Note: **Satisfactory rating - 3 points and above** **Unsatisfactory - below 3 points**

Score = _____

Rating: _____

Information Sheet 2- Reading and interpreting job specifications

2.1. Job Specification

Also known as employee specifications, a job specification is a written statement of educational qualifications, specific qualities, level of experience, physical, emotional, technical and communication skills required to perform a job, responsibilities involved in a job and other unusual sensory demands. It also includes general health, mental health, intelligence, aptitude, memory, judgment, leadership skills, emotional ability, adaptability, flexibility, values and ethics, manners and creativity, etc.

2.2. Purpose of Job Specification

Described on the basis of job description, job specification helps candidates analyze whether are eligible to apply for a particular job vacancy or not.

It helps recruiting team of an organization understand what level of qualifications, qualities and set of characteristics should be present in a candidate to make him or her eligible for the job opening.

Job Specification gives detailed information about any job including job responsibilities, desired technical and physical skills, conversational ability and much more.

It helps in selecting the most appropriate candidate for a particular job.

Job description and job specification are two integral parts of job analysis. They define a job fully and guide both employer and employee on how to go about the whole process of recruitment and selection. Both data sets are extremely relevant for creating a right fit between job and talent, evaluate performance and analyze training needs and measuring the worth of a particular job.

2.3. Automotive Body Technician Job Specification

Table 1 Automotive Body Technician Job Specification

Job description	A body repair technician is able to repair vehicle bodies and straighten vehicle frames.
Responsibilities	a. Thoroughly examine the vehicle damages b. Return the vehicle back to factory specifications c. Remove vehicle trim to gain access to vehicle body d. Can properly fill depressions with body filler and insure a quality repair e. Able to remove damaged parts using power tools and cutting torch Bolt or weld replacement parts in position using power tools and welding equipment straighten bent automobile frames using frame wrack f. File, grind and sand repaired surfaces, using power tools and hand tools g. Aim headlights h. Replace bolts on panels and align properly i. Make cosmetic repairs j. Perform other duties as assigned by management K. Use special equipment to restore damaged metal frames and body sections back to original specifications
Competencies/ skills	a. Effective communication (written and verbal) and interpersonal skills required. b. Ability to work in a high performance, fast-paced team environment. Ability to adapt to and work effectively within a constantly changing environment. c. Excellent problem solving skills required. d. Customer focus e. Organization f. Energy level g. Persistence
Physical demands	a. Ability to sit or stand for prolonged periods of time b. Ability to perform repetitive tasks; manual dexterity c.Vision abilities required include close, distance and depth perception

Self-Check – 2	Written test

Name…… ID…… Date…….

Instruction: Write true if the statement is correct and false if the statement is incorrect

1. Job Specification also known as employee specifications, . (2pts)
2. .Purpose of Job Specification is described on the basis of job description, job specification helps candidates (2pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 3- Observing OHS requirements, including dust and fume collection, breathing apparatus, eye and ear personal protection needs.

3.1. Shop safety practices and Health Protection

Shop accidents are unplanned mishaps that hurt people,damage parts or tools, and result in other adverse effects on the shop and its employees. Because a body shop has so many potential sources of danger, safety must be everyone's primary concern.

The most important considerations in any repair and refinishing shop should be accident prevention. Safety carelessness and lack of safety habits causes accidents.

A. AIR PASSAGES AND LUNGS PROTECTION

Abrasive dust vapour from caustic solutions and solvents spray mist from undercoats and finishes-all present dangers to the air passages and lungs, Especially for workers who are among them day in, day out.

B. EYE AND FACE PROTECTION

Eye protection is required where there is a possibility of an eye injury from flying particles, chips, and so forth clear protective safety goggles, glasses or face shields should be worn when using grinders, disc sanders, power drills, pneumatic chisels, removing shattered glass, or when working underneath the auto. When they are in the metalworking or painting areas of the shop locations there is always the possibility of flying objects, dust particles or splashing liquids entering the eyes. Not only can this be

painful it can also cause loss of sight. Remember eyes are irreplaceable. Get in the habit of wearing safety goggles, glasses, or face shields in the working areas.

A welding helmet or welding goggles with the proper shade lens must be worn when welding. These will protect the eyes and face from flying molten pieces of steel and from harmful light rays.

C. EAR PROTECTION

Panel beating the piercing noise of sanding, the radio blaring full-blast-it is impossible to hear any thing else. It is enough to deafen a person and that is exactly what it will do if proper precautions are not taken. When in metal working areas, wear ear plugs or earmuffs to protect the eardrums from damaging noise levels.

D. BODY AND HAND PROTECTION

Loose clothing unbuttoned shirtsleeves, loose jewellery are very dangerous in body shop. Instead wear approved shop work clothes. Trousers should be long enough to cover the top of the shoes. This will prevent sparks from going down in to the shoes. Especially when using welding equipment. The harmful effects of liquid undercoats and finishes on the hands can be prevented very effectively by wearing proper gloves. When using any body or paint shop chemicals, be sure to wash the hands with soap and water before eating or smoking.

E. FOOT PROTECTION

Wear safety work shoes that have metal toe inserts and no slips. The inserts protect the toes from falling objects; the soles help to prevent falls. In addition, good work shoes provide support and comfort for some one who is standing for a long time. Never wear plastic (rubber) or sandal none of this shoes provided adequate protection in a body shop.

3.2. Vehicle handling in the shop

When handling a vehicle in the shop, keep the following safety precautions in mind.

- Set the parking brake when working on the vehicle. If the car has an automatic transmission, set it in park unless instructed otherwise for a specific service operation. If the vehicle has a manual transmission, it should be in reverse (Engine off) or neutral (engine on) unless instructed otherwise for a specific service operation.
- Use safety stands whenever a procedure requires work under the vehicle
- To prevent serious burns avoid contact with hot metal parts such as the radiator, exhaust manifold, tail pipe, catalytic converter and muffler.
- When moving a vehicle around the shop. Be sure to look in all directions and make certain noting is in the way.

3.3. Handling of solvent and other flammable liquids

- Both the body mechanic and re finisher will be working with various solvents to clean surface and equipment and to thin finishes. These solvents are extremely flammable. Fumes in particular can ignite explosively. The following safety practices will help avoid fire and explosion.
- Use only approved explosion proof equipment in hazardous locations.
- Handle all solvents (or any liquids) with care to avoid spillage. Extra caution should also be used when transferring flammable materials from bulk storage.
- Discard or clean all empty solvent containers. Solvent fumes in the bottom of these containers are prime ignition sources.
- Do not light matches or smoke in the spraying and paint area, and make sure that the hands and cloth are free from solvent when lighting matches or smoking in other areas of the shop where smoking or an open flame is permitted.
- Remove portable lamps before spraying

3.3.1. Fire protection

- Every auto body and paint shop requires fire extinguishers. Since fires are classified as classes there are different types of extinguishers specially designed for a particular class of fire.

TABLE 9–1 GUIDE TO EXTINGUISHER SELECTION

Class of Fire		Typical Fuel Involved	Type of Extinguisher
Class A Fires (green)	**For Ordinary Combustibles** Put out a class A fire by lowering its temperature or by coating the burning combustibles.	Wood Paper Cloth Rubber Plastics Rubbish Upholstery	Water*[1] Foam* Multipurpose dry chemical[4]
Class B Fires (red)	**For Flammable Liquids** Put out a class B fire by smothering it. Use an extinguisher that gives a blanketing, flame-interrupting effect; cover the whole flaming liquid surface.	Gasoline Oil Grease Paint Lighter fluid	Foam* Carbon dioxide[5] Halogenated agent[6] Standard dry chemical[2] Purple K dry chemical[3] Multipurpose dry chemical[4]
Class C Fires (blue)	**For Electrical Equipment** Put out a class C fire by shutting off power as quickly as possible and by always using a nonconducting extinguishing agent to prevent electric shock.	Motors Appliances Wiring Fuse boxes Switchboards	Carbon dioxide[5] Halogenated agent[6] Standard dry chemical[2] Purple K dry chemical[3] Multipurpose dry chemical[4]
Class D Fires (yellow)	**For Combustible Metals** Put out a class D fire of metal chips, turnings, or shavings by smothering or coating with a specially designed extinguishing agent.	Aluminum Magnesium Potassium Sodium Titanium Zirconium	Dry powder extinguishers and agents only

3.3.2.Good House keeping

- Sound safety practices and good work habits usually run hand in hand more often than not in the demanding requirements of body work and refinishing the safe efficient worker is also the most productive.

- The body and refinishing shop has its potential safety and health hazards any person working in this business should be aware of them, and what is important keep them fore most in mind. In short think safety.

Self-Check – 3	Written test

Name…… ID…… Date…….

Instruction: Write true if the statement is correct and false if the statement is incorrect

1. Wear safety work shoes to protect your foot from injury?(4pts)
2. Class A fire include liquid flambe materials?(4pts)

Note: **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 4- Selecting materials for repair

4.1. Material Selection

Material selection is the act of choosing the material best suited to achieve the requirements of a given application.

Many different factors go into determining the selection requirements, such as

- Mechanical properties,
- Physical properties,
- Cost.
- Chemical properties,
- Electrical properties and

Material selection involves a broad set of considerations. As a result, a correspondingly wide variety of knowledge is required to make an appropriate selection. Incorrect material selection can have a huge impact on safety and application success.

In addition to considering how a single material may behave in isolation during the material selection process, it is also important to consider how two or more materials might behave when in contact with each another. A carbon steel part placed in contact with a stainless steel part in an electrolytic solution will undergo galvanic corrosion at a much faster rate than it would if it was not contacting the stainless steel part.

4.1.1. Current materials in use in automotive

I. Automotive sheet metal

To do body work, you must have a basic understanding of metals and their properties.

a. Low-carbon steels

Low-carbon steel, or mild steel (MS), has a low level of carbon and is relatively soft and easy to work. The sheet metal panels on older or antique vehicles are sometimes low carbon. MS can be safely welded, heat shrunk, and cold worked without seriously affecting its strength.

Because MS is easily deformed and relatively heavy, vehicle manufacturers have begun using high-strength steels in load-carrying parts of the vehicle.

b. High-strength steels

High-strength steel (HSS) is stronger than low-carbon or mild steel because of heat treatment. Most new vehicles contain HSS in their structural components. The same properties that give HSS its strength offer some unique challenges. When high-strength steel is deformed by impact, it is more diffificult to restore than mild steel.

Types of high-strength steel

Many types of steels are generally classified as high strength steel. Before explaining their differences, it is important to understand the definition of strength.

High-tensile strength steel

High-tensile strength steel (HTSS) is stronger than low carbon or mild steel because of heat treatment. Most new vehicles contain HTSS in body structural components.

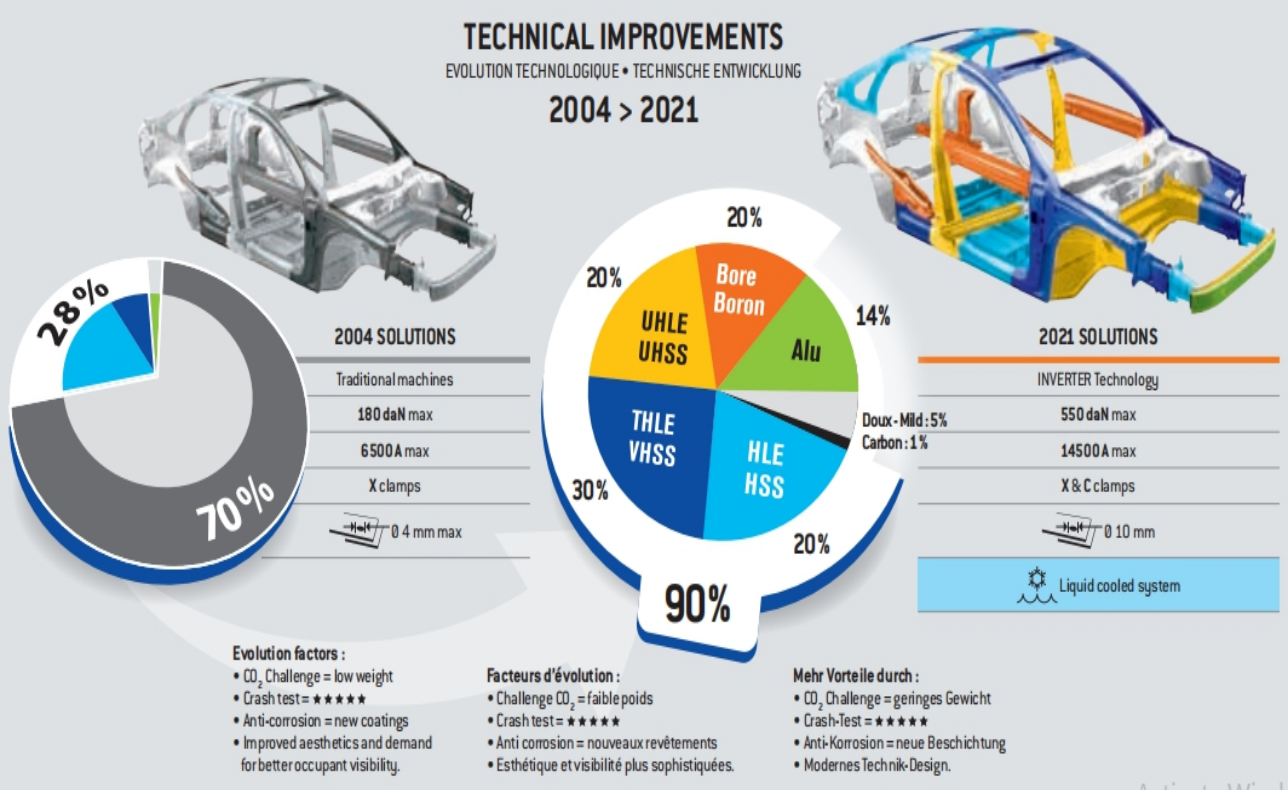


Image 1 material improvement on vehicle body construction

4.1.2. Selecting welding materials

With major collision repair work, many of the panels on a vehicle must be replaced and welded into place. As you will learn, this requires considerable skill and care. The

structural integrity of the vehicle is dependent on how well you weld and install repair panels.

4.2. Joining metals

There are three basic methods of joining metal together in the automobile assembly:

1. Mechanical (metal fastener) methods

2. Chemical (adhesive fastening) methods

3. Welding (molten metal fusion) methods

Welding uses extreme heat to join or fuse pieces of metal together. Welding can be divided into three main categories:

1**. Pressure welding.** The metal is heated to a softened state by electrodes. Pressure is applied, and the metal is joined. Of the various types of pressure welding,electric resistance welding (spot welding) is an indispensable method used in automobile manufacturing and, to a lesser degree, in repair operations.

2. Fusion welding. Pieces of metal are heated to the melting point, joined together (usually with a filler rod), and allowed to cool.

3. Braze welding. Metal with a melting point lower than the base metal to be joined is melted over the joint of the pieces being welded (without fusing pieces of base metal). Braze welding is classified as either soft or hard brazing, depending on the temperature at which the brazing material melts. Soft brazing is done with brazing material that melts at temperatures below 850°F (455°C). Hard brazing is done with brazing materials that melt at temperatures above 850°F (455°C).

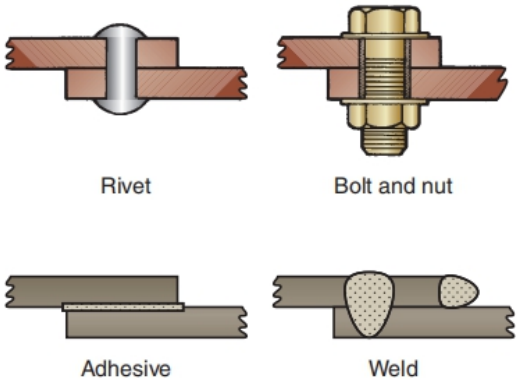


Figure 1 Mechanical joining methods use threaded or non threaded fasteners, which are heavier and less dependable than an adhesive-bonded or welded joint.

4.2.1. Selecting fastening material

Fasteners are the thousands of bolts, nuts, screws, clips, and adhesives that literally hold a vehicle together. As an auto body technician, you will constantly use fasteners when removing and installing body parts. This is why it is important for you to be able to identify and use fasteners properly.

Remember that each fastener is engineered for a specified application. Always replace fasteners with exactly the same type that was removed from the OEM assembly. Never try to re-engineer the vehicle. Keep in mind that using an incorrect fastener or a fastener of inferior quality can result in failure and possible injury to the vehicle occupants.

Fasteners come in many different forms. To make it easy for you, we've compiled the data below as a guide for figuring out what each fastener is called. Scroll down to learn about many different types of nuts, bolts and screws!*

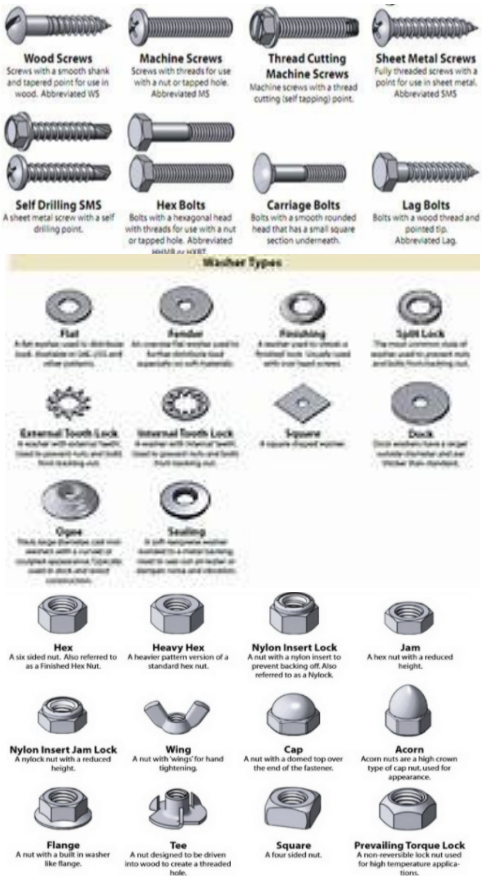
*Note: Bolts are fasteners that require a nut or pre - tapped hole to be installed. Screws use their threads to provide their own holding power. The terms in the industry are commonly mixed so sometimes you will see something that is called a screw or a bolt that is actually the opposite.

Types of Fasteners

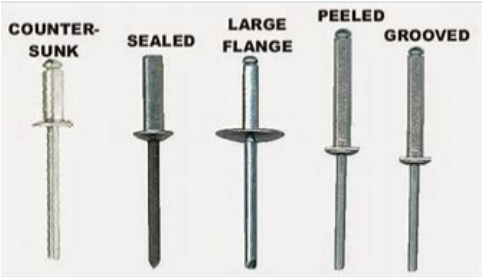
A. Bolts & Screws

B. Washers

C. Nuts



D. Rivets



E. Threaded Rod

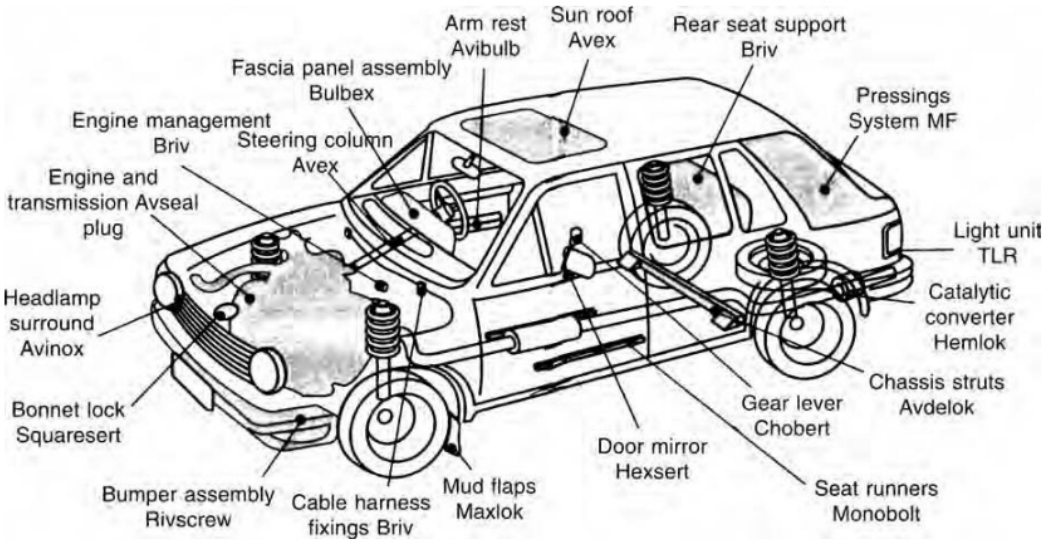


Figure 2 Types of structural fastener used on a vehicle body

4.2.2. Common tools for cleaning

Common options for surface and weld cleaning include bonded abrasives/grinding wheels, coated abrasives/flap discs, and wire brushes and wheels. The choice depends on the requirements of the application and operator preference. Abrasive products and wire brushes differ in their performance and purpose. Abrasive products are designed to remove base material, whereas wire brushes are not.

A. **Bonded abrasives/grinding wheels** If there are slag inclusions or porosity in the weld, for example, a grinding wheel can be used for inter pass cleaning to remove some of the weld material in addition to removing the inclusion. These products are often used to clean mild steel and for sloppier welds that may have a lot of slag or spatter, since the wheels will remove more material faster. Grinding wheels rely on a combination of the grain type, grain size and bonding agents (resins and additive fillers) to determine their performance.

B. **Coated abrasives/flap discs** use the same grain types as those found in bonded abrasives, but the grains are bonded to a backing cloth rather than molded and pressed into a hard grinding wheel. This cloth is layered to form a flap disc, a design that gives flap discs a softer, more forgiving feel. Flap discs can be used on stainless steel (though be sure to use a finer grit) or on mild or carbon steel for slight material removal in pre-weld cleaning, as well as for blending and finishing the surface post-weld. This makes them a good choice when the finished material needs to be painted, primed or powder coated. Be mindful of the direction of spin when using a flap disc. Make sure it's spinning and throwing the sparks and debris away from the base material and weld and not back across them to avoid contamination.

C. **Wire brushes and wheels** are a good option for inter pass or post-weld cleaning, when it is necessary to remove spatter and other contaminants. If the material has a lot of mill scale, rust or heat discoloration to remove (without removing a lot of material), wire brushes also work well for pre - cleaning. When choosing a power brush, there are several knot styles, wire gauges and trim length options.

Self-Check – 4	Written test

Name…… ID…… Date…….

instruction: Write true if the statement is correct and false if the statement is incorrect

1. Fasteners are the thousands of bolts, nuts, screws, clips, and adhesives that literally hold a vehicle together. (2pts)
2. Common options for surface and weld cleaning include bonded abrasives/grinding wheels (2pts)

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

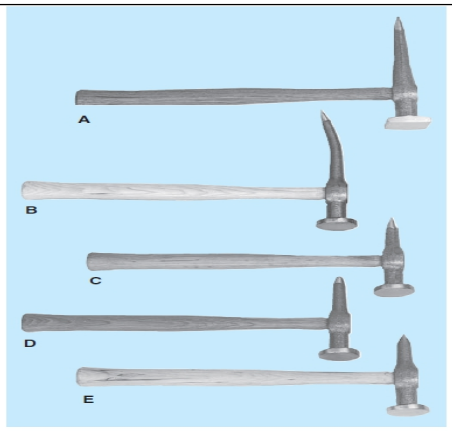
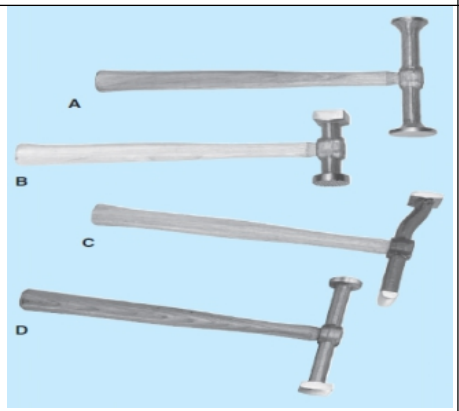
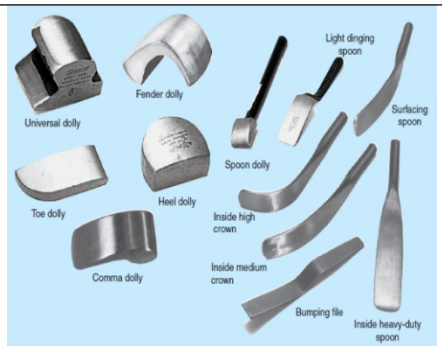
Information Sheet 5- Identifying and checking equipment and tools

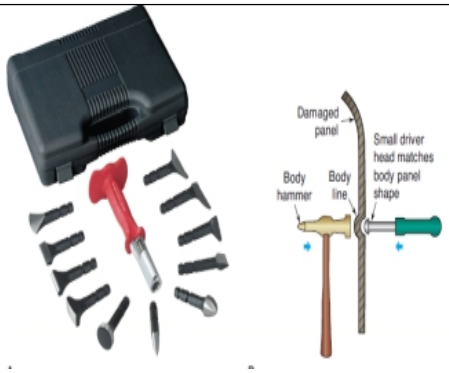
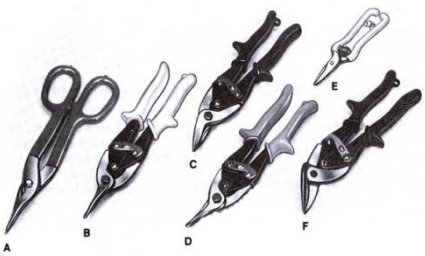
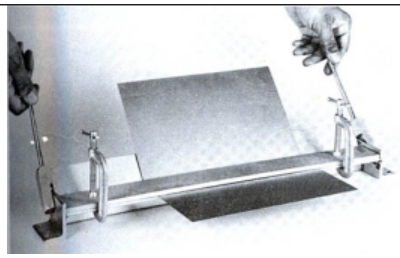
5.1. Body working tools

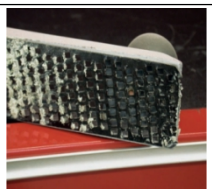
Mass production and methods have made the present day motor car such that it requires special techniques, skills and tools for the rectification of body damage. Specialist tools have been designed to suit the varying contours and shapes of the present all-steel bodies and panels. These tools are made of high-carbon tool steel, which is forged and then heat treated to give long service in the hands of a skilled body repair worker. In a body repair toolkit the basic tools are the hammer and the dolly. All other tools have been developed around these, giving us the specialist tools which are now currently available. A repair job cannot be successfully carried out before one has completely mastered the skill of using the planishing hammer and dolly in coordination with each other, as this skill is the basis of all body repair work involving the use of hand tools.

5.1.1. Hand tools

Name	Hand tools	Function
1. Hammer hammers		**a. Ball peen hammer** is a useful, multipurpose tool for all kinds of work with sheet metal. Heavier than the body hammer **b. Sledgehammer** is an essential tool for the first stages of re-forming damaged thicker metal parts.
2. Mallets hammers		● The rubber mallet gently bumps sheet metal without damaging the painted finish. ● It is often used with the suction cup on soft cave-in–type dents. While you pull upward on the cup, the mallet is used to tap lightly all around the surrounding high spots.

3. Body hammers	 **FIGURE 4–49** Note pick hammer names (*Courtesy of S&H Industries*): (**A**) long pencil point, (**B**) long curved pencil point, (**C**) short pencil point, (**D**) short bullet point, and (**E**) short chisel point.	**a. picking hammer** has a pointed tip on one end and usually a flat head on the other. It will take care of many small dents. The pointed end is used to raise low spots from the inside. The flat end is for hammer-and-dolly work to remove high spots and ripples. Picking hammers come in a variety of shapes and sizes. Some have long picks for reaching behind body panels. Some have sharp pencil points; others have blunted bullet points. Select the head best suited for the job.
		a. **Bumping hammer** Larger dents require the use of this hammer. It have round faces or square faces that are almost flat. The faces are large so that the force of the blows is spread over a large area. These hammers are used for initial straightening on dented panels or for working inner panels and reinforced sections that require more force but not a finish appearance.
a. Double round b. Shrinking hammer c. Off-set bumping d. Dinging hammer		a. **Finishing hammers -** after the bumping hammer is used to remove the dent, final contour is achieved with the **finishing hammer** (figure 4–51). The faces on a finishing hammer are smaller than those of the heavier bumping hammer. The surface of the face is crowned to concentrate the force on top of the ridge or high spot. A *shrinking hammer* is a finishing hammer with a serrated or cross-grooved face. This hammer is used to shrink spots that have been stretched by excessive hammering.
4. Spoons and dolly		a. **Dolly** or dolly block is used like a small anvil while body damage is worked out. It is generally held on the backside of a panel being struck with a hammer. There are many different shapes of dollies **b. Body spoons** are another class of body working tools used like a hammer or a dolly. They are available in a variety of shapes and sizes to match various panel shapes.

5. Interchangeable driver set		● Quick-release hammer and interchangeable dollies included are suitable for flattening metal panels, removing dings and dents, creating outside curves and shrinking metal ● Head-interchangeable hammer, quick release machensim, multi dolly, cross curve dolly, ball pein dolly, ball type dolly, small curve dolly, angle groove dolly, round face dolly, square face dolly and multi curve dolly
6. Metal-cutting shears	  Panel cutter	a. **Snips** are used to trim panels or metal pieces to size. Several types of metal cutters are useful. A. Tin snips, B. Straight cut, C. Right cut shear D. Left cut shear E. Light duty snips F. Aviation snips b. **Metal Cutters** - also called aviation snips, are used to cut through metal panels. The narrow profile of the jaws allows the snips to slip between the cut metal. The jaws are serrated to cut through the tough metal. **c. Panel Cutters** - are special snips used to cut through body sheet metal. These are used to make straight or curved cutouts in panels that require spot repair for rust or damage. They are designed to leave a clean, straight edge that can be welded easily
7. Sheet Metal Brakes		● Many body repairs require metal patches to be riveted or welded in to place. A tool that comes in handing and braking sheet metal is shown in Figure. This sheet metal brake bends sheet metal up to 20-gauge and sheet aluminium up to 16 gauge. Clean, smooth bends up to 90 degrees can be made with a brake.

8. Metal files	 	**Metal files** After working a damaged panel back to its approximate original contour, a metal file is used to mark (scratch) the metal to find high and low spots.

5.2. Body working Equipment

5.2.1. Heat gun

5.2.2. A spot weld drill


5.3. Measuring systems

Tram gauge

A tram gauge is a special body dimension measuring tool. It is usually a lightweight frame with pointers. The pointers can be aligned with body dimension reference points to determine the direction and amount of body misalignment damage.

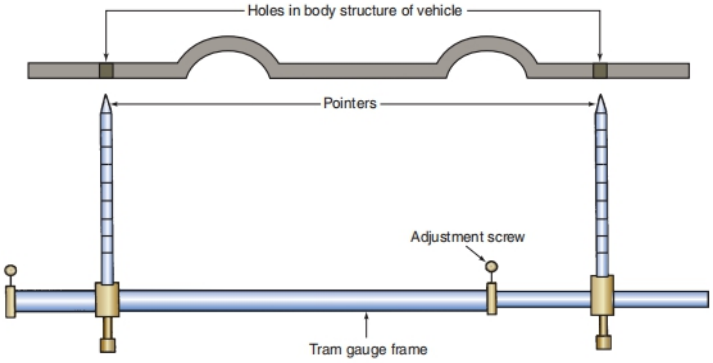


Figure 3 A tram gauge is handy when you have to measure across points on a vehicle to find major damage. Adjust the gauge to the correct dimension from the manual and then compare it to actual points on the damaged vehicle

Self-Check – 5	Written test

Name…… ID…… Date…….

instruction: Write true if the statement is correct and false if the statement is incorrect

1. shrinking hammer finishing hammers - after the bumping hammer is used to remove the dent
2. Bumping hammer has a pointed tip on one end and usually a flat head on the other

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 6- Identifying procedures for maximizing energy efficiency.

6.1. General procedures for body damage repairing

How To Fabricate Patch Panels Step-By-Step

I. Identify the Area in Question

Finding that an aftermarket panel needs to be modified is fairly straight forward since you'll know right away when it doesn't fit. If you're fabricating patch panels due to rust though, you'll first need to determine the extent of the damage. This means sanding down the rusted area to find out how deep the rot is.

II. Drafting/Cutting

After the rust has been exposed you can start identifying where to cut. Remember, you don't want to fabricate patch panels that are more intricate than you need. So, before you cut, really think about the size and shape of the panel. Make quick sketches and draw a sturdy pattern for yourself. Once you feel confident with your sample, you can break out the cut off wheel.

III. Gauging Steel

It's important to use the same gauge of steel that was used on the original panel. You can use a gauge wheel to measure the thickness of the steel or a number of other tools designed specifically for this task. Once the old panel is cut away, you will have access to the area and can take your measurement. Then, once you have the right gauge of steel, you can move on to shaping your panel.

IV. Shaping

Shaping the panel will take the longest amount of time. While shaping, it's smart to make a piece that's larger than what you will actually need. You can always cut it down to the appropriate size later. If you were able to keep the piece that you had to cut away, use it as a template to help out during this part of the process. Metal brakes and other shaping tools go a long way, but with patience and practice you can shape panels with

basic hand tools such as body hammers. And remember that no two panels are the same, so you might have to get a little creative.

V.Welding

Once the panel is properly shaped, you can move onto welding. First, make sure the panel you've created is mounted securely in place. Double, then triple check it's as perfectly lined up as possible before you start tacking. Using a MIG or TIG welder, tack weld it in place.

Once the panel is tack welded in, you can move to butt welding. To avoid warping the metal, Hot Rod Magazine suggests "three or four quick tack welds, followed by an air quench. Move around the part so that consecutive welds are not next to each other." This is another time consuming part of the process, but patience is key to make sure you fabricate patch panels of the best quality.

VI. Grinding

After you have finished welding, you'll have your own little diamond in the rough. Those built-up welds will need to be ground down for a flush finish. Angle grinders and other power tools emit a lot of heat during grinding so, again, take your time. The high heat can warp the sheet metal just like a welder might. As you're grinding, take a moment every few seconds to let the metal cool down before proceeding.

Web reference

https://www.theengineblock.com/tech-corner-how-to-fabricate-patch-panels-step-by-step/

Self-Check – 6	Written test

Name……ID…… Date…….

Directions:

Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Short Answer Questions

1. Write general procedures for body damage repairing ?(10)

Note: Satisfactory rating - 5 points Unsatisfactory - below 5 points

Score = _____

Rating: _____

You can ask you teacher for the copy of the correct answers.

Operation Sheet 1–

Objectives ;

Procedures

LAP TEST	Performance Test

Name…… ID……Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **6** hour. The project is expected from each student to do it.

Task 1:

Task 2:

LG #43	LO #2- Perform vehicle measuring

Instruction sheet

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

- Completing measurement of the vehicle without causing damage to any component or system.
- Selecting equipment for vehicle measuring based on vehicle manufacturer/component supplier specifications
- Preparing and adjusting PPE used for vehicle measuring
- Preparing and installing/locating vehicle on the equipment
- Determining nature and extent of misalignment using approved measuring methods
- Documenting accurately and completely the results of measurements of vehicle alignment.
- Carrying out measuring activities according to industry regulations/guidelines, WHS legislation, and enterprise procedures/policies.

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

- Complete measurement of the vehicle without causing damage to any component or system.
- Select equipment for vehicle measuring based on vehicle manufacturer/component supplier specifications
- Prepare and adjusting PPE used for vehicle measuring
- Prepare and installing/locating vehicle on the equipment
- Determine nature and extent of misalignment using approved measuring methods
- Document accurately and completely the results of measurements of vehicle alignment.
- Carry out measuring activities according to industry regulations/guidelines, WHS legislation, and enterprise procedures/policies.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1 - Completing measurement of the vehicle without causing damage to any component or system.

1.1. Universal measuring systems

Universal measuring systems are the most efficient application of tram/centering gauge technology. They make parts of the measuring job much easier and more accurate, but still require a degree of skill and attention to detail. These systems have the ability to measure all the reference points at the same time. But to get the proper measurement reading, the equipment must be set to the manufacturer's specifications .

With a universal measuring system, all the reference points can be checked just by moving around the vehicle. You can quickly determine where each reference point on the vehicle is in comparison to the measuring system .

If a reference point on the vehicle is not in the same position as the dimension chart says it should be, the reference point on the vehicle is wrong.

When the system is set up properly, you can monitor the key points by simply looking at the pointers. If the pointers are out of position, then the vehicle is not dimensionally correct. A reference point that is out of position must be brought back to pre accident specifications.

Before beginning any universal measuring operations, be sure to:

- Remove detachable damaged body parts, both mechanical and sheet metal body panels.
- If the damage is severe, perform rough straightening to the center section or foundation of the vehicle.
- If the mechanical parts are left in the vehicle and an overhang condition exists, this must be compensated for.

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

Test II Write true if the statement is correct and false if statement is incorrect

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

2.1. Measurement gauges are special tools used to check specific frame and body points. They allow you to quickly measure the direction and extent of vehicle damage. Specific points or locations on the frame or body are given by the manufacturer for making measurements. They might be holes, specific bolts, nuts, panel edges, or other locations on the vehicle. To repair a badly damaged vehicle, you must restore these reference points to their factory dimensions while reference points in the undamaged area remain in their correct locations.

2.2 Visually determining the extent of impact damage

Damaged parts show signs of structure deformations or fractures in most cases.

- When making a visual inspection, stand back from the vehicle to get an overall view.
- Estimate the size and direction of the impact (place where impact was received).
- Estimate how the impact was propagated and the damage sustained.
- Also investigate whether there is any twisting, bending, or slanting of the vehicle overall.
- Inspection must be made along the path of the impact damage through the weak portions of the body.

Damage can be detected easily by finding these types of symptoms:

- Areas where the cross sections of the components were suddenly deformed
- Parts that are broken or missing
- Gaps in strengthening materials, such as reinforcements or patches
- Part-to-part joints that are shifted
- Corners and edges of components that are misaligned

2.3 Measurement of body dimensions

Measuring is critical to the success of any major collision repair job regardless of the type of body structure. But with uni body vehicles, measurements are vital to successful repair because the steering and suspension are mounted to the body structure. In addition, some of the suspension geometry is built into the body structure. As a result,

the angles of wheel alignment (caster and camber) often have a fixed (nonadjustable) value. A distortion of any of these measuring points will change steering or suspension geometry or misalign mechanical components.

Measurement importance

A vehicle cannot be satisfactorily re paired unless all of the major manufacturing control points in the damaged area are returned to the manufacturer's specifications. To achieve this, the body technician must

- Measure accurately
- Measure often
- Recheck all measurements

There are a number of styles of measuring equipment that can be found in body shops, most of it can be divided into five basic systems:

1. Gauge measuring system
2. Universal measuring system
3. Dedicated fixture system
4. Universal/laser
5. Computer/electronic

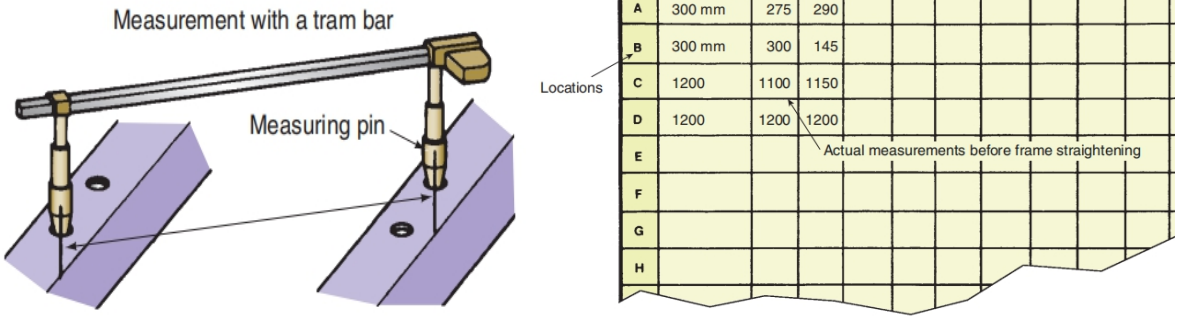
2.4 Gauge measuring systems

The tram gauge, the centering gauge, and the Mac Pherson strut center line gauge can be used separately or in conjunction with one another. Tram gauges are scaled rods used for measurement, while centering gauges are metal rods used to check for misalignment. Supported by suspension system strut tower domes, center line gauges allow visual alignment of the critical control points of uni body vehicles. The tram centering and strut center line gauges are available as a unit or as separate diagnostic tools. Another gauge similar to the tram type is the tracking gauge. This gauge is used to check alignment of the front and rear wheels.

2.5 Tram gauges

The tram gauge measures one dimension at a time. Each dimension must be recorded

and must be cross-checked from two additional control points—at least one being a diagonal measurement. The best areas to select for tram gauge measurements are the attachment points for suspension and mechanical components, because these are critical to alignment.



	Mfg. Spec.	1	2	3	4	5	6	7	8	9
A	300 mm	275	290							
B	300 mm	300	145							
C	1200	1100	1150							
D	1200	1200	1200							
E										
F										
G										
H										

Figure 4 A tram gauge is simply a ridged tape measure with pointers. Place the pointer on the bolt or in the holes to measure between the reference points

Measurement of the Body Side Panel

Any deformation of the body side structure can often be found by noting irregularities in the door when it is opened and closed. Depending on where the deformation is located, attention should be given to possible water and air leakage. It is important that accurate measurements be taken. The tracking tram gauge is primarily used to measure the body side panel (Figure 5).

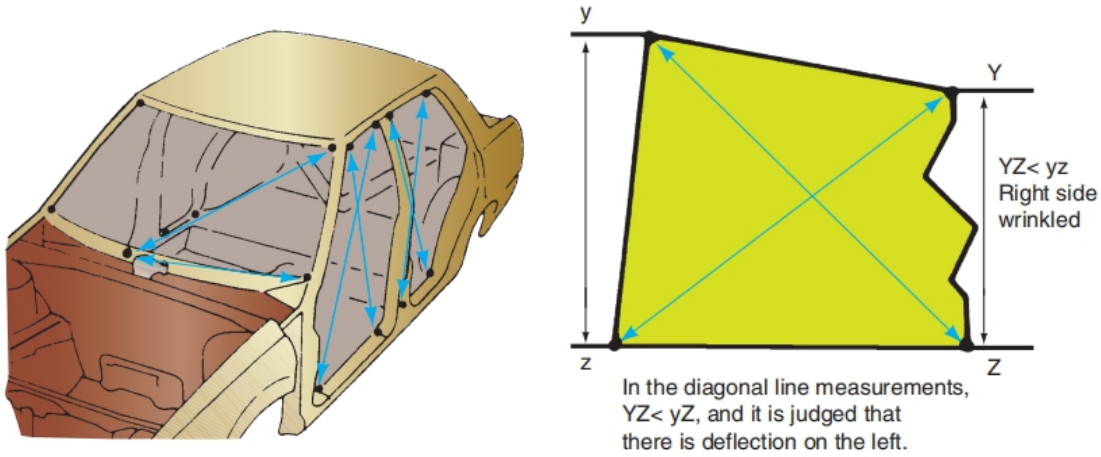


Figure 5 These are typical body side panel measurement points. Diagonal measurements across the door and wind shield

openings tell an important story about major center body damage.

2.6 Digital tram gauges

A digital tram gauge can slide to different lengths and will electronically measure its own length and show a numeric readout in inches or millimeters. Many can send a signal out to the measurement computer to help streamline the damage measuring process.

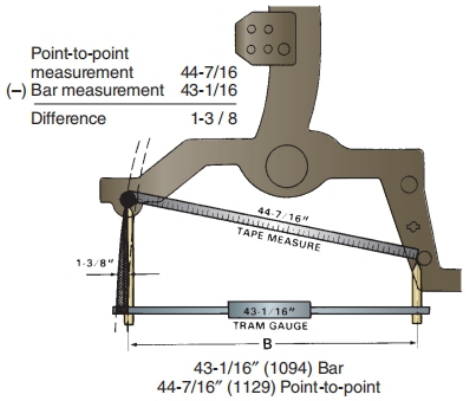


Figure 6 Point-to-point measurement is direct, actual measurement between two points.

2.7 Centering gauges

While self-centering gauges (Figure 7) are closely related to the tram gauges, they do not measure; they show alignment or misalignment by projecting points on the vehicle's structure into the technician's line of sight. They are installed at various control areas on the vehicle.

Self-centering gauges have two sliding horizontal bars that remain parallel as they move inward and outward. This action permits adjustment to any width for installation on various areas of the vehicle. After the gauges are hung on the car (usually three or four sets), the horizontal bar will be parallel to the portion of the structure to which it is attached.

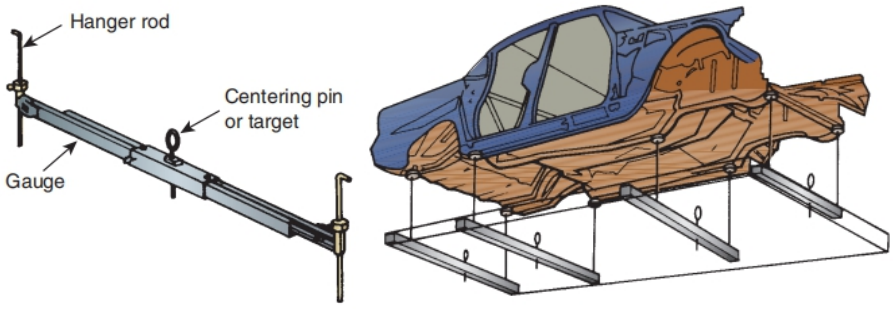


Figure 7 The typical self-centering gauge has a center pin or target for viewing the center line of the vehicle. Hangers are

provided for suspending the tool from the under body of the vehicle

Self-Check – 2	**Written test**

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. ?(2pts)

2. ?(2pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

You can ask you teacher for the copy of the correct answers.

Information Sheet 3- Preparing and adjusting PPE used for vehicle measuring

Preparing personal protective equipment

Personal Safety

Anybody who is involved in automotive body work activity should be aware of the following:

- Protective clothing
- Skin care (personal hygiene systems)
- Hand protection
- Head protection
- Eyes & Face protection
- Foot protection
- Ear protection
- Respiratory protection (Lungs)

  . Dust respirators (masks)

  . Powered respirators

Guidelines, statutory regulations and safe systems for health and safety protection are followed

It is the duty of every employee and employer in the motor industry to comply with the statutory regulations relating to health and safety and the associated guidelines which are issued by the various government offices. That means you must work in a safe and sensible manner. A body repairer is expected to follow the health and safety recommendations of his/her employer; employers are expected to provide a safe working environment and advise on suitable safe working methods.

The current regulations which affect those who work in the motor repair industry are given in this long list which you are not expected to remember:

- Factories Act 1961
- Offices, Shops and Railway Premises Act 1963
- Fire Precautions Act 1971
- Highly Flammable Liquids and Liquefied Petroleum
- Gas Regulations 1972
- Health and Safety at Work Act 1974
- Eye Protection Regulations 1974
- Health and Safety (First Aid) Regulations 1981
- Occurrences Regulations 1985
- Control of Substances Hazardous to Health
- Regulations 1988
- Electricity at Work Regulations 1989
- Noise at Work Regulations 1989
- Pressure Systems and Transportable Gas Containers Regulations 1989

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

3. ?(3pts)
4. ?(1pts)

Test II:write true if the statement is correct and false if the statement is incorrect

1. (2pts)
2. (2pts)

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 4- Preparing and installing/locating vehicle on the equipment

4.1. Preparing and installing/locating vehicle on strut tower gauge

Strut tower gauge shows misalignment of the strut tower/upper body parts in relation to the center line plane and datum plane. It is usually mounted on the strut towers (Figure 8). The strut tower gauge allows visual alignment of the upper body area.

The strut tower gauge features an upper and a lower horizontal bar, each with a center pin. The upper bar is usually calibrated from the center out. Pointers, which are positioned in an adjustable housing on the upper horizontal bar, are used to mount the gauge to the strut tower/upper body locations.

Two types of pointers are provided: cone and reverse cone. The reverse cone is notched to provide additional means of mounting on the vehicle, for example, on ridged surfaces. The pointers are usually held in the housing by means of thumb screws. Different length pointers are provided for situations when more length is needed to position the gauge. When using different length pointers to mount the gauge, remember that they change the scale reading.

Figure 8 Here is typical strut center line gauge in place. The top of the strut towers is a common measurement point, because they are often moved out of alignment during frontal impact.

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. (3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

3. . (2pts)

4. (2pts)

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 5- Determining nature and extent of misalignment using approved measuring methods

5.1. Visually determination of extent of damage

- Inspecting clearance and fit of each part
- Inspecting for inertia damage
- Inspecting for damage from
- Passengers and luggage

5.2. **Measurement of body dimension**

- By body dimensions charts
- By using different measuring system
  - ✓ Tram gauge, the centering gauge

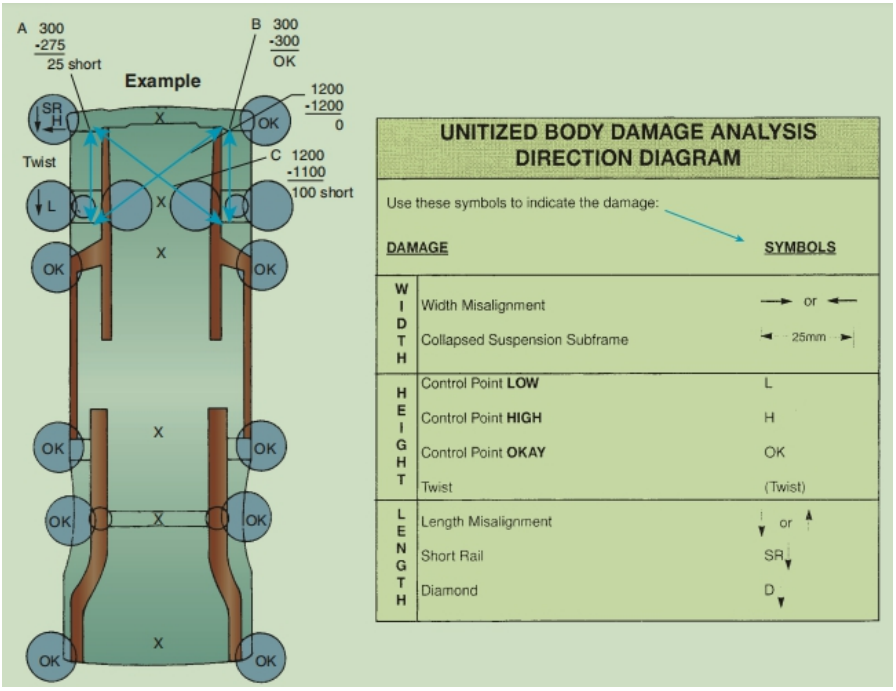


Figure 9 A printout or simple drawing of the dimension diagram will also help you evaluate frame or body damage. Subtract your measurement from its specification to calculate the amount of damage in inches or millimeters. You can then draw arrows to show the direction of damage. On the drawing, abbreviate which damaged areas are high, low, right, left, twisted, diamond, sagging, and so on. This will help you visualize what must be done to pull or straighten the vehicle unibody or frame.

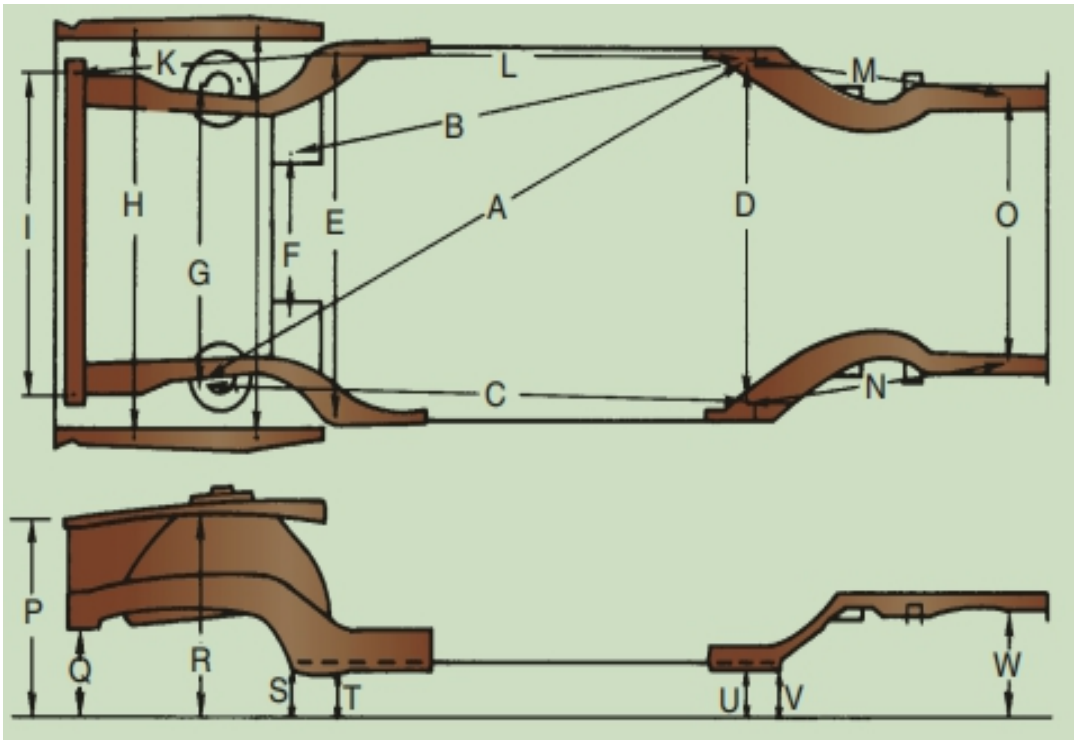


Figure 10 Many body technicians find it is easier to substitute letters for numbers when making up a tabulation chart. If the manual drawing has only letters, you need to refer to the accompanying chart giving number values for each letter

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. ?(3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

1. (2pts)

2. (2pts)

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 6- Documenting accurately and completely the results of measurements of vehicle alignment.

6.1. Report writing

As technicians you may be called on to produce a report for a customer. If you are involved in research of some kind, it is important to be able to present results in a professional way. The following sections describe the main headings that a report will often need to contain together with an example report based on the performance testing of a vehicle alternator.

Laying out results in a standard format is the best way to ensure all the important and required aspects of the test have been covered. Keep in mind that the report should convey clearly to another person what has been done. Further, a 'qualified' person should be able to extract enough information to be able to repeat the test – and check your findings. Use clear simple language remembering that in some cases the intended audience may not be as technically competent as you are.

4.2. Main headings of a report

The following suggestions for the headings of a professional report will cover most requirements but can, of course, be added to or subtracted from if necessary. After each heading, I have included brief notes on what should be included.

A. **Contents :-** If the report is more than about five pages, a list of contents with page numbers will help the reader find his or her way through it.

B. **Introduction:-** explain the purpose of what has been done and set the general scene.

C. **Test criteria :-** define the limits within which the test was carried out. For example, temperature range or speed settings.

D. **Facilities/Resources :-** State or describe what equipment was used. For example: 'A "Revitup" engine dynamometer, model number C3PO was used for the consumption test'.

E. **Test procedures :-** explain here exactly what was done to gain the results. In this part of the report, it is very important not to leave out any details.

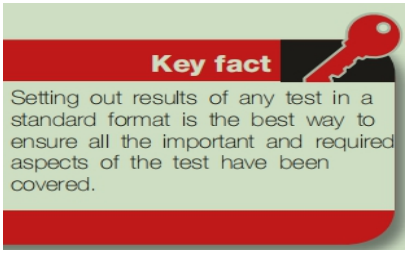
F. **Measured results :-** Present the results in a way that is easy to interpret. A simple table of figures may be appropriate. If the trend of the results or a comparison is important, a graph may be better. Pictures of results or oscilloscope waveforms may be needed. If necessary a very complex table of results from which you draw out a few key figures could be presented as an appendix. You should also note the accuracy of any figures presented (**+/-** 0.5% for example).

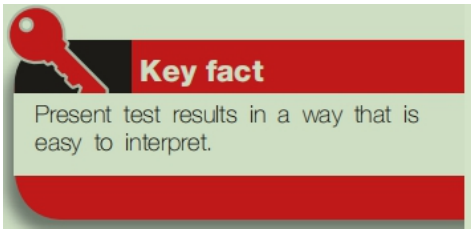
G. **Analysis of results :-** this is the part where you should make comment on the results obtained. For example, if, say, a fuel consumption test was carried out on two vehicles, a graph comparing one result to the other may be appropriate. Comments should be added if necessary, such as any anomaly that could have affected the results (change of wind direction for example).

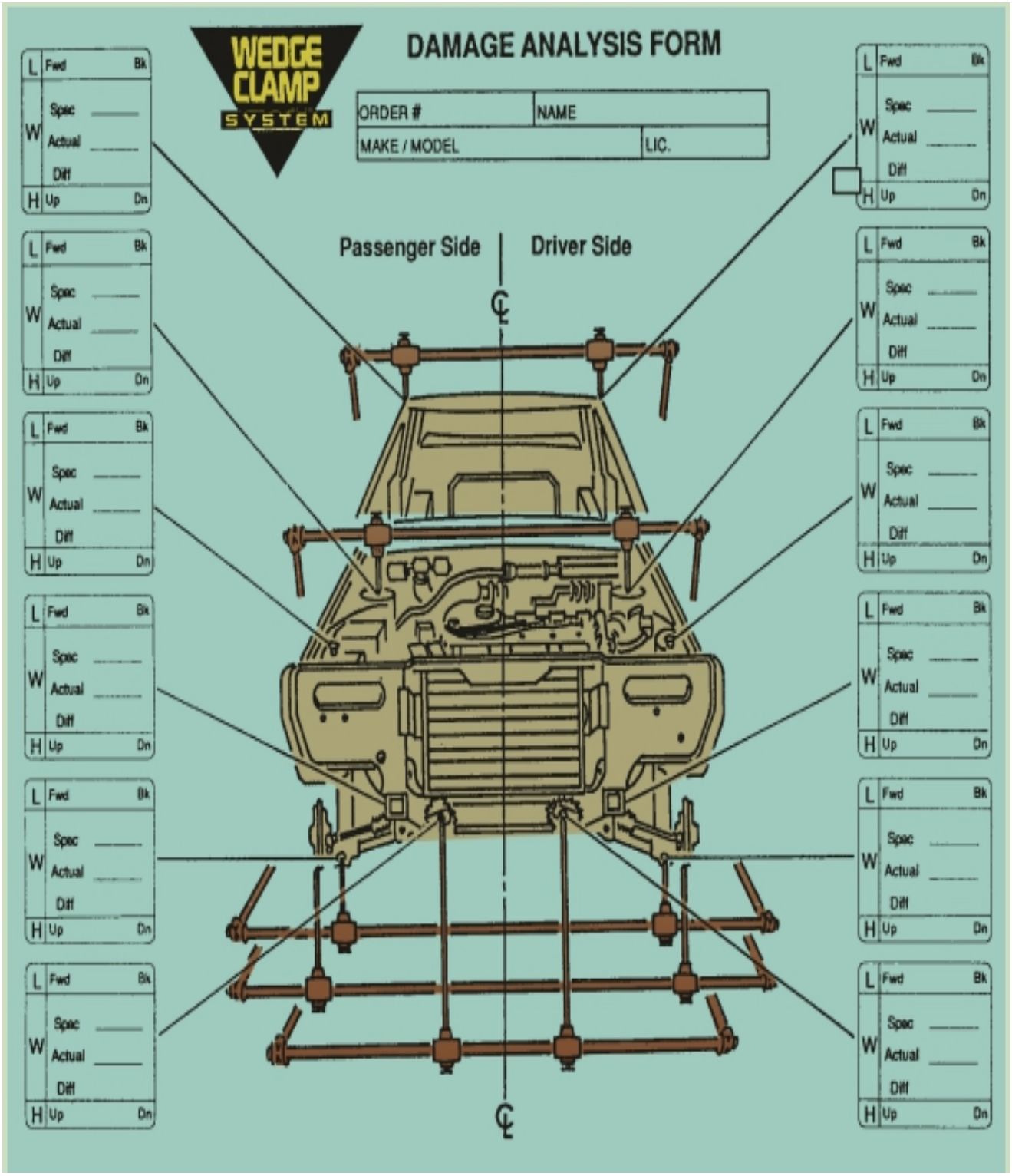
H. **Conclusions/Comments/Observations:-** Note here any further tests that may be necessary. Conclude that device X does perform better than device Y – if it did. If appropriate, add observations such as how device Y performed better under the set conditions, but under other circumstances the results could have been different. Comment on the method used if necessary.

I. **Forecast :-** If necessary comment on how the 'item' tested will continue to perform based on the existing data.

J. **Appendices :-** Detailed pages of results that would 'clog up' the main report or background material such as leaflets relating to the test equipment.






WEDGE CLAMP SYSTEM
DAMAGE ANALYSIS FORM
ORDER #
NAME
MAKE / MODEL
LIC.
Passenger Side
Driver Side
L Fwd Bk
W Spec Actual Diff
H Up Dn

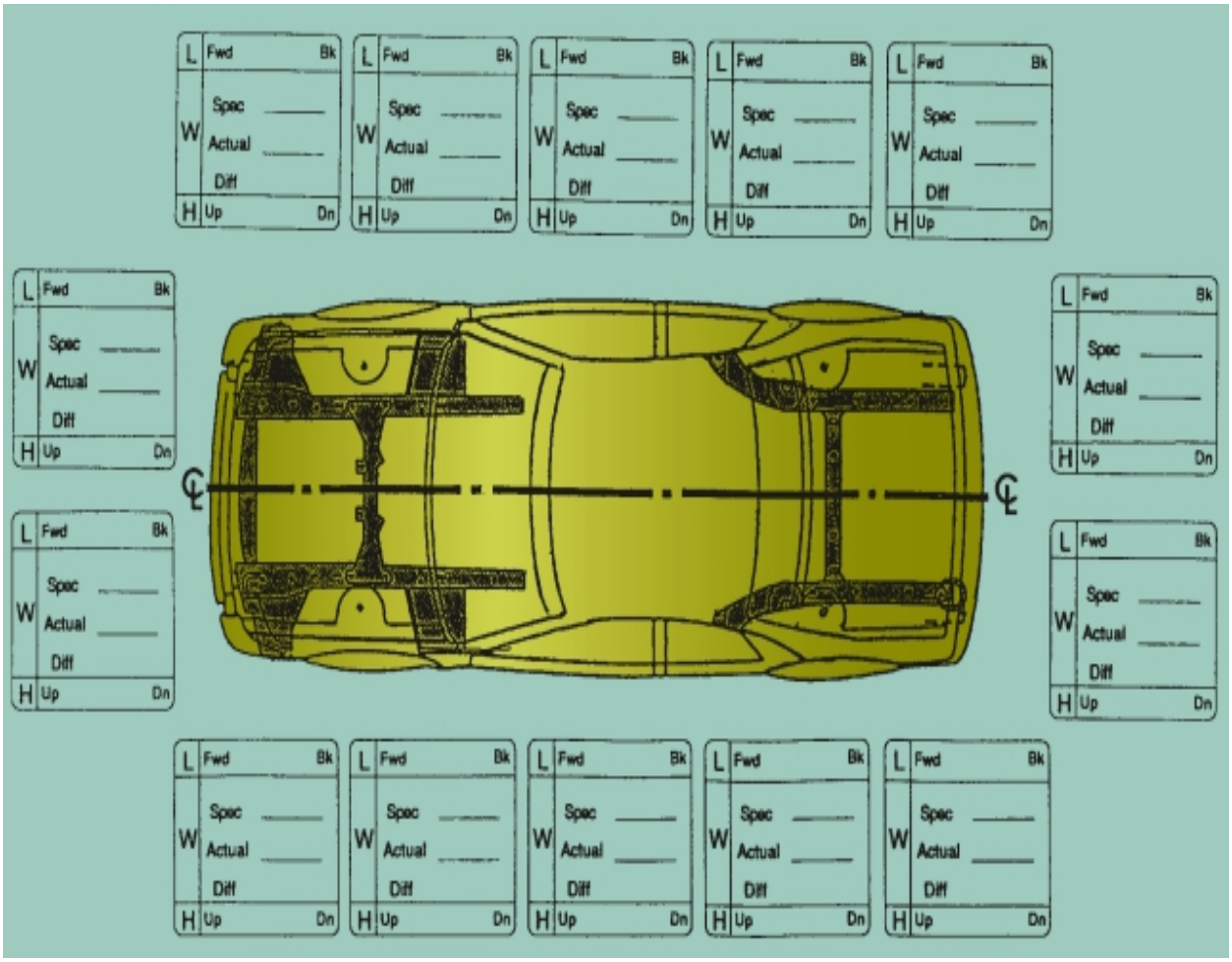


Figure 11 A damage analysis form will simplify the frame/body straightening task. Write down the specifications from the manual. Then, measure and record values taken from the vehicle. By subtracting the two measurements, you can determine the direction and extent of damage.

Self-Check – 6	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

2. ?(3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

3. (2pts)

4. (2pts)

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet	**7- Carrying out measuring activities according to industry regulations/guidelines, WHS legislation, and enterprise procedures/policies.**

7.1.

Self-Check – 7	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

3. ?(3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

5. (2pts)

6. (2pts)

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Operation Sheet 1– Perform measurement on vehicle body panel

Objectives ;

Procedures

LAP TEST	Performance Test

Name…… ID……Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **6** hour. The project is expected from each student to do it.

Task 1:

Task 2:

LG #44	LO #3- Produce patterns and templates

Instruction sheet

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

- Producing paper patterns from sample panel or simulated frame, indicating panel size, panel shapes and all folds and edges
- Producing templates from sample panel or simulated frame
- Identifying the difference between convex and concave shapes correctly

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

- Producing paper patterns from sample panel or simulated frame, indicating panel size, panel shapes and all folds and edges
- Producing templates from sample panel or simulated frame
- Identifying the difference between convex and concave shapes correctly

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1-Producing paper patterns from sample panel or simulated frame, indicating panel size, panel shapes and all folds and edges.

1.1. Introduction

Making patterns or pattern developments is an important part of industrial drafting. Familiar items such as **pipes**, **ducts** for hot- or cold air systems, parts of buildings, **aircraft**, **automobiles**, **storage tanks**, cabinets, boxes and cartons, and countless other items are designed using pattern developments.

To make such items, a drafter must first draw them as a pattern or pattern development. A pattern development, also called a stretch out or simply a development, is a full-size layout of an object made on a single flat plane. A development that is not full size is not a pattern; it is simply a drawing or representation of the pattern. Therefore, outlines for very large objects drawn at a reduced scale are not pattern developments.

The pattern is the original part of the pattern development from which flat patterns can then be cut from flat sheets of material that are folded, rolled, or otherwise formed into the required shape (See Figure 12).

Materials used include paper; wood; fiberboard; fabrics; various cardboards, plastics, and films; metals such as steel, tin, copper, brass, and aluminum; and so on.

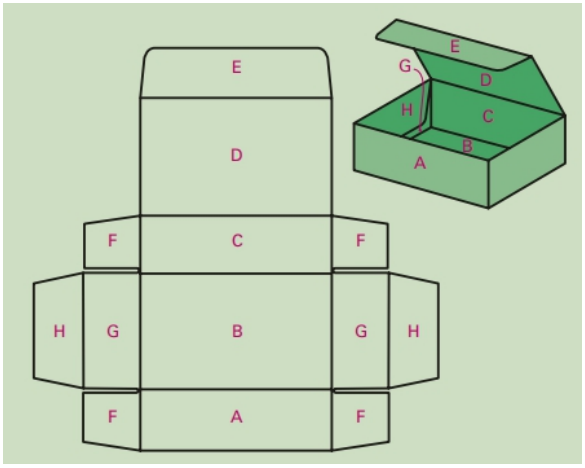


Figure 12 Pattern development and pattern

1.2. Producing paper patterns from sample panel or simulated frame

1.2.1. Why we require pattern for body part?

If the vehicle panel part is partially damaged by different reason (collusion / rust) and if it is not repairable we need to produce paper patterns from sample panel or simulated frame, indicating panel size, panel shapes and all folds and edges for replacement .

1.2.2. Reasons for panel replacement

If the damage to a particular section of your vehicle's body is too great to be repaired, or it would be less expensive to simply replace the part then spend the time repairing it. Fortunately cars are made up of sections that can be removed and replaced should they become too damaged.

These are the most common types of body panel replacements done at auto body repair shops.

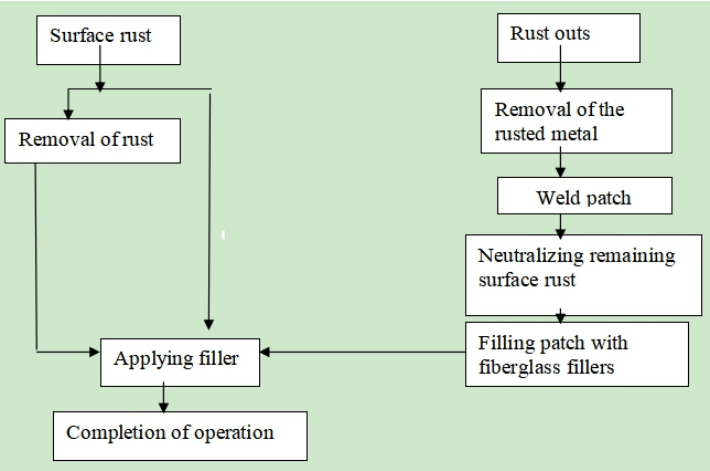
- Fender replacement
- Quarter panel replacement
- Door replacement
- Hood replacement
- Trunk lid replacement
- Bumper replacement

1.2. 3. Repairing rust damage

Corrosion damage on vehicle panels takes two forms: **surface rust** and **rust outs**.

- **Surface rust** in its early stage can simply leave a reddish coating on the metal surface. Given time, the rust will cut pits in to the surface.
- Eventually the pitting will develop in to holes, or **rust outs**. Both types of damage require different repair procedures. These are outlined in the table below.

Table 2 Repairing rust damage



Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

Test II Write true if the statement is correct and false if statement is incorrect

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 2- Producing templates from sample panel or simulated frame

2.1. Introduction

The art of hand-forming sheet metal into complex shapes almost seems like black magic in this age of high-volume production and exotic materials. But there are a lot of persons who still know one end of an English wheel from the other and aren't scared of a planishing hammer.

Figure 13 Manufacturing quarter panel

The original job was to do just **the quarter panel**, but the door skins then needed to be redone to smooth the transition from front to rear

Figure 14 pattern for quarter panel

2.1. Body bucks

To create the sample quarter . some of professionals use wooden buck, and form the two quarters that will eventually go on the car.

Figure 15 bucks for panel

At its essence, coach building involves the complete crafting of a vehicle's body floor pan, firewall(s), roof, and exterior panels. While all of these require time, skill, and the right tooling to complete, it is the creation of exterior panels around body bucks that is most associated with the art.

There are two main types of body buck,

1. **Metal rod bucks:-** is generally made with 6 mm rod to resemble the shape and detail of the car.
2. **Wooden bucks,** In the creation of a wooden buck, the vertical stanchions tend to be placed approximately 350 mm apart, secured to each other with longitudinal to give the plan shape. With a wooden buck, it is possible to fill in sections to form solid areas over which the metal can be hammered to shape. This is particularly helpful when panels have to be turned over edges to form radius-ed entry to ducts.

Figure 16 wood bucks

Figure 17 Wire Frame Car Body Buck

When the panels are being shaped with the English wheel, power hammer, or on a wooden stump, they are regularly trial fitted on the relevant area of the buck to check the contour. A successfully moulded panel will be able to touch the buck without gaps. The wooden buck outlines the shape of the rear quarter and is reversible by swapping the pieces from one side of the backing board to the other.

- Paper patterns were created off the original sample panel. They show the size and shape of each piece and are held in place by small magnets. When laid on a flat piece of sheet steel the pattern is used to outline the shape of each section.

Figure 18 panel pattern preparation

Note:- The above pattern shape will transfer to selected sheet metal read next **LO4 info sheet # 2**

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

3. ?(2pts)

4. ?(2pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

3. . (2pts)
4. . (2pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

You can ask you teacher for the copy of the correct answers.

Information Sheet 3- Identifying the difference between convex and concave shapes correctly

1.1. Convex and concave shapes

Concave

- Describes shapes that curve inward, like an hourglass.
- Is a surface or a line that is curved inward

Convex

- Describes shapes that curve outward, like a football (or a rugby ball).
- A convex shape is the opposite of a concave shape.
- It curves outward, and its middle is thicker than its edges.

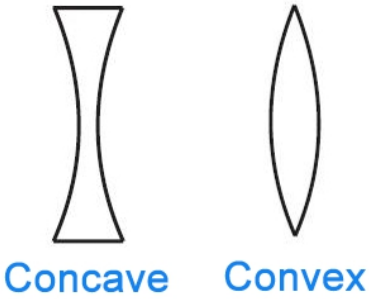


Figure 19 Concave and convex shape

3.2. Convex and concave shapes on body panel

During repairing the vehicle body panel we must consider the construction of body shape (**concave or convex**).

Figure 20 Concave shape door panel

Figure 21 Convex shape door panel

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

5. ?(3pts)
6. ?(1pts)

Test II:write true if the statement is correct and false if the statement is incorrect

3. (2pts)
4. (2pts)

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Operation Sheet 1–

Objectives ;

Procedures

LAP TEST	Performance Test

Name…… ID……Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **6** hour. The project is expected from each student to do it.

Task 1:

Task 2:

LG #45	LO #4- Cut material

Instruction sheet

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

- Selecting and checking panel steel or aluminium sections for quality
- Transferring patterns and templates to steel or aluminium sheet surface.
- Using selected hand tools to cut steel or aluminium based on pattern and panel specification
- Filling panels to remove sharp edges

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

- Select and checking panel steel or aluminium sections for quality
- Transfer patterns and templates to steel or aluminium sheet surface.
- Use selected hand tools to cut steel or aluminium based on pattern and panel specification
- Fill panels to remove sharp edge

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
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9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1-Selecting and checking panel steel or aluminium sections for quality

1.1. Selection criteria of panel material

- **Low cost manufacturing** in the automotive industry is one of the main objectives due to the ever increasing global competition. Low cost production is often connected with the term **lightweight manufacturing** though in many cases lightweight technologies may increase the cost of production due to the need of new processes and equipment.
- Lightweight manufacturing in the vehicle industry is in the forefront of research activities for several reasons: there are very strict and further increasing rigorous environment restrictions concerning the amount of **harmful emissions,** and simultaneously to meet **higher safety requirements**.
- In the fulfilments of these requirements, the weight reduction has an important role. Concerning the overall weight of an automobile the car body has a decisive role. In the production of car body elements often termed as body-in-white production.
- **Sheet metal forming** is regarded as one of the most important manufacturing processes. This is why the elaboration of new, innovative low cost manufacturing processes is one of the main objectives in sheet metal forming: among these new processes, lightweight production principles are of utmost importance. The two main trends for producing lightweight automotive parts are the application of high strength steels or lightweight materials – especially various high strength aluminium alloys.

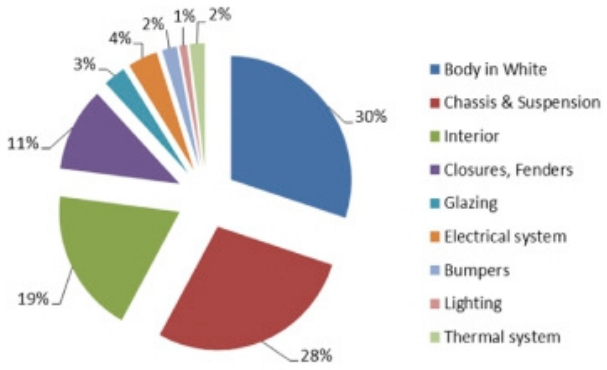

Figure 22 Weight ratio of various vehicle components

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

Test II Write true if the statement is correct and false if statement is incorrect

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 2- Transferring patterns and templates to steel or aluminium sheet surface.

2.1. Introduction

We uses a pen over the top of the paper templates to score out the shapes of the four separate pieces that will make up the rear quarter, also we can uses masking tape to show the lines clearly.

- Here are as example the four pieces marked out on a fresh piece of 1mm CA3-grade steel sheet. Creating the rear quarter out of one single piece is possible, but would be much harder to manage due to its unwieldy size, so its better to do separate part and fix finally.

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

5. ?(2pts)
6. ?(2pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

5. . (2pts)
6. . (2pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

You can ask you teacher for the copy of the correct answers.

Information Sheet 3- Using selected hand tools to cut steel or aluminium based on pattern and panel specification

1.1. Cutting

You can't start metal work without first cutting your sheet metal to an approximate shape and size. The cutting of metal is a step that is perhaps taken for granted, when compared with the more glamorous aspects of shaping and forming custom panels. While many cuts can be completed through the use of a trusty angle grinder and cut-off wheel, professional coach builders often prefer other cleaner, quicker, and more accurate methods, such as using an oxyacetylene cutting torch or a plasma cutter, each of which has its own unique advantages and disadvantages.

A. **oxyacetylene cutting torch**

An oxyacetylene cutting torch is a reasonably simple device, fuelled by separate oxygen and acetylene tanks. When the acetylene flow from the nozzle is ignited, it is concentrated on the surface to be cut until the cut line glows red. Activating the oxygen trigger feeds oxygen to the surface, and the reaction of oxygen with the metal forms iron oxide. An oxyacetylene mixture burns at upwards of 3000°C, and, as iron oxide has a significantly lower melting point, it is liquefied and runs from the cut line.

- One of the biggest advantages of an oxyacetylene set-up is its versatility. As long as there is gas and an ignition source, it can be used.

B. **Plasma cutter**

Plasma cutting is effectively a more technologically advanced version of oxyacetylene cutting, operating under different principles to achieve the same result.

A plasma cutter operates as an electrical circuit, using the metal item as an earth and an electrode in the nozzle as the electrical supply. Compressed gas often oxygen is blasted from the nozzle to the work surface and is ionized by the electrical arc to complete the circuit. The stream of ionized gas, known as '**plasma**', generates extreme heat capable of melting the metal directly in its path, blasting the molten metal clear of

the work surface.

A plasma cutter can efficiently cut through very thick pieces of metal but requires an electrical supply to do so. It is also a complex unit of machinery, and this is reflected in the cost price.

For lighter gauge sheet metal, when precision isn't necessary — such as the beginning of a patch panel you can't beat going manual. This means tin snips, and while it is possible to get a range of air- and electric-powered nibblers, suitable hand-operated tin snips will allow the coach builder to quickly and easily cut out straight and curved sections of sheet metal to be shaped.

1.2. Air nibbler

- The boys use an air nibbler to cut out the rough shapes quickly, staying well outside the masking tape boundary. The size of the main sheet makes it too hard to cut the pieces out with any kind of precision at this point.

Figure 23 Cut out air nibbler

- Hand shears are used to cut away the excess from each piece. Doing this by hand is time consuming and tiring, but the precision is worth it. Then the tape is peeled away and the edges are filed.

Figure 24 hand shear cutting excess

- Here are the four pieces in a flat arrangement as they will sit relative to the **HQ**. There's a stack of work to be done to create the necessary curves and body lines – time to bring in the big guns.

Figure 25 Joining separately formed panels

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

7. ?(3pts)
8. ?(1pts)

Test II:write true if the statement is correct and false if the statement is incorrect

5. (2pts)
6. (2pts)

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 4- Filing panels to remove sharp edges

4.1. Filing

Filing is one of the most important aspects of finishing a body panel. It is carried out using an adjustable file holder, fitted with flexible blades which can be adjusted concave or convex to suit most contours on the average vehicle body.

Initially the file is used

- For removing sharp edge on tip of sheet metal after cutting
- For smoothing off panels prior to sanding
- Locating high and low spots.

With the introduction of body solder and later metal and plastic fillers, filing took on an even greater importance in the finishing of repairs on body panels.

Filing indicates any irregularities in the repaired surface of a panel, and is carried out as the panel is planished.

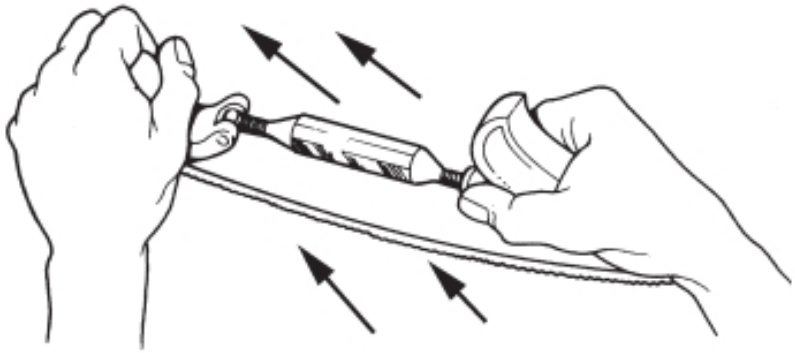

Figure 26 The technique of filing

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

- **Cross filing** means a change in the direction of the file strokes so that the file is moved at an angle between **45º**and **90º** over the previous file strokes, thus checking the accuracy of the curvature in that direction. After filing, and prior to refinishing the panel, the damaged area is sanded using a fine-grit sanding disc which leaves a smooth, even surface ideally suited for painting.

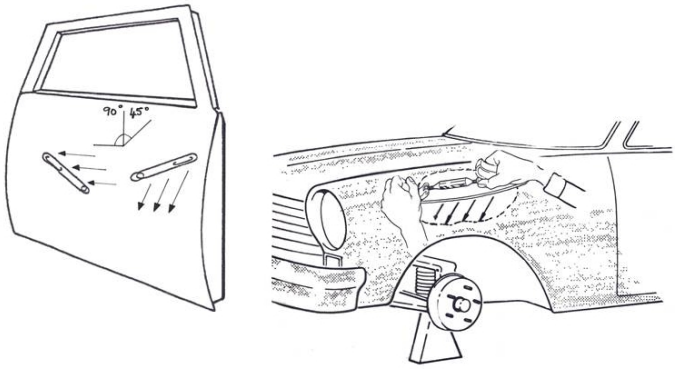

Figure 27 cross filing

4.3. Grinding Techniques

- Use of grinder
- Sanding discs

Several general rules govern the use of the disc grinder. If these are observed they will enable the operator to become proficient very quickly in the use of the grinder.

The rules are considered good shop practice and are directed towards the safety of the operator.

In the first instance, if the device is electrically operated see that it is properly connected and earthed. Shop floors are usually of cement, they are generally moist and therefore, relatively good conductors of electricity. If the grinder is not properly earthed it is possible to receive a fatal electric shock when the machine is in use.

Self-Check – 4	Written test

Name…… ID……. Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

2. (3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

5. . (2pts)
6. (2pts)

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Operation Sheet 1–

Objectives ;

Procedures

LAP TEST	Performance Test

Name…… ID……Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **6** hour. The project is expected from each student to do it.

Task 1:

Task 2:

LG #46	LO #5- Shape panels
Instruction sheet	

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

- Selecting panel shaping equipment and hand tools are, including 'English' wheeling machine
- Identifying and fabricating required shapes to pattern specification, following WHS and workplace environmental practices
- Checking shaped panel sections against pattern and template specifications for quality requirements finish and conformity
- Inspecting fabricated panel sections for quality finish and fits to sample panel or frame
- Fitting Panels to vehicle or frame without distortion

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

- Selecting panel shaping equipment and hand tools are, including 'English' wheeling machine
- Identifying and fabricating required shapes to pattern specification, following WHS and workplace environmental practices
- Checking shaped panel sections against pattern and template specifications for quality requirements finish and conformity
- Inspecting fabricated panel sections for quality finish and fits to sample panel or frame
- Fitting Panels to vehicle or frame without distortion

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8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Selecting panel shaping equipment and hand tools are, including 'English' wheeling machine.

1.1. Panel beating: forming panels by hand

Essentially, panel beating is a hand method of producing hollow or double-curvature shapes by means of hammering. Nevertheless, the panel beater's craft still retains its place in body work and as yet is irreplaceable by more modern methods; in spite of the tremendous developments in recent years of mechanical methods of forming, panel beating remains an essential means of fabrication of special parts. Some metal shapes cannot be produced at all by mechanical methods and others only with great difficulty, and in such cases panel beating is used to finish the shape that has been roughed out by power processes.

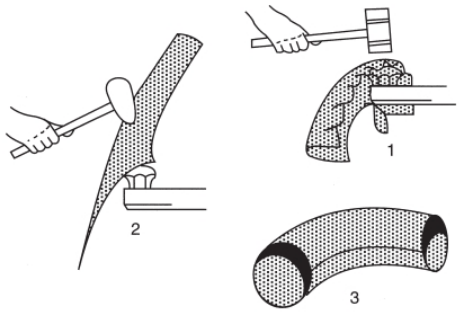

Figure 28 Shaping metal by hand

A. Hollowing

One of the methods of shaping metal by hand is that of hollowing (Figure 28). In this method the metals used for the purpose of shaping panels for body work applications are usually aluminium and its alloys and mild steel; aluminium is by far the easier of the two to shape owing to its higher ductility and malleability properties. This is a process of shaping a sheet metal blank into a double-curvature shape by beating the blank into a sandbag or hard wood block with the aid of a pear-shaped boxwood mallet, or for thin metal a rubber mallet, or for steel a hollowing hammer with a steel head

Figure 29 The technique of hollowing

B. Raising

Raising is another method of shaping metal by hand into a double-curvature shape (Figure 29). The method of raising is carried out by drawing the metal in courses over a suitably shaped steel stake or wood block, using floating blows which are struck slightly off the stake with a boxwood pear-shaped mallet. A series of blows is made in the metal starting at the centre, the blows being struck slightly off the stake.

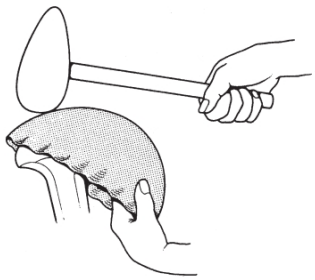

Figure 30 Raising

C. Split-and-weld system of shaping metal

The introduction of welding into the panel beater's craft has led to the development of split-and-weld panel beating, which is at once less laborious and much quicker than the older methods of hollowing and raising. The system consists of making a pattern on a panel jig with pattern paper. The paper is held off the jig by tension at its edge. To allow the paper to drop on to the jig, the paper is slit at suitable points, the edges then opening out to let the pattern fall into position (Figure 30).

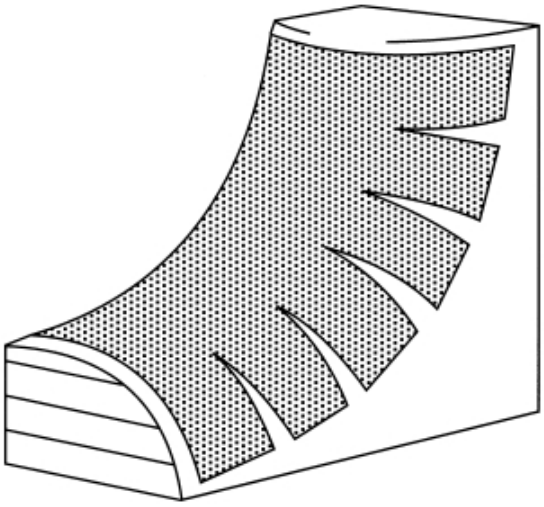

Figure 31 Split and weld pattern

D. Planishing

The technique of planishing is a very old and established craft in the history of hand-fabricated metal articles. Basically planishing takes over from hollowing and raising, which shape the article, to smooth its entire surface and finalize its shape. Planishing can be performed in three different ways. First, there is the technique which is used mostly by the panel beater in planishing new work. In this case a planishing hammer is used in conjunction with a steel stake, both having highly polished faces. The steel stake is mounted on a bench and is of suitable curved shaped for the article being planished. The work is taken to the stake and planished over it to achieve the final finish (Figure 31).

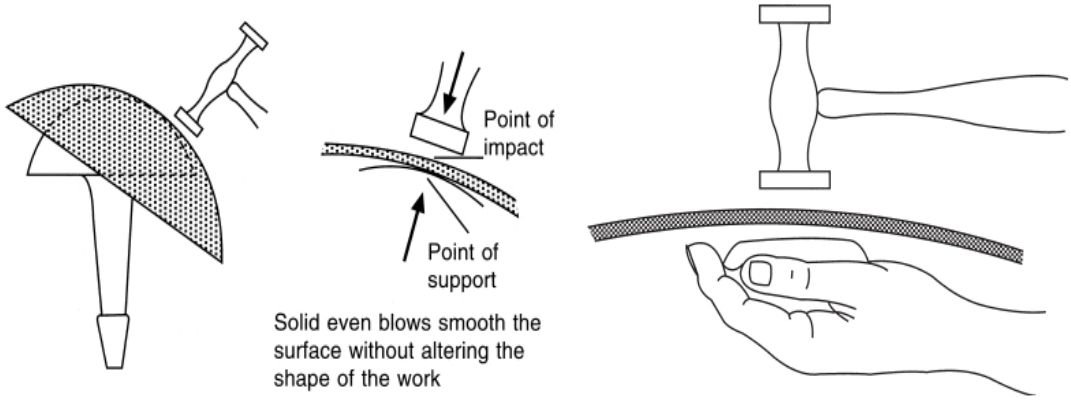

Figure 32 Planishing using a steel stake and dolly and hammer

E. English 'wheeling'

Figure 33 Wheeling a panel to restore a vintage

To use an English wheel is known as ‘wheeling’ and is often required for compound curves in the repair and manufacture of automotive panels. Panels produced this way require highly skilled labour, but the method has the flexibility to produce different panels using the same machine.

The English wheel is shaped like a large, closed letter ‘C’. At the ends of the C, there are two wheels. The upper wheel is known as the ‘rolling’ wheel, while the lower wheel is called the ‘anvil’ wheel. The anvil wheel usually has a smaller radius than the rolling wheel. The rolling (top) wheel is flat in cross section, while the anvil (bottom) wheel is domed.
Operating the machine requires the sheet metal to be passed between the anvil wheel and the rolling wheel. This process stretches the material and causes it to become thinner. As the material stretches, it forms a convex surface over the anvil wheel. This surface is known as ‘crown’ and provides the rigidity and strength in the surface of the work piece.

Key tool: English wheel
The top rolling wheel and the bottom anvil wheel are adjustable to suit the exact requirements of each particular job.

Expert tip: “When using an English wheel, it’s always easier with two people to ensure a consistent shape.”

F. Swaging

Figure 34 ‘Swages’

‘Swages’ are grooved tools used by traditional panel beaters to form shapes in metal that may be too difficult to make with a hammer alone. ‘Swaging’ is a technique in which

cold metal is formed over a swage. The technique is also used in the joining of two panels when an edge of one panel is swaged so as to overlap the other to create the impression of one continuous surface.

A swage puts a furrow or groove through a section of sheet metal for decorative purposes or for the purpose of increasing its rigidity. It is often used in larger areas of sheet that require stiffening and increased structural strength.

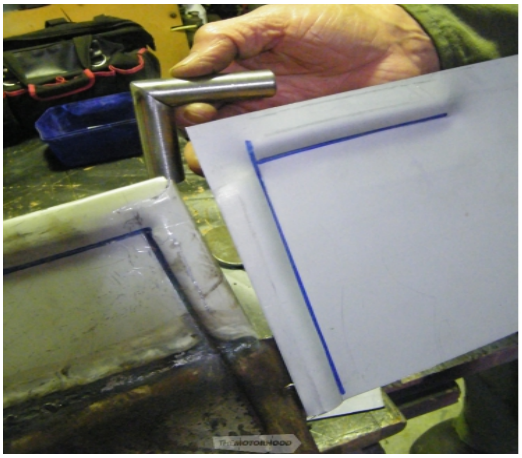

Figure 35 swagged panel

Swagging machines come in different sizes with a variety of interchangeable dollies, which come in male and female sides. These allow the worker to create different swage shapes or profiles, and can be used in new work or to match swags used in existing panels while in the process of repair or replacement. Custom-made jigs can be used to finish the swage or complete corners in specific jobs.

Expert tip: “When swaging freehand shapes, use two people; smooth, even speed; and get in a comfortable position for guiding. Again, when wheeling, ensure correct height, and smooth, even wheeling, and don’t be afraid to experiment with the pressure on the wheel.

G. Edge shrinking and spreading

Edge shrinking and spreading are key skills in many aspects of panel production and repair in classic motor vehicles. This can be done through manual techniques utilizing a hammer, or with the help of a mechanical spreader.

Heat can be applied to a damaged area of the panel and a special hammer used to

reshape the metal. This technique is used together with planishing to restore the panel to its original shape and contours.

The folding machine and the mechanical spreader can be used to create curved and flanged sections like those often found in rusted bases of door pillars or door corners.

Figure 36 Edge shrinking

Key tool: shrinker stretcher

The shrinker stretcher is perhaps the most bang-for-buck item in terms of metal shaping. Modern shrinker stretchers operate so as to negate the need for more labour-intensive processes, including relief cuts, heating, and hammer shaping. This allows the operator to add a gentle radius to a metal panel by either shrinking or stretching, and its versatility means that it can be used to form patches for just about any panel repair.

Figure 37 shrinker stretcher

Expert tip: “Before you start shaping metal for wheeling, swaging, or hammer forming, consider the type of material or metal you use. Cold rolled or deep drawn is best, as it is softer and more malleable.”

1.2. Hammering techniques

Unlike most other trades, where the hammer is used with a follow-through action from a combination of wrist, elbow and shoulder, in the skilled hands of a body repair worker the planishing hammer swing is a rhythmic action involving finger and wrist movement, producing a ringing blow (Figure 37). The hammer should not be held tensely, but during the complete cycle of movement it should be held loosely in the hand. This will achieve a higher degree of accuracy and at the same time help to reduce fatigue. This loose holding of the hammer applies equally to dolly blocks, as it permits them to bounce back naturally and to assume the correct position for striking the next blow.

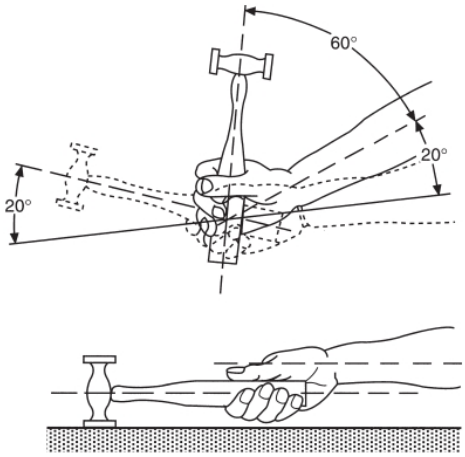

Figure 38 Swing of the planishing hammer

Roughing out damage

In minor repair work which can be carried out using hand tools, the first major operation is to reshape the damaged area back to its original contour. This is done by a technique known as roughing out, which must be carried out prior to any finishing process such as direct hammering or planishing.

Roughing out is the reshaping of the area by hand with the aid of a heavy dolly, which forces back the damaged section to its original shape (Figure 38). When repairing collision work, the normal method of correction is to reverse the process which caused the original damage. In a case of minor repair the point of impact is now the lowest part of the damage. To reverse the process this point on the underside of the panel should be struck using the same force as was originally directed against it.

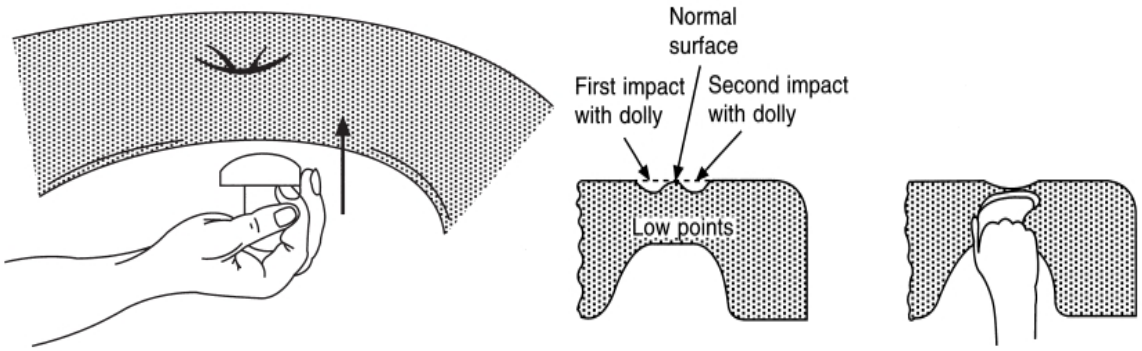

Figure 39 The technique of roughing out damage

A. Direct hammering

Direct hammering is in fact the process of planishing, and the body repair worker uses it as a finishing process after the work has been preshaped and roughed out (Figure 39). Before using the hammer and dolly together, it will be necessary to clean the underside of the portion of the wing or panel on which you will be working. Body panels and wings are covered with a sound deadening material which must be removed before starting the work.

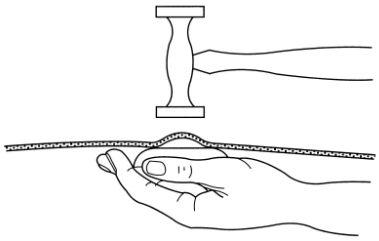

Figure 40 The technique of direct hammering

B. Indirect hammering (off the dolly block)

Indirect hammering is another technique which uses hammer and dolly to level a panel surface. A low area can be raised by hammering round the outer edges in such a manner that the rebound action of the block tends to push the low area upwards to its original contour. This in fact is achieved by the sequence of hammering just off, or at the side of, the dolly block; hence the name of indirect hammering (Figure 40). This technique is used in conjunction with direct hammering or planishing to achieve a final finish on the panel surface.

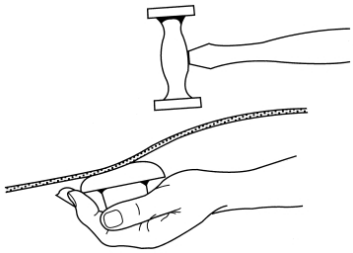

Figure 41 The technique of indirect hammering

C. **Spring hammering**

This is another technique of using hand tools to smooth and level a panel surface. In this case only a hammer is used, and it is not supported with a dolly block. The technique is used to reduce high spots which sometimes form as a panel is planished. In some cases these high spots can be reduced by careful, controlled hammering which

spreads the force of the blow over the area of the metal, thus reducing the high spot. When a crown or curved surface is formed in a metal panel, it becomes strong in that it resists any change to its shape. The strength of this crowned surface can be used to support the surface being hammered without the use of a dolly. This type of hammering is called spring hammering, and can be used to correct high spots on metal panel surfaces (Figure 41). To take advantage of a great amount of the natural support provided by the crown of the metal, the force of the hammer blow is spread over a larger area.

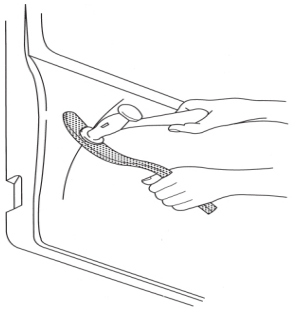

Figure 42 The technique of spring hammering

D. Removing low spots

Low spots can be removed in several ways, the two most common being the use of a pick hammer or a dolly block. When using the dolly block, start by holding it so that it can strike the underneath of the low spot on the panel with one of its rounded corners. It must be noted that if the operator does not hit exactly in the centre of the low spot, he will raise metal in some unwanted place.

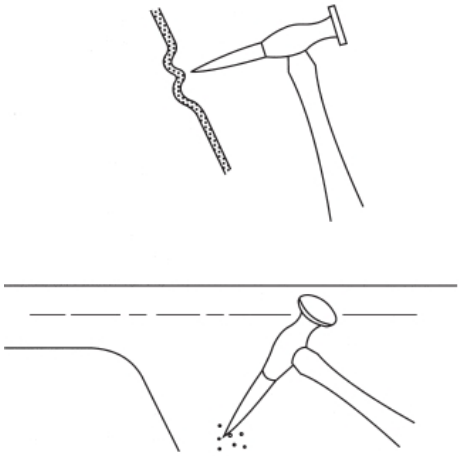

Figure 43 Pick hammering used to remove low spots

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

Test II Write true if the statement is correct and false if statement is incorrect

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 2- Identifying and fabricating required shapes to pattern specification, following WHS and workplace environmental practices

2.1. Introduction

The biggest metal-shaping tool **power hammer**. It does the same job as an **English wheel** – shaping panels – but uses a cyclical up-and-down motion controlled by a speed-sensitive foot pedal. Definitely requires ear-protection!

Figure 44 Fabricating sheet metal with power hammer

Remember the paper patterns? Well they have measurements all along them that correspond to points on each panel, and these cardboard templates are used to check the shape of the curves

Figure 45 checking accuracy of formed sheet metal by using pattern

The buck also comes in handy for holding pieces in place. Here, we see the top of the rear quarter fixed in the correct position while panel bitter works the back corner into shape.

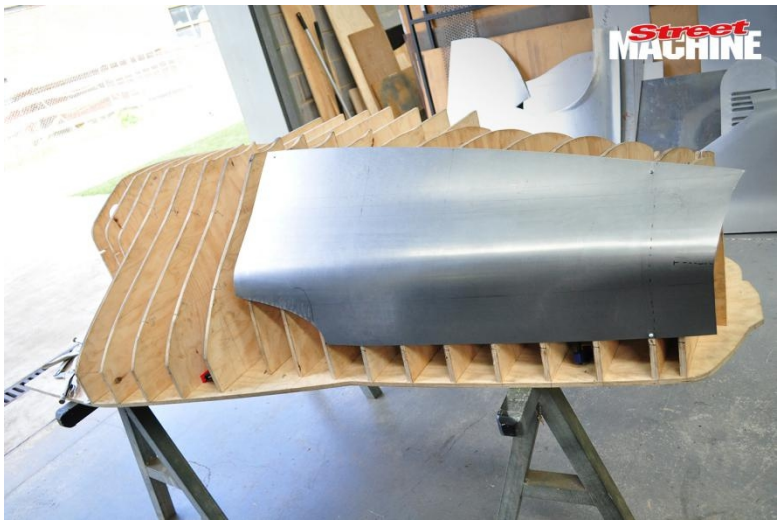

Figure 46 buckle holding pieces in place

From there it's back to Yoder to shrink the metal of that same back corner. "Other than speed, this is the main advantage of a power hammer over an English wheel, "You can stretch metal with an English wheel, but you can't shrink it".

Figure 47 the metal shrinking process

The Pull max can do all kinds of things depending on the dies used. In this case the

technician is making a fold line on the edge of the panel. Like the power hammer, the bottom die is stationary while the top die rapidly cycles up and down

Figure 48 Forming shape with Pull max

Not everything can be done with power tools; there's still plenty to do with the good old hammer and dolly. The bag on top of the panel, filled with lead shot, helps hold the piece in place.

Figure 49 forming metal with hammer and dolly

The **shrinker/stretcher** does exactly what you think. Two pairs of jaws clamp on the edge and pull away from each other to stretch, or push towards each other to shrink,

which helps make curves in panel edges

Figure 50 Making curves with shrinker/stretcher

Several models of metal forming tools are available. They include the following:

- Heavy Cast Iron Deep Throat Shrinker/Stretcher
- Super Duty Shrinker/Stretcher
- Double Foot Operated Shrinker / Stretcher
- Deep Throat Shrinker/Stretcher
- Portable Shrinker/Stretcher.

Self-Check – 2	**Written test**

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

7. ?(2pts)
8. ?(2pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

7. . (2pts)
8. . (2pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

You can ask you teacher for the copy of the correct answers.

3.1. Checking shaped panel sections against pattern

With the two top pieces roughly in the correct shape, they're screwed to the buck in preparation for welding together. The two bottom pieces will also be welded together to create an upper and lower section

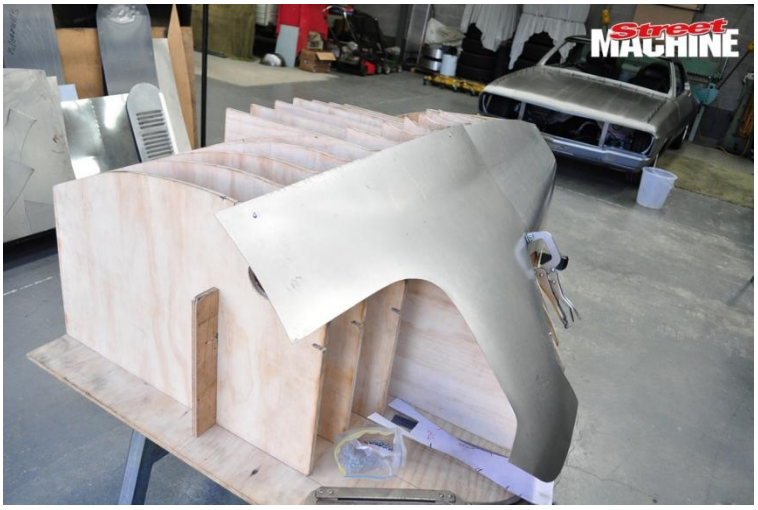

Figure 51 Preparation of panel on buckle for welding

With two halves bent, beaten and pressed into shape, they're screwed to the buck and the overlapping material is removed. Any remaining excess is trimmed away with hand shears so the two halves butt up against each other

Figure 52 Trim away unwanted part which prevents lap joint

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

9. ?(3pts)
10. ?(1pts)

Test II:write true if the statement is correct and false if the statement is incorrect

7. (2pts)
8. (2pts)

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 4- Inspecting fabricated panel sections for quality finish and fits to sample panel or frame

4.4.

4.4.1. H

4.4.2.

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

3. (3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

7. . (2pts)
8. (2pts)

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 5- Fitting Panels to vehicle or frame without distortion

1.1. Fitting Panels to the vehicle

Now the pieces are carefully TIGed together, with the buck holding them in place. Tack the panels together first with no filler rod, then he goes over all the joins with the rod.

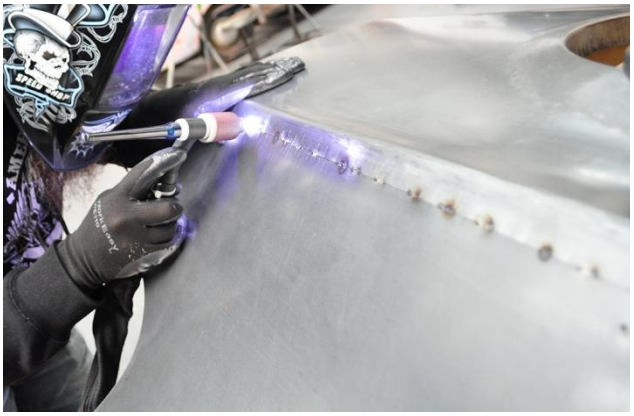

Figure 53 carefully TIG together upper and lower panel

And here the first time the rear quarter is together as one single piece, but there's plenty left to do. The boys don't grind the weld off; they work it with a hammer and dolly and then smooth it flat with an adjustable body file.

Figure 54 filling well all welded areas

Time to test-fit the panel to the car. It's really starting to take shape now and you can see where the custom bumper has been recessed into the rear, requiring some modification to the panel.

Figure 55 fixing quarter panel on the vehicle

The bumper recess is clamped into place prior to welding. Because of the shape, the recess has been created separately and needs to be welded in. As before, Jamie will tack the piece into place using the TIG without filler

Figure 56 Clamp into place prior to welding

This is precision welding. There's no point dumping excessive heat into the panel, especially with a non-structural piece like this. That just creates more work; they don't grind the welds smooth for the same reason.

Figure 57 There's no point dumping excessive heat into the panel

The last piece of the puzzle is the rear window sill, which has to be formed separately before it's welded into position. Imagine trying to create all those curves while wrangling the whole panel around.

Figure 58 Forming rear window sill

Hammers, dollies and body files are the tools of the trade when it comes to finishing off

the sheet metal. But you'll need a whole lot of experience, skill and patience to create metal magic like you've seen here.

Figure 59 body working tools for finishing

Figure 60 The finished product

.

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

4. (3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

9. . (2pts)
10. (2pts)

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Operation Sheet 1–

Objectives ;

Procedures

LAP TEST	Performance Test

Name…… ID……Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **6** hour. The project is expected from each student to do it.

Task 1:

Task 2:

LG #47	LO #6- Clean up work area and maintain equipment

Instruction sheet

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

- Collecting Material that can be reused and stored.
- Removing waste and scrap by following workplace and environmental procedure.
- Cleaning and inspecting tools and equipment and work area for serviceable condition in accordance with workplace procedures.
- Identifying and tagging unserviceable equipment and faults
- Completing operational maintenance in accordance with manufacturer specifications and work site procedures.
- Maintaining tool in accordance with workplace repair procedures

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

- Collect Material that can be reused and stored.
- Remove waste and scrap by following workplace and environmental procedure.
- Clean and inspecting tools and equipment and work area for serviceable condition in accordance with workplace procedures.
- Identify and tagging unserviceable equipment and faults
- Complete operator maintenance in accordance with manufacturer specifications and work site procedures.
- Maintain tool in accordance with workplace repair procedures

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Collecting Material that can be reused and stored

1.1. Introduction

The proper care and storage of materials, tools and equipments are not only the concern of the management but of the workers who use the equipment.

A major responsibility of the technician is to ensure that materials, tools and equipment are maintained in a good condition and are readily available when required for the various work activities. Faulty tools and equipments are a common reason for delays on technical activities.

1.2. Proper storage of material to reused

One of the responsibilities of a shop instructor/trainer is to organize and handle storage in order to protect tools equipments and materials against loose and deterioration. These, the following factors should be given due consideration.

Accessibility:- classification and making

Ease of handling :- based on the weight and bulk of the piece

Inventorying:- protect against un authorized withdrawals of materials

Safety Procedure: - un authorized usage and un necessary damage or deterioration.

However general storage should be:-

- Convenient storage
- Safe storage
- Visible storage

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

Test II Write true if the statement is correct and false if statement is incorrect

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 2- Removing waste and scrap by following workplace and environmental procedure

2.1. Waste Disposal Practices

There are eight major groups of waste management methods, each of them divided into numerous categories. You can start using many techniques right at home, like reduction and reuse, which works to reduce the amount of disposable material used.

- **Methods of Waste Disposal**

I. **Land fill**:- which is the most popularly used method of waste disposal used today. This process of waste disposal focuses attention on burying the waste in the land

II. **Incineration/Combustion**:- which is a type disposal method in which municipal solid wastes are burned at high temperatures so as to convert them into residue and gaseous products. .

III. **Recovery and Recycling**:- It is the process of taking useful discarded items for a specific next use. These discarded items are then processed to extract or recover materials and resources or convert them to energy in the form of useable heat, electricity or fuel.

IV. **Recycling** is the process of converting waste products into new products to prevent energy usage and consumption of fresh raw materials. Recycling is the third component of Reduce, Reuse and Recycle waste hierarchy. The idea behind recycling is to reduce energy usage, reduce volume of landfills, reduce air and water pollution, reduce greenhouse gas emissions and preserve natural resources for future use.

V. **Plasma gasification**:- It is another form of waste management. Plasma is a primarily an electrically charged or a highly ionized gas. Lighting is one type of plasma which produces temperatures that exceed 12,600 °F . With this method of waste disposal, a vessel uses characteristic plasma torches operating at +10,000 °F which is creating a gasification zone till 3,000 °F for the conversion of solid or liquid wastes into a gas.

Trainers are concerned how to handle the disposal of the following three types of materials or tools or equipments.

Scrap:-it is an item or equipment which becomes salvaged after giving service for ample period of time

Surplus:-this refers to the existence of items or equipments in excess of the requirements. Materials or equipments become obsolete as a result of change in technology.

There are three ways of disposing materials. They are:-

1. Transferring to another equivalent organization
2. Selling
3. Discarding the material/equipments

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

9. ?(2pts)

10. ?(2pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

9. . (2pts)
10.. (2pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 3- Cleaning and inspecting tools and equipment and work area for serviceable condition in accordance with workplace procedures

3.1. Cleaning and inspecting tools and equipment

Cleaning up is not just a measure of respect for the workspace, it also removes hazards. Cleaning is so important because when we clean an area, we are also doing some inspection or checking of machinery, equipment, and work conditions.

An operator cleaning a machine can find many mal - functions. When a machine is covered with oil, soot, and dust, it is difficult to identify any problems that may be developing.

While cleaning the machine, however, one can easily spot oil leakage, a crack developing on the cover, or loose nuts and bolts. Once these problems are recognized, they are easily fixed. It is said that most machines breakdowns begin with vibration (due to lose nuts and bolts), with introduction of foreign particles such as dust (due to the crack on the cover, for instance), or with inadequate oiling and greasing. For this reason cleaning is useful to make discoveries while cleaning machines.

3.2. Cleaning Solvents and Uses

Table 3 Uses of Cleaning Solvents

Cleaning Solvents	Uses
1. Gasoline	- It is used to wash oil/greasy tools/equipment.
2. Diesoline	- It is used to wash oil engine, transmission and other parts of the vehicle.
3. Kerosene	- It is used to remove dust, grease oil, paint, etc.
4. Thinner	- It is used to remove spilled paint on the floor, walls and tools.
5. Soap and water	- It is used to wash/clean upholstered furniture such as seats, tables, cabinets, etc.

3.3. Clean up procedures

- Clean up every time whenever you leave an area, including sweeping the floor.
- Clean and return all tools to where you got them.
- Use compressed air sparingly; never aim it at another person or use it to clean hair or clothes.
- Shut off and unplug machines when cleaning, repairing, or oiling.
- Never use a rag near moving machinery.
- Use a brush, hook, or a special tool to remove chips, shavings, scraps etc. from the work area. Never use the hands.
- Keep fingers clear of the point of operation of machines by using special tools or devices, such as, push sticks, hooks, pliers, etc.
- Keep the floor around machines clean, dry, and free from trip hazards. Do not allow chips to accumulate.
- Mop up spills immediately and put a chair or cone over them if they are wet enough to cause someone to slip.

3.4. Inspection of work tools/equipment

The purpose of inspection is to identify whether work tool/equipments and working area can be operated, adjusted and maintained safely. Not all work area, tools/equipments needs formal inspection to ensure safety and in many cases a quick visual check before use will be sufficient. However inspection is necessary for any work area, tools/ equipments where significant risks to health and safety may arise from incorrect installation, re installation, deterioration or any other circumstances. The need for inspection and inspection frequencies should be determined through risk assessment.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

11. ?(3pts)
12. ?(1pts)

Test II:write true if the statement is correct and false if the statement is incorrect

9. (2pts)
10. (2pts)

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 4- Identifying and tagging unserviceable equipment and faults

4.1. Tags

The use of tags is considered an administrative control and as such only provides limited protection to people and plant; therefore in all cases a physical isolation must be used in conjunction with a tag to prevent the accidental activation of an isolation point.

4.2. Attaching the Tag

The person attaching the tag must completely fill the tag with the following information:

• Name & company of person placing tag

• The classification/department the person works for

• The date that the tag was placed

• The equipment / plant the tag was placed on

• Contact number

• Work order / job number if applicable

• Signature

It is important to clearly identify the exact piece of equipment that the tag and lock was placed on to allow identification of those personnel working on the plant.

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

5. (3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

11.. (2pts)

12. (2pts)

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

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 5- Completing operating maintenance in accordance with manufacturer specifications and work site procedures

5.1. Introduction

Maintenance is controlling the condition of tools, machines and equipments against deterioration. There are different failure modes and their behavior in time is met with different maintenance strategies

All tools, equipment and vehicles must be properly maintained so that workers are not endangered. Construction regulations require inspections of vehicles, tools, machines and equipment before use.

5.1.1. Maintaining Equipments/Machines

The following are some of machines / equipment maintenance strategies.

1. Preventive maintenance
2. Predictive maintenance
3. Break down maintenance

1. Preventive maintenance

Understood as periodic or schedule activates in which the main objective is the direct prevention of modes or defects. It includes

- Periodic lubrication
- Inspection
- Cleaning
- Testing
- Charging
- Draining
- Balancing
- Overhauling
- Repairing
- Adjusting
- Varnishing
- Replacement

2. Predictive maintenance

Is a periodic inspection followed by replacement or overhaul if incipient defects are detested? This method does not directly reduce the deterioration rate but indirectly control the consequences of accidents, breakdowns, malfunctions, and general troubles .It involves the observer's sense of seeing, hearing, feeling and smells.

This strategies dictates a continues search for defects i.e. continues monitoring of machinery /equipment conditions and performance coupled with continues feed back.

3. Break down maintenance

Is the maintenance activities necessary to restore machines and equipments back to service after failure modes developed which were:-

Preventable but not prevented

Preventable but not predicted

Predicted but not acted upon

Not preventable or predictable

Eg. **Pneumatic tool maintenance**

Air tools need little upkeep. However, you will have problems if basic maintenance is not performed. For example, moisture gathers in the air lines and is blown into tools during use. If a tool is stored with water in it, rust will form and the tool will wear out quickly.

Lubricate your air tools periodically. A few drops of special, non contaminating oil (spray gun-type oil) should be used in your air sanders, chisels, grinders, and other air tools. Do not use motor oil or transmission fluid to lubricate body shop air tools. Conventional oil could contaminate the body surface and cause painting problems.

Squirt a couple of drops of oil into the air inlet or into special oil holes on the tool before and after use . This will prevent rapid wear and rusting of the vane motor and other parts in the tool. Run the tool after adding the oil. Wipe excess oil off the tool to keep it from the body parts. An in-line oiler is an attachment that will automatically meter oil into air lines for air tools. It can be used on lines used exclusively for air tools but not for spray guns.

Remember not to use in-line oilers in the paint area.

Never over-oil sanders, grinders, and other air tools. You could contaminate the vehicle’s surface with oil.

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

4. ?(3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

7. (2pts)

8. (2pts)

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

Score = _____

Rating: _____

You can ask you teacher for the copy of the correct answers.

Information Sheet 6- Maintaining tool in accordance with workplace repair procedures

6.1.

Self-Check – 6	Written test

Name……ID…… Date…….

Directions:

Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Short Answer Questions

2. What guideline follow while performing various processing operations / tasks?(3)

Note: Satisfactory rating - 3 points Unsatisfactory - below 3 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Operation Sheet 1–

Objectives ;

Procedures

LAP TEST	Performance Test

Name…… ID……Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **6** hour. The project is expected from each student to do it.

Task 1:

Task 2:

Reference Materials

Book:

1. A.Robinson and W.A.Liversey,2004. ***THE REPAIR OF MOTOR BODIE***S, Britain (Butterworth-Heinemann publication), Fourth Edition, ISBN 0 7506 45172.

2. Porter, Lindsay. ***THE CAR BODY WORK REPAIR MANUAL.*** New edition

3. .Robert Scharff and James E.Duffy, 1992. ***MOTOR BODY REPAIR*** .United States Of America, 3rd edition .ISBN 0827368585

4. Scharff.Robert. ***MOTOR AUTO BODY REPAIR.*** Third edition

5. Alan Robinson, 1997. ***THE REPAIR OF VEHICLE BODIES***. British 3rd edition, ISBN 0 7506 0955 9

6. L.C.Rhone, 1983***. TOTAL AUTO BODY REPAIR***. United States of America, second Edition. ISBN 0 02 682110 9.

7. A.G.Deroche, 1996***. THE PRENCIPLES OF AUTO BODY REPAIRING AND REPAINTING***. United States of America, sixth Edition. ISBN 0-13-440033-X

8. Alan Robinson, 1993. ***THE REPAIR OF VEHICLE BODIS.*** Great Britain, Second

Edition. ISBN 0 7506 0159 0

9. John D. Anderson, JR., 1991. ***FUNDAMENTALS OF AERODAYNAMICS.***

Singapore, Second Edition. ISBN 0 07 100767 9

WEB ADDRESSES

1. https://www.youtube.com/watch?v=PkDY4b_I8w0&list=UUCRd-C63GOe5ZhHPKO6gHmw

2. https://www.machinemart.co.uk/p/clarke-cs10brk-10-ton-body-repair-kit/

3. https://www.youtube.com/watch?v=GZS0hTZHhLg

4. https://www.whichcar.com.au/features/guide-to-forming-the-wide-body-shqrp-hqs-panels

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