RTB | RWANDA TVET BOARD

RQF LEVEL 3

AUTLS301

AUTOMOBILE TECHNOLOGY

Engine Lubricating System Repairing

TRAINEE'S MANUAL

December 2023

ENGINE LUBRICATING SYSTEM REPAIRING

2023

AUTHOR'S NOTE PAGE (COPYRIGHT)

The competent development body of this manual is Rwanda TVET Board ©, reproduced with permission.

Copies available from:

- *HQs: Rwanda TVET Board-RTB*
- *Web: www.rtb.gov.rw*

KIGALI-RWANDA

Original published version: December 2023.

ACKNOWLEDGEMENTS

Rwanda TVET Board (RTB) would like to recognize all parties that contributed to the development of the Trainer's and Trainee's manuals for the TVET Certificate III in Automobile Technology module"**AUTLS301 Engine Lubricating System Repairing."** Thanks to Swisscontact for its technical and financial support towards the implementation of this project.

We would also wish to acknowledge all trainers, technicians, and practitioners for their contribution to this project.

The Management of Rwanda TVET Board appreciates the efforts of its staff as well who coordinated this project.

Finally, RTB would like to extend its profound gratitude to MCT Global team that technically led the entire assignment.

Under Rwanda TVET Board (RTB) guiding policies and directives

Under Swisscontact supervision and involvement

COORDINATION TEAM

Aimable Rwamasirabo

Sosthene Kazima

Production Team

Authoring and Review

Martin Niyonzima

Tumaini Manimbi

Conception, Adaptation and Editorial works

Jean Marie Vianney Muhire

Vincent Havugimana

Tumaini Manimbi

Formatting, Graphics, Illustrations, and infographics

Albert Ngarambe

Jean Claude Asoka Niyonsaba

Paul Semivumbi

Coordination and Technical support

SWISSCONTACT and RTB

Project Implementation

MCT Global Ltd

TABLE OF CONTENT

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

% : Percentages

AC : Air Conditioning

BSL : British Sign Language

CBET : Competency-Based Education and Training

CO : Carbon Monoxide

COVID-19 : Corona Virus Deseases-19

Km/h **:** Kilometer per hour

Mph : Miles per hour

PPE : Personal Protective Equipment

RQF : Rwanda Qualification Framework

RTB : Rwanda TVET Board

TVET **:** Technical and Vocational Education and Training

INTRODUCTION

This trainee manual encompasses all necessary skills, knowledge and attitudes required to repair engine lubricating systems. Students undertaking this module shall be exposed with practical activities that will develop and nurture their competences. The writing process of this training manual embraced competency-based education and training (CBT) philosophy by providing enough practical opportunities reflecting real life situations.

The trainee manual is subdivided into units, each unit has various topics, trainee will start with a self-assessment exercise to help trainee rate him/herself on the level of skills, knowledge and attitudes about the unit.

A discovery activity is followed to help trainee discover what he/she already know about the unit.

After these activities trainee will learn more about the topics by doing different activities, reading the required knowledge, techniques, steps, procedures and other requirements under the key facts section, trainee may also get assistance from the trainer. The activities in this training manual are prepared such that they give opportunities to students to work individually and in groups.

After going through all activities, trainee shall undertake progressive assessments known as formative and finally conclude with his/her own self-reflection to identify his/her strengths, weaknesses and areas for improvements.

Do not forget to read the point to remember section which provides the overall key points and takeaways of the unit.

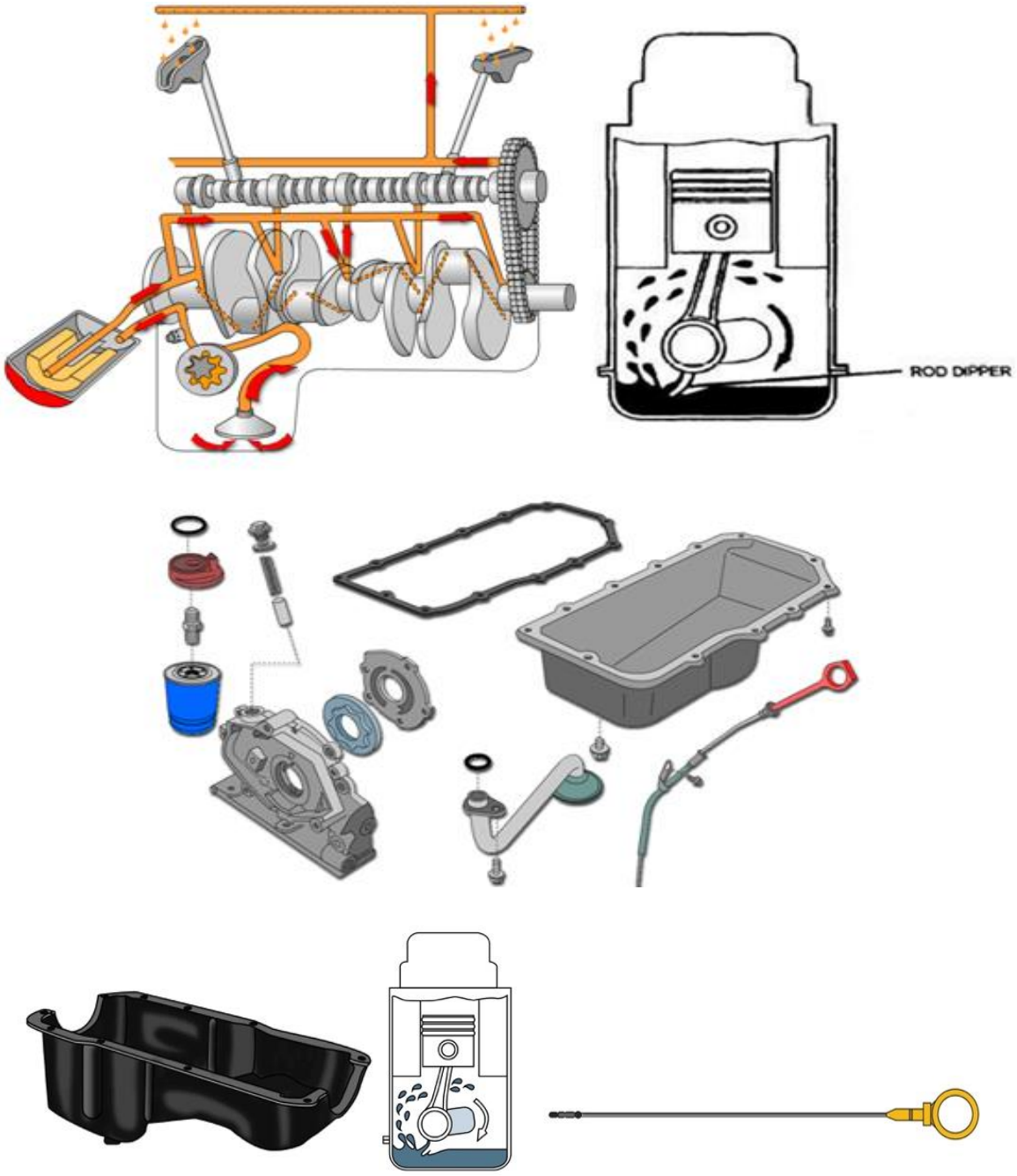
Module Units:

Unit 1: Describe engine lubricating systems

Unit 2: Prepare the workplace and apply safety

Unit 3: Repair engine lubricating system components

UNIT 1: DESCRIBE ENGINE LUBRICATING SYSTEMS



Unit summary:

This unit provides trainees with the knowledge, skills and attitudes to describe the engine lubricating systems. It covers the classification of the engine lubricating system and the description of engine lubricating system components.

Self-Assessment: Unit 1

1. **Study the unit illustration above and answer the following questions.**
    a. What does the illustration show?
    b. What is the structure called?
    c. What activities are performed in the illustration above?
    d. What topics do you think will be covered under this unit based on the illustration?
2. **Fill in and complete the self-assessment table below to assess your level of knowledge, skills and attitudes under this unit.**
    a. There are no right or wrong ways to answer this assessment. It is for your own reference and self-reflection on the knowledge, skills and attitudes acquisition during the learning process.
    b. Think about yourself: do you think you have the knowledge, skills or attitudes to do the task? How well?
    c. Read the statements across the top. Put a tick in a column that best represents your level of knowledge, skills and attitudes.
    d. At the end of this unit, you will assess yourself again.

My experience Knowledge, skills and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Explain the engine lubricating system					
Identify types of engine lubrication systems					
Identify types of engine lubrication system components					
Classify engine lubricating systems					

My experience Knowledge, skills and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Describe engine lubricating system components					
Describe the splash Lubrication method					
Describe the Pressurized Lubrication method					
Comply with safety precautions at the workplace					
Pay attention to details while dealing with engine lubricating system components					
Demonstrate team spirit while working with others					
Comply with national and international standards related to workplace					

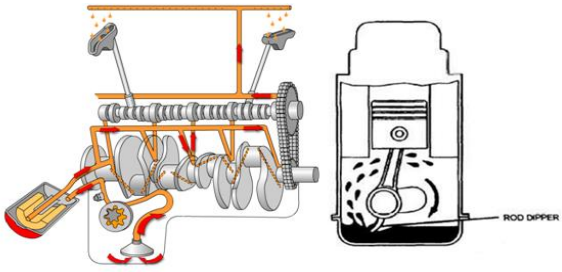
Key Competencies:

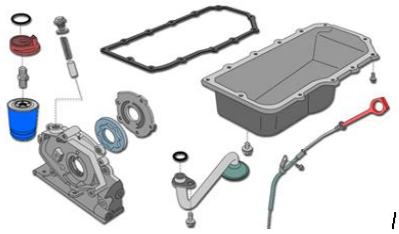
Knowledge	Skills	Attitudes
1. Explain the engine lubricating systems	1. Classify engine lubricating systems	1. Comply with safety precautions at the workplace
2. Identify types of engine lubrication systems	2. Describe engine lubricating system components	2. Pay attention to details while dealing with engine lubricating components
3. Identify types of engine lubrication system components	3. Describe splash lubrication method	3. Demonstrate team spirit while working with others
	4. Describe the pressurized lubrication method	4. Comply with national and international standards related to housekeeping organization

Discovery activity

Task 1

Analyse the following pictures and answer the questions

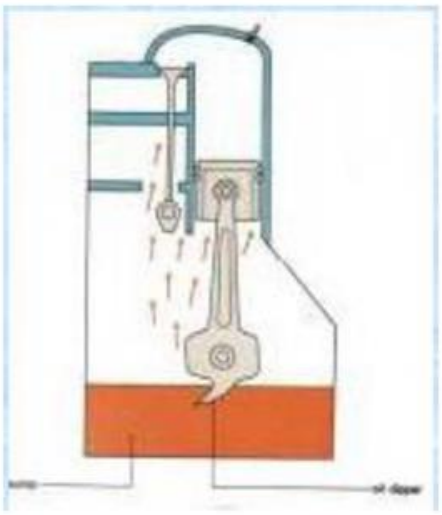


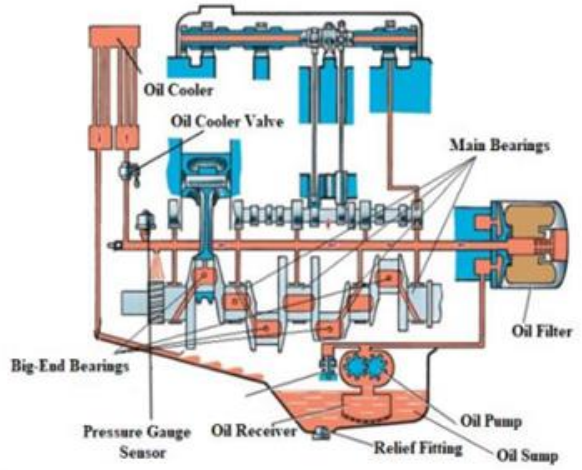


1. What do you see on the picture above?
2. Write down the constitutional parts you observed.

☞ Share your responses with the rest of the class.

Topic 1.1: Classification of Engine Lubricating Systems





a) b)

Figure 1: Engine lubricating systems

Activity 1: Problem Solving

Task 2:

Visit the school automotive workshop and check the engine lubrication system of a Toyota RAV4 and that of a Honda Motorcycle. Answer the following questions:

1. Are the two engine lubrication systems a) and b) identical?
2. What is the difference?
3. What is the class of the RAV4 engine' lubrication system?

☞ Refer to Key facts for further information and clarifications.

Key Facts 1.1: Engine lubricating system

- **Definition:**[1]

The engine lubricating system is a critical component of an internal combustion engine that ensures proper lubrication of its moving parts. It consists of various components, including an oil pump, oil filter, oil pan, and a network of oil passages.

- **Purpose/Function**

1. Lubrication: The primary function is to provide a layer of lubricating oil between the moving parts of the engine, such as the pistons, crankshaft, and camshaft. This reduces friction and wear, ensuring smooth operation and extending the lifespan of the engine.

2. Cooling: The engine lubricating system helps in dissipating heat generated during engine operation. The oil absorbs heat from the engine components and carries it away, preventing overheating and maintaining optimal operating temperatures.

3. Cleaning: The lubricating oil also acts as a cleaning agent, carrying away dirt, debris, and contaminants that may accumulate in the engine. The oil passes through an oil filter, which removes impurities, ensuring clean oil circulates throughout the engine.

4. Sealing: The engine lubricating system helps in creating a seal between various engine components, such as the piston rings and cylinder walls. This prevents oil leakage and maintains proper compression within the engine cylinders.

5. Corrosion and Rust Prevention: The lubricating oil contains additives that protect engine components from corrosion and rust. These additives form a protective film on the metal surfaces, preventing damage and ensuring longevity.

Overall, the engine lubricating system plays a crucial role in maintaining the performance, efficiency, and durability of an internal combustion engine.

• **Splash Lubrication system method**	**Splash Lubrication:** Splash lubrication is a method of lubricating internal combustion engines, gears, or other rotating machinery by allowing the lubricating oil to be splashed or

[1]https://www.engineeringchoice.com/what-is-engine-lubrication-system/

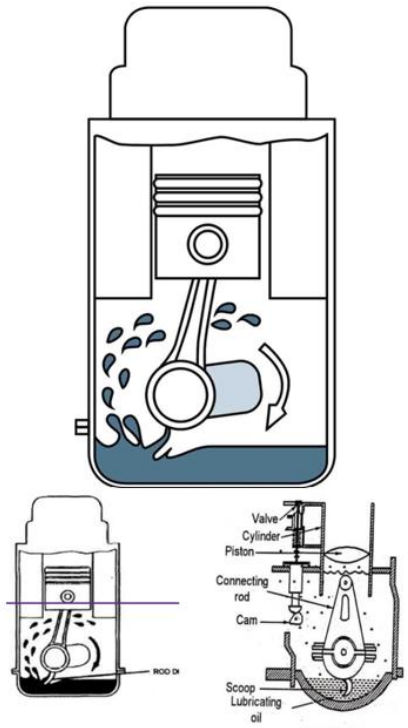


Figure 2: Splash Lubrication system

thrown onto the surfaces of moving parts by the motion of the rotating components. This technique is commonly used in various types of engines, including some small internal combustion engines, gearboxes, and certain types of industrial machinery.

- **Pressurized Lubrication method**

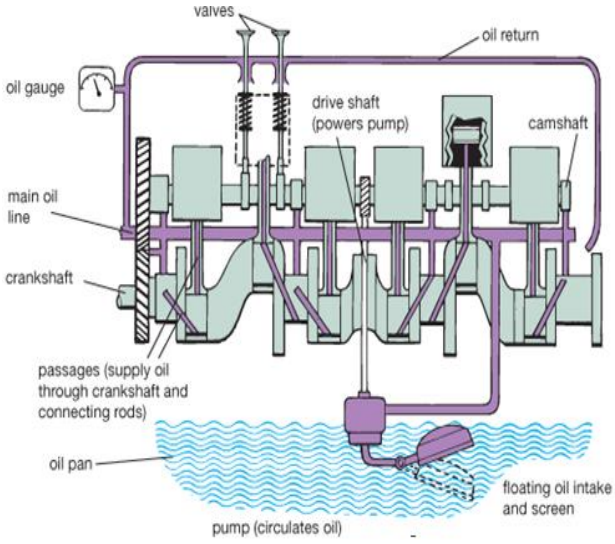


Figure 3: Pressurized Lubrication system

Pressurized lubrication: is a full force-feed lubrication method. It lubricates internal combustion engines in which a pump forces oil into the engine moving parts.
Engine oil is stored in the oil pan or sump.
The oil pump draws the oil from the sump.
It passes it through oil filter.
The oil is then moved throughout the engine via oil passages or galleries.

Activity 2: Guided Practice

Task 3

Visit the school workshop, and under the guidance of the trainer, perform the following tasks

1. Develop all the procedures that you can follow in order to classify vehicles and motorcycles lubrication systems
2. Differentiate vehicles and motorcycles lubrication systems.

☞ Share your work with the rest of the class

☞ Ask for clarifications to your trainer if you have questions.

Activity 3: Application

Task 4

Visit the nearest garage and observe the two engines lubricating systems (vehicles and motorcycles lubrication systems) being repaired by mechanics in the garage then do the following tasks:

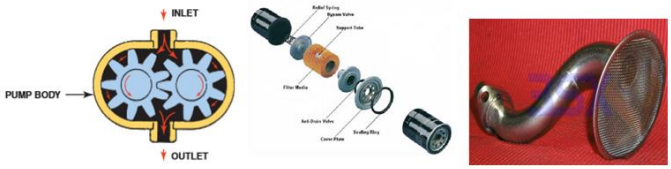
1. Analyse the two cases.
2. Make a report focusing on the below:
    a. Splash engine lubricating method description
    b. Pressured engine lubricating method description
    c. Difference between the two methods
    d. The function of the engine lubrication system.

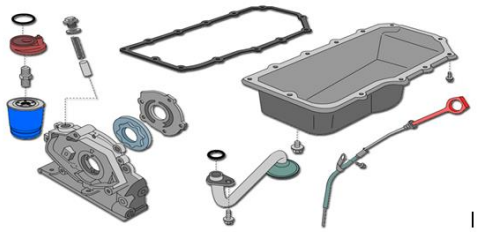
Topic 1.2: Description of Engine Lubricating System Components

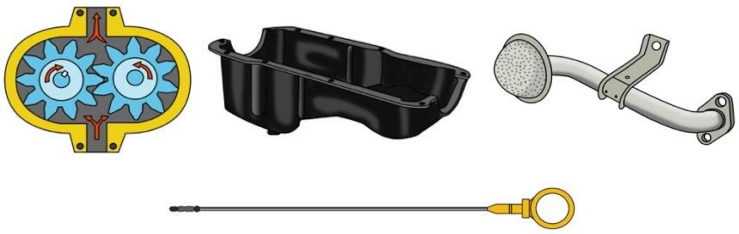
Activity 1: Problem Solving

Task 5

Analyze the illustrations below and answer the questions that follow.



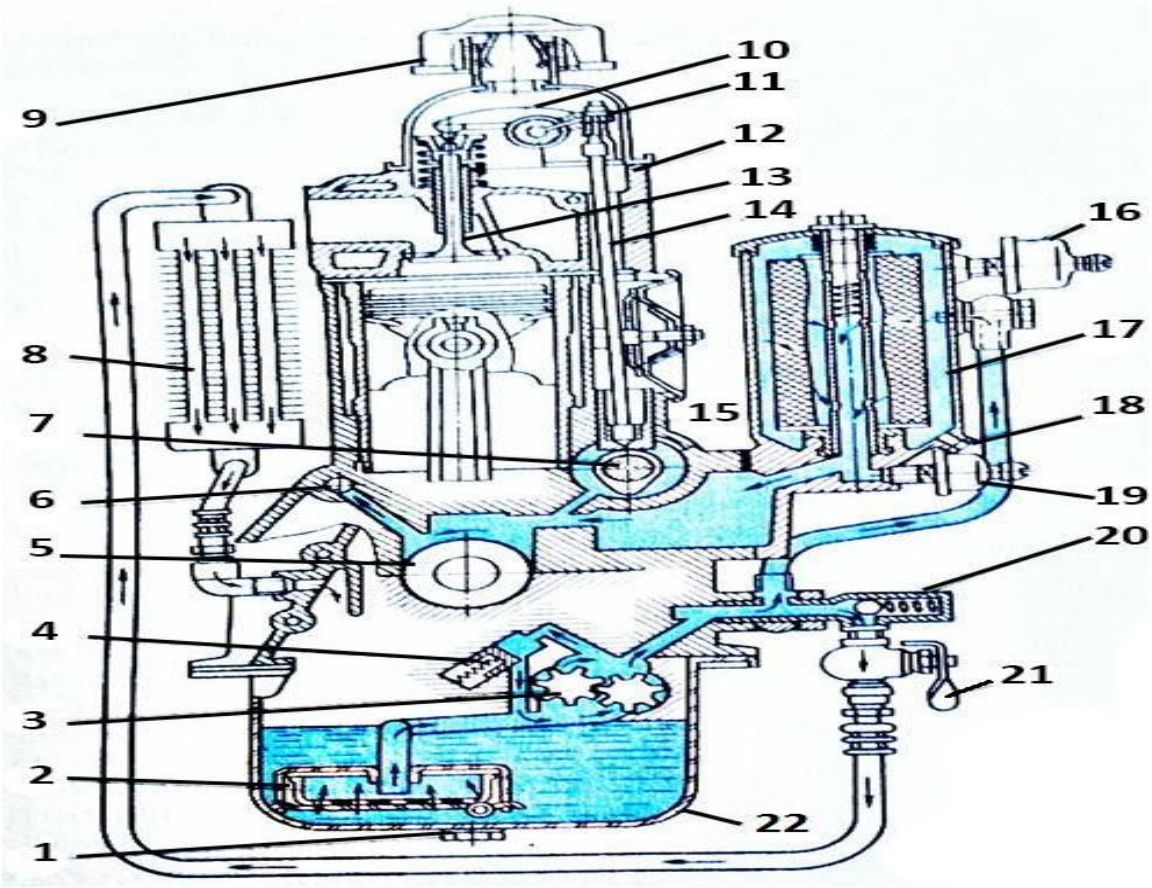




1. Mention the engine lubricating system components above.
2. Mention the function of each component.
3. Are there any other components of an engine lubricating system BUT NOT shown in the figure?

#	Component name	Function
1.		
2.		
3.		
4.		
5.		

☞ Refer to the key facts 1.2 for further information and clarifications.



1. List the lubrication system components above labelled from 1 to 21.
2. Give the function of each component.
3. Which other component of the lubrication system BUT NOT shown in the figure?

#	Component name	Function
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		

☞ Refer to the key facts 1.2 for further information and clarifications.

Key Facts 1.2: Description of engine lubricating system components

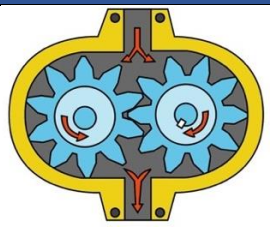
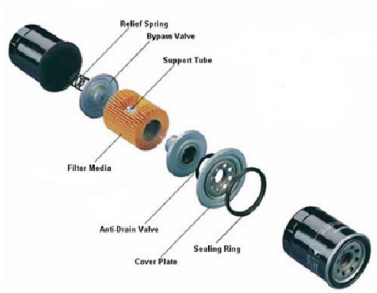
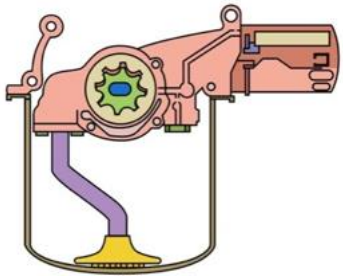
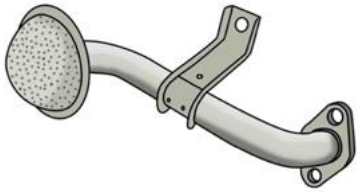
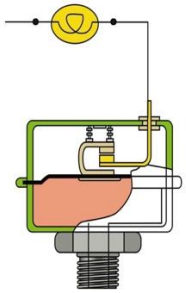
Components	Description
 Figure 4: Oil pump	Oil pump The oil pump in internal combustion engine circulates engine oil under pressure to the moving parts of the engine.
 Figure 5: Oil sump	Oil sump Oil sump or oil pan is usually situated at the bottom of an engine and it serves as a reservoir for oil.
	Oil filters Oil filter strains the oil to trap debris, dirt, metal particles, and other contaminants that can wear down and cause damage to engine components. An

Figure 6: Oil filters	oil filter is a filter designed to remove contaminants from the engine oil.
 Figure 7: Relief valve	Relief valve Relief valve regulates oil pressure for consistent flow as load and engine speed change. Relief valve regulates oil pressure.
 Figure 8: Oil strainer	Oil strainer Oil strainer is a screen that is on the bottom of the oil pump pickup. It prevents anything from getting into the oil pump that may cause a problem.
 Figure 9: Oil pressure indicator	Oil pressure indicator Oil pressure gauge or indicator is either mechanically or electrically operated and displays the actual oil pressure of the engine. It warns the driver of low oil pressure by using oil pressure switch.
 Figure 10: The oil cooler	The oil cooler The function of an engine oil cooler is to regulate the temperature of the engine oil by dissipating excess heat.

Activity 2: Guided Practice

Task 6

- Visit school workshop, analyse and describe Toyota Rush lubricating system components. Share your work with the rest of the class
- Ask for clarifications to your trainer if you have questions.

Activity 3: Application

Task 7

Read the scenario below and perform the tasks that follow

ATECAR garage mechanic has requested you to assist him when servicing Toyota Coaster's lubrication system:

1. Describe the components of the lubrication system for this vehicle.
2. Generate a report focusing on the following:
    a. The description of the system
    b. The components and their functions

Formative Assessment

1. Which part of the lubrication system removes unwanted impurities?
2. Name the engine lubrication system part that stores engine oil.
3. How to measure the level of oil in the oil pan?
4. Describe at least five components of an engine lubrication system.

Points to Remember

- Engine lubrication system plays a vital role in automobiles as they comprise two or more robing, moving parts; these parts produce friction and generate heat which causes excessive wear and tear of the parts. When two moving parts experience a film of lubrication, they are separate from each other.
- Engine lubrication systems are classified into splash and pressurized systems.
- Engine lubrication system has various components to enable the system to function:
  - ✓ Oil sump
  - ✓ Engine oil filter
  - ✓ Piston cooling nozzles
  - ✓ The oil galleries
  - ✓ Oil cooler
  - ✓ The oil pressure indicator/light

Self-Reflection

Fill in and complete the self-assessment table below to assess your level of knowledge, skills and attitudes after covering this unit.

There are no right or wrong ways to answer this assessment. It is for your own reference and self-reflection on the knowledge, skills and attitudes acquisition during the learning process. Think about yourself:

a. Do you think you have the knowledge, skills or attitudes to do the task?
b. How well?

Read the statements across the top. Put a check in a column that best represents your level of knowledge, skills and attitudes.

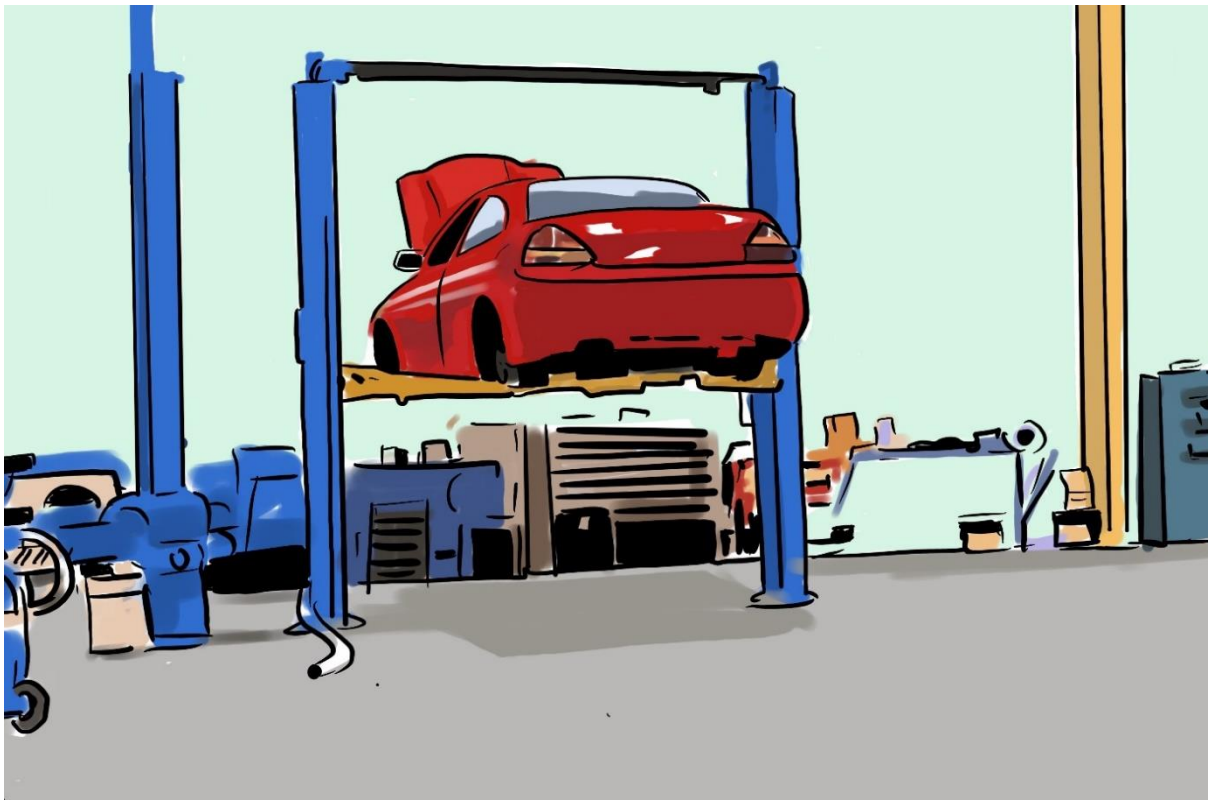
My experience Knowledge, skills and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Explain the engine lubricating system					
Identify types of engine lubrication systems					
Identify types of engine lubrication system components					
Classify engine lubricating systems					
Describe engine lubricating system components					
Describe the splash Lubrication					
Describe the Pressurized Lubrication					
Describe engine lubricating components					
Comply with safety precautions at the workplace					
Pay attention to details while dealing with engine lubricating components					
Demonstrate team spirit while working with others					

My experience Knowledge, skills and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Comply with national and international standards related to workplace					

Fill in the table below and share the results with the trainer for further guidance.

Areas of strength	Areas for improvement	Actions to be taken to improve
1.	1.	1.
2.	2.	2.

UNIT 2: PREPARE WORKPLACE AND APPLY SAFETY



Unit summary:

This unit provides you with the knowledge, skills and attitudes to prepare workplace. It covers the identification of safety precautions at workplace, selection of personal protective equipment (PPE), cleaning and arrangement of the workplace.

Self-Assessment: Unit 2

1. **Study the unit illustration above and answer the following questions:**
    a. What do you see in the illustration?
    b. What topics do you think will be covered under this unit based on the illustration?
2. **Fill in and complete the self-assessment table below to assess your level of knowledge, skills and attitudes under this unit.**
    a. There are no right or wrong ways to answer this assessment. It is for your own reference and self-reflection on the knowledge, skills and attitudes acquisition during the learning process.
    b. Think about yourself: do you think you have the knowledge, skills or attitudes to do the task? How well?
    c. Read the statements across the top. Put a check in a column that best represents your level of knowledge, skills and attitudes.
    d. At the end of this unit, you will assess yourself again.

My experience Knowledge, skills and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Identify personal safety at workplace					
Describe the work area safety at workplace					
Describe the tools and equipment safety					
Classify personal protective equipment (PPE)					
Use of personal protective equipment (PPE)					
Identify types of cleaning method at workplace					

My experience Knowledge, skills and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Describe the procedures for cleaning the workplace, tools and equipment					

Key Competencies:

Knowledge	Skills	Attitudes
1. Identify the safety precautions at workplace	1. Describe the Safety precautions at workplace	1. Pay attention to details while describing the procedures for cleaning the workplace, tools and equipment
2. Identify personal protective equipment (PPE)	2. Select personal protective equipment (PPE)	2. Demonstrate team spirit while working with others
3. Identify types of cleaning method at workplace	3. Describe the procedures for cleaning the workplace, tools and equipment	3. Pay attention to details while using personal protective equipment (PPE)
	4. Apply cleaning techniques	

Discovery activity

Task 8:

1. **Analyse the figure below and answer the following questions:**

a. What do you see on the picture?

b. Explain the personal protective equipment you see on the picture.

c. In the picture below explain the types of hazards an employee must prevent at workplace.

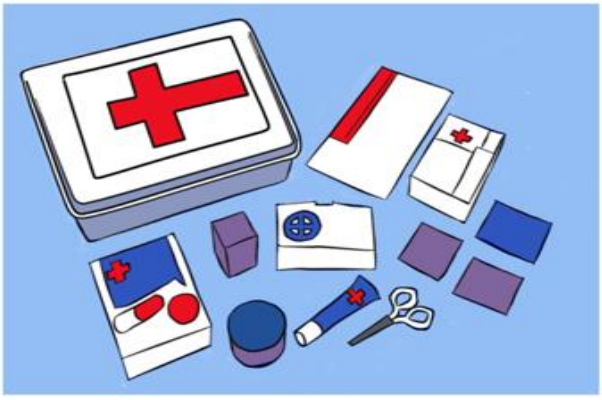
d. Describe the type of cleaning the person is performing in the picture. Are there others that are not shown on the picture?

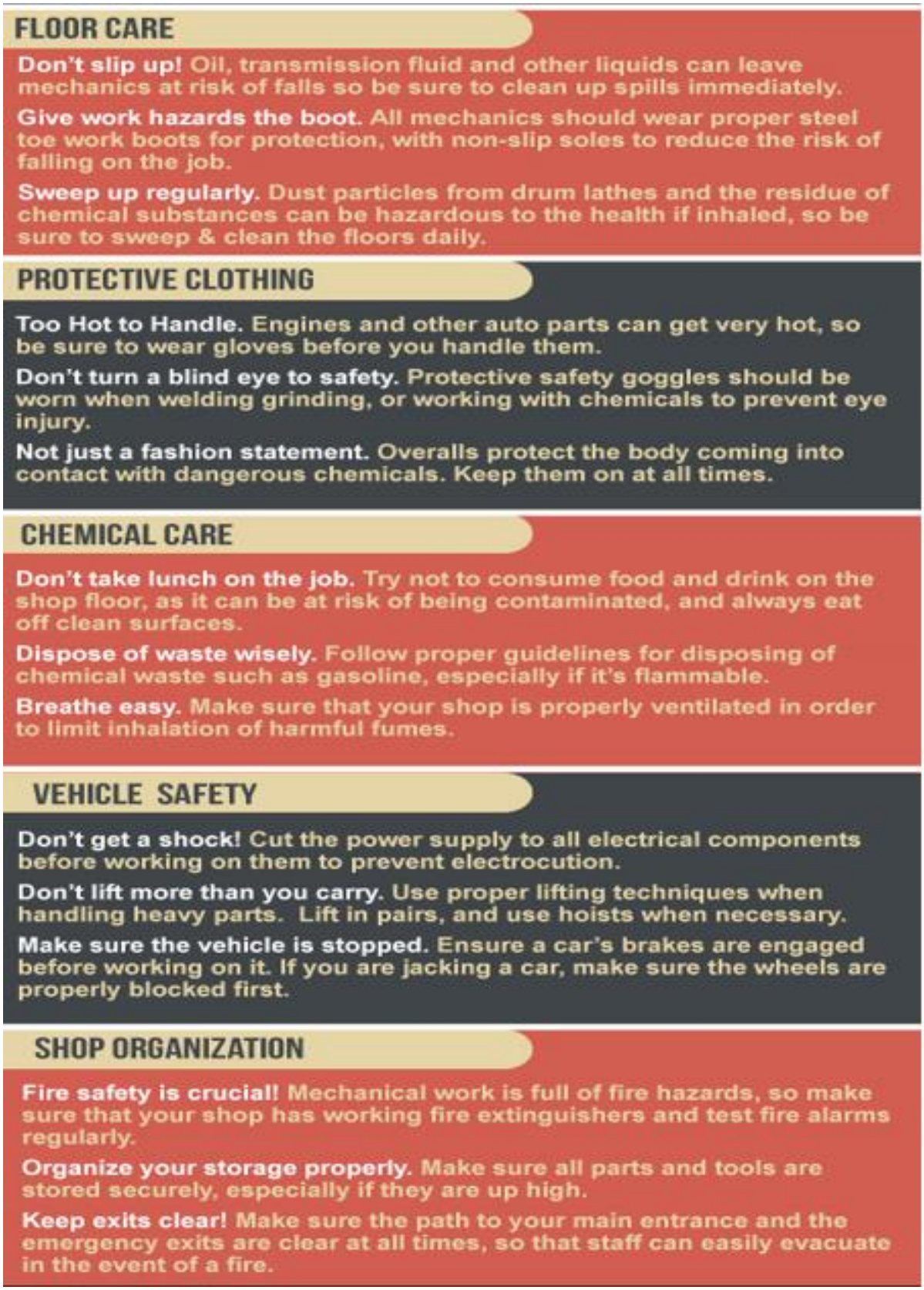
Topic 2.1: Application of safety precautions at workplace

Activity 1: Problem Solving

Task 9:

Discuss the pictures below and answer the questions that follow.





2

[2]https://www.autotrainingcentre.com/blog/infographic-mechanics-guide-shop-safety/

Questions:

1. What is happening on the various pictures above?
2. Explain the personal protective equipment you see on the picture above.
3. Explain the types of hazards in the workplace.
4. Describe the personal safety, cleaning safety and work area safety.
5. Describe safety tools and equipment.

☞ Refer to the key facts 2.1a &b for further information

Key Facts 2.1a: Safety precautions at workplace

Introduction

Working on vehicles in automotive repair shops requires safety measures. Everyone involved in such activities needs to ensure that proper safety precautions are followed always for everyone's protection.

Personal, tools and equipment safety

Safety measures protect workers and visitors from injuries. As accidents happen more frequently when someone slips on an oily floor, falling off ladders with tools clutched tightly by slippery fingers. Therefore, it is essential to know how to safeguard yourself and your co-workers and even customers because accidents happen.

Common injuries in automotive repair shops

Auto mechanic work involves dangerous machinery, chemicals, and tools which put employees at a greater risk of accidents. These lead staff to lose their lives, level of productivity and incur higher medical costs. Below are some of the injuries in automotive shops.

- **Cuts and Burns**

In an automotive shop, chances are your job involves using tools and handling automobile parts. These are things that can be sharp or heavy enough to injure anyone if something goes wrong. A 2011 study published in Industrial Health found mechanics reporting cuts as the most common type of accident experienced in place of work. In addition,

mechanics and other workers in the automotive industry are also injured due to falls or equipment tip-over, leading to severe cuts or burn accidents.[3]

- **Trauma**

Employees in automotive shops like mechanics are at risk of all sorts of injuries. For example, they need to lift heavy objects, leading to straining their muscles. In addition, they often work for hours with poor posture, which can lead to repetitive stress injury or cumulative trauma disorder such as muscle pulls, spinal and wrist injuries. Slips and trips could cause trauma even without falling, and they are common in the automotive workplace.

According to the BSL, in 2005, heavy lifting accounted for more than 50% of all overexertion injuries. Using advanced tools and utilizing proper techniques while performing any physical task could prevent such injuries. Unfortunately, some of these musculoskeletal injuries cannot always be avoided despite your best efforts.

- **Eye injuries**

Eye injuries among auto mechanics are nothing new. However, studies have shown that most eye injuries occur with workers who aren't wearing safety equipment due to the unavailability of safety gear like goggles or inadequate training on how important they are to protect their eyes. As a result, every day in America alone, 1,000 people suffer from work-related eye injuries. In addition, the prevalence of workplace accidents involving an injured worker's eye is widespread.[4]

- **Chemical burns**

Mechanics and other technicians are faced with danger when they are overexposed to harmful chemicals and sharp tools. However, even with all the precautions in place, incidents sometimes still happen. Breathing in fumes or coming into contact are the two most common ways of exposure to harmful chemicals.

[3]https://www.gloves.com/pages/safety-guide-for-automotive-workers
[4]https://www.hseblog.com/safety-rules-for-automotive-repair-shops/

Similarly, auto mechanics are also exposed to these dangerous substances when the engine parts start to wear off, and they contain these chemicals. For instance, toxic chemical additives could be present in the oil.

Automotive gas is highly flammable, and if not handled properly, it could lead to severe burns if they come into contact with sparks, high temperatures of fire.

- **Loss of body parties**

Working with power tools and equipment in an automotive workshop is dangerous. For example, the use of grinders, electric metal shears, etc., present the danger that you could lose a body part if not careful enough. Some of these injuries can be prevented by following practices to keep yourself safe while working:

- ✓ Make sure that all power cords are unplugged before moving any machine
- ✓ Wear grounding straps when using grinders both on your body and around loose clothing items like sleeves;
- ✓ Use only one hand at a time with electric shears, so you don't get caught by blades while cutting metal sheets, etc.; and finally
- ✓ Never push heavy objects without assistance from another individual.

- **Slips, Trips, and Falls**

The auto garage is one of the most dangerous places to work. The constant presence of fluids and cables on the floor creates a slippery surface, leading to accidents such as slips, trips, or falls. In addition, some chemicals may be stored next to regular foot traffic in areas where they should not be stored.

- **Strains, Sprains, Tears**

Working in the automotive repair shop can cause injuries like over-work oneself by lifting heavy objects or being forced to repeat tasks without breaks. If left untreated, the strains could lead to severe injuries for those working on vehicles all day long. Therefore, it is

recommended to implement safe practices that will help reduce stress-type strain exposures like improper lifting techniques.

To be effective, safety guidelines should comprise the personal safety, safety of tools and equipment, and work area safety.

Prevention of common injuries

Mechanics and employees in the automotive industry often conduct some of the most difficult and daunting tasks. They are tasked with some of the most challenging repairs that stretch them mentally, physically, and emotionally too.

Their jobs come with a significant risk of injuries with the thousands of pounds of metal hanging above them with sharp tools around. In addition, the repetitive nature of the operations can potentially be a source of risks to injury. However, safety precautions can be put in place to prevent some foreseeable incidents before they happen. For that reason, some injuries can be avoided by watching out and taking preventive measures. The following are some of the measures:

In the event of an electrical shock, time is crucial. The severity and effects depend on several factors such as whether or not you are wet (because water conducts electricity), how much current was passed through your body, what pathway it took throughout, and how long, but most importantly- you need to do something fast.

To avoid any issues at hand, always make sure you have protection against these dangers.

- ✓ Always ensure all tools are cleared away before you start any work near the source of power like the motors or generators because they pose an increased risk.
- ✓ Children should be kept out of repair areas, especially when you're working.
- ✓ Always make sure you maintain good housekeeping practices by keeping floors clean.

Strain and Sprain

Strains and sprains are some of the most common injuries in automotive repair shops. You can help prevent or minimize these painful accidents by ensuring you have good physical fitness, maintaining a healthy weight, avoiding smoking or drinking too much alcohol (as this will lead to weariness), practicing proper posture while at work, or keeping alert. Always have an adequate sleep and rest when needed. As for workplace safety measures that contribute to an increased risk of injury, always know how equipment is designed and do not overload them.

Workers should be encouraged to take a few minutes in the morning for a warm-up exercise or a stretch and flex program as they will reduce sprains, tears, and strains.

Proper safety gear

Machines are a great way to automate tasks that would otherwise be very difficult for humans. However, even with the help of safety equipment, workers need to take care when operating machinery not to hurt themselves or others around them.
Workers need to wear personal safety equipment (PPE). Some standard PPE includes closed-toe shoes, helmets, gloves, and many others. These safety gears are available in many different varieties, depending on what you are doing. For instance, full wrap goggles can prevent debris from reaching your eyes while operating machinery. Similarly, cut-resistant gloves are suitable for those working with sharp tools or pointed edges that could potentially cause injury.

Machine Injuries

Many ways can be used to reduce the risk of workplace injuries when using work equipment or handling tools—by taking adequate steps. Employers have a responsibility to ensure the safety of the workplace for all employees. Therefore, they should take every action possible to protect their employees from injury.

Some of the appropriate measures to reduce machine injuries include the following:

- ✓ **Risk assessment** - Never invest in work equipment without first doing a thorough risk assessment. The process of assessing risks is crucial because knowing your liabilities can allow you to avoid accidents and injuries before they happen.
- ✓ **Getting rid of the hazards** - The best way to avoid injury when on the job is to plan and work around hazardous equipment. If this cannot be done, other forms of protecting yourself from injury should be considered.

Emergency response for workplace accidents

Businesses should always prepare in advance for disaster. This includes developing an emergency response plan that trains all employees on how to deal with potential workplace injuries during a crisis.

Occupational Safety and Health team/task force's emergency action plan should be designed to protect workers from workplace emergencies. It requires employers to make an assessment of the worst-case emergencies probable at their facilities, such as fires and explosions. Once a potential disaster has been identified, it can be mitigated by employees following predetermined procedures for dealing with that particular situation - an example would be evacuating after hearing a fire alarm.

A well-crafted emergency action plan can save your life. It should include the preferred method of reporting an emergency, evacuation policy and escape routes, contact information for outside agencies and personnel to be contacted during a crisis or disaster scenario inside the facility.

Figure 11: Vehicle safety Guidelines[5]

Safety responsibility

A careless attitude and poor work habits invite disaster. Shop/garage accidents can cause serious injury, temporary or permanent disability, and death. Safety is not a one time or an individual effort. It takes everyone working together to notice and report any hazards

[5]https://www.gloves.com/pages/safety-guide-for-automotive-workers

to the employer. Both the employer and the employees must work together to protect the health and welfare of all who work and walk in the shop.

Key Facts 2.1b: Work area safety

Safety guidelines

The work area should be kept clean and safe. These safety guidelines include but not limited to the following:

i. The floor and bench preparation

The floor and bench tops should be kept clean, dry, and orderly. Any oil, coolant, or grease on the floor can make it slippery. Slips can result in serious injuries. To clean up oil, use a commercial oil absorbent. Keep water off the floor.

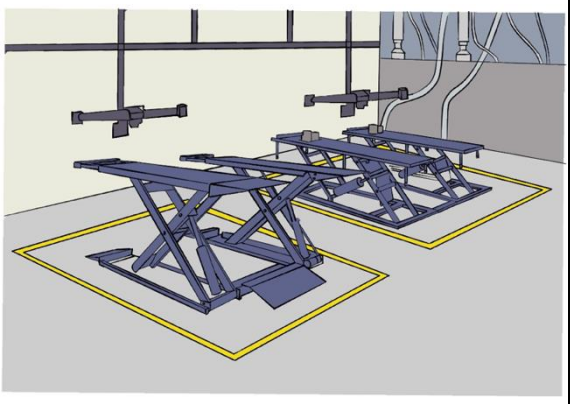


Figure 12: Safety zone markings

Water is slippery on smooth floors, and electricity flows well through water. Aisles and walkways should be kept clean and wide enough to move through easily. Make sure the work areas around machines are large enough to operate the machine safely.

ii. Ventilation set properly

Proper ventilation of space heaters, used in some shops, is necessary to reduce the CO levels in the shop. Also, proper ventilation is very important in areas where volatile solvents and chemicals are used. (A volatile liquid is one that vaporizes very quickly.) Keep an up-to-date list of emergency telephone numbers clearly posted next to the telephone. These numbers should include a doctor, hospital, and fire and police departments.

iii. First-Aid kit availability

Also, the work area should have a first-aid kit for treating minor injuries. There should also be eye flushing kits readily available. Gasoline is a highly flammable volatile liquid. Always keep gasoline or diesel fuel in an approved safety can, and never use it to clean your hands or tools. Oily rags should also be stored in an approved metal container. When these oily, greasy, or paint-soaked rags are left lying about or are not stored properly, they can cause spontaneous combustion.

iv. Fire extinguishers and blanket availability

Car repair shops pose a range of fire risks, from flammable liquids to high tech equipment, plus a potentially combustible mix of dust, swarf and lubricants.
Therefore, the shops should always equip themselves with at least two different types of fire extinguisher. As spontaneous combustion results in a fire that starts by itself, without a match. Make sure that all drain covers are snugly in place.

Open drains or covers that are not flush to the floor can cause toe, ankle, and leg injuries. Know where the fire extinguishers are and what types of fires they put out.
A multipurpose dry chemical fire extinguisher will put out ordinary combustibles, flammable liquids, and electrical fires. Never put water on a gasoline fire. The water will just spread the fire. Use a fire extinguisher to smother the flames. Remember, during a fire, never open doors or windows unless it is absolutely necessary; the extra draft will only make the fire worse.

A good rule is to call the fire department first and then attempt to extinguish the fire. To extinguish a fire, stand 6–10 feet from the fire. Hold the extinguisher firmly in an upright position. Aim the nozzle at the base and use a side-to-side motion, sweeping the entire

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

width of the fire. Stay low to avoid inhaling the smoke. If it gets too hot or too smoky, get out. Remember, never go back into a burning building for anything.

Figure 13: Class of Fire and extinguishers types

Figure 14: fire blanket [6]

v. Storage of tools and equipment

Properly store all parts and tools by putting them away in a place where people will not trip over them. This practice not only cuts down on injuries, but also reduces time wasted looking for a misplaced part or tool.

vi. Use of warning signs

Always be familiar with evacuation routes and where to gather outside the building. Always know the location of all safety equipment in the shop, and be familiar with the operation of this equipment.

[6]https://www.google.com/search?sca_esv=557208691&sxsrf=AB5stBioFF4_kohREHFZj7x7dFHTpdU2bg:1692141376205&q=fire+extinguisher+types&tbm=isch&source=lnms&sa=X&ved=2ahUKEwibtY3t5d-AAxVHWaQEHYegDsMQ0pQJegQIDBAB&biw=1141&bih=536&dpr=1.68#imgrc=nYytllrNoKLLwM

Activity 2: Guided Practice

Task 10:

Read the scenario below and perform the tasks related to it.

IPRC NGOMA has a mechanic workshop and is expecting the fall intake for short course candidates. You have been tasked to prepare the workshop by applying the safety precautions for the workplace.

1. Ensure the work area is safely prepared
2. Ensure the safety tools and equipment are available
3. Ensure the personal safety is ready to be applied
4. Describe for the users how fire extinguishers are used in case of fire outbreak

☞ Seek guidance from your trainer if need be.

Activity 3: Application

Task 11:

Visit auto repair shops neigbhouring your school, participate in the application of safety precautions at the workplace.

Make a report on the safety measures put in place by focusing on the following:

1. Work area safety
2. Tools and equipment safety
3. Personal safety
4. Types of fire extinguishers at the place
5. Recommendations on what to improve for a safer environment.

Topic 2.2: Selection of Personal Protective Equipment (PPE)

Activity 1: Problem Solving

Task 12:

Analyse the picture below and answer the questions that follow:

Questions:

1. What do you see on the picture?
2. Name the types of PPE.
3. What are the functions of these PPE.
4. Indicate when and why to wear these PPE.

☞ Refer to the key facts 2.2 for further information

Key Facts 2.2: Selection and use of PPE

Use of PPEs

In auto repair activities,, employees are exposed to hazards such as falling, flying, abrasive and splashing objects, or are exposed to harmful dusts, fumes, mists, vapors, or gases; therefore, they must be provided with personal protective equipment necessary to protect them from the hazard.

Selection

The following considerations should be evaluated in the selection and use of PPE when working in the repair shop and using portable power tools. There are similarities in PPE used for hand and power tools however, there are also distinct differences.

- **Safety glasses or goggles** must be worn in order to protect the eyes from projectiles. A face-shield may be used in addition to safety glasses or goggles to provide additional protection. A face-shield will protect the face and neck from hot metal fragments created during such tasks as grinding;
- **Cut resistant gloves**, while capable of preventing lacerations due to hand tools, will not protect against blades and bits of power tools;
- **Safety shoes** should also be worn while working with power tools to prevent injury from dropped tools.
- **Ear protection** may be necessary due to the increased noise levels produced by power tools.
- **Respiratory protection** might be necessary when workers are exposed to dusts and fumes.

Figure 15: (A) Safety goggles, (B) face shield, and (C) safety glasses

Function of PPEs

Personal safety simply involves those precautions you take to protect yourself from injury. These include wearing protective gear, dressing for safety, and correctly handling tools and equipment.

- **Safety goggles and face shields**

Face and Eye protection PPEs includes safety goggles and face shields and should be used for tasks that can cause eye damage or loss of vision, sprays of toxic liquids, splashes, and burns.

Figure 16: Eye wash

Eye Protection

Your eyes can become infected or permanently damaged by many things in a shop.

Some repair procedures, such as grinding, result in tiny particles of metal and dust that are thrown off at very high speeds. These metals and dirt particles can easily get into your eyes, causing scratches or cuts on your eyeball. They can also get into your lungs if you are not properly protected. Pressurized gases and liquids escaping a ruptured hose or fuel line fitting can spray a great distance. *Figure 8.A combination eye wash and safety shower.*

If these chemicals get into your eye, they can cause blindness. Dirt and sharp bits of corroded metal can easily fall down into your eyes while you are working under a vehicle. Eye protection should be worn whenever you are exposed to these risks. To be safe, you should wear safety glasses whenever you are working in the shop. There are many types of eye protection available. To provide adequate eye protection, safety glasses have lenses made of safety glass.

If chemicals such as battery acid, fuel, or solvents get into your eyes, flush them continuously in an eyewash station or with sterile water from an eye wash bottle. Have someone call a doctor and get medical help immediately.

- **Safety overall**

PPE includes safety overall, vests and overcoat that can be used for tasks that can cause body injuries from extreme temperatures, flames and sparks, toxic chemicals, insect bites and radiation.

Your clothing should be well-fitted and comfortable and made with strong material. Loose, baggy clothing easily can get caught in moving parts and machinery. Cut-offs and short pants are not appropriate for shop work.

- **Safety boots**

PPE includes knee pads and safety boots and should be used for tasks that can cause serious foot and leg injuries from falling or rolling objects, hot substances, electrical hazards, and slippery surfaces.

Automotive work involves the handling of many heavy objects that can be accidentally dropped on your feet or toes. Always wear shoes made of leather or a similar material, or boots with nonslip soles. Steel-tipped safety shoes can give added protection for your feet. Sports sneakers, street shoes, and sandals are not appropriate in the shop.

- **Safety gloves**

Figure: These tight-fitting latex gloves keep your skin safe from dangerous fluids.

PPE includes safety gloves and should be used for tasks that can cause hand and skin burns, absorption of harmful substances, cuts, fractures or amputations.

Figure 17: safety gloves

Good hand protection is often overlooked. A scrape, cut, or burn can limit your effectiveness at work for many days. A well-fitted pair of heavy work gloves should be worn during operations such as grinding and welding or when handling high-temperature components. Always wear approved rubber gloves when handling caustic chemicals. Caustic chemicals are strong and dangerous chemicals. They can easily burn your skin. Be very careful when handling this type of chemical.

Close-fitting surgical gloves that offer some protection from toxic chemicals such as engine oil, gasoline, brake fluid, and cleaning chemicals. It is important to remember that the skin is an organ and it absorbs some of the fluids that are placed on it. Close-fitting surgical gloves are very inexpensive, disposable, and come in different versions, such as latex, powdered, and nitrile.

There are thicker, padded gloves too, these gloves are a little bit thicker than the surgical gloves, but offer better protection to sharp or hot objects. Most of the higher-quality gloves of this type offer padded protection in high-wear areas, such as the palm and fingers. They are also very comfortable when you have to work on a very hot engine component and you cannot wait for it to cool down. It is a good practice to have many different types of gloves in your toolbox so you can switch to the one that fits the job.

- **Safety harnesses**

PPE includes safety harnesses and lanyards and should be strictly used for tasks that can cause falling from heights and serious injury or death.

- **Ear muffs**

PPE includes ear muffs and plugs and should be used for tasks that can cause hearing problems and loss of hearing.
Exposure to very loud noise levels for extended periods of time can lead to a loss of hearing. Air wrenches, engines running under a load, and vehicles running in enclosed areas can all generate annoying and harmful levels of noise.

Figure 18: ear muffs

Simple ear plugs or earphone-type protectors should be worn in constantly noisy environments.

Beware of long hair and hanging jewellery

Long hair and loose, hanging jewellery can create the same type of hazard as loose-fitting clothing. They can become caught in moving engine parts and machinery. If you have long hair, tie it back or cover it with a cap. Never wear rings, watches, bracelets, or neck chains. These easily can get caught in moving parts and cause serious injury.

- **Face masks**

These PPEs including full-face respirators, self-contained breathing apparatus, gas masks, and surgical masks are used for a task that can cause inhalation of harmful materials to enter the body.

Figure 19: face masks

This includes harmful gas, chemicals, large-particle droplets, sprays, splashes, or splatter that may contain viruses and bacteria such as COVID-19, viral infections, and more.

Technicians often work with chemicals that have toxic fumes. Air or respiratory masks should be worn whenever you will be exposed to toxic fumes. Cleaning parts with solvents and painting are the most common times when respiratory masks should be worn. Masks should also be worn when handling parts that contain asbestos or when handling hazardous materials.

- **Hard hat**

PPE includes hard hats and headgears and should be required for tasks that can cause any force or object falling to the head.

Importance of PPEs

Here are some benefits of using PPEs:

- ✓ Prevent injury in the workplace;
- ✓ Protect employees from excessive chemical exposure;
- ✓ Prevent the spread of germs and infectious diseases
- ✓ Help businesses comply with regulatory requirements
- ✓ Improve employee productivity and efficiency.

PPEs types	How to set and use them
Face and Eye protection	1. Check if safety glasses comply with the eye protection standard. 2. Ensure that there are no cracks or deformities on the lenses. 3. Ensure the strap is in good working condition and is firmly sealed to the cheek and forehead. 4. Clean and disinfect after use.
Respiratory protection	1. Ensure that the equipment is fit-tested and the employee has undergone proper training before wearing one. 2. Carefully read the instructions to determine if it is designed to help protect against the hazards you may face.

	3. Change filters on half-mask or full-mask respirators frequently. 4. Replace disposable respirators with every use. 5. Surgical masks are not to be shared with anyone. 6. Avoid touching the surgical mask after wearing it. 7. Change surgical mask timely and should be disposed of after use. 8. Replace the mask immediately if it is damaged or soiled.
Skin and Body protection	These PPE includes the following categories to protect employees from physical hazards: head, body and hand protection. **Head** 1. Ensure that there are no dents or deformities on the shell and connections are tightened inside. 2. Do not store in direct sunlight as extreme heat can cause damage. 3. Choose appropriate cleaning agents as it can weaken the shells of hard hats and may eliminate electrical resistance. 4. Always replace a hard hat if it was used for any kind of impact, even if the damage is unnoticeable. **Body protection** 1. Ensure that they are clean and free from cuts and burns. 2. Always get a good fit to ensure full body protection. 3. Ensure bodysuit is heat-resistant clothing when working with high-temperature hazards. **Hand protection** 1. Ensure hand protection fits perfectly with no spaces and is free from cuts, burns and chemical residue.

	2. Always replace them if any sign of contamination was observed. 3. Use rubber gloves when working with heat and electricity to reduce the risk of burn or electrical shock.
Foot protection	1. Ensure boots have slip-resistant soles that can protect against compression and impact. 2. Ensure the sole plate is in good condition to prevent punctures.
Fall protection	1. Ensure that the straps are free from tears, deformities and burn marks. 2. Check the buckles if connected securely and tightly. 3. Dispose of the equipment if used after a falling incident.
Hearing protection	1. Ensure the equipment fit the ear canal perfectly. 2. It is recommended to use formable earplugs to fit on different sizes of ear canals. 3. Use protectors that reduce noise exposure to an acceptable level to have a room for communication. 4. Ensure earplugs are clean and in good condition.

Be familiar with the location of all safety equipment when you enter a new shop.

Activity 2: Guided Practice

Task 13:

Discuss on the workshop harzards listed below and identify PPEs needed for that.

1. Slips, trips, and falls
2. Electrical shock
3. Fire
4. Working in confined spaces

5. Physical hazards (potential)
6. Chemical hazards
7. Biological hazards
8. Asbestos
9. Noise
10. Lack of guards or screens on equipment or around dangerous areas.

Activity 3: Application

Task 14:

Visit Mr.MUHIRE's garage where there is a vehicle TOYOTA Carina-E for the engine lubricating system leaking repair. You, as a mechanic for engine lubricating system repair, prepare needed PPEs for the interns and demonstrate how to use them properly.

Compile a report on what was done and how you have proceeded

Topic 2.3: Cleaning and Arrangement of the Workplace

Activity 1: Problem Solving

Task 15:

Analyse the picture below and answer the questions that follow:

Questions:

1. What is happening in the picture above?
2. What types of cleaning method is this employee using?
3. Explain the benefits of workplace cleaning and arrangement.

Key Facts 2.3: Cleaning and arrangement of the workplace

Why cleaning the workplace?

The following benefits will explain why cleanliness is important for workplaces:

- ✓ **Well-being:** Providing a clean work environment helps in maintaining the well-being of employees. In a workplace where litter and waste are disposed correctly and surfaces are cleaned regularly, employees take fewer days of sick leave, which results in improved overall productivity.
- ✓ **Productivity:** Provisions for a clean environment can increase the productivity of employees. Cleanliness can help drive motivation and boost the morale of employees thereby creating a feeling of belonging within their organization.
- ✓ **Impression:** A clean and tidy business space leaves a good impression on both its employees and its visitors.
- ✓ **Cost saving:** By maintaining good levels of cleanliness in the workplace, companies can save on cleaning costs and refurbishments, which may become necessary if the premises are not properly maintained.

Types of cleaning methods

Several categories of automotive materials call for different cleaning methods, including water-soluble deposits (dirt), organic soils, scale, and rust. Cleaning methods include:

- ✓ **Wet cleaning or chemical cleaning:** with petroleum solvents or water based chemical solutions like Alkaline (base), and Acid.
- ✓ **Abrasive cleaning:** Materials to be cleaned by abrasive cleaning methods must be free of oil and grease, which can interfere with the proper operation of an abrasive cleaning machine. Following preclearing, two types of abrasive blasting are used for various cleaning applications. Shot is round and grit is sharp and angular. Several blast materials are used by rebuilders for cleaning parts. Steel shot and glass beads are used for automotive part cleaning when

removal of the surface of the material being cleaned is not desired. Beads and shot come in various sizes, depending on the application

- ✓ **Thermal cleaning:** Many rebuilders use thermal cleaning—a cleaning procedure in which a high-temperature pyrolytic oven cooks oil and grease, turning them to ash. The hard, dry deposit that remains on the part is removed by shot blasting or jet washing.

There are two types of thermal ovens: convection and open flame. A convection oven is a flameless, insulated oven that is heated by burners from the bottom. Parts are not exposed to flame and are warmed up gradually as the oven heats up. Gradually heating parts allows less chance of warpage.

An open flame oven is like a rotisserie. Parts are mounted in a cage that avoids hot spots by slowly rotating the parts directly over a flame.

Procedures for cleaning workplace, tools and equipment

Shop Floors

Mostly auto shop floor is filled with slick materials. This could lead to a serious hazard, as one fall in five causes serious injury. Do the following to avoid the above:

- ✓ Pick up floor mats.
- ✓ Sweep up dirt and debris.
- ✓ Spot clean spills.
- ✓ Quick mop.
- ✓ Replace mats.

Working Spaces

To make it safe the following are to be done:

- ✓ Pick up debris.
- ✓ Put tools away.
- ✓ Replenish supplies.
- ✓ Wipe down surfaces.

Equipment

Staff use both fixed and movable tools throughout the day. A quick, daily check can help to limit catastrophic failures that cost time and reputation by doing as follows:

Wipe down permanent equipment (like tire changers).

Check for loose parts or missing pieces.

Ensure everything is lubricated and running smoothly.

Linens

Consumers understand that mechanics get dirty. But they may also expect to shake hands with and otherwise interact with auto professionals. Grime-coated towels and linens make it tough to keep hands clean. Swapping out soiled linens for fresh sets takes just minutes. And it could make a big difference in how clean and tidy the shop looks the next day.

Waiting Areas & Restrooms

Staff can track dirt and debris into these spaces. Scouring surfaces and mopping floors keep bathrooms and waiting rooms clean and tidy.

Sanitize and clean restrooms

Both customers and employees need a clean bathroom, including plenty of soap, toilet paper, and paper towels. It is advisable to have extra supplies on hand, so you don't run out unexpectedly. Also, set up a daily reminder to sanitize and disinfect all surfaces.

Air fresheners are essential in public restrooms, they reduce any unpleasant odors and keep bathrooms smelling fresh.

Schedule deep cleanings

Daily cleaning is essential but does not remove all automotive fluid build-up from the floor and other spaces. Power steering fluids, antifreeze, and lubricants can make the shop floor an unsafe environment for employees and customers but it can also be unattractive. schedule for a deep cleaning and stick to the plan.

Declutter the Shop

Equipment, parts, or supplies in the shop that are broken or obsolete should be or get rid of them. Not only do they take up extra space, but they add to a disorganized workplace.

Clean up broken glass and remove parts with jagged metal edges from the shop area right away. Recycle bins should be provided for recycling metal and glass. If you fail to clean up broken glass properly, someone could be cut and injured. Also, if you fail to clean out dash ducts, glass can blow into people's eyes when the heater or air conditioning is turned on.

Improve employee appearance

customers may be more willing to do business with clean, uniformed technicians. In addition, uniforms that show the shop's name and employee name create a great first impression for the customers.

Promote Clean Hands

While repairing, technicians will inevitably have grease and oil on their hands after working on cars, proper handwashing stations are recommended and heavy-duty soaps and substantial paper towels.

Arrangement of workplace

A clean, organized facility is more pleasant for workers and could make jobs go quicker too. When workers can find what they need, they don't waste time looking.

- ✓ **Designate a storage for tools and equipment.** It is integral for technicians to have a designated space to put tools when they are finished using them. When a shop has a home for each instrument, technicians can quickly find the necessary tools, and the shop looks organized. Likewise, when new order for automotive repair parts or supplies comes in, these should have a designated place for them to be stored.
- ✓ **Use approved storage for hazardous materials.** Often overlooked area in auto repair shop is hazardous materials. This area should stay clean and safe

when approved storage containers are used with securely closed lids and a proper fit.

- ✓ **Keep gas cylinders away from sources of heat**, such as a furnace or room heater. Check and service furnaces and water heaters in the shop at least once every six months.
- ✓ **Store toxic materials properly**, solvents, chemicals, and other materials can contaminate clothing and wind up on the hands when you remove personal protective equipment or put away the refinishing tools.

Activity 2: Guided Practice

Task 16:

1. Visit the school auto workshop and follow the procedures to clean workplace, tools and equipment.
2. Ask your trainer for clarifications

Activity 3: Application

Task 17:

Visit a nearby auto repair workshop, clean and arrange the workplace.

Compile a report on the tasks undertaken by elaborating on the following elements:

1. The importance of the cleanliness of the workplace.
2. The cleaning methods used by the staff in the workshop.
3. The procedures followed to clean the work area, tools and equipment.
4. The workplace arrangement
5. The weakness and strength observed of the workshop, in the cleaning the workplace

Formative Assessment

1. List five items that are personal protective equipment (PPE).
2. What are the types of fire extinguishers and their usage?
3. What items are included in a typical first aid box?
4. List five common automotive chemicals or products that may be considered hazardous materials.
5. List five precautions to which every technician should adhere when working with automotive products and chemicals.
6. Describe how to use fire extinguisher.
7. Discus the good workplace precautions that should be followed in every repair workshop.
8. List the types of cleaning methods in repair shop.
9. Why cleanliness is important for workplaces.
10. Discus on skin and body protection in repair workshop.
11. What are the safety precautions to be applied in case of the hazardous situations below?
    a. Batteries contain highly corrosive and potentially explosive acids……
    b. Fuels and cleaning solvents are flammable……
    c. Exhaust fumes are poisonous……
    d. During some repairs, technicians can be exposed to harmful dust particles and vapours……
    e. High voltage on some types of vehicles present shock and burn hazards……

Points to Remember

- Automobile mechanics and technicians often suffer injuries due to their work environment, tools, lack of appropriate protection, and machinery. Frequently these exposures can lead to poor health or even death if not appropriately addressed.
- Cuts are the leading causes of injury among automobile repair workers, with improper postures and repetitive work and tool design seen playing a role.
- Dressing safely for work is very important. Wear snug-fitting clothing, eye and ear protection, protective gloves, steel-toed shoes, and caps to cover long hair.
- Safety while using any tool or equipment is essential, and even more when using power tools. Before plugging in a power tool, make sure the power switch is off.
- Use care whenever it is necessary to move a vehicle in the shop. Carelessness and playing around can lead to a damaged vehicle and serious injury.
- Always connect an exhaust hose to the tailpipe of any running vehicle to help prevent the buildup of carbon dioxide (CO) inside a closed garage space.

Self-Reflection

1. Fill in and complete the self-assessment table below to assess your level of knowledge, skills and attitudes under this unit.

    a. There is no right or wrong ways to answer this assessment. It is for your own reference and self-reflection on the knowledge, skills and attitudes acquisition during the learning process.
    b. Think about yourself: do you think you have the knowledge, skills or attitudes to do the task? How well?
    c. Read the statements across the top. Put a check in a column that best represents your level of knowledge, skills and attitudes.

My experience Knowledge, skills and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Identify personal safety at workplace					
Describe the work area safety at workplace					
Describe the tools and equipment safety					
Classify personal protective equipment (PPE)					
Explain the use of personal protective equipment (PPE)					
Identify types of cleaning method at workplace					
Describe the procedures for cleaning the workplace, tools and equipment					

Fill in the below table

Areas of strength	Areas for improvement	Actions to be taken to improve
1.	**1.**	**1.**
2.	**2.**	**2.**
3.	**3.**	**3.**

UNIT 3: REPAIR ENGINE LUBRICATION SYSTEM COMPONENTS

Unit summary:

This unit provides you with the knowledge, skills and attitudes to repair the engine lubrication systems components. It covers the selection of tools, materials and equipment used to repair, inspection and correction of faults as well as engine oil changing.

Self-Assessment: Unit 3

1. **Study the unit illustration above and answer the following questions.**
    a. What do you see in the illustration?
    b. What does the illustration above tell you?
    c. What topics do you think will be covered under this unit based on the illustration?
2. **Fill in and complete the self-assessment table below to assess your level of knowledge, skills and attitudes under this unit.**
    a. There are no right or wrong ways to answer this assessment. It is for your own reference and self-reflection on the knowledge, skills and attitudes acquisition during the learning process.
    b. Think about yourself: Do you think you have the knowledge, skills or attitudes to do the task? How well?
    c. Read the statements across the top. Put a check in a column that best represents your level of knowledge, skills and attitudes.
3. **At the end of this unit, you will assess yourself again.**

My experience Knowledge, skills and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Select materials, tools and equipment					
Detect engine lubricating system components faults					
Correct engine lubricating system components faults					
Perform engine oil change					

My experience Knowledge, skills and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Perform dynamic engine performance testing					
Perform static engine performance testing					
Pay attention to details while using the tools, materials and equipment					
Demonstrate team spirit while working with others					
Be meticulous while repair engine lubricating system					
Be careful while testing engine lubricating system					
Respect safety precautions at workplace while repairing the engine lubricating system					
Comply with safety rules related to the handling of tools and equipment					

Key Competencies:

Knowledge	Skills	Attitudes
1. Identify tools, materials and equipment	1. Select tools, materials and equipment for lubrication system	1. Pay attention to details while using the tools, materials and equipment
2. Outline lubrication system faults	2. Follow the diagnosis process Engine lubrication system	2. Demonstrate team spirit while working with others
3. Identify the diagnosis process Engine lubrication system	3. Inspect faults	3. Be meticulous while repairing the engine lubricating system
4. Identify the correction techniques of faults	4. Fix engine lubricating system components faults	4. Be careful while testing the engine lubricating system
	5. Change oil	5. Respect safety precautions at the workplace while repairing the engine lubricating system
		6. Comply with safety rules related to the handling of tools and equipment

Discovery Activity

Task 18

Observe the following pictures and answer the questions

1. What do you see on the pictures above?
2. What are the tools, materials and equipment used to repair the lubricating system?
3. Describe the steps you should follow to inspect lubricating system faults.
4. Explain the procedures for dismounting the lubricating system.
5. What are the procedures for remounting the lubricating system.
6. Explain how to change the oil.

☞ Share your responses with the rest of the class.

Topic 3.1: Selection of Tools, Materials and Equipment

Activity 1: Problem Solving

Task 19

Read the scenario below and perform the related tasks.

Mugenzi has two Toyota Coaster for his business. At the end of activities, he usually parks them at TERACO garage for morning check out of the lubrication system.

1. What are the needed materials for this task?
2. What are the tools needed for this task?
3. What are the equipment needed for this task?

☞ Share your results with the rest of the class

☞ Refer to Key Facts 3.1 for further information and clarifications.

Key Facts 3.1 a: Selection of Tools, Materials and Equipment

Engine lubrication system repair requires a series of tools, materials and equipment in order to be undertaken.

Depending on the faults, components and the corrections to be made, the technician will select the needed tools, select the materials or equipment to correct the faults or prevent the damage.

a) Selection of tools

Types of tools	Function
 Figure 20: screwdriver	A screwdriver is a hand tool used for various applications in automotive repairs; The primary role of a screwdriver is to tighten or loosen screws or drives a variety of threaded fasteners used in the automotive industry.

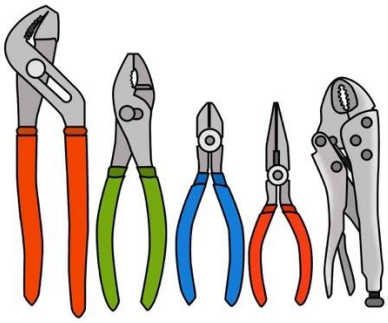
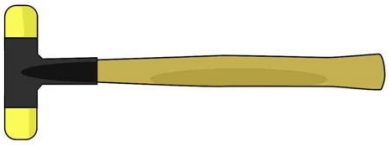
 Figure 21: Pliers	Pliers are a hand tool used to hold objects firmly. They are also useful for bending and compressing a wide range of materials. Pliers are gripping tools used for working with wires, clips, and pins.
 Figure 22: Spanners or wrenches	Spanners or wrenches mean twist. These are tools for twisting or holding bolt heads or nuts. The jaw of a wrench fits around the sides to turn the bolt or nut. All technicians should have a complete collection of wrenches.
 Figure 23: Pressure tester tool kit	A pressure tester tool kit is an essential set of tools used to diagnose and troubleshoot faults related to pressure in engine lubrication, The primary role of a pressure tester tool kit is to measure and test pressure levels for engine lubrication system, helping mechanics to identify problems and ensure proper system operation.
 Figure 24: oil filter wrench	An oil filter wrench is a special tool designed to remove and install oil filters in vehicles. It plays a crucial role in automotive maintenance. The main role is to provide a secure grip on the oil filter, allowing it to be loosened and tightened easily.
 Figure 25: plastic hammer	A plastic hammer, also known as a rubber mallet, is made with a non-metallic head, usually constructed from durable plastic or rubber materials. is used for assembling or disassembling parts that need a gentle but controlled force.

 Figure 26: feeler gauge	A feeler gauge is a tool used in automotive repair, to measure the gap or spacing between two surfaces. It consists of a set of thin metal strips of varying thicknesses. Each is marked with its measurement. To use a feeler gauge, you select the appropriate blade with the desired thickness
 Figure 27: toolbox	The complete toolbox contains a series of hand-held spanners with different sizes for holding bolt heads or nuts for the advantage of tightening or loosening them.

Selection of materials

In this category, we have spare parts to replace the damaged/faulty components or any other consumables that are needed to repair/service the lubrication system components.

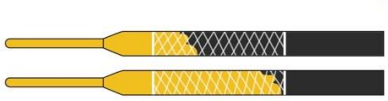
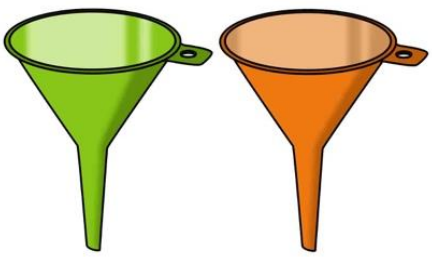
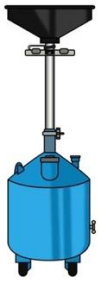
Types of materials	Function
 *Figure 28: oil pan or sump*	The oil pan or sump acts as a reservoir for the engine oil, it stores the engine oil and covers the bottom of the engine.
 *Figure 29: oil dipstick*  *Figure 30: oil dipstick*	An oil dipstick typically consists of a long, thin rod that is marked with measurement indicators along its length. The rod is usually made from metal (such as stainless steel) or plastic, and it has a handle or grip at one end to facilitate easy insertion and removal from the engine. It is used to measure the oil level in the engine's oil pan. it helps ensure that the engine has the correct amount of oil for proper lubrication and cooling.

 *Figure 31: Engine oil*	Engine oil is a lubricant used in internal combustion engines. The main function of oil is to reduce friction and wear on moving parts and to clean the engine from sludge.
 *Figure 32: Oil filter*	Oil filter strains the oil to trap debris, dirt, metal particles, and other contaminants that can wear down and cause damage to engine components.
 Figure 33: Rags	Rags also known as shop rags or wiping rags are absorbent cloths and are used in various automotive workshops. They are used to absorb oil and fluids, while hand cleaning surfaces and wiping.
 *Figure 34: Oil Filter Gasket*	An oil filter gasket is used to provide that seal. Some gaskets seal low-pressure fluids gaskets also serve as spacers, wear insulators and vibration dampers. Gaskets are only used between two stationary parts.
 *Figure 35: Oil Filter Gasket*	The funnel is used to perform various tasks, particularly when dealing with liquids or substances that need to be poured or transferred into containers with narrow openings or to channel liquids into mouthed containers.
b) Selection of equipment	

The following are the main equipment used in engine lubrication system repair activities.	
Types of equipment	**Function**
 *Figure 36: Drain pan*	A drain pan is a tool used to collect and contain fluids. Its primary role is to provide a safe and clean way to capture and store fluids that are drained from systems or components during oil-changing tasks, especially in automotive workshops.
 *Figure 37: Car lift*	Car lift is a mechanical device used in automotive repair shops and garages. The primary role of a car lift is to provide easier access to various components of the vehicle, creating a safe and convenient working environment for automotive technicians.
 *Figure 38: Oil Pump*	An oil Pump is an air-pressure operated equipment used in automobile workshop repair to pour oil into the engine.
 *Figure 39: Air compressor*	The air compressor is a workshop equipment that works by compressing and pressurizing air for the purpose of powering tools, inflating tires or operating other pneumatic equipment.

Activity 2: Guided Practice

Task 20

Visit the school automotive workshop, and under the guidance of the trainer, perform the following tasks:

1. Select tools used for engine lubrication system repair and explain the function of each.
2. Select materials used for engine lubrication system repair and explain the function of each.
3. Select equipment used for engine lubrication system repair and explain the function of each.
4. What is the basic maintenance the garage carries to keep the tools and equipment safe?

☞ Refer to the Key facts 3.1b, for further information and clarifications.

Key Facts 3.1 b: Maintenance of Tools and Equipment

The tools and equipment suffer a lot of wear and tear. Hence, it is important to maintain them regularly. This will help increase the service life as well as the performance of the equipment. Preventive (precautionary) maintenance of tools and equipment will also help to reduce unwanted expenses related to broken or faulty equipment. Small problems generally lead to bigger issues if left unattended.

Tools and equipment maintenance techniques:

- ✓ **Cleaning:** Cleaning the tools regularly is essential to their proper functioning. After a day of work, your tools will be covered with some amount of dirt.
- ✓ **Lubrication:** Lubricating tools & equipment helps them to perform better and reduces wear and tear of components.
- ✓ **Regular inspection:** Regularly inspect your tools and equipment for signs of damage and faulty functioning. Inspections should take place at the end of each construction job. Ensure that you repair them immediately if there is any damage. This will avoid any last-minute hassle.

- ✓ **Careful storing:** Storing tools and equipment properly is of prime importance. Although they are designed for rough use, it is important to store them properly. Once all the tools and equipment are washed, use a clean rag to wipe them dry so that the metal surfaces do not get corroded. Inspect all parts of the tools for fragments, breaks and cracks. Ensure that there are no signs of corrosion in the metal parts.
- ✓ **Reporting:** In case of any damage, report this to the concerned department or personnel

Activity 3: Application

Task 21

Visit the nearest garage and then do the following tasks:

1. Assist the technician in selecting tools, materials and equipment used for engine lubrication system repair and the ways they are handled for safety.
2. Compile a report based on the information gathered from the garage during the visit.

Topic 3.2: Detection of Engine Lubrication System Components Faults

Activity 1: Problem Solving

Task 22

Mrs gasore is a driver of a school bus toyota coaster in IPRC KIGALI. During his driving he notice that the engine is overheated, then the vehicle was towed and brought to the school workshop for repair. After inspection trainer find that the problem is engine lubricating system. Then you as mechanic answer the following questions:

1. What might be the cause of heat increase due to lubricating system?
2. Enumerate all parts that might be the cause of the problems

☞ Share your responses with the rest of your class

☞ Refer to Key Facts 3.2 for further information

Key Facts 3.2: Detection of Engine Lubricating System Components faults

Before troubleshooting an engine lubricating system, the first step is to gather information on the problem. Ask the operator/customer questions, analyze the symptoms using your understanding of system operation and reach a logical deduction about the cause of the problem.

The four problems most often occur in the lubrication system are as follows:

1. High oil consumption (oil must be added frequently)
2. Low oil pressure (gauge reads low, indicator light glows, or abnormal engine noises)
3. High oil pressure (gauge reads high, oil filter swelled)
4. Defective indicator or gauge circuit (inaccurate operation or readings)

When diagnosing these troubles, make a visual inspection of the engine for obvious problems. Check for oil leakage, disconnected sending unit wire, low oil level, damaged oil pan, or other troubles that relate to the symptoms.

- **High Oil Consumption**

If the operator must add oil frequently to the engine, this is a symptom of high oil consumption. External oil leakage out of the engine or internal leakage of oil into the combustion chambers causes high oil consumption. A description of each of these problems is as follows:

External oil leakage - detected as darkened oil wet areas on or around the engine. Oil may also be found in small puddles under the vehicle. Leaking gaskets or seals are usually the source of external engine oil leakage.

Internal oil leakage - shows up as blue smoke exiting the exhaust system of the vehicle. For example, if the engine piston rings and cylinders are badly worn, oil can enter the combustion chambers and will be burned during combustion.

- **Low Oil Pressure**

Low oil pressure is indicated when the oil indicator light glows, oil gauge reads low, or when the engine lifters or bearings rattle. The most common causes of low oil pressure are as follows:

- ✓ **Low oil level** (oil not high enough in pan to cover oil pickup)
- ✓ **Worn connecting rod or main bearings** (pump cannot provide enough oil volume)
- ✓ **Thin or diluted oil** (low viscosity or fuel in the oil)
- ✓ **Weak or broken pressure relief valve spring** (valve opening too easily)
- ✓ **Cracked or loose pump pickup tube** (air being pulled into the oil pump)
- ✓ **Worn oil pump** (excess clearance between rotor or gears and housing)
- ✓ **Clogged oil pickup screen** (reduce amount of oil entering pump)

A low oil level is a common cause of low oil pressure. Always check the oil level first when troubleshooting a low oil pressure problem.

- **High oil pressure**

High oil pressure is seldom a problem. When it occurs, the oil pressure gauge will read high. The most frequent causes of high oil pressure are as follows:

- ✓ **Pressure relief valve struck open** (not opening at specified pressure)

- ✓ **High relief valve spring tension** (strong spring or spring has been improperly shimmed)
- ✓ **High oil viscosity** (excessively thick oil or use of oil additive that increases viscosity)
- ✓ **Restricted oil gallery** (defective block casting or debris in oil passage)

- **Indicator or gauge problems**

A bad oil pressure indicator or gauge may scare the operator into believing there are major problems. The indicator light may stay on or flicker, pointing to a low oil pressure problem. The gauge may read low or high, also indicating a lubrication system problem.

Inspect the indicator or gauge circuit for problems. The wire going to the sending unit may have fallen off. The sending unit wire may also be shorted to ground (light stays on or gauge always reads high).

To check the action of the indicator or gauge, remove the wire from the sending unit. Touch it on a metal part of the engine. This should make the indicator light glow or the oil pressure gauge read maximum. If it does, the sending unit may be defective. If it does not, then the circuit, indicator, or gauge may be faulty.

Components faults	Inspection process
Detection of oil filter faults	1. Park your vehicle on a level surface and ensure the engine is cool before proceeding. 2. Locate the oil filter, where is situated on the engine 3. Detect for clogged oil filter: When the filter becomes clogged with dirt, debris, and contaminants, it restricts the flow of oil to the engine 4. Examine for any visible damage, leaks, or signs of wear 5. Detect if oil leaks, check if there is oil around the oil filter surface 6. Check if the oil filter is not clogged which leads to restriction of oil flow in the engine 7. Detect oil filter Bypass Valve Failure if it has it. 8. Inspect the oil filter element, the filter element itself can collapse due to various reasons, including poor

	manufacturing or excessive pressure differentials this should be cleaned and free from any debris. 9. Detect oil filter leakage: Faulty seals or improper installation can cause oil to leak from the filter housing
Detection of oil pump faults	1. Detect for oil filter low pressure 2. Detect for cavitation due to the occurrence of air or bubbles forming in the oil, ensure that the engine has enough oil 3. Detect for oil leaks, check if any visible oil leaks around the oil pump surface 4. Detect for oil pump gears wear 5. Detect for contamination: If debris or contaminants enter the oil pump 6. Detect for oil pump seals and gasket failure 7. Check the oil pressure relief valve 8. Detect the oil pump internal parts(gears, vanes ,crescent) 9. Detect drive mechanism problems(crankshaft or another component) 10. Listen for abnormal noises
Detection of oil sump faults	1. Detect oil leaks: Check the area around the oil sump for any signs of oil leakage 2. Detect debris accumulation(debris, sludge, and contaminants a at the bottom of the oil sump) 3. Check oil level: Ensure the engine is off and has cooled down for a few minutes 4. Inspect for contaminants: check the oil on the dipstick for any signs of contamination. 5. Listen for abnormal sounds: A sign of oil sump is loosened. 6. Perform a pressure test: If there are suspicions of leaks but no visible

	7. Check sump corrosion due to harsh weather conditions 8. Inspect gasket or seal problems 9. Inspect residue or stains around the mating surfaces of the oil sump 10. Detect if the sump is properly installed.
Detection of relief valve faults	1. Detect failure to open when pressure builds up 2. Detect failure to close after releasing pressure, 3. Observe system operation 4. Detect if relief valves tuck or jammed due to debris, corrosion, or wear over time 5. Check pressure gauge (if available) 6. Inspect relief valve setting: Determine the relief valve's set pressure 7. Verify relief valve Functionality 8. Detect if relief valve has mechanical wear (springs and seals, can wear out) 9. Check for Leakage 10. Inspect improper installation 11. Detect for lack of maintenance (Relief valve require periodic maintenance and inspection)
Detection of oil strainer faults	1. Park it on a level surface and ensure the engine is off 2. Locate the oil strainer: Situated on the oil pan 3. Detect clogging oil strainer due to dirt, sludge, and debris that accumulate in the oil pan 4. Detect inadequate filtration 5. Detect if no corrosion due to the harsh environment inside the oil pan 6. Check the oil pickup tube for any damage or clogs 7. Detect improper installation

	8. Detect if no sediment accumulated at the bottom of the oil pan
Detection of oil pressure indicator faults	1. Prepare the vehicle: Park the vehicle on a level surface 2. Identify the oil pressure indicator 3. Detect if there is no false low-pressure reading 4. Detect if there is no false high-pressure reading 5. Detect if no delayed response 6. Detect if oil pressure indicator stucks 7. Detect for proper wiring or electrical 8. Listen unusual noises such as ticking or knocking. 9. Check the oil level, ensure if is within the recommended range
Detection of oil galleries faults	1. Prepare the vehicle: Park the vehicle on a level surface 2. Detect blockages or restrictions due to the buildup of sludge, debris, or contaminants carried by the engine oil 3. Detect for debris accumulation due to broken component or a damaged bearing 4. Detect if oil galleries tuck due to debris, corrosion, or wear. 5. Detect foreign object intrusion due to metal shavings or other particles. 6. Inspect blockages or damage 7. Detect if for improper cleaning or flushing 8. Detect if there is no improper engine assembly 9. Inspect the oil filter and oil pressure regulator
Detection of oil cooler faults	1. Detect if no leakage due to corrosion, vibration, or damage from road debris 2. Detect if the coolant is not contaminated 3. Detect clogged oil cooler

	4. Detect improper installation 5. Detect if no corrosion due to harsh weather conditions 6. Detect if there are no thermal expansion problems due to continuous system heating

Activity 2: Guided Practice

Task 23

Toyota Starlet and Hyundai Santa Fe vehicles for your school need some repair and service of lubrication systems:

1. Conduct and plan for preventive maintenance of the Toyota Starlet and
2. Detect faults of lubrication system for Hyundai Santa Fe
3. Write a technical report of the faults identified.

Activity 3: Application

Task 24

Visit a neighborhood garage working on lubrication system repairs and servicing and perform the tasks that follow

1. Detect engine lubrication sytem faults
2. Write a report based on what should be done.
   Your report should focus on faults and their causes.

Topic 3.3: Correction of Engine Lubricating System Components Faults

Activity 1: Problem Solving

Task 25

From the list of faults identified in the previous activity propose solutions on how to correct them.

Key Facts 3.3: Correctionof Engine Lubricating System Components Faults

After the detection of faults of the engine lubrication system, the next step would be to correct the identified faults or prevent them through servicing.

- **Oil filter faults correction**
  - ✓ Ensure that the engine is turned off, and the vehicle is parked on a level surface
  - ✓ Drain the oil to access the filter
  - ✓ Remove the oil filter from the engine.
  - ✓ Attempt the repair for damaged parts (if feasible) (Housing, bypass valve,)
  - ✓ Replace damaged parts if applicable
  - ✓ Reinstall the oil filter securely
  - ✓ Refill with new oil
  - ✓ Check for leaks

- **Oil pump faults correction**
  - ✓ Ensure the engine is turned off
  - ✓ Drain the oil from the system
  - ✓ Remove the oil pan
  - ✓ Locate the oil pump
  - ✓ Inspect the oil pump for visible damage
  - ✓ Disassemble the oil pump following the manufacturer's guidelines
  - ✓ Replace worn or damaged parts
  - ✓ Clean the oil pump

- ✓ Reassemble the oil pump
- ✓ Use an oil pressure gauge to measure the oil pressure while the engine is running
- ✓ Reinstall the oil pan
- ✓ Refill with oil
- ✓ Start the engine and test

- **Oil sump faults correction**
  - ✓ Ensure the engine is turned off
  - ✓ Drain the Engine Oil
  - ✓ Raise the Vehicle (if needed)
  - ✓ Remove the Oil Sump
  - ✓ Clean the Oil Sump
  - ✓ Correct the Damage (welding, replace gasket, patching)
  - ✓ Reassemble the Oil Sump
  - ✓ Refill with Fresh Engine Oil:
  - ✓ Test for Leaks

- **Relief valve faults correction**
  - ✓ Park the vehicle on a level surface and ensure the engine is off
  - ✓ Locate the relief valve
  - ✓ Drain the engine oil
  - ✓ Remove engine components
  - ✓ Inspect the relief valve for damage
  - ✓ Disassemble the relief valve respecting the guidlines
  - ✓ Clean the relief valve components
  - ✓ Inspect and measure components
  - ✓ Replace worn or damaged parts
  - ✓ Reassemble the relief valve
  - ✓ Reinstall engine components
  - ✓ Refill with fresh engine oil
  - ✓ Test the system

- **Oil strainer faults correction**
  - ✓ Park the vehicle on a level surface and ensure the engine is off
  - ✓ Drain the engine oil
  - ✓ Locate the oil strainer
  - ✓ Remove the oil pan
  - ✓ Inspect the oil strainer for damage
  - ✓ Clean the oil strainer
  - ✓ Check the oil pickup tube
  - ✓ Reassemble the oil pan
  - ✓ Refill with fresh engine oil
  - ✓ Test the engine

- **Oil pressure indicator faults correction**
  - ✓ Park the vehicle on a level surface
  - ✓ Identify the oil pressure indicator
  - ✓ Observe the oil pressure indicator when the engine is in the ON position
  - ✓ Start the Engine
  - ✓ Monitor the oil pressure
  - ✓ Listen for unusual noises
  - ✓ Address Abnormal Oil Pressure
  - ✓ Check the Oil Level
  - ✓ Inspect the oil pressure sensor and replace it if necessary
  - ✓ Check the wiring and instrument cluster and ensure connections are secure and free from damage

- **Oil gallery faults correction**
  - ✓ Park the vehicle on a level surface and ensure the engine is OFF
  - ✓ Drain the engine oil
  - ✓ Remove engine components
  - ✓ Inspect the oil galleries
  - ✓ Check oil passages in components
  - ✓ Reassemble engine components

- ✓ Refill with fresh engine oil:
- ✓ Test the engine
- ✓ Monitor for leaks

- **Oil cooler faults Correction**
  - ✓ Park the vehicle on a level surface and ensure the engine is off and cool before proceeding
  - ✓ Check for external leaks
  - ✓ Repair oil lines
  - ✓ Repair coolant lines (if applicable)
  - ✓ Repair the oil cooler fins
  - ✓ Repair oil cooler hoses from cracks, bulges
  - ✓ Repair or replace the oil cooler
  - ✓ Reassemble engine components
  - ✓ Refill with fresh engine oil and coolant
  - ✓ Test the engine
  - ✓ Monitor for leaks

Engine Lubricating system maintenance

There are certain engine lubricating system service jobs that are more or less done automatically when an engine is repaired. For example, the oil pan is removed and cleaned during such engine overhaul jobs as replacing bearing or rings. When the crankshaft is removed, it is usual procedure to clean out the oil passages in the crankshaft. Also, the oil passages in the cylinder block should be cleaned out as part of the overhaul.

It is required to maintain the engine lubrication system. This maintenance normally consists of changing the oil and filter(s). Occasionally you will be required to perform such maintenance tasks as replacing lines and fittings, servicing or replacing the oil pump and relief valve, and flushing the system. The following steps provide information that will aid you in carrying out these duties.

- **Oil Pump Service**

Service on oil pumps is limited since they are relatively trouble-free. An oil pump will often still be operating trouble-free when the vehicle is ready for salvage.

A bad oil pump will cause low or no oil pressure and possibly severe engine damage. When inner parts wear, the pump may leak and have a reduced output. The pump shaft can also strip in the pump or distributor, preventing pump operation.

- ✓ **To replace the oil pump, it is first necessary to determine its location.** Some pumps are located inside the engine oil pan Others are on the front of the engine under a front cover or on the side of the engine. Since removal procedures vary, refer to the manufacturer's service manual for instructions.
- ✓ **Most mechanics install a new or factory-rebuilt pump when needed.** It is usually too costly to completely rebuild an oil pump in the shop. Before installation, prime (fill) the pump with engine oil. This will assure proper initial operation upon engine starting.
- ✓ **Install the pump in reverse order of removal.** A new gasket should be used and the retaining bolts torqued as specified by the service manual.

- **Pressure Relief Valve Service**

A faulty pressure relief valve can produce oil pressure problems. The valve may be located in the oil pump, filter housing, or engine block.

- ✓ **If symptoms point to the pressure relief valve, it should be disassembled and serviced.** Cleaning and adjusting is all that is usually required. Remove the cup or cap, holding the pressure relief valve. Then, slide the spring and piston out of their bore.
- ✓ **Measure the free length of the spring (length of extended spring) and compare it to the specifications.** If the spring is too short or long, install a new spring. Some manufacturers recommend checking spring tension.

- ✓ **Use a micrometer and a small hole gauge to check the valve and valve bore wear.** Also, check the sides of the valve for scratches or scoring. Replace the parts if any problems are found.
- ✓ **Assemble the pressure relief valve.** Make sure that the valve is facing correctly in its bore. Slide the spring into place. Install any shims and the cover plug or cap. Refer to the service manual for details.
- ✓ **The pressure relief valve may be adjusted in one of two ways.** One way is by an adjusting screw (having a jam or locknut) which adds or relives pressure on the spring. The other way is by adjusting shims that are added or removed to adjust opening pressure of the relief valve.

Activity 2: Guided Practice

Task 26

In the school workshop, a trainer assigns you to repair a vehicle Toyota Yaris which has a failed engine oil pump, you as a lubrication mechanic replace the pump and correct all faults that are affecting the pump operation.

Activity 3: Application

Task 27

Visit one of the garages where cars and motorcyles are being repaired for engine lubrication system faults and perform the tasks that follow:

1. With the team of mechanics correct the faults of the lubrication system.
2. Write a report on what were performed during this task.

Topic 3.4: Changing of Engine Oil

Activity 1: Problem Solving

Task 28

Read the questions below and answer them.

1. How do you proceed in order to change an engine oil?
2. What should be the level of the oil?

☞ Refer to the key facts 3.4 for further information and clarifications

Key Facts 3.4 a: Changing of Engine Oil

It is extremely important that the oil and filter(s) of the engine are serviced regularly. Lack of oil and filter maintenance will greatly shorten engine service life.

- **Oil and Filter Change**

Manufacturers give a maximum number of miles or hours a vehicle can be operated between oil changes. Newer automotive vehicles can be operated 5,000 miles between changes. Older automotive vehicles should have their oil changed about every 3,000 miles. Most construction equipment average between 200 and 250 hours of operation between oil changes. However, depending on the climate and working conditions the miles and hours between oil changes can be greatly reduced. Refer to the service manual for exact intervals.

To change the engine oil, warm the engine to full operating temperature. This will help suspend debris in the oil and make the oil drain more thoroughly. Unscrew the drain plug and allow the oil to flow into a catchment pan Be careful of hot oil; it can cause painful burns.

Usually, the filter elements are replaced at the same time the oil is changed. The most common filters are the spin-on filter or replaceable element type oil filter.

Spin-on, throwaway oil filter - replaced as a complete unit. Unscrew the filter from the base by hand or a filter wrench and throw the filter away. When replacing, wipe the base clean

with a cloth and place a small amount of oil or grease on the gasket to ensure a good seal. Screw on a new filter, tightening at least half a turn after the gasket contacts the base. Do not use a filter wrench because the filter canister could distort and leak.

Replaceable element oil filter - removed from the filter housing and replaced. Place a pan underneath the filter to catch oil from the filter. Remove the fastening bolt and lift off the cover or filter housing. Remove the gasket from the cover or housing and throw it away. Take out the old element and throw it away. Clean the inside of the filter housing and cover it. Install a new element and insert a new cover or housing gasket (ensure the gasket is completely seated in the recess). Replace the cover or housing and fasten it to the center bolt securely.

After the oil has been completely drained and the drain plug replaced, fill the crankcase to the full mark on the dipstick with the proper grade and weight of oil. Start and idle the engine. Check the oil pressure immediately. Inspect the filter or filter housing for leaks. Stop the engine and check the crankcase oil level and add to the full mark.

- **Oil changing procedure**

  - ✓ **Park your vehicle on a level surface and engage the parking brake**
  - ✓ **Let the engine cool down for a few minutes**
  - ✓ **Locate the oil drain plug**:
    Locate the engine oil drain plug under the vehicle
  - ✓ **Position the oil drain pan**:
    Locate the oil drain pan beneath the oil drain plug to catch the old oil
  - ✓ **Loosen the oil drain plug**:
    Loosen the oil drain plug in a counter clockwise direction
  - ✓ **Drain the old oil**:
    Fully remove the oil drain plug, allowing the old oil to drain into the oil pan
  - ✓ **Inspect the oil drain plug and gasket**:
    Check the drain plug and its gasket for damage
  - ✓ **Replace the oil filter**:
    Loosen and remove the old oil filter in a counter clockwise direction

- ✓ **Lubricate the new oil filter**:

  Apply a thin layer of new engine oil to the rubber gasket of the new oil filter
- ✓ **Install the new oil filter**:

  Carefully screw on the new oil filter in a clockwise direction. Hand-tighten the filter until snug. Do not over-tighten
- ✓ **Replace the oil drain plug**:

  Reinstall the drain plug and tighten it securely in a clockwise direction
- ✓ **Refill with fresh engine oil**:

  Using a funnel to avoid spills, pour the recommended amount and type of new engine oil into the engine's oil filler cap
- ✓ **Check the oil level**:

  Use the dipstick to check the engine oil level
- ✓ **Start the engine**:

  Start the engine and let it run for a few minutes to circulate the new oil throughout the engine
- ✓ **Check for leaks**:

  While the engine is running, check around the oil drain plug and oil filter for any signs of leaks
- ✓ **Dispose of old oil and filter:**

  Properly dispose of the old engine oil and filter at a recycling centre or an auto parts store that accepts used oil and filters
- ✓ **Record the oil change**:

  Keep a record of the date and mileage of the oil change for future reference.

Activity 2: Guided Practice

Task 29

Visit the school workshop and analyse the Hyundai Sonata lubrication system. With the help of your trainer,

1. Perform engine oil changing.
2. Discuss about procedures of testing engine performance statistically

☞ Refer to the Key facts 3.4 b for further information

Key Facts 3.4 b: Test Engine Lubricating system Performance

The main objective of static lubricating system performance testing is to measure the lubricant's ability to adhere, protect against corrosion, and provide long-lasting lubrication even when the equipment is not in use.

- **Static engine lubricating system performence testing procedure**

✓ **Sample Selection:**

Choose the lubricant samples to be tested

✓ **Test Equipment Setup:**

Set up test equipment that simulates a stationary or non-operating scenario. This could include metal test panels or devices that mimic components of the machinery or equipment

✓ **Surface Coating:**

Apply a controlled layer of the lubricant to the test surfaces or components.

✓ **Test Static Conditions:**

Put the engine in a static or non-operating state

✓ **Test Corrosion effect:**

Evaluate the lubricant's ability to protect engine components from corrosion during static conditions.

✓ **Wear Prevention:**

Assess how well the lubricant prevents wear on engine components even when the engine is not running.

- ✓ **Test Oil:**

  Test collected oil samples from the engine at regular intervals during the static period and determine contamination level

- ✓ **Test Temperature and Viscosity:**

  Measure the lubricant's temperature and viscosity during the static period.

- ✓ **Corrosion Protection:**

  Examine how well the lubricant prevents corrosion on the test surfaces, especially under conditions that might promote rust or corrosion

- ✓ **Performance Comparison:**

  Compare the performance of different lubricants under the same testing conditions. Analyze data on adhesion, corrosion protection; wear prevention, and overall effectiveness.

- ✓ **Data Analysis and Interpretation:**

  Analyze the results of the tests to determine which lubricant provides the best static performance.

- ✓ **Reporting and Recommendations:**

  Document the test results, observations, and conclusions. Based on the findings, provide recommendations for lubricant selection, school automotive workshop

- **Dynamic engine lubricating system performance testing procedure**

The purpose of dynamic engine lubricating performance testing is to assess how a lubricant performs in real-world engine conditions, ensuring optimal protection, reduced wear, and enhanced efficiency

- ✓ **Test Engine Selection:**

  Choose a representative engine for testing that

- ✓ **Apply Lubricant:**

  Pour the lubricant in the engine being tested

- ✓ **Test Friction and Wear:**

Monitor the engine's performance for indications of friction reduction and wear prevention. Use sensors and monitoring equipment to measure wear on critical components.

- ✓ **Test Temperature and Viscosity:**
  Measure the lubricant's temperature and viscosity during engine operation.
- ✓ **Oil Analysis:**
  Collect oil samples to evaluate lubricant's conditions (contamination levels, and any signs of degradation)
- ✓ **Component Inspection:**
  After testing, disassemble the engine and inspect key components for signs of wear, damage, or abnormal conditions. Compare the condition of these components with baseline measurements.
- ✓ **Analyze and Interpret Data:**
  Analyze the data collected during testing, including wear rates, oil analysis results.
- ✓ **Report and Recommend:**
  Document the test results, observations, and conclusions. Based on the findings, provide recommendations for the selection and application of lubricants in engines.

Activity 3: Application

Task 30

Read the scenario below and perform the tasks that follow

TUMECO garage mechanic has requested you to assist him in Toyota Land Cruiser's oil changing.

1. Perform engine oil changing
2. Write a report detailing steps followed
3. Perform static engine performance testing
4. Perform dynamic engine performance testing
5. Write down the objectives of testing

Formative Assessment

1. Which Tools, Materials and Equipment used to diagnose Engine Lubrication system?
2. Perform engine lubrication system components faults detection
3. How can you correct Engine lubrication system components faults?
4. Explain the steps followed while static engine lubricating system performance testing
5. Explain Dynamic engine lubricating system performance test steps
6. List the steps followed when diagnosing an oil pump.
7. Enumerate all steps followed when performing an engine oil change.

Points to Remember

- Engine Lubrication System: supplies the engine components with an adequate amount of lubricating oil. The correct pressure must be guaranteed in the process, and are used to keep the wear between moving parts as low as possible. They are intended to prevent the surfaces that slide on each other from coming into contact by mean friction.
- Regularly changing the oil and oil filter according to the manufacturer's recommended schedule will help maintain the engine's longevity and performance.
- Repairing an oil filter is not recommended, not standard practice and may not be safe or effective. If you encounter a damaged or malfunctioning oil filter, it is best to replace it with a new, high-quality filter designed for your vehicle model
- It is essential to prioritize safety when working on engine components. Always wear appropriate safety gear and follow safety precautions to avoid accidents and injuries

Self-Reflection

Fill in and complete the self-assessment table below to assess your level of knowledge, skills and attitudes after covering this unit.

There are no right or wrong ways to answer this assessment. It is for your own reference and self-reflection on the knowledge, skills and attitudes acquisition during the learning process. Think about yourself:

a. Do you think you have the knowledge, skills or attitudes to do the task?
b. How well?
c. Read the statements across the top. Put a check in a column that best represents your level of knowledge, skills and attitudes.

My experience Knowledge, skills and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Select materials, tools and equipment					
Detect engine lubricating system components faults					
Correct engine lubricating system components faults					
Perform engine oil change					
Perform dynamic engine performance testing					

My experience Knowledge, skills and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Perform static engine performance testing					
Pay attention to details while using the tools, materials and equipment					
Demonstrate team spirit while working with others					
Be meticulous while repair engine lubricating system					
Be careful while testing engine lubricating system					
Respect safety precautions at workplace while repairing the engine lubricating system					
Comply with safety rules related to the handling of tools and equipment					

Fill in the table below and share the results with the trainer for further guidance.

Areas of strength	Areas for improvement	Actions to be taken to improve
1.	1.	1.
2.	2.	2.

Summative assessment (Integrated situation)

Integrated/Summative assessment	
Integrated situation GAKIZA is a driver from KIKU transport company Ltd, located in GASABO District, KIMIRONKO Sector. He was driving a HYUNDAI SANTA FE from his resident place at KIMIRONKO, on his way going at his working place located at NYARUGENGE District in GITEGA Sector. During his journey, he noticed a dramatic decrease in engine power caused by the malfunction of engine lubricating system. He called the head of KAZANA garage located near his working place for intervention. As an engine Mechanic, you are requested by the Head of the garage to solve the above-mentioned problem within 4 hours.	
Tools	Screw drivers, Set of pliers, soft hummer, pressure tester tool kit, toolbox, spanners Set of screw drivers, set of pliers, oil filter wrench
Equipment	Projector, Multimeter, computer, air compressor, drain pan, motor vehicle, car lift ,PPE
Materials/ Consumables	Hot Water, shop rags, clamps, engine lubricating system components, funnel, Engine silicone, engine oil

BIBLIOGRAPHY

1. Automotive technology volume principles diagnosis and services fourth edition James D. Haldman, 2012

2. Automotive technology volume a systems approach 5th edition Jack Erjavec, 2009

3. Technology of automotive trade volume 2, H. Girschler, 2011

4. Modern automotive technology Europa Lehmetel 2nd edition, 2011

5. Advanced Engine Technology [2 ed.] by HEINZ HEISLER, 2002

RTB | RWANDA TVET BOARD

December, 2023