Vehicle body repair
Level-III

Based on November 2016, Version 2 Occupational standard

Module Title: - Performing Thermoplastic and Aluminum Body Part Repair

LG Code: EIS VBR3 M10 LO (1-3) LG (39-41)

TTLM Code: EIS VBR3 TTLM 1220v1

December, 2020

Adama, Ethiopia

Table of Contents

LG #39	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:

- Determining job requirements, including job sheets, quality and quantity of materials.
- Reading and interpreting job specifications
- Observing OHS requirements throughout the work.
- Selecting and inspecting materials quality for repairs and replacements
- Identifying and checking hand, power tools and safety equipment
- Determining procedures to minimize waste material
- Identifying safe procedures for maximizing energy efficiency

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:

- Determine job requirements, including job sheets, quality and quantity of materials.
- Read and interpret job specifications
- Observe OHS requirements throughout the work.
- Select and inspect materials quality for repairs and replacements
- Identify and check hand, power tools and safety equipment
- Determine procedures to minimize waste material
- Identify safe procedures for maximizing energy efficiency

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	Determining the job requirements, including method, materials and equipment based on work instructions

1.1 Introduction

In order to define job requirements, the company has to perform several processes. It is not as simple as looking at the job title of the open position, and deciding right there and then the requirements that you expect from the candidates. This may work for some organizations, but it is haphazard at best, and there is a risk that the recruitment and selection process may not go about the way they want it to.

Much of the success of recruitment and selection depends on how properly the company has defined the requirements of the job, as stated in the job description on the posting. And the first thing that must be done is to perform job analysis.

1.2 Job analysis

Job analysis is the process performed to determine and identify the particular tasks, duties and requirements of a given job, and why they are important.

Job analysis is performed to “establish and document the job-relatedness of employment procedures, such as training, selection, compensation, and performance appraisal.”

In the recruitment process, job analysis is very useful in determining the duties or tasks that will be included in the crafting of job postings and advertisements. It is also a vital tool that is used in the determination of the salary level or range for that position. During the screening, the selection tests, as well as the questions that will be asked during the interview will be developed by using the results of job analysis.

In the context of this discussion on defining job requirements, job analysis is used in recruitment and selection procedures to identify the minimum and other requirements for the screening and selection of candidates.

In the analysis, the job will be broken down into its component parts, where all the tasks and activities of the person who will perform the job are taken into careful consideration. The next thing that will be considered will be the competencies, behaviors and attributes that the company will be looking for in the person.

That is one thing that must be underlined: job analysis is an analysis of the job, not of the person. After all, it is the job that will be described, and not the person who will do the job.

1.3 Steps in Job analysis for setting job requirement

Step 1: Make a list of the factors that will be used as a guide in gathering information.

The factors that information will be collected on include:

- **Duties and responsibilities of the job.** What are the activities, functions and tasks involved in the job?
- **Skills and knowledge required for performance of the activities.** What are the skills needed to accomplish the identified activities, functions and tasks? What knowledge is needed to accomplish the activities, functions and tasks?
- **Attitudes and behaviors of the jobholder in performing his functions.** What attitudes are expected and required of the person who will carry out the tasks, functions and activities? Should he be flexible, punctual, outgoing, etc.?
- **Context of the job.** Does the job entail constant contact with other employees? With the customers? What are the unique working conditions of the job that are likely to have an impact on the jobholder and his performance of his tasks and activities?
- **Responsibility levels.** Does the job entail supervision of other employees or workers? What supervision will the jobholder require? Who will the employee report and be accountable to?

Step 2: Identify your sources of information

Obviously, your best source of information will be within the organization, where the job is. This will not be much of a problem if we are talking about a small operation, where there are only around five people, because they are likely to be well-informed about the nature of the job and its requirements.

Some of the identified best sources of information include:

- **A former employee who actually held the job.** If the job under analysis is one that already exists, look for someone who performed the actual tasks and functions of the job in the past. Their actual experience will definitely aid the analysis. The risk in using this source is that there may be some bias on the part of the former employee, especially if the circumstances of his being a "former" employee are favorable.
- **The immediate supervisor, or the employee that is directly responsible for supervising the job.** At best, the supervisor will know the basic or fundamentals of the job, although not its details or nitty-gritty. The risk in using this as the sole source of information is that the supervisor may be unaware of the smaller details about the job, since he is mostly tasked to manage.
- **The division, team or work group where the job will belong to, and where it will be performed.** The members of the team may have knowledge and even experience about what the job entails, even if it's not to its full extent. Do not just get information from the team leader or the head of the department. You will find that the better sources are the co-workers, or those who are roughly on the same level as the job under analysis.

Step 3: Collect or gather information.

There are several methods employed by analysts to gather or collect the information needed. The most commonly used methods are:

- **On-site observation:** Information is gathered by observing a person actually performing the tasks, activities or functions of the job. This may be applicable if there is already someone who may be observed. It won't be as reliable if the job being analyzed is new, and there is no one actually performing the tasks yet.

- **One-on-one interviews:** If the job already exists and the plan is to obtain information from former jobholders, the best method to use is an individual interview. This same method is effective when current or incumbent jobholders and supervisors are being tapped as sources of information.

- **Panel or group interviews:** In this setting, members of the group or team where the job is performed may be interviewed collectively at one time.

- **Questionnaires:** Questionnaires and check lists may be distributed to incumbent and former jobholders, supervisors and managers, and team members and co-workers. The questionnaires may be structured, or they may be open-ended.

- **Existing records related to the job:** Review of records that pertain to the job and its performance may also be conducted. Examples of these records are task inventories and work logs.

  Example: Job analysis of an Office Manager position

  Tasks:

  - Delegation of work to the staff with matching skills and knowledge
  - Procurement and distribution of office supplies and materials
  - Bookkeeping
  - Monitoring of costs and expenses
  - Training of staff

  Skills required:

  - Communication
  - Time management
  - Computing and numeracy
  - Clerical
  - Teaching and mentoring

Knowledge required:

- Procurement and reorder procedures
- Inventory management
- Awareness of staff skills and qualifications

Attitudes/behaviors required:

- Pleasant, friendly and approachable
- Strict adherence and commitment to schedule or timetable
- Desire to involve everyone and make them feel that they belong to a unit

1.4 Importance of job requirements

Job requirements are a crucial part of both job descriptions and job postings (job ads). They are equally important for both employers and job seekers.

1.4.1 For employers

Employer use job requirements as a way of preselecting potential candidates. Job requirements are used to communicate employer's expectations from job seekers. By laying out clearly defined job requirements, employers can attract the right type of candidates. Over or under qualified candidates will be turned away from applying, thus saving employers a lot of time and money in the long run.

1.4.2 For job seekers

For job seekers, job requirements are the crucial part of job postings (job ads). Job requirements section of the job ads clearly states what an employer is looking for. That way, potential candidates can know what is required of them before applying. If they match all the job requirements criteria, it means they are a good fit for a job.

1.5 Determining job requirement

Determine exactly what the job requirements are before looking at any resume—or even placing an ad. It's almost impossible to find qualified candidates if the job requirements are unclear.

Job requirements are "must haves" that an employer is looking for in a candidate for a certain job position. Job requirements aren't just a list of specific qualifications,

education, knowledge and skills needed for a particular position. They are a great opportunity to showcase your Employer Brand and company culture and attract the best candidates!

1.6 Purpose and Importance of Job Requirements

- **To improve the accuracy of the recruitment process**, resulting to the company being able to hire the right person for the job, or the candidate with qualifications that match the requirements of the job.
- **To reduce the number of potential applicants.** Without the job requirements, pretty much anyone and everyone may apply, and would have to be considered, for an open position. By making the jobs requirements as specific as possible, employers are able to reduce the pool of applicants further, resulting in a shortlist of candidates that possess the necessary qualities and qualifications for the job.
- **To assist applicants in making decisions on whether to apply for the job or not.** They may be interested to apply for the open position in the company. However, when they go through the job requirements and realize that they do not meet these requirements, then they can look elsewhere for other job prospects.

1.7 Components of job requirements

It was mentioned earlier that job requirements are specific, so that they target only the candidates who are qualified for the job. But what are the requirements that employers focus on throughout the recruitment process?

- **Skill and knowledge requirements:** There are jobs that require specific and, often, technical skills and knowledge that are unique to the job.
- **Years of work experience:** Employers often pay attention to two aspects of work experience: the quality of work experience, and the amount or duration of the work experience.
- **Quality of work experience:** The relevance of the experience will be taken into account.

- **Amount of work experience:.** This refers to the number of years of work experience of the candidate. It could be in a general capacity, where the employers specify that the candidate must have at least 5 years experience working in the IT industry.
- **Educational requirements:** There are jobs that require candidates to have obtained a certain level of education, and that fact will be emphasized in the job posting.
- **Equivalent experience:** "Equivalent experience" is what employers accept in all educational requirements, or even direct and paid work experience. For example, the job posting may require the candidate to "at least have a Bachelor's degree, or a certification from a specific regulatory agency".
- **Professional certification:** There are jobs that require the jobholder to be licensed or certified as a professional. For instance, an Accountant position requires the jobholder to be a Certified Public Accountant**.**

Self-Check – 1	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. What is Job analysis?(2pts)
2. List the components of job requirement?(2pts)
3. What is the **Purpose of Job Requirements**?(3pts).
4. Explain the components of job requirement. (3pts)

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

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

Score = _____

Rating: _____

2.1 List of job qualifications

The job qualifications list is one of the most important parts of the job specification or description. This list may include:

- Education level
- Work experience
- Required licenses or certificates
- Required skills

This list will typically be broken up into preferred and required qualifications. The most important qualifications will often be listed first, so if you meet those qualifications, be sure to emphasize them in your cover letter. If you have a qualification that's similar to one the employer listed, also try to mention it in your resume or cover letter.

- **Read through the job duties**

Employers will also often include a list of duties required for the job. These duties can vary wildly from job-to-job, even if the job titles are the same. Similar to the qualifications, the job duties are often listed in order from most important to least important. As you read through the job duties, make a list of the one you've done in your previous jobs. Then, include some of what you listed in your cover letter.

- **Check for questions or keywords**

Sometimes, employers will ask candidates to answer a question or use a certain keyword in their application to make sure that they thoroughly read through the job description. This question may be something simple, or it might be an important part of the application. Before you move away from the job description and start writing your cover letter, be sure to double check all the requirements in the description.

- **Use the description in your cover letter**

Employers want to know that you carefully read the description and understand what the job entails. One way to show this is to use the description in your cover letter. Put some of the description into your own words, and say how your skills match what's

being described. For example, if one of the job duties is managing meetings, you could discuss a particularly successful meeting you organized at your previous job. Or, if you're just coming out of college and don't have professional experience yet, you could discuss club meetings you've held, or class discussions you've led. When you use the description in your cover letter, you'll show the company that you spent time thinking about their job listing, and that you understand how your unique skillset will fit into the company.

2.2 How to Find the Important Information

As we mentioned above, a job description can be overwhelming and overly detailed. So, when you read a posting, be sure to read it carefully for these key takeaways:

- Check for keywords. You know by now to use keywords on your resume. A job description is the place to find the right keywords to use, as well as give you an idea of what the employer will look for in the right candidate.
- How does the employer want you to respond? Make sure you've found out the company's preferred method of communication. Don't plan to email a resume if the organization wants you to apply through its online job portal.
- Don't get too caught up in jargon. Words and phrases such as passion, commitment, team player, responsibility, dynamic interpersonal skills, ability to work independently, detail oriented, and analytical skills are oftentimes just buzzwords that recruiters and managers use in every job description.

Preparing personal protective equipment is necessary to protecting the person as related to the job performed. Select boot, hats, lotions, goggles, mask and gloves. In similar manner you need to identify the likely risks that might occur on your body or sense organs from specific activities, then once you identify the risks it is necessary to select the necessary personal protective equipment that fit the body or the sense organ involved.

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: choose the correct answer

1. Which one of the following is included in specification or description? (2pts)
   a. Education level
   b. Work experience
   c. Required skills
   d. all
2. ---------- helps the candidates to answer a question or use a certain keyword in their application to make sure that they thoroughly read through the job description. (2pts)
   a. Read through the job duties
   b. Check for questions or keywords
   c. Use the description in your cover letter
   d. none

Note: **Satisfactory rating – greater than 2 points** **Unsatisfactory – less than 2 points**

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

Score = _____

Rating: _____

3.1 Shop safety practices and health protection

The most important considerations in any body repair and refinishing shop should be accident prevention and safety carelessness and the lack of safety habits cause's accidents. Accidents have a far-reaching effect, not only on the victim, but on the victim's family and society in general. More importantly accident can cause serious injury, temporary or permanent or even death. Therefore it is the obligation at all shop workers, instructors and students to foster and develop a safety habit to protect the health and welfare of those involved.

- **Air Passages and Lungs Protection**

Abrasive dust vapor 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. The cartridge filter or organic vapor type of respirator, which covers the nose and mouth, is equipped with a replacement cartridge that removes the organic vapors by chemical absorption painting without this equipment it is harmful to our respiratory organ.

The dust respirator or mask is worn to protect against dust from sanding and grinding. These operations in the body shop create dust can that can cause bronchial irritations and possibly long terms lung damage such as silicosis (well known in mining areas). Keep in mind that these respirators are good for removing solid particles from the air and have little if any ability to remove vapors. They should never be worn when spray painting use cartridge filter.

- **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 metal working 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.

- **Ear protection**

Panel beating the piercing noise of sanding, the radio blaring full-blast-it is impossible to hear anything 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 are plugs or ear muffs to protect the eardrums from damaging noise levels.

- **Body and Hand Protection**

Loose clothing unbuttoned shirt sleeves, loose Jewelry 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 anybody or paint shop chemicals, be sure to wash the hands with soap and water before eating or smoking.

- **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. In the vehicle has a manual transmission, it should be in reverse (Engine off) or neutral (engine on) unless instructed otherwise fort a specific service operation.
- Use safety stands whenever a procedure requires work under the vehicle
- To prevent serious burns avoid contact with hot metal party such as the radiator, exhaust manifold, tail pipe, catalytic converter and muffler.
- Keep clothing and oneself clear from moving parts when the engine is running. Especially the radiator fan blades and belts.
- When moving a vehicle around the shop. Be sure to look in all directions and make certain noting is in the way.
- Do not smoke while working on vehicles.

3.3 Handling of solvent and other flammable liquids

- Both the body mechanic and refinisher 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.
- Keep all solvent containers closed, except when pouring
- 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 arte 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.

- Paints thinners solvents and other combustible materials used in the body and paint shop must be stored in approved and designated storage cabinets or rooms. Storage rooms should have adequate or rooms. Storage rooms should have adequate ventilation never have more than one day's supply of paint outside of approved storage areas.
  - ✓ When spraying paint follow these procedures.
  - ✓ Remove portable lamps before spraying
  - ✓ Ventilation system must be turned on
  - ✓ Spray areas must be free from hot surface such as heat lamps
  - ✓ The spray area must be kept clean of combustible residue.
  - ✓ Ventilation system must be left on while the paint is drying.
- **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. Fires are classified according to the type of fuel energizing the fire knowledge of the classes of fires is important since the type of fuel involved will determine the method of extinguishing the fire. Each class of fire requires a specialized action.

✓ **Class A Fires**

These fires result from the combustions of carbonaceous materials such as wood, textiles and papers for class A Fires extinguishers containing water, which will cool and quench the burning material, are suitable. Dry chemical Extinguishers may also be used since they provide a fire vet ardent blanket to prevent re-flash.

✓ **Class B Fires**

These fires result from materials that become gaseous when heated such as oil, grease and paints. For class B fires, carbon dioxide extinguishers are Excellent. Dry chemical Extinguishers are also useful in these fires.

✓ **Class C Fires**

Live electrical equipment is the cause of class C fires for class C fires use Ethics a carbon dioxide extinguisher (carbon dioxide is non-conductive) or a dry chemical extinguisher. Dry chemical extinguishers are called tri-class extinguishers since they can be used on class A, B and C fires.

✓ **Class D fires**

The specialized classification includes fires from comestible metals, such as magnesium, titanium, Zirconium and potassium. It should be noted that the same fire may involve more than one class as soon as the fire spreads to other materials. Also once electricity is disconnected, a class C fire becomes another class of fire.

3.4 Hazard control and hazardous materials and substances

Effective controls protect workers from workplace hazards; help avoid injuries, illnesses, and incidents; minimize or eliminate safety and health risks; and help employers provide workers with safe and healthful working conditions. The processes described in this section will help employers prevent and control hazards identified in the previous section.

To effectively control and prevent hazards, employers should:

- Involve workers, who often have the best understanding of the conditions that create hazards and insights into how they can be controlled.
- Identify and evaluate options for controlling hazards, using a "hierarchy of controls."
- Use a hazard control plan to guide the selection and implementation of controls, and implement controls according to the plan.
- Develop plans with measures to protect workers during emergencies and non-routine activities.
- Evaluate the effectiveness of existing controls to determine whether they continue to provide protection, or whether different controls may be more

effective. Review new technologies for their potential to be more protective, more reliable, or less costly.

3.5 Hierarchy of Controls

When evaluating the risks associated with specific hazards, the results of this evaluation should guide the researcher in the selection of risk management techniques including elimination, substitution, engineering controls, administrative controls, and personal protective equipment. This is known as the Hierarchy of Controls.

- **Elimination and Substitution**

The most preferred method of controlling risk is to eliminate the hazard altogether. In most cases, elimination is not feasible and when possible, substitution is the best approach to hazard mitigation. When possible, substitute less hazardous agents in place of their more hazardous counterparts. This also applies to conditions and activities.

Examples include substituting toluene(aromatic hydrocarbon) for benzene, non-lead-based paints for lead-based ones for existing traditional table saws.

- **Engineering Controls**

Engineering controls consist of a variety of methods for minimizing hazards, including process control, enclosure and isolation, and ventilation.

- Process controls involve changing the way that a job activity is performed in order to reduce risk. Examples of this include using wet methods when drilling or grinding or using temperature controls to minimize vapor generation.
- Enclosure and isolation are targeted at keeping the chemical in and the researcher out, or visa versa. Glove boxes are a good example of enclosure and isolation. Interlock systems for lasers and machinery are other good examples of isolating processes.

- The most common method for ventilation in research laboratories is localized exhaust systems. Fume hoods, snorkels, and other ventilation systems are discussed at length in the Laboratory Equipment and Engineering Controls section of this site.

- **Administrative Controls**

Administrative controls are controls which alter the way work is performed. They may consists of policies, training, standard operating procedures/guidelines, personal hygiene practices, work scheduling, etc. These controls are meant to minimize the exposure to the hazard and should only be used when the exposure cannot be completely mitigated through elimination/substitution or engineering controls.

- **Personal Protective Equipment (PPE)**

PPE should always be used as a last line of defense and is an acceptable control method when engineering or administrative controls cannot provide sufficient protection. PPE may also be used on a temporary basis while engineering controls are being developed. See the standalone PPE section of this site for more information.

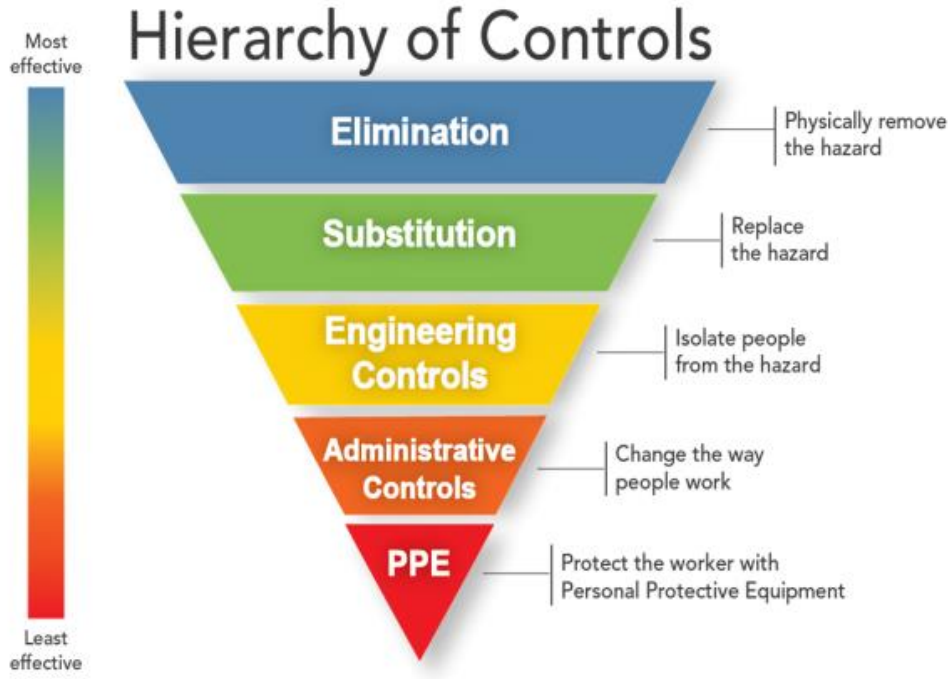


Figure 1 Hierarchy of Controls

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

1. Which of the following component is worn to protect against dust from sanding and grinding? (2 pts)
   a. Mask
   b. Helmet
   c. welding goggles
   d. work shoes
2. ---------- is required to prevent the possibility of eye injury from flying particles, chips, (2 pts)
   a. Ear protection
   b. Foot protection
   c. Eye protection
   d. all
3. Which of the following safety precautions you are going to keep in your mind when handling a vehicle in the shop? (2 pts)
   a. Use safety stands whenever a procedure requires work under the vehicle
   b. Keep clothing and oneself clear from moving parts when the engine is running
   c. Do not smoke while working on vehicles
   d. Al
4. A fires result from the combustions of carbonaceous materials such as wood, textile sand papers is---------- (2 pts)
   a. Class A
   b. Class B
   c. Class C
   d, Class D

Note: **Satisfactory rating – greater than/equal 4 points** **Unsatisfactory – less than 4**

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

Score = _____

Rating: _____

Information Sheet – 4 selecting and inspecting materials quality for repairs and replacements

4.1 Material Selection

Materials selection in the automotive industry is governed by the demands emerging from customers expectations and legal requirements. The development of materials application in the near future will be determined by ecological needs like consumption reduction and used vehicle disposal and by the necessity to reduce costs.

Selection of materials is a long-standing, complex decision-making problem with potential impact on entire life cycle of a product including manufacturing, distribution, consumer use, recycling, and disposal.

Such selection is also integral to every product development/fabrication process. How a product should be made relies heavily on the nature of the materials selected. Typically, materials account for as much as 50% of the overall cost of manufactured goods and it is estimated that there are between 40,000 and 80,000 materials available today with at least 1,000 different ways to process them.

Such vast number of materials and processes and variety of requirements in the design process is the root of difficulty of the selection problem.

The problem is further compounded by rapid technological changes, increasing level of sophistication and growing volume of technical

4.2 Non-Metallic & Plastic Material selection criteria

- **Temperature —** Will the parts in your application be exposed to frequent fluctuation or temperature extremes? Many materials have a maximum and minimum operating temperature, as they can become brittle in extreme cold or oxidize when exposed to intense heat.
- **Mechanics —** If your application requires high tensile strength or will be exposed to competing forces, you'll need a material capable of withstanding these pressures and stresses without deforming or fatiguing.

- **Flexibility —** Closely tied to tensile strength, some components may need to be extremely stiff or flexible depending on their role in the application.
- **Impact Resistance —** Will the component require toughness in its planned environment? If so, you'll need to select a material with strong resistance to impact and erosion effects over time.
- **Dielectric Strength —** If your application involves the transfer of electricity, the part may need to be able conduct an electric current or, conversely, be insulated and protected from it.
- **Chemical Resistance —** What chemicals or other harmful substances will the components be exposed to? Industries processing volatile chemicals or producing high levels of toxic waste will require more resistant materials than those in less severe environments.
- **Industry Demands —** Your material may need to meet specific requirements depending on the specifications of the individual application, as well as any specific standards or legal regulations — such as ASME or ISO — that may exist within a particular industry.
- **Cost —** While it can be challenging to strike a balance between cost and quality, you should always try to select the material that will offer the best performance for your budget.

4.3 New or alternative materials

It is possible to divide possible alternatives to currently used materials into three categories:

- Materials already in use which can be improved and/or made cheaper through further development.
- Materials which have already been developed, but which have however not been used in automobile construction to date.
- Newly developed materials ("high-tech" materials).

Since development is a continuous process, a degree of overlap between categories is inevitable.

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. Write the three material selection criteria. (5 pts)
2. What are the three possible categories to divide alternatives to currently used materials? (5 pts)

Note:

Satisfactory rating greater than/ equal - 5 points **Unsatisfactory – less than 5 points**

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

Score = _____

Rating: _____

Information Sheet – 5 Identifying and checking hand, power tools and safety equipment

5.1 Hand Tools used for welding plastic material

The following is a description of the most commonly used plastic working tools.

- **Pliers**

Pliers are a universal multi-function tool that is ideal for welding, electrical work, mechanical jobs and farm or home use. The pliers have comfortable grips and a spring-loaded handle. Pliers act as that extra support to your hands when you need that additional strength. And tackling such a task should be easy and not an additional job

Figure 2: ball peen hammer

- **Metal Bristle Cleaning Brush**

Metal Bristle Cleaning Brush: The heavy-duty scratch brush features an economy curved handle. Designed for use in hard-to-reach areas that require a narrow face

Figure 3: Metal Bristle Cleaning Brush

- **Plastic welder**

Fuses together plastic sheets, using hot-air gun to melt and join edges of sheets: Cuts sheets to be joined to form smooth edges, using knife. Fuses together plastic sheets, using hot-air gun to melt and join edges of sheets: Cuts sheets to be joined to form smooth edges, using knife.

Welding Gun – Manual (hand-held) welding tools are used for small fabrication work, detailed projects, and repair work, and should not be used for thicknesses beyond 10mm. For larger fabrications, use extrusion welding tools.

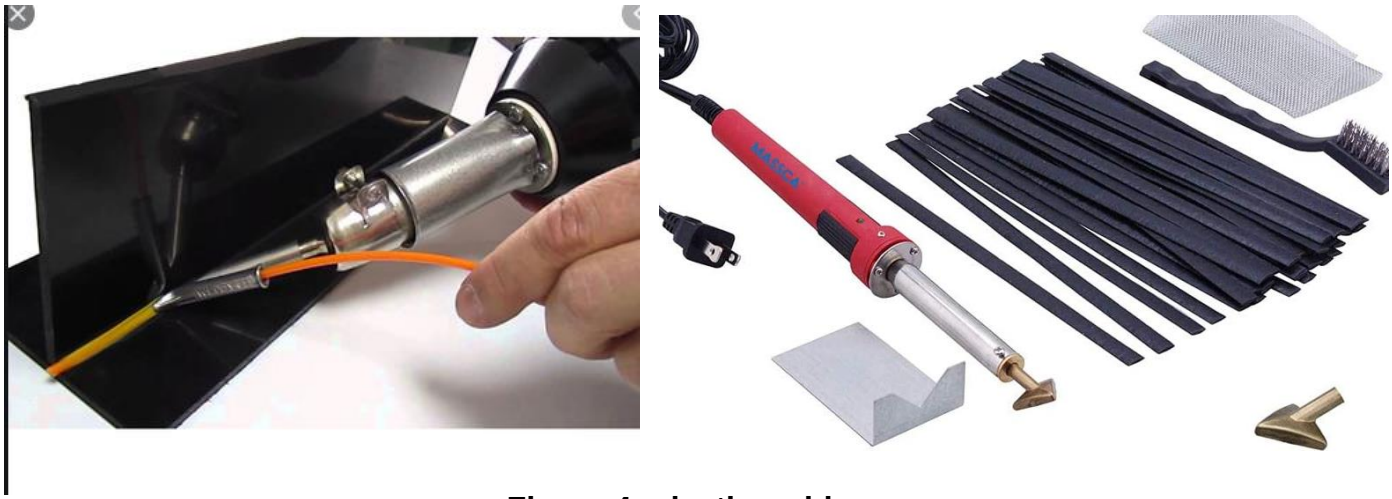


Figure 4: plastic welder

- **Welding Rod** – It's crucial that the welding rod is the same material as the plastic to be welded and to ensure the end of the welding rod has been trimmed so that it's in pencil-point form.

- **A Welding Kit** – For beginners, plastic welding kits are a great option because they are fully equipped with what you need for most repairs. Kits come with a welder, varying welder rods, welding tips, and a guide to help you through your welding process.
- **Welding Clamps & Magnets-** Tight joints are key when welding pieces of plastic together. Using welding clamps and grips will allow you to set your work piece up firmly while welding it together. Clamps and grips come in all shapes and sizes, so be sure to find the right kinds of clamps for your job.

Figure 5: Welding Clamps & Magnets

- **Hacksaw**

The cutting options presented below scale from least to most expensive. For cutting thin rod and tube affordably, look no further than a **hacksaw**. Be sure to use the right blade for your material in your saw. Mild steel requires a blade with fewer teeth per inch (commonly referred to as TPI), like this 18 tooth per inch blade .

Figure 7: Hacksaw

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: give short answer (10 pts)

1. Describe the most commonly used plastic working tools.

Note: **Satisfactory rating greater than/equal - 5 points Unsatisfactory – less than 5 points**

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

Score = _____

Rating: _____

Information Sheet – 6: Determining procedures to minimize waste material

6.1 Determining waste minimizing procedure

Waste minimization is a set of processes and practices intended to reduce the amount of waste produced. By reducing or eliminating the generation of harmful and persistent wastes, waste minimization supports efforts to promote a more sustainable society.

Waste minimization involves redesigning products and processes and/or changing societal patterns of consumption and production. Waste minimization entails limiting the amount of waste that is generated thereby helping to

eliminate the production of persistent and harmful wastes effectively supporting efforts that promote a society that is sustainable. Thus, waste minimization involves a change of societal patterns that relate to production and consumption as well as redesigning products to eliminate the generation of waste.

Waste Minimization is reduction in the quantity of hazardous wastes achieved through a conscientious application of innovative or alternative procedures. Simple adjustments to a process producing wastes (e.g. a teaching lab experiment, a vehicle cleaning operation, etc.) may be the only requirement to achieve some results.

6.2 Benefits of Waste Minimization

While it is obvious that waste minimization supports sound business and economic practices

in addition to protecting the environment, other benefits include the following:

- Improved product quality New technological practices and innovation will not only reduce generation of waste but also contribute to improved input quality that translates to improved products.
- Economic benefits Efficiency in product use translates to reduced costs when purchasing materials thus significantly affecting financial performance.
- Efficiency of production practices – Waste minimization will attain more output of the product for every part of raw material.

- Environmental responsibility eliminating or minimizing generation of waste will make it easy for you to achieve environmental policies, standards and regulations.
- Public image Embracing waste minimization will boost the reputation of your company, as it is a reflection of proactive movement in the quest to protect the environment.

6.3 R's of Waste Minimization

Waste minimization revolves around three R's as follows:

- **Reduce**

This calls for using resources that are just enough to cater to your needs for instance building a smaller house. This is an effective way of conserving resources as it also lowers the costs. This can be achieved through attaining accuracy when ordering to ensure that there is no waste or no material is sitting on the site for long periods that it is damaged.

- **Reuse**

Here, you will do well to reuse existing materials and buildings effectively reducing the need for resources while lowering waste volumes and saving money. A huge percentage of resources are incorporated in the construction of homes owing to the mixed materials that are used yet the end destination for most of them are landfills. Thus, renovating a house is a much better option than bringing it down to put up another one because a negligible fraction of the old house may be reused/recycled.

- **Recycle**

Using left over resources or those resources that have reached the end of their life minimizes the need for new materials as well as lowers the volume that ends up in landfills. Thus, it is advisable to use materials that are recyclable as this creates a market for the resources that are recycled while also raising the price that recyclers pay for resources that are recovered even as the recycling viability increases.

6.4 Waste Minimization Techniques

1. Optimization of resources

In order to reduce the quantity of waste that is produced by individuals or organizations calls for the optimization of raw materials used in production. For instance, a dressmaker will do well to arrange the pieces of pattern in a certain way along the length of the fabric to use a small portion of the fabric.

2. Scrap metal reuse

Incorporating scraps into the initial stages of manufacturing is a surefire way of ensuring that they do not end up in landfills as waste products. A majority of industries embrace this process effectively returning rolls that are damaged to the initial production line and in the manufacturing of off cuts, plastic items so that scrap is re-incorporated in the new commodities.

3. Quality control improvement and process monitoring

Measures can be put in place to control the number of rejects and ensure it is at a minimum. This may be achieved through increased frequency of inspection as well as increasing the number of inspection points. For instance, installation of continuous monitoring device that is automated will help in identifying production problems before they get to an advanced stage.

4. Exchange of Waste

Here, the waste products from one process are used as raw materials for other processes. Exchange of waste is another means of minimizing waste disposal volumes especially for waste that may not be eliminated.

5. Shipping to the point of use

Here, raw materials as well as other components are directly delivered at the point of assembly or manufacturing plant ostensibly to minimize handling and use of enclosures and protective wrappings.

6. Zero waste

This systems approach is designed to eliminate waste from the source as well as at every point of the supply chain to ensure that no waste is produced. This design philosophy places emphasis on waste prevention and not waste management at the end of production line.

6.5 Waste Minimization for Households

Households can practice waste minimization by employing various techniques. One of the ways to achieve this is through purchasing adequate sizes and amounts of food. Purchasing large containers of paint when taking small decorating jobs or purchasing large volumes of food than you need result wastage. In instances where cans or packs may be thrown the remains of the containers should be removed to allow for recycling of the container.

Home composting, thoughtful use of electricity as well as reducing the number of car journeys is also a great way of waste minimization. Generally, buying fewer products or products that last longer, mending worn or broken equipment or clothing can also minimize household waste. Additionally, households can also minimize wastage of water and cycle or walk to various destinations as opposed to using cars thereby saving on fuel. Overall, personal waste reduction will have an effect on the general waste volumes. Consumers may also shun products without eco-labeling.

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. What is Waste minimization? (2 pts)
2. Explain the benefits of Waste Minimization. (2 pts)
3. What are R's of Waste Minimization? (2 pts)
4. List at least four Waste Minimization Techniques(4 pts)

Note: **Satisfactory rating greater than/equal - 5 points Unsatisfactory – less than 5 points**

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

Score = _____

Rating: _____

Information Sheet – 7 Identifying procedures to maximizing energy efficiency

7.1 Energy Efficiency

Energy efficiency is a resource that can be acquired to help utilities meet current and future energy demand. To realize this potential requires leadership at multiple levels, organizational alignment, and an understanding of the nature and extent of the energy efficiency resource.

- Leadership at multiple levels is needed to establish the business case for energy efficiency, educate key stake holders, and enact policy changes that increase investment in energy efficiency as a resource. Sustained leadership is needed from:
  - ✓ Key individuals in upper management at the utility who understand that energy efficiency is a resource alternative that can help manage risk, minimize longterm costs, and satisfy customers.
  - ✓ State agencies, regulatory commissions, local governments and associated legislative bodies, and/or consumer advocates that expect to see energy efficiency considered as part of comprehensive utility management.
  - ✓ Strong support from upper management and one or more internal champions.
  - ✓ A framework appropriate to the organization that supports large-scale implementation of energy efficiency programs.
  - ✓ Clear, well-communicated program goals that are tied to organizational goals and possibly compensation.
  - ✓ Adequate staff resources to get the job done.
  - ✓ A commitment to continually improve business processes.
- Understanding of the efficiency resource is necessary to create a credible business case for energy efficiency.

7.2 Best practices on Energy Efficiency

- ✓ Conduct a “potential study” prior to starting programs to inform and shape program and portfolio design.
- ✓ Outline what can be accomplished at what costs.
- ✓ Review measures for all customer classes including those appropriate for hard-to-reach customers, such as low income and very small business customers.

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

1. What is Energy efficiency? (5 pts)
2. Write the Best practices on Energy Efficiency. (5 pts)

Note: **Satisfactory rating greater than/equal - 5 points Unsatisfactory – less than 5 points**

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

Score = _____

Rating: _____

Operation Sheet 1– preparing tools and equipment for work

Objectives of conducting pre-start check of tools, equipment and machinery;

- To know all the tools, equipment and machine functional and sufficient enough
- To know tools, equipment and machine which needs maintenance

Procedures to undertak a pre check on your tools and equipments before you *start* work.

Step 1: Select, fit and use personal protective clothing and/or equipment

Step 2: Inspecting equipment condition for wear;

Step 3 - Visual inspections of important features prior to starting the work.

Step 4: Visual & function tests while the machine is turned on but stationary

Step 5: Maintain work area to meet housekeeping standards

Step 6: Clean tools equipment and machinery

Step 7: Turn tools equipment and machinery in to their storing area

Step 8: Make record and report to your supervisors

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 **2** hour. The project is expected from each student to do it.

Task: prepare tools and equipment for work

LG #40	LO # 2- Repair plastic panel/component

Instruction sheet

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

- Accessing and interpreting information from manufacturer specifications.
- Using protective equipment appropriate to repair activities
- Repairing components by using approved methods and equipment
- Seeking authorized assistance where straightening and realigning of components includes disturbance to electrical, mechanical, air conditioning systems or trim
- Carrying out thermoplastic repair (covers splits/tears and dents) up to pre- paint condition.
- Carrying out repair activities according to industry regulations
- Checking **Repair methods**
- Completing Workplace t**ooling and equipment** documentation and dealling with relevant to repair outcomes.

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:

- Access and interpret information from manufacturer specifications.
- Use protective equipment appropriate to repair activities
- Repair components by using approved methods and equipment
- Seek authorized assistance where straightening and realigning of components includes disturbance to electrical, mechanical, air conditioning systems or trim
- Carry out thermoplastic repair (covers splits/tears and dents) up to pre- paint condition.
- Carry out repair activities according to industry regulations
- Check **Repair methods**
- Complete Workplace t**ooling and equipment** documentation and dealling with relevant to repair outcomes.

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: Accessing and interpreting information from manufacturer specifications

1.1 Introduction

Plastics and other composite materials are in widespread use for outer panels and on occasion, complete body shells. Materials most likely to be used for bumpers are types of thermoplastic or polypropylene. Rigid materials like glass reinforced plastic and reinforced polyester are better for body panels.

Plastic still has a poor image even today, being connected more with flimsy toys than the leading edge of motor industry technology. But plastics are becoming increasingly used in making cars, largely as a result of the drive towards weight reduction for lower fuel consumption and greater economy.

For many years the problem has been that plastics are not strong enough to be used without reinforcement. Now the scene is changing, with more complicated, composite materials taking over from simple plastics. These new materials bring changes in design and manufacturing processes but, most of all, offer greater driving economy.

1.2 Thermoplastic

Thermoplastic is a material, usually a plastic polymer, which becomes softer when heated and hard when cooled. Thermoplastic materials can be cooled and heated several times without any change in their chemical or mechanical properties. When thermoplastics are heated to their melting point, they melt to a liquid. They freeze to a glassy state when cooled below their glass transition temperature.

Thermoplastic materials have many features. Some products made from thermoplastic materials are used for electronic applications. They protect against electrostatic discharge and radio frequency interference. Thermoplastics are one of the main two types of plastics.

Thermoplastic can be moulded into any shape. Thermoplastics differ from thermosetting polymers. Thermosets form irreversible chemical bonds during the curing process.

Thermoplastics are synthesized from plants in large amounts and transformed through chemical processing. Some of the most important thermoplastics are polyethylene [low density polyethylene (LDPE) and high density polyethylene (HDPE)], polypropylene (PP), poly (vinyl chloride) (PVC) and polystyrene. These polymers can be used in many possible applications structural purposes such as wire and light duty utilities. Thermoplastic polymers are also being used as a matrix for natural and synthetic fibers. Thermoplastic polymers can melt at specific temperatures and can be shaped and reshaped (through reheating) according to the mold. Reprocessing thermoplastic polymers can lose its physical properties due to a breakage of polymeric chains; it is best to not recycle thermoplastics.

Many of the plastic-bodied cars in production now use different types of plastic for different parts. Bumpers need to be deformable to absorb impact, and elastic to avoid permanent damage, so they are made from a variety of specially modified plastics with some rubber-like properties (such as polypropylene or modified thermoplastic polyester). For panels like the boot lid it's better to use more rigid material such as fairly heavy gauge glass fiber or cold-pressed reinforced polyester so that the driver feels solidness when slamming it.

Using many different materials is easy to arrange if the body is made up from a number of different parts bolted to a central structure. With vehicles that have individual panels bolted on to a separate steel frame.

1.2.1 Main types of thermoplastics

- **PET (polyethylene terephthalate)**:- Light, rigid or semi-rigid, naturally transparent or colorless, PET is an excellent moisture and gas barrier and is resistant to impacts. It is one of the most easily recyclable plastics and is used to produce bottles, bags and synthetic fibers for clothing.

- **HDPE (high-density polyethylene)**:- HDPE is translucent, strong and easy to process, resistant to impacts and non-toxic. It is used to make bottles, tanks, bins and containers for transport.
- **LDPE (low-density polyethylene):-** LDPE can be translucent or transparent. Suitable for contact with food, it is the lightest and most heat-sensitive plastic. It is used for packaging, bags, sacks, cable coatings, containers, pipes and toys.
- **PVC (polyvinyl chloride):-** PVC is a very versatile plastic, resistant to wear and tear, chemical and atmospheric agents and fire. It is used in the paper industry and for packaging, food containers, credit cards, furnishings, clothing and toys.
- **PP (polypropylene):-** Transparent, light and strong, this material can be used as both a plastic and a fiber. Easily colored, it does not absorb water. It is used to make textile fibers, couplings, containers for transport, furniture, carpets, ropes and food containers.
- **PS (polystyrene or styrofoam)**:- One of the most important thermoplastic materials, it is transparent, hard and inflammable, very bright and inert against many corrosive agents. It can be given shiny or opaque colors. Polystyrene is commonly used to replace glass, aluminum and wood because it is cheaper. It can also be used in packaging materials (including for foods), containers, boxes, lamps, disposable objects, cups and toys.

1.2.2 Advantages of Thermoplastics

- The softening or melting by heating allows welding and thermoforming.
- The processing cycles are very short because of the absence of the chemical reaction of crosslinking.
- Processing is easier to monitor, because there is only a physical transformation.
- Thermoplastics don’t release gases or water vapor if they are correctly dried before processing.

- The wastes are partially reusable as virgin matter because of the reversibility of the physical softening or melting

1.2.3 Disadvantages of thermoplastics

- When the temperature rises, the modulus retention decreases, due to the absence of chemical links between macromolecules.
- For the same reason, the creep and relaxation behaviors are not as good as for the thermosets.
- During a fire, fusibility favors dripping and annihilates final residual physical cohesion.

1.3 Aluminum

Aluminum is the most abundant metallic element in Earth's crust and the most widely used nonferrous metal. Because of its chemical activity, aluminum never occurs in the metallic form in nature, but its compounds are present to a greater or lesser extent in almost all rocks, vegetation, and animals.

1.4 Advantages & disadvantages of aluminum auto bodies

1.4.1 Advantage:

The main advantage gained by using aluminum in auto body construction is increased fuel economy due to the significantly lower weight. In promotional campaigns, Ford claims the aluminum F-150 has 29% better fuel economy than its predecessor.

While Ford also claimed that, 'pound–for-pound', aluminum is stronger than steel, that claim somewhat defeats the lower-weight advantage – a pound of aluminum weighs the same as a pound of steel.

Performance benefits

Because aluminum is lighter, it allows automakers to increase dent resistance—they can make body panels thicker while still lowering weight. And a lower weight vehicle

has better acceleration, better braking and better handling. In addition, lighter vehicles can haul and to more because the engine isn't carrying unneeded weight.

Weight, strength and safety benefits

When applied to an optimized automotive body structure, aluminum can provide a weight savings of up to 50 percent compared with the traditional mild steel structure. Aluminum body structures are equal or superior in strength to steel and absorb twice as much crash-induced energy. Primary-structure weight savings also allow other vehicle systems to be downsized (including the engine, transmission, suspension and wheels). Across the board, in weight, strength and safety, aluminum's advantages are clear.

1.4.2 Disadvantage:

While you'll hear a lot of what seem like disadvantages of using aluminum in cars and trucks, they are generally all related to the fact that it's a relatively new material in the industry and the industry hasn't adjusted to working with it. For example, Ford had an issue with paint peeling from aluminum tailgates, but that's only because the paint was not properly formulated for use on aluminum.

Self-Check – 1	Written test

Name…… ID…… Date…….

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

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

1. Thermoplastic is a material, usually a plastic polymer, which becomes softer when heated and hard when cooled (2 pts)
2. PET is one of the most easily recyclable plastics and is used to produce bottles, bags and synthetic fibers for clothing. (2 pts)
3. Thermoplastic processing is easier to monitor. (2 pts)
4. Aluminum allows the vehicle to become lower in weight, better acceleration, better braking and better handling. (2 pts)

Note: **Satisfactory rating greater than/equal - 4 points Unsatisfactory – less than 4 points**

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

Score = _____

Rating: _____

Information sheet – 2: Using protective equipment appropriate to repair activities

2.1 Using protective equipment

Correctly observing the safety requires little effort, but it can have a big influence on your health. PPE means personal protective equipment or equipment you use to guarantee your (own) safety. Use PPE always and anywhere where necessary. Observe the instructions for use, maintain them well and check regularly if they still offer sufficient protection. But when do you use what type of protection

Safety for the head: Wearing a helmet offers protection and can prevent head injuries. Select a sturdy helmet that is adapted to the working conditions. These days you can find many elegant designs and you can choose extra options such as an adjustable interior harness and comfortable sweatbands.

Figure 8: Helmet

Protect your eyes: The eyes are the most complex and fragile parts of our body. Each day, more than 600 people worldwide sustain eye injuries during their work. Thanks to a good pair of safety glasses, these injuries could be prevented. Do you come into contact with bright light or infrared radiation? Then welding goggles or a shield offer the ideal protection!

Figure 9: Goggle

Maintain a good respiration: Wearing a mask at work is no luxury, definitely not when coming into contact with hazardous materials. 15% of the employees inhale vapors, smoke, powder or dusk while performing their job. Dust masks offer protection against fine dust and other dangerous particles. If the materials are truly toxic, use a full-face mask. This adheres tightly to the face, to protect the nose and mouth against harmful pollution

Figure 10: Mask

Protect your hands with the right gloves: Hands and fingers are often injured, so it is vital to protect them properly. Depending on the sector you work in, you can choose from gloves for different applications:

- ✓ Protection against vibrations
- ✓ Protection against cuts by sharp materials
- ✓ Protection against cold or heat
- ✓ Protection against bacteriological risks
- ✓ Protection against splashes from diluted chemicals.

Figure 11: gloves

Protection for the feet: even your feet need solid protection. An antiskid sole is useful when working in a damp environment, definitely if you know that 16,2% of all industrial accidents are caused by tripping or sliding. On slippery surfaces, such as snow and ice, shoe claws are recommended. Special socks can provide extra comfort.

Figure 12: safety shoe

Wear the correct work clothing: Preventing accidents is crucial in a crowded workshop. That is why a good visibility at work is a must: a high-visibility jacket and pants made of a strong fabric can help prevent accidents. Just like the hand protection, there are versions for different applications.

Figure 13: correct work clothing

Worst-case scenario: Prevention is better than cure. A smart thing is to be prepared for the worst. A classic first-aid kit is no luxury but a first-aid kit for the eyes can also be an essential first aid. If the employee comes into contact with chemicals, a safety shower is mandatory, so that he can rinse the substances off his body at any moment.

Preventing accidents: Pictograms

Not only is preparing your workshop for accidents a smart thing to do, it is even smarter to organize your workshop in such a way that no serious accidents can take place. A simple way to make your workshop safer is to use pictograms: indicating flammable materials, the necessary use of hearing protection, indicating emergency exits …

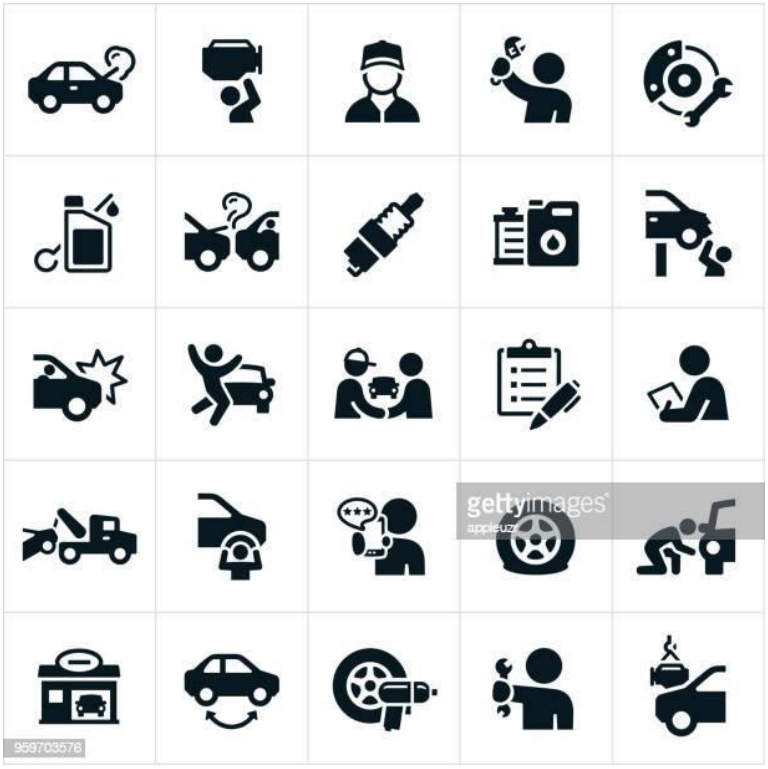


Figure 14: Pictograms

Self-Check – 2	Written test

Name…… ID…… Date…….

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

Give short answer (10 pts)

1. What type of PPE you are going to use while you are performing plastic welding

Note: **Satisfactory rating greater than/equal - 5 points** **Unsatisfactory – less than 5 points**

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

Score = _____

Rating: _____

Information sheet – 3: Repairing components by using approved methods and equipment

3.1 Auto Body Panel Repair & Replacement

Following an auto accident you will probably find yourself at an auto body shop awaiting an estimate that details the cost of repairing your car. When talking with a technician about the services your car requires in order to be returned to its pre accident condition they may say something about auto body panel replacement. This is the act of completely replacing a portion of your car or truck's body instead of repairing the damage done to it. They may need to do this if the damaged area is beyond repair if using conventional repair techniques. Sometimes replacing the panel will be faster and less expensive than repairing the damage. These are some of the common types of auto body panel replacement done at auto body repair shops.

- **Hood Replacement**

If a hood has been dented or crumpled in a front impact it will likely need to be replaced. You may also need a new hood if the current one has dented from something falling on it.

- **Trunk Lid Replacement**

  Trunk lids, similar to front end hoods, will likely need to be replaced if they become damaged. This part is easy to find and replace for most cars and trucks.

- **Bumper Replacement**

  Most wrecks will result in some type of damage to the bumper or bumpers of a vehicle. If the bumper has been subject to a hard impact there is reason to believe that your vehicle will need a new bumper installed.

- **Fender Replacement**

The fenders are body panels that start at the front of the doors, go over the front wheels and often wrap around the headlights. Occasionally these are referred to as front quarter panels.

- **Quarter Panel Replacement**

Quarter panels are a second term for fenders, however they generally refer to the back part of the vehicle. These start at the rear of the doors and go over the back wheel wells and often wrap around the real lighting assembly.

- **Door Replacement**

A door that has become badly damaged or misaligned due to an impact will probably need to be completely replaced to restore its functionality. This is because there are many electrical and mechanical parts and inside door panels.

3.2 Panel stripping and preparation

Stripping paint off of a car is the first step towards giving it a fresh look—whether it's for a restoration project or simply because drivers sometimes get bored of looking at the same old color.

There are a few techniques that auto body experts use to remove paint, and there have been many debates over the years regarding which method is the most effective.

If you want to become an auto body technician, you'll learn that choosing the right paint stripping technique depends on a wide range of factors, including the condition of the car you're working on, the client's budget, and the amount of time it will take.

Sanding Is Time-Consuming, but Effective: Sanding and scraping are among the most common methods of paint stripping. Experts say that these methods tend to work best when working on a car that still has its original finish, or hasn't been eaten away by rust. Sanding and scraping is as straightforward as it sounds: an auto body

technician uses different grades of sandpaper or scraping tools to strip the paint off of the vehicle.

Using a mechanical sander can clear the paint off of a panel pretty quickly, but it's advised to use broad strokes so that no area of the metal becomes warped by the heat that's produced from friction. Using a scraping tool like a razor blade, on the other hand, creates no heat or dust but can be very time-consuming.

Use Media Blasting to Quickly Remove Paint: Media blasting uses compressed air to shoot tiny pieces of material (media) from a nozzle in order to strip away the surface paint. It's similar to pressure washing; however, it uses a lower pressure as well as media that are much more abrasive than water.

This paint stripping technique used to be referred to as "sandblasting", but sand is no longer used due to its associated health risks. Today, the most common media used for this method include plastic or glass beads, aluminum oxide, and ground-up walnut shells.

Media blasting can strip paint without damaging a car's panels, and is even effective for quickly removing multiple layers of paint. Automotive painting experts try to avoid media blasting paint when the metal surface is too thin—like on the hoods of certain car models—to avoid warping caused by intense air pressure.

Use Chemicals to Strip Away Paint: Industry experts know that chemical dipping is one of the most effective paint stripping techniques used in today's auto body shops. This process requires body shop experts to send the car to a separate facility, where its panels will be dipped in tanks that contain strong chemicals. Panels are usually immersed in a tank that first degreases and loosens the paint. The body then undergoes a warm pressure wash to remove all paint, grease and grime. The second tank is usually filled with an alkaline solution, which makes the car's body appear much cleaner and shinier than before.

This process is most effective because it ensures that the paint is removed from every corner and crevice of the vehicle. And of course, it should come as no surprise that it is also among the most expensive technique.

While many auto body shops have access to tons of useful chemical paint strippers, such products can also create hazardous waste and are therefore not the preferred method of every industry professional.

3.3 Stretched metal

Stretched metal has been forced thinner in thickness and larger in surface area by impact. When metal is severely damaged in a collision, it is often stretched in badly buckled areas. Sometimes these same areas are also stretched slightly during the straightening process. Most of the stretched metal will be found along ridges, channels, and buckles in the direct damage area. When there are stretched areas of metal, it is impossible to correctly straighten the area back to its original contour. The stretched areas can be compared to a bulge on a tire. There is no place for the area to fit within the correct panel contour.

Before shrinking, dolly the damaged area back as close as possible to its original shape. Then you can accurately determine whether there is stretched metal in the damaged area. It will usually pop in and out if stretched. If stretched, you must shrink the metal

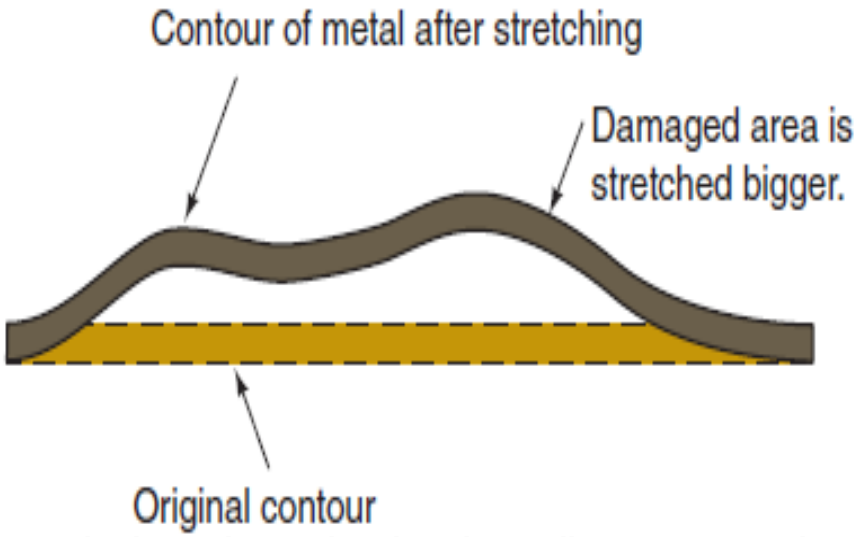


Figure 15: stretched metal must be shrunk to relieve stress so the damaged are will lie flat again

3.4 Principles of shrinking

A steel bar, with both ends frees to expand or contract, will expand when heated and contract to its original length when cooled.

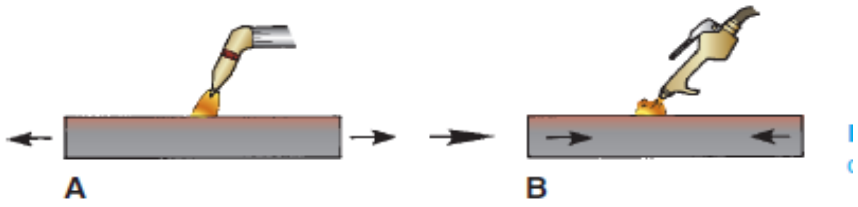


Figure 16: (A) heat causes metal to expand. (B) Cooling causes metal to contract

- **Shrinking Discs**

When using a Shrinking Disc, you are able to shrink overstretched areas and repair damaged sheet metal panels to a like new condition, making for a better quality, longer lasting finish with little or no body filler at all! The secret to them is they create the heat that is needed to shrink through friction. They produce better results and much more controllable than shrinking with a torch or a solid tipped stud gun. When using a torch, you are directly controlling how much heat is being inserted, and were it is going. This is easily and many times overdone, resulting in warping and further damaging the panel. With the shrinking disc and its large surface area, it eliminates some of the guess work, especially when smoothing a lumpy panel by only touching the higher overstretched areas! The heat is also more concentrated on the higher peaks of the damage and tapers off to the lower areas, which results in a much greater accuracy of heat placement, in turn ending with a much smoother nicely blended panel.

How is it used?

In normal conditions, you would roughly straighten the panel, tap the dents and low areas up with a hammer and dolly and then make a couple of passes with the shrinking disc, heating and cooling. Look over the panel to determine were more work is needed, and using a hammer and dolly, rearrange or tap up any remaining

low spots followed by a few more passes with the disc. After completing several loops of this process, your panel will be smooth, and back to normal surface tension.

When using the shrinking disc after welding in a patch panel to arrive at an almost invisible seam, you should start by carefully grinding the bulk of the weld. While doing this, you want to minimize excessive heat buildup and prevent thinning of the panel itself.

Then the HAZ (Heat Affected Zone, the area that was discolored while welding) needs to be stretched by using a hammer and dolly (with slightly more contour than your panel), striking the hammer "On Dolly". This is required, because the welding process heat causes shrinking just like the shrinking disc does, although it happens in an unwanted and uncontrolled manner. After stretching the HAZ, it will be closer to the original profile, but still lumpy, uneven and possibly over stretched from the various hammer blows. Now is when the shrinking disc works its magic. By using the shrinking disc over this area, and blending around the edges if needed, it will only touch the higher overstretched areas as mentioned before, and shrink them down so the entire weld area is smooth, and has the same surface level. More details on using the discs included in the Instruction Manual.

- **Heat shrinking work**

Shrinking occurs after heating (causing expansion) and cooling metal (resulting in contraction). This happens because while a panel or sheet of metal is being heated, the heated area is trying to expand. The surrounding cold metal is containing the majority of the expansion and holding it in, preventing the expansion from happening. When cooling the panel, the heated metal contracts (which the surrounding metal cannot prevent, in turn shrinking the heated area. Important aspects of this method are heating and cooling fairly quickly. Slow heating is usually more of a problem than slow cooling, as it will let the heat disperse into the entire panel before any expansion containment has taken place, reducing the shrinking discs effectiveness greatly. If heating happens quick enough, some shrinking can occur with only room temperature cooling, but is greatly accelerated and multiplied

by cooling with either compressed air or water (squirt bottle or rag), but water generally tends to provide quicker cooling

These shrinking discs work well on steel, stainless, aluminum, brass and may on some other metals. (it is recommended to use separate discs to prevent cross contamination) Also it only touches the higher overstretched spots that need to be shrunk. So you are able to shrink an area on a panel without worrying about making the problem even worse like you can with a torch. The shrinking disc also works excellent on removing those "oil can" dents that were caused by overworking and stretching the metal too much!

Shrinking metal is needed to remove strain or tension on a damaged, stretched sheet metal area. During impact, the metal can be stretched. When pulled or hammered straight, the area can still have tension or strain on it. This is because the stretched metal no longer fits in the same area. The metal will tend to pop in and out when you try to final straighten it.

If a strained area is filled with body filler, road vibrations can cause the panel to make a popping or flapping noise. After prolonged movement of the strained area, the filler can crack or fall off. Eventually, you will be required to spend extra time correcting work that should have been done properly in the first place.

- **Shrinking steel panels with heat**

To shrink a damaged area with heat from an electric welder or gas torch, a small spot in the middle of the stretched area of sheet steel is heated to a “cherry-red color.” The shrink is placed in the highest spot of the stretched area, then in the next highest spot, and so on. This is repeated until the area has been shrunk back to its proper position.

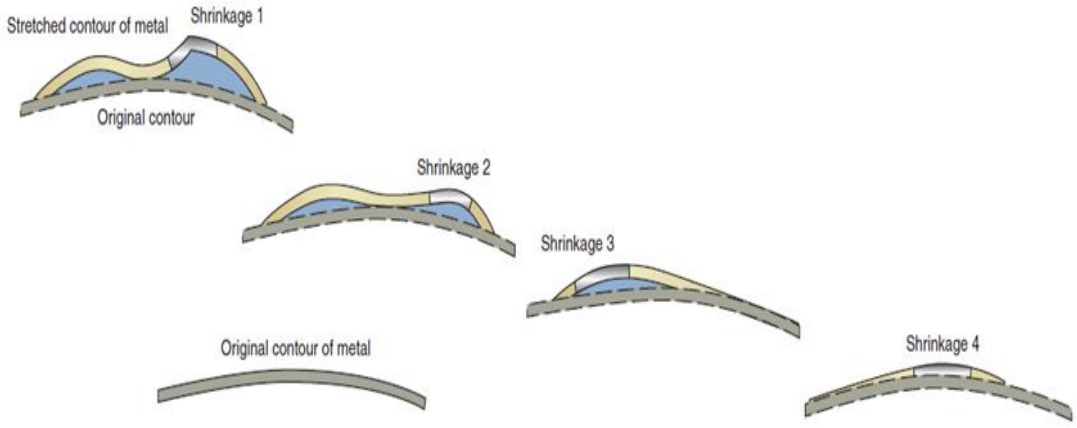


Figure 17: Shrinking stretched metal usually requires heating more than one spot. Always heat the highest or lowest spot first

The size of the shrink or hot spot is determined by the amount of excess metal in the area to be shrunk. The shrinks can be anywhere in size from a silver dollar down to the head of a thumbtack. The larger the hot spot, the harder the heat is to control. An average-sized shrink is usually about the size of a dime. Small shrinks should always be used on flat panels, because panels tend to warp easily.

A very small hot spot would be used to take an oil can–size bulge out of a flat panel. The term *oil can* is used to describe an area of a panel that is stretched very slightly. It can be pushed in. However, as soon as the pressure is released, the area will pop back out again, just as the bottom of an oil can does.

3.5 Different Kinds of Welding

The main types of welding used in industry and by home engineers are commonly referred to as MIG welding, TIG welding, arc welding, gas welding. Hands down, MIG welding is the most common form of welding practiced, but there are other options for fusing metal together.

3.5.1 GMAW or Gas Metal Arc Welding

GMAW or Gas Metal Arc Welding (more commonly called MIG welding) is the most widely used and perhaps the most easily mastered type of welding for industry and home use. The GMAW process is suitable for fusing mild steel, stainless steel as

well as aluminum. A few years ago the full name - Metal Inert Gas (MIG) welding was changed to Gas Metal Arc Welding (GMAW) but if you call it that most people won't know what the heck you're talking about - the name MIG welding has certainly stuck.

MIG (Metal Inert Gas welding)is a semi-automatic arc welding process in which a consumable wire electrode and a shielding gas are fed through a welding gun, also known as the torch. The machine produces massive electrical current that travels through the consumable wire to your work pieces fusing and melting both the wire and the base metal together.

MIG welding uses an arc of electricity to create a short circuit between a continuously fed positive anode (the wire-fed welding gun) and a negative cathode (the base metal being welded).

Figure 18: MIG welding

3.5.2 GTAW or Gas Tungsten Arc Welding

GTAW (**G**as **T**ungsten **A**rc **W**elding), or more commonly **T**ungsten **I**nert **G**as (**TIG)** welding is comparable to oxyacetylene gas welding and needs quite a bit of hand/eye/foot coordination from the operator. TIG welds are best suited for out high-touch work, such as sculptures and architectural features. TIG welds provide a superior finish that needs minimal clean up by sanding or grinding.

TIG welding provides a very clean way to weld. In one hand you wield a torch electrode and connect ground to your base material. You activate the flow of current with a foot pedal and control the amount of current on the welder. Instead of a consumable wire feed being burned from the torch, the person welding gently feeds

filler material from a rod into the welding pool. Since you control the feed of material, slag splatter is minimal.

Figure 19: GTAW or Gas Tungsten Arc Welding

Self-Check – 3	Written test

Name…… ID…… Date…….

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

Choose the correct answer

1. What are the common types of auto body panel replacement done at auto body repair shops?

   a. Hood Replacement
   b. Bumper Replacement
   c. Fender Replacement
   d. all

2. Which of the following is not the most common methods of paint stripping.

   a. Sanding
   b. Burning
   c. scraping
   d. all

3. At which condition Shrinking occurs?

   a. after heating metal
   b. after cooling metal
   c. a & b
   d. none

4. ---------- Process is suitable for fusing mild steel, stainless steel as well as aluminum.

   a. Gas Metal Arc Welding
   b. Gas Tungsten Arc Welding
   c. Arc welding
   d. all

Note: **Satisfactory rating greater than/equal - 5 points** **Unsatisfactory – less than 5 points**

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

Score = _____

Rating: _____

Information sheet – 4: Seeking authorized assistance where straightening and realigning of components

4.1 Straightening and realigning of components

Theory and analysis will tell you what is wrong. After that you must have the basic skills to repair the damage. Then you must know how to put these things together to produce the overall results required of a professional body technician. You must develop a good procedure for repair. Good procedure saves a great deal of "technician created" damage so that overall repair time is kept to a minimum for higher profits.

The repair procedure begins with a diagnosis of the damage. The actual work on the metal begins with the rough-out stage. Rough-out means to remove the most obvious damage to get back the original part shape. It must be done properly if finishing operations are to succeed.

When finishing operations are started too soon, it becomes difficult to do a good job.

Roughing out the damage can be as simple as using a rubber or plastic hammer on the edge of a door. Carefully placed hammer blows on the back of the panel may be all that is needed to straighten minor damage. When using hammer blows, always grasp the end of the handle and make sure the hammer head strikes the metal squarely.

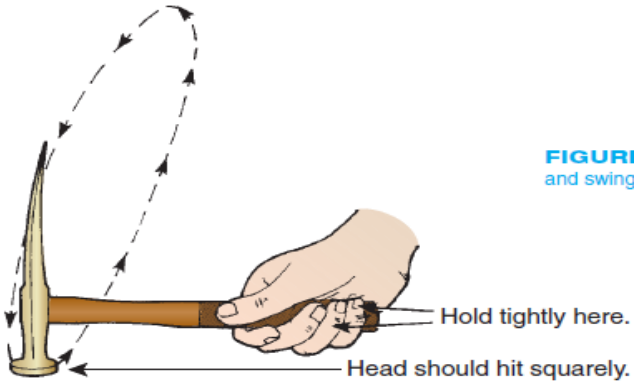


Figure 20: Hammer head strikes the metal squarely

The rough-out operations change with each damage, with each vehicle, and with each location of the damage on the car. In other words, the rough-out is very important to the particular vehicle being worked on.

The rest of the chapter is devoted to explaining some of the common skills used by body technicians from the rough-out stage of repair up to the body filling stage.

The buckles and creases in a dented panel can be unlocked in a variety of ways. On panels where the back side of the panel is accessible, hammers and dollies or spoons are used for the initial roughing out. On areas where the back side of the panel is difficult to reach, slide hammers, picks, and welded studs can be used to reverse the damage.

Always remember the rule: “First damage in, last damage out,” or “Work indirect damage first, work direct damage last.” This means that you must repair the damage away from the point of impact before finally removing the worst damage at the point of impact. If you are using a hammer and dolly to work a small dent, start working around the perimeter of the dent and gradually work your way in to the deepest part to remove it last. If you work backward, trying to hammer out the deepest point of the dent first, you will not be able to work the dent out as smoothly.

- **Using body hammers**

Body hammer is designed to strike sheet metal and rebound off its surface as a means of straightening minor bumps and dents. It is not designed to be driven down, as you would in driving a nail. A driving action would create additional damage in the sheet metal.

Figure 21: Body hammer to lower the sheet metal area

The secret of metal straightening is to hit the right spot at the right time with the eight hammers, and with the right amount of force. When using a body hammer, whether one with a metal or plastic head, swing in a circular motion at your wrist. Do not swing the hammer with your whole arm and shoulder. Hit the part squarely and let the hammer rebound off the metal. Space each blow 3/8 to 1/2 inch (9.5 to 13 mm) apart until the damaged metal is level.

The face of the hammer must fit the contour of the panel. Use a flat face on flat or low-crown panels. Use a convex-shaped or high-crown face when bumping inside curves.

Heavy body hammers should be used for roughing out the damage. *Finishing hammers,* or dinging hammers, should be used for final shaping. The secret to finish hammering is light, rapid taps. It is also important to hit squarely. Hitting with the edge of the hammer will put additional nicks in the metal.

Figure 22: Remove a small dent using a plastic mallet

- **Bumping dents with dollies**

A ***dolly*** is a heavy steel block with various shapes on each side for straightening sheet metal. In the rough-out phase, a heavy steel dolly block is sometimes used as an impact tool. A dolly is often used as a striking tool on the back of panels. Sometimes you can reach into obstructed areas with a steel dolly more easily than you can with a hammer.

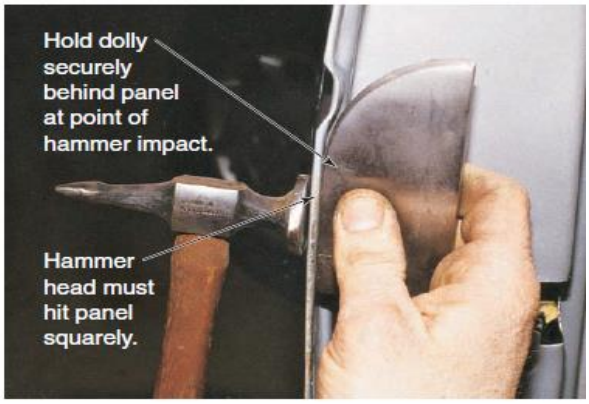


Figure 23: Hammer and dolly used to flatten and strengthen damage on a door

The contour of the dolly must fit the contour of the back side of the damaged area. This will make the blows from the dolly force the metal back into the original contour. Use accurate hammer blows. Start out with light blows from the dolly while watching the front of the panel. Make sure you are hitting exactly where needed. Gradually increase the force of your blows to raise the damage. It is normally better to use several moderate blows than to use a few hard blows. Numerous well-placed blows with the dolly will let you better control how you work the metal back into shape.

As you hit the panel, the dolly tends to rebound slightly. This creates a secondary lifting action on the metal. You can increase rebound blows by releasing pressure as soon as the dolly hits the panel. Using a large dolly will also increase impact and rebound forces on the panel.

- ✓ **Hammer-on-dolly method**

Hammer-on-dolly is a method used to exert a smoothing force to a small area on a damaged panel. The dolly is held against the back of the damage and the hammer hits the metal right over the top of the dolly. This exerts a pinching force on the metal between the dolly and hammer head. A small area of damaged metal is crushed and flattened between the faces of the dolly and hammer.

Hammer-on-dolly straightening requires you to repeatedly move the point of hammer impact and the dolly slightly. Each blow should overlap the next. By repeatedly moving hammer-on-dolly blows, you can steadily smooth and level the panel damage. Try to work out the damage methodically. Generally start at the outside of a dent and gradually work toward the center of the damage.

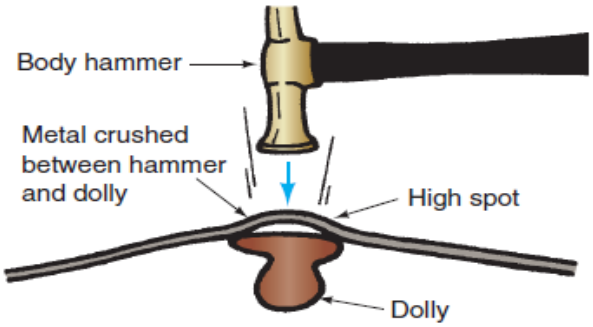


Figure 24: Hammer on dolly repairing is done by hitting the panel right over the dolly

When learning hammer-on-dolly straightening, you might want to practice on an old scrap of metal or a discarded panel. Practice making light blows to the correct locations right over the top of the dolly. Make sure the hammer head hits the panel squarely. If you hit with the edge of the hammer head, a unwanted half-moon dent or “ding” will be formed.

A proper hammer-on-dolly blow will make a high pitched “ping” sound. The force of the blow goes into the panel and then into the heavy steel block. Hitting the heavy dolly block makes the pinging sound. If you accidentally miss the spot backed by the dolly, a more dull or dead sound is produced as only the metal is hit. If you miss the dolly with a hammer tap, a small unwanted dent is often produced in the panel.

With the hammer-on-dolly method, the shapes of the dolly and hammer head must match the desired shape of the panel. If the area to be straightened is flat, the dolly surface and hammer head must be flat. If the panel is curved, the dolly and hammer head must also be curved to match the panel’s shape. When you bump or hit the damage with the hammer, the metal is flattened against the dolly and a tiny area is formed into the shape of the hammer face and dolly face.

Always start out with light hammer blows. A common mistake is to use excessively hard or poorly aimed hammer blows that dent, stretch, and damage the panel. By starting light and working up to stronger blows, you can better control the movement of the metal to avoid unwanted dents.

Carefully observe the results of each blow to make sure you slowly reshape the metal as desired.

Hold the dolly securely against the back of the panel. Hit the area lightly so that the hammer bounces back. Light hammer-on-dolly blows are used to smooth small, shallow dents and bulges. Hard hammer-on-dolly blows can be used to stretch the metal.

To lower a bulge, place the dolly against the back side of the panel directly behind the bulge and use a hammer from the front side. There will be a slight rebound as your hammer hits the dolly. The dolly will then hit the back side of the panel. As the force of the dolly pressing against the panel is increased, the flattening action will also increase.

With hard blows using hammer-on-dolly, the metal is smashed between the hammer and dolly. This tends to crush the metal thinner and make it stretch out to fill a slightly larger surface area. All blows that are designed to stretch should be hard and accurate. Remember that an inaccurately placed hard blow can damage the panel.

Keep in mind that light hammer blows are for straightening, not stretching. In other words, when using the hammer-on-dolly technique for stretching hit hard and does not miss!

Hammer-on-dolly is used only if there is access to the back side of the panel. If not, dent pullers and filling are used. The hammer-on-dolly method can also be used to stretch metal.

- ✓ **Hammer-off-dolly method**

The hammer-off-dolly method is used to raise low spots and lower high spots simultaneously. The hammer hits the panel slightly to one side of where the dolly is being held. It is often used to rough out or shape large areas of damage during initial straightening. In this procedure, you hold the dolly under the lowest area on the back of the panel, and then hit any high area right next to the dolly with your hammer. Hammer off to one side of the dolly, not directly on top of the dolly (Figure 11–22).

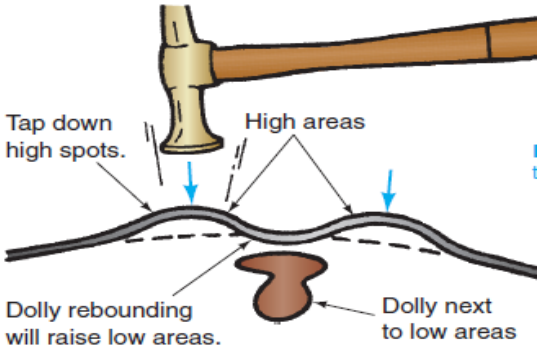


Figure 25: Hammer off dolly position is done by hitting the metal to one side of the dolly

Generally, use the hammer and dolly to roll out the damage in the reverse order from which it was formed. Normally, the damage must be rolled out working toward the center. Start at the outer perimeter of the damage and work to the middle of the damage.

If a panel has a large buckle, you can use the hammer-off- dolly method. Place the dolly on the low spot at the back of the panel, then hit a high spot with your hammer. This will lower the high spot and raise the low spot without stretching the metal. The hammer blow will push the high spot down and the rebound of the dolly will force the low spot up.

If the panel has a raised ridge of damage, you can also use the dolly-off method. Use a flat-faced dinging hammer to direct light to medium blows at the outer ends of the ridge. The blows from the hammer gradually force down the ends of the ridge. The dolly pressure forces the end of the channel upward. Gradually work toward the center. As the pressure is released, the metal tends to move back to its original position. The dolly can also be used as a driving tool to help you work the damage.

Once the area has been brought back to its basic shape, use the hammer-on-dolly method to smooth and level smaller damaged areas. You are then ready for metal finishing or plastic filling procedures.

- **Picking dents**

There are several methods of picking up metal with the use of a pointed (not necessarily sharp) tool. Picking dents often involves final straightening of very small areas of damage with the pointed end of a body hammer or with a long rod that has a curved, pointed tip.

The pick on a body hammer is often used to lower any small, high spots in the repair area. Very light, carefully placed blows with the point of the hammer will lower any dimples still sticking up in the repair area.

Long picking tools can also be used to pry up metal in areas that cannot be reached with a dolly or spoon. A car door is a good example. A pick can sometimes be inserted through a drainage hole or a hole drilled behind the door gasket. This eliminates the need to remove the inside door trim or to drill holes in the outer panel for pulling the dent. Picks are used during paint less dent removal (removing small body dings or dents without painting the panel).

When prying with a pick, be careful not to stretch the metal by exerting too much pressure. Deep creases should be straightened by starting from the shallow area and working toward the deep area. Start with the original point of contact or the lowest point. Slowly pry the crease up. On larger dents, use a flat blade pick rather than a pointed one. Tap down pressure areas while prying up low tension areas.

Figure 26: A pointed head or pick on a hammer is used to lower small high spots

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: Give short answer

1. What is Hammer-on-dolly is a method?
2. What is Hammer-off-dolly is a method?

Note: **Satisfactory rating greater than/equal - 5 points** **Unsatisfactory – less than 5 points**

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

Score = _____

Rating: _____

5.1 Carry out plastic welding

Plastic welding is the process of creating a molecular bond between two compatible thermoplastics. Welding offers superior strength, and reduces cycle times. There are three main steps to any weld: pressing, heating, and cooling. Plastic welding processes are primarily differentiated by their heating methods. The application of force and allowances for cooling are mechanical considerations which, may vary from machine to machine within the general process category. There are several methods of plastic welding.

5.2 Plastic Welding Processes

While there are several plastic welding processes and each has its own pros and cons, depending on the type of job you're working on, the basic principle of welding uses heat, pressure, and filler material to fuse the two pieces of plastic.

The process itself can be quick and cheap, but knowing which plastic welding process is the best for you can be difficult when there are so many different ways to do so. Here are three types of welding you might consider when starting.

- **Hot Gas Welding**

This is a manual plastic welding process which uses heat and dry air from a specifically designed hot gas gun, known as a hot air welder which will soften both parts of the plastic joint and a plastic filler rod (these must be the same or a similar type of plastic) and form it as one. This is one of the quickest processes and is ideal for manufacturing small items such as plumbing fittings.

- **Friction Welding**

Compared to using a specially designed tool like the hot gas gun, this type of welding involves using friction to produce the heat to join the pieces together. Not only is it efficient as it can form the object in seconds, but it also will clean the surfaces that are being joined together.

- **Solvent Welding**

Instead of using heat to join the plastic pieces, this form of welding uses a solvent which will soften the two pieces. Once this solvent has evaporated, the two pieces will have welded together and hardened.

5.3 The Right Welding Equipment

Welding is one of the most effective methods for joining two plastic components as long as you have the right tools so you can carry it out efficiently but also safely. Some of the basic equipment for welding includes:

- Welders
- Electrodes
- Angle Grinders
- Clamps

You should also invest in correct safety and protective gear. To ensure that no harm comes to you while welding, you must wear a helmet, gloves, and leather clothing. However, this can get very warm, so many welders choose to wear long sleeves, gloves, and a leather apron and opt for an open back.

5.4 Weld Plastic to Plastic

Whenever you need to repair a piece of plastic or join plastic parts together, welding offers an easy way to solve the problem. Learning how to weld can take time and practice, but it isn't a complicated process to learn. Any plastic you can weld is given the name "thermoplastic." That's because that plastic will melt when you heat it to a high temperature, meaning you can also fuse with plastic.

The plastics that are usually used for welding are all thermoplastics like Polypropylene, Polyethylene, Polyurethane, Polyvinyl Chloride, also known as PVC, and Acrylonitrile Butadiene Styrene (ABS).

Whenever you want to combine two plastic pieces or fix a cracked piece of plastic, welding is a great way to get the job done.

To complete the steps we are giving you below, all you will need is an electric welding gun and the correct welding rod. We'll cover the welding of plastic in three phases.

First, we'll cover how you should clean your plastic and make sure you identify it. Second, we'll cover how you can utilize your gun to weld the plastic together. Last, we'll cover how you can complete the weld and smooth it out for a strong weld.

Phase I: Cleaning Plastic and Setting-Up

For our first phase, we'll outline some steps so that you understand how to set-up your weld, and clean your plastic. We'll cover each step in more detail below.

Step -1: Create Your Workspace

First, you'll need to focus on setting up your workspace. You'll want to use a ventilated area so that you don't breathe in anything harmful (check out our Recommended Respiratory Equipment here).

Keep in mind that there are a few safety concerns that you'll need to review before you start any weld.

If possible, try to work outside, or at least make sure you have a sound ventilation system around you. Also, open up any nearby doors as well as windows, and put some fans around you so that you are airing the fumes away from your workspace.

You'll also need to wear a dust mask and some welding glasses (or some solid welding goggles) or a welding helmet when you start cleaning the plastic.

Make sure that you tell other people to stay out of your area while you are welding. You want as few issues as possible surrounding you when you weld, and you especially want to make sure that you aren't endangering other people.

Step- 2 Dress Yourself in Heat-Resistant Gloves and Protective Clothing

Next, you'll need to ensure your safety by putting on some heat-resistant gloves and wearing long-sleeved clothing or a welding jacket to protect your body.

Heat-resistant gloves are usually comprised of leather and will keep you safe from burns. You'll also want to make sure you have a long-sleeved shirt or welding jacket, pants, and closed work boots. Keep your face safe with a welding visor.

Figure 27: Heat-Resistant Gloves

Step - 3 Clean the Plastic

Now you'll need to clean your plastic using some soap and warm water. Scrub away all the debris that you can with a sponge.

If that isn't enough, you can also wash the plastic with dish soap. Get rid of any dirt, grease, or other particles that might weaken the weld as you clean your plastic.

Step - 4 Select a Matching Welding Rod

You'll need to know the type of plastic you are welding. Some plastics have letters on them that help identify what they are, like PE for Polyethylene or PVC for polyvinyl chloride.

Step - 5 Remove Paint with Sandpaper

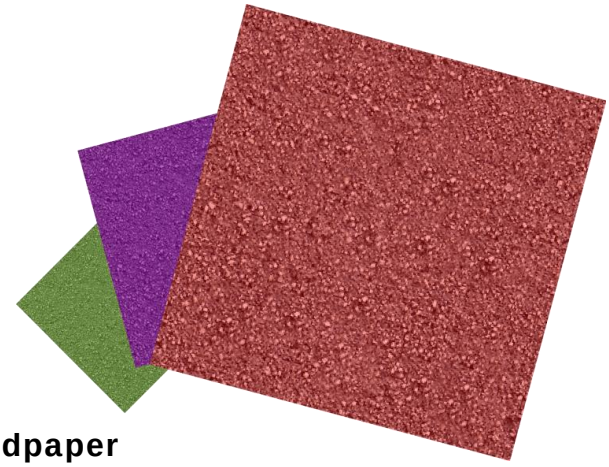


Figure 28: Sandpaper

Using some 80-grit sandpaper, you'll want to remove the paint you find on the plastic. If you see that the area of plastic you want to weld still has color on it, you'll need to get rid of the color by using sandpaper.

Step – 6 Clamp the Plastic Pieces Together

Figure 29: Clamp

Now you'll need to clamp, and also possible tape, your plastic parts together so that the joint stays in place.

Make sure you've formed your joint before you start your torch. Then, put your plastic parts on your bench and place them very close together.

Phase 2: Combining Your Plastic Pieces Together

After you are done cleaning and preparing your workspace, you'll be ready to combine your plastic pieces. Below we'll cover the steps so that you can join your plastic parts.

Step - 1: Preheat Your Welding Gun

When you preheat your welding gun, you'll need to leave it on for at least two minutes. However, depending on the type of plastic you are welding, you'll need to set your temperature appropriately.

Most plastics melt at temperatures between 392 degrees F and 572 degrees F.

Step - 2 Tack Weld the Plastic Ends

You'll need to secure your plastic and tack weld the plastic's ends. However, don't immediately move into welding.

You'll first need to pin loose parts of the plastic by melting your joint's ends. Grab a tack welding nozzle and add it to your welding gun. Then, you'll need some heat.

Once the plastic starts melting, you can join the pieces together. Now, the plastic won't move as you continue.

Step – 3: Trim a Welding Rod's End Using Angle Cutting Pliers

It's straightforward to trim a rod. Grab your pliers and angle them diagonally as you face the rod's end. Snip it to a point.

You can also use a trimming knife to create a point if you can't find your pliers.

Remember, you want to point the end of your rod so that you wind up with a smooth weld and no bubble of plastic residing where you began.

Step – 4: Insert the Welding Rod into the Welding Gun's Speed Nozzle

You'll find an opening to place your welding rod while you melt the joint in your speed nozzle. If you notice that you didn't get one when you purchased your heat gun, then you can buy it separately.

Once you get the nozzle fitted on your welding gun, you'll need to feed the rod into the second top opening. Remember, start with the clipped end in first.

As you do this, avoid touching the tack nozzle if it is still heated. You'll need to either wait for that nozzle to cool off or swap it out and use a different nozzle.

Step – 5 Use the Welding Gun's Tip Slowly

Use the welding gun's tip and slowly hover over the plastic for your weld. Begin at the top of the plastic's cracked area if you are fixing it, or on the area, you are joining.

Angle your gun down using a 45-degree angle and touch the nozzle's edge to the plastic. After that, heat the plastic until it starts to melt.

Then, push the welding torch towards the joint, and start feeding your welding rod with your other hand.

Remember, you need to stay consistent whenever you are welding if you want to make great pieces. If you move at a specific pace, you should be able to successfully melt the plastic and welding rod so that you can combine them and not burn either.

Step – 6 Mimic a Pendulum Weld

Now you'll need to move your welding gun from side to side, much like you would if you were performing a pendulum weld.

When you do this, keep the nozzle about a full inch above the crack area you are welding. As you do that, tilt your welding gun using a 45-degree angle on the opposite side.

Keeping the rod in place, now move the nozzle across it a few times to melt it. Then, move down the rest of the area to finish the plastic weld.

If you don't own a plastic gun that also has a speed nozzle, then pendulum welding can help.

That's because pendulum welding can be done just using a propane torch. You can also use pendulum welding anytime you want to fill a problematic joint your speed nozzle can't seem to handle or reach.

Remember, though, and you will need to control the torch along with the welding rod simultaneously, so sometimes this step takes a bit of practice.

Keep in mind that you have to move consistently so that your plastic won't burn.

Now that you know how to weld two plastic pieces together, we'll cover phase three of welding plastic to plastic, which is finishing the weld.

Phase 3: Finishing the Weld

When you are ready to finish your mold, you'll want to start by allowing the plastic you've been working with to cool first. You need to wait for five minutes, possibly more, for this to happen.

Step -1 Fix the Plastic if Necessary, then Cool the Plastic

Wait for the plastic to return to room temperature before you finish your weld. You'll notice right away that welded plastic cools much more quickly than welded melded.

Still, you can wait as long as you feel it is necessary. Make sure you check to ensure that the plastic is turned solid. Also, wave your hands around it to make sure there is no further heat coming off of the plastic before you begin.

Also, if you need to fix a part of your weld, you'll want to do that before the plastic cools off.

Check to make sure your welds look good and smooth. You will need to add more of the welding rod or use your gun to smooth the plastic out before you let it cool down.

At this point, you are ready to put your welding gun away. Make sure you store it in a safe place until it has cooled down.

Step -2 Sand Your Welded Joint

Start sanding down your welded joint using 120-grit sandpaper. With the sandpaper, smooth out any rough areas of the weld so that everything has a smooth, consistent look.

You'll need to use slight pressure as you do this and rub the sandpaper up and down the plastic piece. Do your best to make the weld look as level as the other parts of the plastic surrounding it.

However, be careful not to scratch the plastic as you are doing this. You can also use a sanding wheel on a rotary if you have one.

Step -3 Finish the Product

Now you'll need to get some 180 and 320-grit sandpaper as well. Start using the finer sandpaper options to make the weld look as smooth as possible.

Remember, although this sandpaper is less abrasive than what we just used, you can still wind up scratching the plastic if you don't watch closely.

Self-Check – 5	**Written test**

Name…… ID…… Date…….

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

Give short answer (10 pts)

1. What are the three plastic welding processes?

Note: **Satisfactory rating greater than/equal - 5 points** **Unsatisfactory – less than 5 points**

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

Score = _____

Rating: _____

Information sheet 6: Checking *Repair methods*

6.1 Checking Repair methods

6.1.1 Checking Tools & Equipment

Employees work with machines, tools and equipment every day. Workplaces couldn't operate without them; however, interacting with them has potential for serious injuries or fatalities if they are not used and maintained properly.

The potential hazards are numerous, and include:
Safety hazards

- Contact with moving parts
- Contact with electricity, heat, fire, cold, and other energies
- Contact with pressurized gas or liquid

Health hazards

- Contact with harmful chemicals or biological hazards
- Contact with harmful noise, radiation, and/or vibration
- Exposure to ergonomic or MSD hazards

Effect of tools and equipment safety

A safe environment is a productive workplace. **Health and safety is not simply a legal obligation: it is a business opportunity.** You can boost your bottom line by improving health and safety performance, which reduces the costs associated with avoidable losses and lost-time injuries, and leads to higher productivity.

What you can do

Machinery and other workplace equipment can be dangerous if not used properly. Anyone using equipment in the workplace needs to be thoroughly trained in its operation and kept up to date. Here are other ways to help staff stay safe when using equipment.

- Keep the work area clean, tidy, well swept/washed, and well lit; floors should be level and have a non-slip surface.
- Do not remove any guarding devices; make sure that they are in position and in good working condition before operating.
- Follow lock-out procedures before measuring, cleaning or making any adjustments.
- Check and adjust all safety devices before each job.
- Wear appropriate personal protective gear as prescribed, including CSA-approved safety glasses with side shields (prescription eye wear is *not* a substitute).
- Ensure that all cutting tools and blades are clean and sharp; they should be able to cut freely without being forced.
- Ensure there is enough room around the machine.
- Ensure that all stationary equipment is anchored securely to the floor.
- Keep hands away from the cutting head and all moving parts.
- Avoid awkward operations and hand positions: sudden slips could cause the hand to move into the cutting tool or blade.
- Do not leave machines unattended: turn the power off.
- Avoid distracting an operator; horseplay can lead to injuries.
- Avoid wearing loose clothing, gloves, neckties, rings, bracelets or other jewelry that can become entangled in moving parts; confine long hair; do not use rags near moving parts of the machine.
- Return all portable tooling to their proper storage place after use.
- Clean all tools after use.
- Do not use cutting fluids to clean hands.
- Use a vacuum, brush or rake to remove any cuttings.
- Do not use compressed air to blow debris from machines or from worker clothes.

6.1.2 Aluminum repair alerts

It is important to remember that there are specific details to be aware of when repairing aluminum vehicles. Of particular concern is the avoidance of cross-contamination when working on steel panels or parts that are adjacent to aluminum materials.

Steel metallic dust or grinder sparks can deposit fine particles on aluminum parts. The fine steel particles are extremely corrosive to aluminum alloys, especially if moisture is present. Therefore, it is necessary to isolate steel and aluminum repair work areas by using shop curtains or performing these procedures in separate work areas. Similarly, a separate set of tools should be used for working on steel and aluminum parts to avoid further cross-contamination.

In the collision repair shop, the technician will handle painted aluminum panels and parts. Very little aluminum will be exposed during the repair process, and the aluminum that is exposed is localized.

Still, caution must be taken to avoid cross-contamination between steel and aluminum. An ideal method for accomplishing this is to use dust removal or extraction equipment. The equipment not only prevents cross-contamination but also protects the respiratory health of technicians.

Sanding and grinding tools should be attached to a vacuum system to prevent dust particles from reaching the air. And as with the separation of other work areas and tools, separate vacuum systems should be arranged for steel and aluminum repair work.

Self-Check – 6	Written test

Name…… ID…… Date…….

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

Choose the correct answer from the following questions

1. Which of the following is included in potential Safety hazards (2 pts)

   a. Contact with moving parts
   b. Contact with pressurized gas or liquid
   c. Contact with electricity,
   d. all

2. Which of the following is included in potential Health hazards (2 pts)

   a. Contact with harmful chemicals or biological hazards
   b. Contact with harmful noise, radiation, and/or vibration
   c. Exposure to ergonomic or MSD hazards
   d. All

3. What are the other ways to help the technician stay safe when using equipment? (2 pts)

   a. Check and adjust all safety devices before each job
   b. Avoid distracting an operator
   c. Clean all tools after use
   d. all

Note: **Satisfactory rating greater than/equal - 3 points** **Unsatisfactory – less than 3 points**

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

Score = _____

Rating: _____

Information sheet 7: Completing Workplace tooling and equipment documentation and dealing with relevant to repair outcomes

7.1 Introduction

Using and maintaining equipment's correctly reduces the risk of accidents or damage to health. It helps you to meet health and safety requirements. 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.

Preventive maintenance is the systematic care and protection of tools, equipment, machines, and vehicles in order to keep them in a safe, usable condition, that limits downtime and extends productivity. We must always be aware that maintenance tasks themselves are potentially hazardous and can result in injury. The successful maintenance program is:

- well organized and scheduled
- controls hazards
- defines operational procedures
- Trains key personnel.

General requirements for equipment maintenance include:

- Obtaining a copy of the maintenance schedule recommended by the manufacturer.
- Ensuring that maintenance is performed as required.
- Ensuring that the person(s) performing the maintenance are competent (e.g. licensed mechanic).
- Retaining records of maintenance/service conducted.
- Specifying who is responsible for overseeing equipment maintenance and where the records are kept.
- Setting up a system for removal and tagging of damaged or defective tools and equipment.

Completing repair schedule documentation

Documentation is a set of documents provided on paper, or online, or on digital or analog media, such as audio tape or CDs. Examples are user guides, white papers, on-line help, quick-reference guides.

It is becoming less common to see paper (hard-copy) documentation.

Documentation is distributed via websites, software products, and other on-line applications.

Procedures and techniques

The procedures of documentation vary from one sector, or one type, to another. In general, these may involve document drafting, formatting, submitting, reviewing, approving, distributing, reposting and tracking, etc., and are convened by associated

Documentation should be easy to read and understand. If it's too long and too wordy, it may be misunderstood or ignored. Clear, Short, Familiar words should be used to a maximum of 15 words to a sentence.

Documentation should be prepared by qualified specialists. The key to good documentation is to correctly identify the problem to be solved, and hence to specify an appropriate solution.

Most documents contain lists (known as schedules) of components such as windows or floor finishes.

For conservation work, schedules of repairs are commonly prepared for each room or other element. Schedules are an effective way to summaries the works to be done.

Poorly documented repair works could result in the work making matters worse rather than better.

The Need to Document

- Documenting maintenance and renewal information enables repair and maintenance work to be conducted efficiently and effectively.
- It also provides key information to the owners, supervisors and depreciation report providers.
- These documents are also important in order to provide proper maintenance to ensure warranty insurance coverage.

Follow these three general principles to develop records and documents:

1. Keep it short and simple. Use bullet points and flow diagrams instead of long sentences and lengthy paragraphs.
2. Clarity is important. Step-by-step instructions are easily understood.
3. Use a standardized, consistent format. Although different programs may need different documents and records, using a similar approach will help staff learn quickly.

Some common poor work practices include:

- using machinery or tools without authority
- operating at unsafe speeds or in other violation of safe work practice
- removing guards or other safety devices, or rendering them ineffective
- using defective tools or equipment or using tools or equipment in unsafe ways
- using hands or body instead of tools or push sticks
- overloading, crowding, or failing to balance materials or handling materials in other unsafe ways, including improper lifting
- repairing or adjusting equipment that is in motion, under pressure, or electrically charged
- failing to use or maintain, or improperly using, personal protective equipment or safety devices
- creating unsafe, unsanitary, or unhealthy conditions by improper personal hygiene, by using compressed air for cleaning clothes, by poor housekeeping, or by smoking in unauthorized areas
- standing or working under suspended loads, scaffolds, shafts, or open hatches

Follow these three general principles to develop records and documents:

1. Keep it short and simple. Use bullet points and flow diagrams instead of long sentences and lengthy paragraphs.
2. Clarity is important. Step-by-step instructions are easily understood.

3. Use a standardized, consistent format. Although different programs may need different documents and records, using a similar approach will help staff learn quickly.

Cleaning and making ready workplace for next work

- ✓ Cleaning is not just a measure of respect for the workspace, it also removes hazards.
- ✓ Plan to easily and regularly remove trash and debris. Enforce a strict cleanup policy throughout the workspace.
- ✓ Keep work areas tidy as well by minimizing the number of wires running around. Extension cords quickly become tripping hazards, and power strips also cause trouble on the ground or as they tumble erratically on a desktop. We suggest you provide access to grounded outlets all along the perimeter of the room and/or dropped from the ceiling for each workbench.

Cleaning 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, 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.

Processing Job card with workplace procedures

- ✓ Job card is a record card relating to a job and giving details of the time taken to do a piece of work and the materials used.
- ✓ This is used to allocate direct labor and materials costs. a card in a cost-accounting system on which the detailed costs of an order are accumulated cost sheet .
- ✓ Cost sheet is a sheet on which detailed cost elements relating to a specific production order or process are assembled —called also cost card. so every technician should be prepare job cards after completion of work, allocate / assign a whole item of cost, or of revenue, to a single cost unit, center, account or time period (like labor and material cost)

Self-Check – 7	**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. what are the general requirements for equipment maintenance (5 pts)
2. What are the three general principles to develop records and documents?(5 pts)

Note: **Satisfactory rating greater than/equal - 5 points** **Unsatisfactory – less than 5 points**

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

Score = _____

Rating: _____

Operation Sheet 1– Cleaning and Setting up the Plastic

Objectives of conducting pre-start check of tools, equipment and machinery;

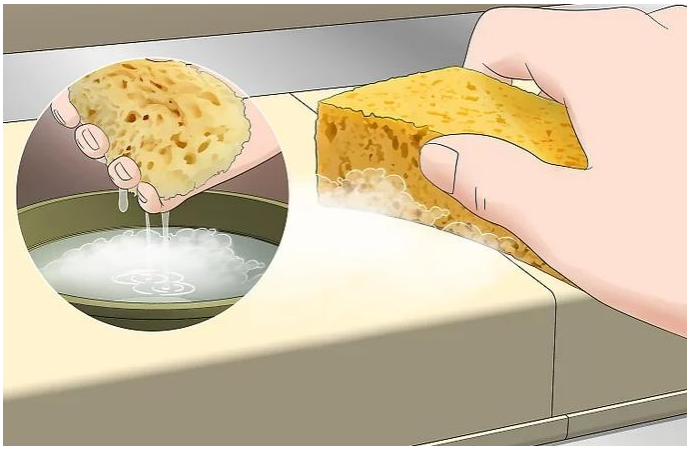
- To use all the tools, equipment and sufficient enough

Cleaning and Setting up the Plastic step by step procedures:

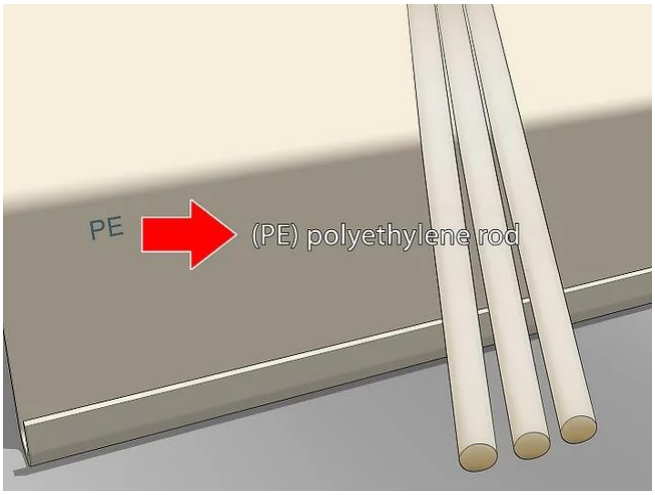
Step -1: Set up a workspace in a ventilated area to protect against dust and fumes.

Step -2: Put on heat-resistant gloves and long-sleeved clothing for protection.

Step -3: Clean the plastic with soap and warm water to remove debris.

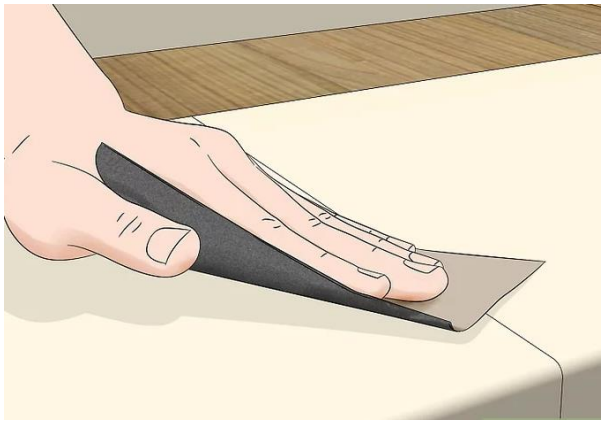


Step -4: Use the letter identification on the plastic to choose a matching welding rod.

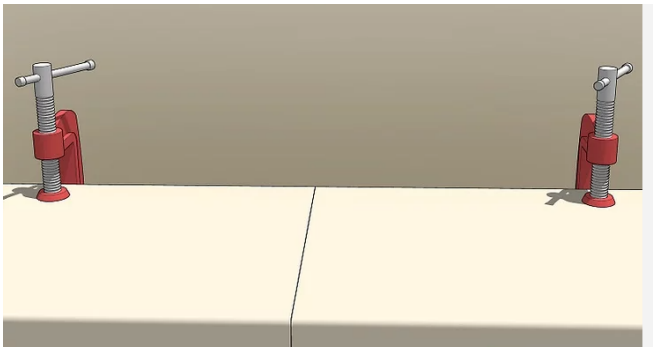


Step -5: Use a welding rod testing kit if you're not sure what kind of plastic you have.

Step -6: Remove paint on the plastic with a piece of 80-grit sandpaper.



Step -7: Clamp and tape plastic pieces together to hold the joint in place.



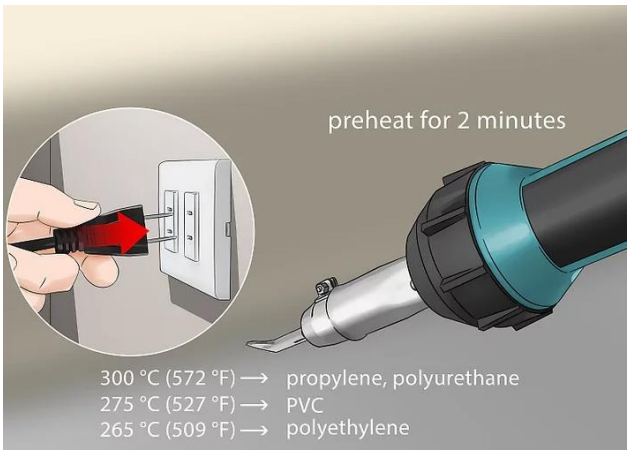
Operation Sheet 2– Joining the Plastic

Objectives of conducting pre-start check of tools, equipment and machinery;

- To use all the tools, equipment and sufficient enough

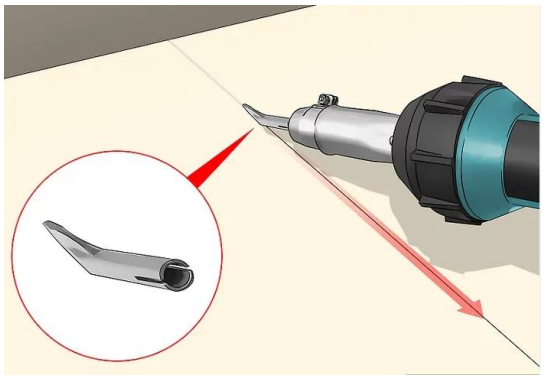
Joining the Plastic step by step procedures:

Step -1: Preheat the welding gun for at least 2 minutes. Every type of plastic melts at a different temperature, so setting your welding gun up correctly is important.

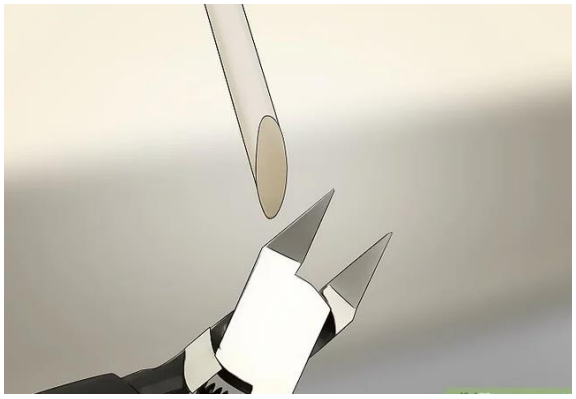


Step -2: Secure the plastic together by tack welding the ends.

1. Before you start the actual weld, pin loose pieces of plastic together by melting the ends of the joint.
2. Fit a tack welding nozzle on your welding gun, then apply a little bit of heat. Wait for the plastic to begin melting, joining the pieces of plastic together. This will keep the plastic from moving as you complete the weld

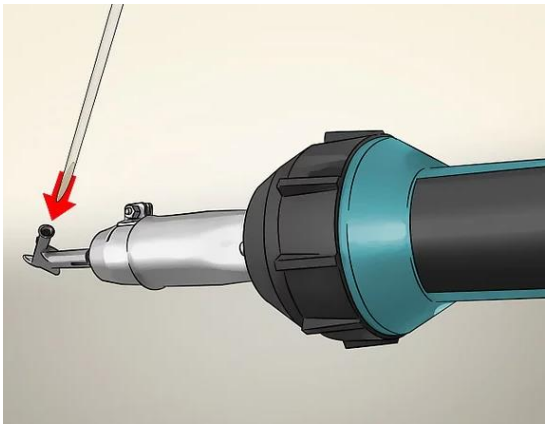


Step -3: Trim the end of a welding rod with angle cutting pliers.



Step -4: Insert a welding rod into a speed nozzle on a welding gun.

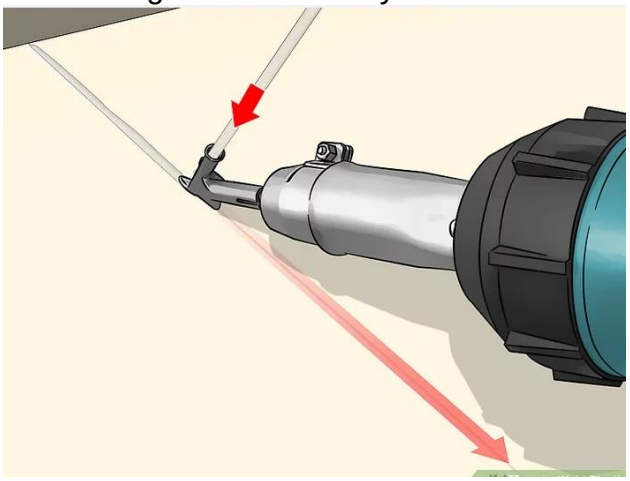
1. Make sure you don't touch the tack nozzle if it is still hot. Either wait for the nozzle to cool or swap the nozzles carefully with a pair of pliers.
2. With a speed nozzle, you will need to feed the rod into the opening while you weld.
3. You could also hold the rod horizontally over the joint and melt it with a technique called pendulum welding, where you sweep the gun or torch back and forth. It takes a little longer but is great for tight spots.



Step -5: Move the tip of the welding gun slowly over the plastic for a speed weld.

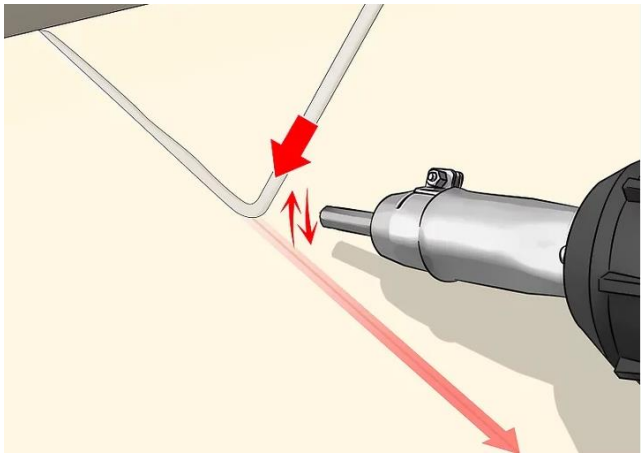
1. Start at the top of the crack or area you wish to join.
2. Hold the gun downward at about a 45-degree angle, touching the edge of the nozzle to the plastic.

3. Then, heat the plastic until you see it beginning to melt. As you push the welding torch along the joint, feed the welding rod into it with your free hand.



Step -6: Swing the welding gun back and forth if you're doing a pendulum weld.

1. Position the welding rod at a 45-degree angle from the opposite side.
2. As you hold the rod in place, sweep the nozzle back and forth 3 or 4 times to melt it.
3. Keep doing this as you move down the plastic to complete the weld



Operation Sheet 3– Finishing the Weld

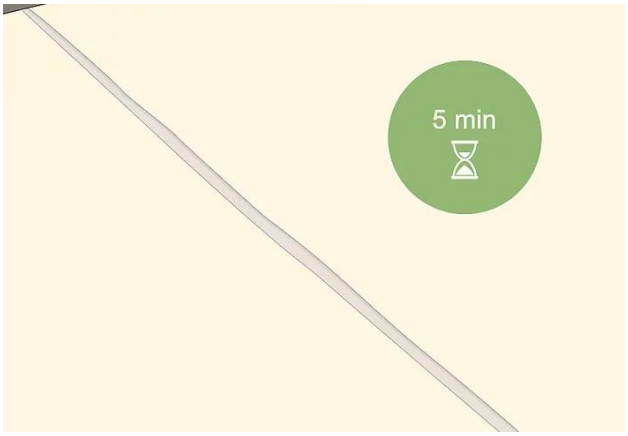
Objectives of conducting pre-start check of tools, equipment and machinery;

- To use all the tools, equipment and sufficient enough

Finishing the Weld step by step procedures:

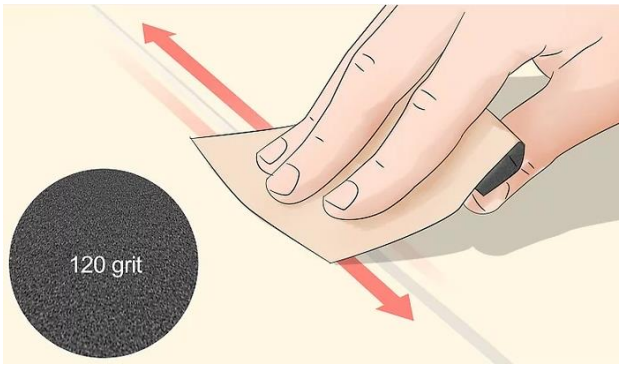
Step -1: Wait at least 5 minutes for the plastic to cool.

- The best time to fix a weld is before it cools. A good weld looks relatively smooth and consistent.
- Add more of the welding rod or smooth out the melted plastic with your gun as needed.



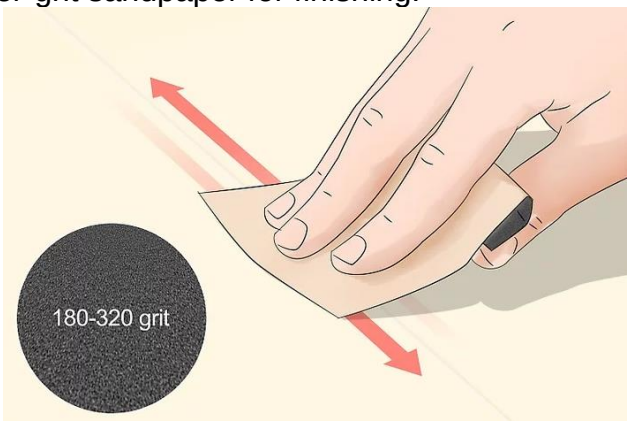
Step -2: Sand the welded joint down with 120-grit sandpaper.

- Apply light pressure to the weld, rubbing the sandpaper back and forth across it.



Step -3: Finish the plastic with 180 and 320-grit sandpaper.

- Switch to finer grits of sandpaper to neaten out the weld.
- Always start with the lower-grit sandpaper. It is coarser, so it wears away more of the plastic. Save the higher-grit sandpaper for finishing.



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 **2** hour. The project is expected from each student to do it.

Task 1: Cleaning and Setting up the Plastic

Task 2: Joining the Plastic

Task 3: Finishing the Weld

LG #41	LO #3- Cleanup 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 and storing materials that can be reused
- Removing waste and scrap by following workplace procedures.
- Cleaning and inspecting equipment and work area for serviceable conditions
- Identifying and tagging unserviceable equipment
- Completing operating maintenance
- Maintaining tool in accordance with workplace procedures and repair methods

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 and store materials that can be reused
- Remove waste and scrap by following workplace procedures.
- Clean and inspect equipment and work area for serviceable conditions
- Identify and tag unserviceable equipment
- Complete operating maintenance
- Maintain tool in accordance with workplace procedures and repair methods

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 and storing materials that can be reused

1.1 Collecting and storing material that can be reused

Storage and Preservation are an important part of the storekeeping function. When materials remain idle in the store these materials should be taken care of and looked after properly. Otherwise these materials may get perished due to natural chemical reaction like rusting by moisture, melting by heat etc and also may get affected by insets, rats etc.

In order to protect the materials from various adverse effects the following actions should be taken: -

1. Materials should be stocked free from ground. No material should be stocked on the floor as it may be affected by dampness, white ants etc.
2. Materials should be stocked in the appropriate place according to the nature of the materials

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.

Good organization of stored materials is essential for overcoming material storage problems whether on a temporary or permanent basis. There will also be fewer strain injuries if the amount of handling is reduced, especially if less manual materials handling is required. The location of the stockpiles should not interfere with work but they should still be readily available when required. Stored materials should allow at least one meter (or about three feet) of clear space under sprinkler heads.

1.2 Housekeeping Signs

The workplace or office is a place where productivity is expected and having a pleasant work area certainly adds to a positive environment. Employees can do their part in addition to regular cleaning staff housekeeping and caretaker maintenance to keep it clean, safe, and healthy for all

Figure 30: proper storage of tools, materials and equipments

- **Importance of proper storage of tools and equipments**
  - ✓ It is important factor for safety and health as well as good business.
  - ✓ Improves appearance of general-shop and construction areas.
  - ✓ Reduce overall tool cost through maintenance.
  - ✓ This also ensures that tools are in good repair at hand.
  - ✓ Teaches workers principles of tool accountability.

- **Pointers to follow in storing tools and equipments**
  - ✓ Have a designated place for each kind of tools.
  - ✓ Label the storage cabinet or place correctly.
  - ✓ Store them near the point of use.
  - ✓ Wash and dry properly before storing.
  - ✓ Store sharp edge materials properly when not in use with sharp edge down.
  - ✓ Put frequently used items in conveniently accessible conditions.
  - ✓ Gather and secure electrical chord to prevent entanglement or snagging.
  - ✓ Cutting boards should be stored vertically to avoid moisture collection
  - ✓ Metal equipment can be stacked on one another after drying.

- ✓ Make sure the areas where you are storing the equipment are clean, dry and not overcrowded.

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

1. What are the actions that should be taken in order to protect the materials from various adverse effects?(10 pts)

Note: **Satisfactory rating greater than/equal - 5 points** **Unsatisfactory – less than 5 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 procedures

2.1 Waste Disposal Practices

Waste management is the precise name for the collection, transportation, disposal or recycling and monitoring of waste. This term is assigned to the material, waste material that is produced through human being activity. This material is managed to avoid its adverse effect over human health and environment. Most of the time, waste is managed to get resources from it. The waste to be managed includes all forms of matter i.e. gaseous, liquid, solid and radioactive matter.

There are eight major groups of waste management methods, each of them divided into numerous categories. Those groups include source reduction and reuse, animal feeding, recycling, composting, fermentation, landfills, incineration and land application. You can start using many techniques right at home, like reduction and reuse, which works to reduce the amount of disposable material used.

2.2 Methods of Waste Disposal

1. **Landfill**:- 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

2. **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. .

3. **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.

4. **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.

5. 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.

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

1. What are the methods of Waste Disposal? (8 pts)

Note: **Satisfactory rating greater than/equal - 4 points** **Unsatisfactory – less than 4 points**

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

Score = _____

Rating: _____

Information Sheet – 3: Cleaning and inspecting equipment and work area for serviceable conditions

3.1 Identifying and reporting maintenance requirement

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 Kinds of Cleaning Solvents

Solutions are homogeneous mixture of two or more components. They can be gaseous, liquid or solid. When we speak of a solution, we usually think of a solid dissolved in water. While water is the most common solvent, other liquids are frequently employed as solvents for certain substances for example wax maybe dissolved in gasoline. The dissolved material in a solution is termed as solute (e.g. wax) while the dissolving medium is called solvent (e.g. gasoline). Solvent is a component of a solution that dissolves solute and is usually present in large proportion or amount. It can be classified as polar or non polar.

- **Polar solvents**: are solvents which dissolve/are soluble in water;
- **Non polar solvents**: are solvents which do not dissolve/are insoluble in water.

Solvents usually used for cleaning in automotive shops are: water, gasoline, kerosene, thinner and detergent soap.

3.3 Properties of Cleaning Solvents

A useful generalization much quoted is that “Like dissolves like”. More specifically, high solubility occurs when the molecules of the solute are similar in structure and electrical properties to the molecules of the solvent.

When there is a similarity of electrical properties; e.g. high dipole element between solute and solvent, the solute-solvent attractions are particularly strong. When there is dissimilarity, solute-solvent attractions are weak. For this reason, a polar substance such as H2O usually is a good solvent for a polar substance such as detergent soap but a poor solvent for a non polar substance such as gasoline.

3.4 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.

3.5 Occupational Health and Safety Practices in Handling Cleaning Solvents

A great percentage of eye injury and cuts results from a disregard for the simplest of rules in handling cleaning solvents. You should never use compressed air to clean your clothes, hands or body. The pressure could cause the cleaning solvents and dirt particles to penetrate your skin, resulting in infection and /or blood poisoning. Do not use compressed air to clean an object immediately after it has been removed from a hot cleaning tank. First, rinse the cleaning solvents away with water. Do not use carbon tetrachloride as a cleaning solution. The fumes, when inhaled can cause serious internal injury and possibly result in death. When steam-cleaning, place the

object to be cleaned on a pallet and wear a face shield and rubber gloves for protection against loose debris.

If a job or cleaning task requires the use of gloves, use the appropriate gloves. Do not for instance use welding gloves when removing an object from a hot tank, or rubber gloves when welding. If you have cut, nicked, or burned yourself, or something has got into your eyes, report immediately to the first-aid person. Keep all inflammable cleaning solvents in closed tin containers and whenever possible, store them in a separate area.

3.6 Inspection of work tools/equipment

The purpose of inspection is to identify whether work tool/equipment and working area can be operated, adjusted and maintained safely. Not all work area, tools/equipment 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/ equipment where significant risks to health and safety may arise from incorrect installation, reinstallation, deterioration or any other circumstances. The need for inspection and inspection frequencies should be determined through risk assessment.

3.7 Importance of inspection

As an essential part of a health and safety program, workplaces should be inspected. Inspections are important as they allow you to:

- listen to the concerns of workers and supervisors
- gain further understanding of jobs and tasks
- identify existing and potential hazards
- determine underlying causes of hazards
- monitor hazard controls (personal protective equipment, engineering controls, policies, procedures)
- recommend corrective action

Self-Check – 3	Written test

Name…… ID…… Date…….

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

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

1. Solvent is a component of a solution that dissolves solute and is usually present in large proportion or amount. (2pts)
2. Non polar solvents are solvents which dissolve/are soluble in water (2pts)
3. Polar solvents are solvents which do not dissolve/are insoluble in water (2pts)

Note: **Satisfactory rating greater than/equal - 3 points** **Unsatisfactory – less than 3 points**

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

Score = _____

Rating: _____

Information Sheet - 4 Identifying and tagging unserviceable equipment

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.

Depends on what you need it for. You can include a stub to give to your customers, or feature numbering so you can easily track each defective part. Choose materials with a bit more durability if you'll be working outside, replace old tags, or fasten your tags to something new.

- We specialize in Repair Tags and we stock several different options for whatever suits your space. Check out our repair tag material guide to compare.
- All tags feature smudge-proof surface. Write your information with a pen, pencil, or marker.

- Bright colored repair and inspection tags with bold, legible prints display and highlight vital information.
- Order tags with our handy Tag-in-a-Box® for convenient storage and dispensing of tags. Just pull and tear!
- Looking for the right fit? Get a custom design. Our customer service staff is happy to help you find what you need.

Self-Check – 4	Written test

Name…… ID…… Date…….

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

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

1. What are the information that the person attaching the tag must completely fill in the tag. (10pts)

Note: **Satisfactory rating greater than/equal - 5 points Unsatisfactory – less than 5 points**

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

Score = _____

Rating: _____

Information Sheet – 5: Completing operating maintenance

5.1 Tools and Equipment Maintenance

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.

5.2 Components of maintenance program

A maintenance strategy includes procedures as well as corrective and preventive maintenance

- Inspections ensure that tools and equipments are operating correctly. Safety inspections ensure the tools/equipments are safe for both patients and operators.
- Corrective maintenance (cm) restores the function of a failed device and allows it to be put back in to service.
- Preventive maintenance (pm) aims to extend the life of the tools/equipment and reduce failure rates.
- Preventive maintenance is the systematic care and protection of tools, equipment, machines and vehicles in order to keep them in a safe, usable condition, limit downtime and extend productivity. We must always be aware that maintenance tasks themselves are potentially hazardous and can result in injury. The successful maintenance program is:

  ✓ well organized and scheduled,

  ✓ controls hazards,

  ✓ defines operational procedures, and

  ✓ trains key personnel.

Self-Check – 5	Written test

Name…… ID…… Date…….

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

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

1. Any activities which require maintenance should be identified properly and reported immediately as soon as possible. (2pts)

2. Corrective maintenance is work carried out following the failure of the plant and equipment.(2pts)

3. Emergency maintenance is that work which is required to be performed without delay due to a failure of a component which. (2pts)

Note: **Satisfactory rating greater than/equal - 5 points Unsatisfactory – less than 5 points**

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

Score = _____

Rating: _____

Information Sheet – 6: Maintaining tool in accordance with workplace procedures and repair methods

6.1 Equipment maintenance

Equipment maintenance is any process used to keep a business's equipment in reliable working order. It may include routine upkeep as well as corrective repair work. Equipment may include mechanical assets, tools, heavy off-road vehicles, and computer systems. The resources needed to keep it all in good repair will vary by type. For instance, repairs made on heavy construction equipment won't look the same as those performed on automated food processing machines.

Maintenance extend the life of tools and equipment, here are the major maintenance components you should be aware of.

Keep Them Dry: In terms of preventative care, it's crucial that you keep your machine tools dry. By storing them out of the elements where they can be exposed to rust and other environmental pollutants, you can keep your equipment in better working order for a longer period of time.

Keep Them Lubricated: While it's crucial to keep the body of the machine dry, it's equally important to keep moving parts lubricated properly. If you use your machine tool on a daily basis, be sure to check lubrication levels of joints, moving parts, and internal components. Without proper lubrication, friction on these moving parts can cause your machine tool to break down. For questions about what kind of lubrication you should use between maintenance visits, contact your local Phoenix machine shop.

Keep Them Sharpened: If your machine tool has components designed for cutting, slicing, or sharpening, it's crucial that you check your equipment regularly for sharpness. Not only can wear and tear on these sharpening elements force your machine to work harder, causing unnecessary wear and tear, but it can also put production at risk by producing substandard products. This is especially true if the

materials you're producing are designed with precision in mind, where accuracy is of the utmost importance.

Keep Them Clean: If your machine tool isn't clean, then problems can start to crop up in both the short and long term. Machines clogged with potentially flammable or hazardous materials can pose a threat to both your workers and your machinery in the short term. Over time, grime can keep your machinery from running at optimal levels, leading to a shorten lifespan or more costly repairs. The technicians at a Phoenix machine shop should be able to advise you on what an ideal cleaning schedule should look like based on your machine, your production output, and other factors that are unique to you.

Self-Check – 6	**Written test**

Name…… ID…… Date…….

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

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

1. What is Equipment maintenance. (2pts)

2. Write the major maintenance components you should be aware of.(2pts)

Note: **Satisfactory rating greater than/equal - 5 points** **Unsatisfactory – less than 5 points**

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

Score = _____

Rating: _____

Operation Sheet 1– Cleaning workplace step by step procedures

Objectives; to know successful shut down procedure of spice and herbs primary processing equipment / machine.

The procedure to successful shut down equipment/machine

Following the steps outlined below will help to cleanup the workplace

Cleaning workplace step by step procedures

Step 1: Clean up every time whenever you leave an area, including sweeping the floor.

Step 2: Clean and return all tools to where you got them.

Step 3: Remove Everything & Prepare your Supplies.

Step 4: Give the garage floor a good sweep to get the debris and bugs out.

Step 5: Mop up spills immediately and put a chair or cone over them if they are wet enough to cause someone to slip.

Step 6: Hang some pictures, signs, or posters

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 **2** hour. The project is expected from each student to do it.

Task: Clean workplace

Reference

1. https://www.wikihow.com/Fiberglass
2. http://www.gogaragedoorguru.com/blog/tips-for-cleaning-up-and-organizing-your-garage-this-spring-.shtml
3. https://www.newprocess.com/material-selection-criteria
4. https://www.vehicleservicepros.com/collision-repair/article/21189700/what-to-know-when-repairing-plastic-anywhere-on-a-vehicle
5. https://www.instructables.com/Welding-Tools-and-Materials/
6. https://www.wikihow.com/Weld-Plastic
7. https://www.leonsautobody.com/news/main-advantages-disadvantages-aluminum-auto-body-construction/#.X-xpUdgzbIU
8. https://vin.dataonesoftware.com/vin_basics_blog/aluminum-bodies-and-frames-the-future-of-the-auto-industry
9. https://www.wsps.ca/Information-Resources/Topics/Machines,-Tools-Equipment.aspx
10. **https://www.autotrainingcentre.com/blog/3-auto-body-technician-students-paint-stripping/**
11. https://swellcomposites.com/blogs/news/step-by-step-guide-measuring-and-mixing-epoxy-resins
12. https://www.onupkeep.com/learning/maintenance-applications/equipment-maintenance

AKNOWLEDGEMENT

We would like to express our appreciation to the TVET instructors and experts of regional TVET bureau, TVET College, and Federal Technical and Vocational Education and Training Agency (FTVETA) who made the development of this learning module with required standards and quality possible.

No	Name	Qualification	Educational background	Region	Phone Number	E-mail
1	**Mulualem Yimer Adem**	A	Automotive Technology	Amhara/ Ethiopia	0920207415	son.yimer@gmail.com

The trainers who developed this learning guide