

**EXCITING WORLD OF
AUTOMOBILES**



STUDENT WORKBOOK

Curriculum : AUTO-SRV L3-NQ²⁰¹²

Unit : AUTO-SRV L3U1

Regular maintenance of an engine

Vocational Learning Material for Schools

**PSS Central Institute of Vocational Education
Bhopal**

PREFACE

Improving the parity of esteem between the general academic education and vocational education, is the policy priority of the Government of India. The National Vocational Education Qualification Framework (NVEQF) developed by the Ministry of Human Resource Development (MHRD), Government of India, is a descriptive framework that provides a common reference for linking various qualifications. It will be used for setting common principles and guidelines for a nationally recognized qualification system covering Schools, Vocational Education and Training Institutions, Technical Education Institutions, Colleges and Universities. The NVEQF will act as a translation device to make qualifications more understandable to employers, students and institutions. It will promote transparency of qualifications and facilitate learner's mobility between different qualifications, thus encouraging lifelong learning. PSSCIVE has taken lead in development of learning material for the Automobile Sector for all level in collaboration with the Automobile Skill Development Corporation (ASDC).

The present material contains activity related to Level L-3 for the Automobile service sector. This will fulfill the needs of the students willing to learn activities relating to the Automobile Service Sector. Any student/ entrepreneur willing to start an Automobile Service Sector can acquire the desired competencies with the help of this book.

The book has been written by experts but reviewed by all the members of the group. I am grateful to the authors for the development of this book and to the members of the Working Group for their candid suggestions, during the development and review. Their names are given elsewhere.

I appreciate efforts put in the by Dr. Saurabh Prakash, as the Project Coordinator of the Working Group in planning and organizing Meetings which led to the final form of this title.

I shall be grateful to receive suggestions and observations from readers, which would help in bringing out a revised and improved version of this book.

Bhopal
June, 2012

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This student workbook was developed, with active involvement of the Automobile Skill Development Council (ASDC), keeping in view the National Occupation Standard (NOS) for Service Technicians L4 developed by ASDC.

This project for development of the student workbook was coordinated by the PSS Central Institute of Vocational Education, a constituent unit of National Council of Educational Research and Training, which is under the Ministry of Human Resource Development, Government of India.

Student Details

Student Name: _____

Student Roll Number: _____

Batch Start Date: _____

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About this Workbook

This workbook is to assist students with completing the Auto Sector **L3U1-NQ2012** unit of competency: **Regular maintenance of an engine**. Students should peruse the workbook in class or in their own time.

This workbook contains sessions for imparting knowledge & skills on various basic aspects of the unit of competency. The workbook also includes information, exercises and assessment activities to complete.

The assessment plan has been included in the workbook to assist you in scheduling your time for completing the assignments. Each assessment activity is followed by a checklist for meeting the assessment criteria. The criteria will help you to ensure that you have fulfilled all of the assessment requirements to receive a 'competency' grading/Certification by ASDC.

Unit Information**Unit name: Regular maintenance of an engine****Unit code: Auto L3U1-NQ2012****Unit descriptor:**

This unit provides introductory knowledge & skills covering vehicle servicing, specially for engine of a four wheeler. Students will be given a broad view of these important issues.

Resources required:

- Notebooks, Pen, Pencil, Eraser,
- Computer, Open Source Software for making digital presentation,
- LCD projector.
- Sketches, pictures, animation and videos of engine of automobiles and its components.
- Posters for building awareness about these topics.

Nominal hours: 80 Periods

Elements and Performance Criteria

- Elements define the critical learning outcomes of a unit of competency.
- Performance criteria specify the level of performance required to demonstrate the achievement of the Competency Element.

Element of knowledge	Performance Criteria
Inspection of an engine	• Able to trace different leakages like those of oil, coolant and combustion gases
Washing of a engine	• Able to wash an engine externally • Able to handle the washing equipment • Able to follow appropriate precautions
Tuning fuel system of an engine	• Able to trace the fuel system in a given vehicle engine • Able to check the fuel line for leakage • Able to conduct fuel pump test and compare its reading with the service manual • Able to set carburetor for ideal speed • Able to test nozzle for pressure
Tuning of an ignition system of an engine	• Able to trace the primary and secondary circuit(s) • Check the terminals for loose connection. • Able to clean spark plug and distributor

Tuning engine lubrication system	• Able to check the level and quality of lubricating oil • Able to replace the oil and change the oil filter • Able to check the oil pressure
Tuning of engine cooling system	• Able to read the temperature gauge • Able to check circulation of water in cooling system • Able to trace for coolant leakage
Tightening of fastener (Nuts/Bolts/Screws)	• Able to tight fasteners with specified torque and with sequence in the following components; cylinder head, induction manifold, Exhaust manifold and • engine foundation nuts and bolt .
Engine Timing	• Able to understand importance of engine timing • Able to feel the sound change after tuning process

Relevant Knowledge and Skills**1. Relevant Knowledge**

- Inspection of an engine
- Washing of an engine
- Tuning fuel system of an engine
- Tuning of the an ignition system of an engine
- Tuning of the engine lubrication system
- Tuning of the engine cooling system
- Tightening of fastener (Nuts/Bolts/Screws)
- Engine Timing

2. Skills

Able to do the following tasks in a vehicle

- Able to trace different leakages like oil, coolant and combustion gases
- Able to wash an engine externally
- Able to handle the washing equipment
- Able to follow appropriate precautions
- Able to trace fuel system in a given vehicle engine
- Able to check the fuel line for leakages
- Able to conduct fuel pump test and compare its reading with service manual
- Able to set carburetor for ideal speed
- Able to test nozzle for pressure
- Able to trace the primary and secondary circuit(s)
- Check the terminals for loose connection.
- Able to clean the spark plug and distributor
- Able to check the level and quality of lubricating oil
- Able to replace the oil and change the oil filter

- Able to check the oil pressure
- Able to read temperature gauge
- Able to check circulation of water in cooling system
- Able to trace for coolant leakage
- Able to tight fasteners with specified torque and with sequence in the following components; cylinder head, induction manifold, Exhaust manifold and engine foundation nuts and bolt
- Able to understand importance of engine timing
- Able to feel the change in sound after tuning

Assessment Plan

Session No.	Assessment method	Due Date	Completion Date
1.	Fill in the Blanks		
2.	Fill in the Blanks		
3.	Fill in the Blanks		



Introduction

Driving a car can be fun, but its maintenance can be a pain. No one really enjoys the task of automobile maintenance. As long as the automobile works fine, we are happy and don't always remember to get its maintenance done. Even if your vehicle works fine, getting its servicing and maintenance regularly is necessary. General vehicle maintenance helps to keep it in good condition and can save your trouble of repairing or changing its major parts in the long run.

Regular oil check and change is required and can be considered as one of the most important steps to maintain your car. Vehicle owners never keep track of when their engine needs an oil change. Old oil or insufficient oil in your engine will heat up the engine quickly and might lead to damage and other problems in your vehicle. To fix these problems you will have to pay quite a lot. To keep your automobile running efficiently and engine well maintained, a regular oil change is essential.

Checking air regularly and filling air in the tyres is another important task, which is often neglected by car owners. The pressure in the tyres goes down over a period of time, but due to some leak, it might go down even sooner. Air in tyres should be filled in correct proportion. If tyres have insufficient air, they will wear out faster. In the case of less air, the tyre touches the road and the rim of car, which will spoil the treads of tyres. Overfilling of tyres without using a gauge might cause your tyres to burst and this can be very dangerous.

Tuning up your motor on a regular basis will save you from a sudden shock and expense if costly parts in your car fail. Regular check-up of your car will keep you updated on the performance of your car and car parts. In this unit we will go through all the maintenance procedure for a vehicle.

Session 1: Inspection of an engine**Relevant Knowledge**

When it comes to a car, the most important component is its engine. The engine can well be regarded as the soul of a car. In fact, you might have the most well-maintained and sparkling set of wheels in your neighborhood, but if its engine is not working, it is as good as waste. In order to make sure that your car has a long life, you need to undertake regular maintenance of the engine. As we know, engine is a power producing unit of an automobile, where fuel is burned to create heat energy and that heat energy is converted into kinetic energy. Engine is a complex unit of different parts, which work together and produces power for the movement of a vehicle.



Fig : Engine

Various types of leakages take place in an engine, and it is a very important element of regular vehicle checkup.

- The leakage of combustible gases will reduce mileage and pickup.
- The leakage of coolants leads to, increased engine temperature and may causes engine overheating, due to which the components will deteriorate faster
- The leakage of the lubricating oil will increase the friction and engine will reduce power output. So it is necessary to regularly inspect for the leakage and if traced then the leakage must be repaired to avoid failure of an engine

Procedure to check the leakage in the vehicle

- Keep the vehicle on hard surface
- Open the engine bonnet and support with lever
- Adopt the following process for the checking of the leakages

(A) Cooling system leakage

When, we notice greenish colour near/ below mentioned points, it indicates that, there are chances of coolant leakage.

- Inspect coolant tank and its connections.
- Inspect radiator hose clips for looseness and if noticed leakage, tighten the clips.
- Check hose pipe for distortion/ deterioration and replace.
- Inspect radiator cap, neck and radiator core for coolant leakage.
- Inspect for torn thermostat housing gasket for leakage.
- Inspect for water pumps seal and gasket for leakage of coolant.

(B) Fuel leakage

Fuel leakage can be easily checked by smell and leakage of fuel. It reduces mileage of vehicle.

The causes of fuel leakage can be

- Evaporation of fuel
- Broken or loose fuel line connection

Following areas must be inspected for fuel leakage

- Fuel tank out let and tank cap/ rubber washer
- Flexible fuel line for slackness
- Torn fuel filter gasket or loose fuel filter
- Fuel pump connections and connectors
- Loose connection at nozzle/ carburetor areas

(C) Combustion gases leakage

The leakage of combustion gases may be traced when black soot is noticed around following areas on an engine

- Cylinder head and cylinder block

- Torn cylinder head gasket
- Spark plug /nozzle
- Engine induction and exhaust manifold
- Valve guide/ improper tappet clearance

(D) Lubricating oil leakage

The leakage of lubricating oil can be traced by simple method.

- Place a news paper below the engine
- Now run the engine for 5 min (do not move the vehicle)
- The leakages will be traced on the news paper as spots will be observed
- Exactly perpendicular to the spot noticed will be the area of leakage.
Stop leakage by changing the gasket oil seal etc.
- Note down the area of leakage in the table given below

Sr. No.	Name of area of leakage

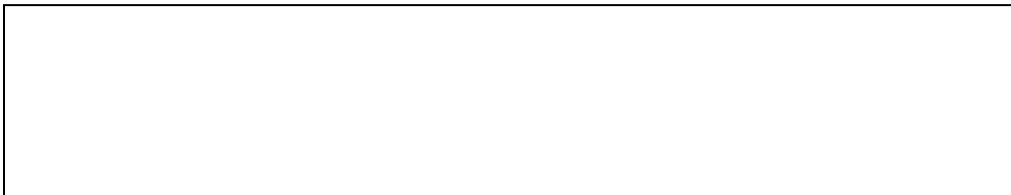
Session 1: Inspection of an engine

Exercise: Assignment

1. List the types of leakages found in an engine.

S.No.	Types of leakage

2. Prepare a diagram of an engine of a vehicle.



Session 1: Inspection of an engine

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. For fuel leakage following areas _____, _____, _____ must be checked in the engine.
2. Check hose pipe for _____ / deterioration.
3. Inspect radiator cap, neck and radiator core for _____ leakage.
4. Inspect radiator hose clips for _____, if noticed leakage _____ the clips

Session 1: Inspection of an engine

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for maintenance of engine.

Part A

Share importance of leakages in an engine.

Part B

Discussed in class the following:

- Why leakages must be controlled?
- What are the steps to be followed while checking the leakages in engine?

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of inspection of engine		
Able to list general steps during inspection of engine		

Session 2: Washing of an engine

Relevant Knowledge

The modern automobile is equipped with latest technology. So, while providing services like engine washing, proper care must be taken to avoid the damages to the components as, they are very expensive.

The latest engines are compact and fitted in the small area. It is necessary to clean the engine at regular intervals to remove oily layers, depositions of muck (mud and water) which may causes engine heating and changes in engine performance.

Material and equipment required to clean engine

- Car washer
- Compressor
- Diesel sprayer gun etc

Steps to clean/wash the engine

- Keep the vehicle on hard surface
- Open the engine bonnet/cover and support it properly
- Inspect for external leakage of oil, coolant, gases - locate the area
- Allow the engine to reach atmospheric temperature.
- Disconnect negative terminal of battery for safety
- Now use diesel sprayer and spray the diesel only on oily layer of an engine.
- Now operate the car washer and set the water spraying nozzle at low pressure



Fig : Automatic car washing unit

- Spray water and remove the oily layers and muck water from an engine
- Now, take some liquid soap and apply the soap slowly in the area where the hand can reach
- Again, with low water pressure, clean the engine externally
- Also clean the bonnet area and engine room
- Now, start the compressor and give air pressure to remove the water from the electrical and electronic gadgets
- Allow the engine to dry
- Connect the battery terminal and start the engine and check for smoother working

Precautions

- Do not use high pressure to clean engine
- Safeguard sensors, spark plugs, nozzle, and electronic gadgets from water
- Do not give water pressure when engine is in running condition
- Do not clean the engine when engine is hot
- Do not blow air at high pressure

Session 2: Washing of an engine**Exercise: Assignment**

1. List the elements of safeguard during engine washing

Sr. No.	Elements

2. Prepare a diagram of car washer.



Session 2: Washing of an engine

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. Latest engines are compact and fitted in the small area.
2. _____ is used for washing the engine.
3. Spray _____ and remove the oily layers and muck water from an _____.
4. Liquid soap should be applied slowly in the _____ where the hand can reach.
5. Do not clean the _____ when engine is hot.

Session 2: Washing of an engine

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for washing of an engine.

Part A

Share importance of washing of an engine.

Part B

Discussed in class the following:

- Why washing is necessary?
- What are the steps to be followed while washing the engine?

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of washing		
Able to list general steps during washing of an engine		

Session 3: Tuning fuel system of an engine

Relevant Knowledge

One of the basic components of a car comprises of its engine and talking about the car engine, its fuel system needs to be properly taken care of. In fact, proper car maintenance is as good as incomplete without adequate maintenance of the fuel system. Taking proper care of the fuel system will ensure that, your car does not consume extra fuel, runs smoothly and does not suffer from frequent breakdowns.

Tuning : The final and finest adjustment at recommended interval to maintain originality in performance of an engine is called tuning.

Every new engine gives better mileage and good performance to achieve high and low speeds in variation with load. But, after certain intervals due to vibration etc normal wear of components take place. So, it is necessary to inspect and adjust the following systems of an engine;

- Fuel system
- Ignition system
- Cooling system
- Lubrication system
- Mechanical system

Tuning of fuel system of an engine

As we have seen the sound of an engine, it should be maintained to its original level. If there is less fuel supply the engine performance will change and it will make a noise while running. To avoid this situation, it is necessary to tune the fuel system of a vehicle.

Steps for fuel tuning

- Clean the air cleaner and fuel filter
- Remove the tank cap,
- Inspect the rubber washer

- Clean the vent hole to maintain atmospheric pressure on the fuel
- Now inspect the fuel line for leakage and if flexible fuel line is damaged, replace immediately
- Inspect the suction/vacuum of fuel pump
- Check the fuel pump pressure
- Compare reading with specification as specified in the service manual.

Setting idle speed of an engine

- Warm up the engine and turn the idle speed screw in clockwise direction so the engine rpm will increase.
- Now slowly turn idle speed screw in the anti clockwise direction till you get the prescribed rpm
- Use tachometer to read rpm
- Now, turn the air screw in clockwise direction so that the engine will stop
- Slowly open the screw and start the engine till we get recommended rpm of an engine

Nozzle pressure test

- Remove the injector/nozzle from an engine
- Hold container below the injector/nozzle
- Connect the fuel pipe to the nozzle and start the engine
- Observe the injector/nozzle spray, if proper fix it back to the cylinder head
- Repeat for all cylinders

(If pressure is noticed less than it is necessary, calibrate the FIP pump)

Precautions

- Do not pull out the flexible pipe connection
- Do not over tighten the fuel line connection
- Do not twist the fuel line

- Do not work on fuel system with flame/spark
- Change the gaskets to avoid evaporation of fuel after regular intervals

Session 3: Tuning fuel system of an engine

Exercise: Assignment

1. List the steps used in tuning of fuel system.

Sr. No.	Steps used

2. Prepare a line diagram of fuel system of a vehicle.



Session 3: Tuning fuel system of an engine

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. _____ is used as fuel in the vehicle.
2. Warm up the _____ and turn the idle speed screw in _____ direction so the engine rpm will increase
3. Use _____ to read rpm
4. Injector/nozzle is used in an _____.

Session 3: Tuning fuel system of an engine

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for tuning fuel system of an engine.

Part A

Share importance of tuning fuel system of an engine.

Part B

Discussed in class the following:

- Why tuning is necessary?
- What are the steps to be followed while tuning the fuel system?
- Advantages of tuning.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of tuning		
Able to list general steps during tuning of a fuel system		

Session 4: Tuning of Ignition system of engine**Relevant Knowledge**

The ignition system plays an important role in process of combustion. The system converts current from 12volt to 20,000 volt. To ignite the charge, the weak or the advance spark/retarded spark will change the process of combustion and will lead to imbalanced combustion which will affect engine performance. Due to which engine tune will also change. The thin wires and their connections will supply the current between 12 volt and are called Low Tension Leads. The wires which are thick will supply the current of 20-25,000 volt and are called High Tension Leads.

The ignition system is classified in two ways i.e. primary circuit with LT leads and secondary circuit with HT leads.

The connection from battery to ignition switch to HT coil and to the distributor – C.D.I. comes under primary circuit. Whereas from distributor till sparkplug connections come under H.T leads or secondary connection.

Steps for tuning of ignition system

- Inspect the battery terminal for loose contact
- Inspect the socket connection for slackness
- Check the connection to ignition switch
- Inspect connection at primary circuit of LT lead
- Inspect the connection with pick up coil and CDI unit
- Disconnect the sparkplug connection
- Now remove the distributor cap and check the HT lead for loose connections.
- Check distributor contact point for erosion/burn
- Inspect working of spark advance mechanism
- Clean distributor cap and fix it properly
- Using appropriate spanner loosen the spark plug slowly from each cylinder

- Inspect the spark plug condition
 - Colour – black soot - rich mixture – cold engine
 - Dead white soot – lean mixture – hot engine
 - Brownish colour – normal
- Check for eroded central electrode and make it straight to maintain air gap
- Check for deposition and clean the plug by sand blast machine or by emery paper
- Using wire feeler gauge, set the spark plug gap as per the specification
- Clean the spark plug threads
- Apply oil and check spark plug sealing gasket washer, if need replace
- To install plug, first fix it with hand
- Thread it smoothly and tighten the same with specified torque
- Connect the lead wire with plug
- Start the engine and check the engine sound and ascertain if there is any change in engine sound

Session 4: Tuning of Ignition system of engine

Exercise: Assignment

1. List the steps used in tuning of ignition system.

S.No.	Steps used

2. Prepare a line diagram of ignition system of a vehicle.

--

Session 4: Tuning of Ignition system of engine

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. The ignition system plays _____ role in process of combustion. and ignition system converts current from _____ to 20,000 volt.
2. Normal temperature of engine is in the range of _____ and _____.
3. Ignition system is classified in two ways _____ circuit with LT leads and _____ circuit with HT leads.

Session 4: Tuning of Ignition system of engine

Checklist for Assessment activity

Use the following checklist to see if you've met all the requirements for tuning of ignition system of engine.

Part A

Share importance of tuning of ignition system of engine.

Part B

Discussed in class the following:

- Why tuning Of ignition system of engine is necessary?
- What are the steps to be followed while tuning of ignition system of engine?

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of tuning of ignition system of engine		
Able to list general steps during tuning of ignition system of engine		

Session 5: Tuning of Engine Lubrication System

Relevant Knowledge

We know that the lubrication fulfills the following purposes:

- It reduces wear/friction
- It reduces heat
- It provides cleaning of an engine parts
- It helps in giving cushioning effect
- It fill the gap

The engine lubrication system working on pressurized lubrication system. In which the oil sump stores and collects the circulated lubricating oil. Oil pump will circulate lubricating oil to lubricate engine components at recommended pressure and control by safety valve. The role of oil filter and oil strainer is to filter the circulated lubricating oil and re-circulate the same.

The lack of lubrication will lead to engine sound and also the tune of engine will change; because of increase in friction thus it is necessary to check the lubricating oil at specified intervals. Also change the lubricating oil, if oil loses viscosity or after recommended interval of distance in km.

Tuning procedure

Slowly remove the dip stick from the sump and wipe it with cotton waste.

Now check the level on the dip stick and if it is low, check the quality of oil. If it is heavy, quality of oil is better viscosity then add the oil. If the oil is black it lacks viscosity. Then change the oil and oil filter.

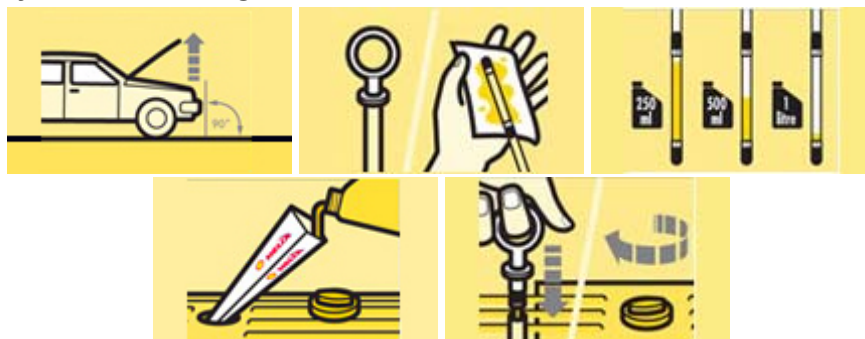


Fig : Checking of Engine Oil

Changing of the oil

Bring the vehicle on lubrication bay and place the container below the drain plug

Using specified spanners, loosen the drain plug and drain the oil in container

Switch on the engine for 3 seconds so that engine becomes warm. It will remove oil present in pores of engine and oil will be drained out easily

Fix the plug with a new washer and tighten the same with specified torque

Refill the lubricating oil from filler plug with the recommended quantity and quality



Fig : Filling of Oil

Changing of oil filter

Slowly remove the oil filter.

Use rubber gasket of appropriate size and place the gasket in the housing groove.

Check the gasket is not twisted or trained.

Now, fix the new oil filter tightly at specified torque



Fig : Changing of Oil Filter

Measuring oil pressure

Start and run the engine to achieve optimum temperature

Check the oil pressure on pressure gauge and compare with the service manual

Session 5: Tuning of Engine Lubrication System**Exercise: Assignment**

1. List the steps used in tuning of engine lubrication system.

S.No.	Steps used

2. Prepare a line diagram of engine lubrication system of a vehicle.



Session 5: Tuning of Engine Lubrication System

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

- _____ is used for lubrication the engine of vehicle.
- The lack of lubrication will _____ to engine sound and also the tune of engine will _____ because of increase in _____.
- Change the _____ oil, if oil loses viscosity or after recommended distance of _____.

Session 5: Tuning of Engine Lubrication System

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for tuning of engine lubrication system.

Part A

Share importance of engine lubrication in a vehicle.

Part B

Discussed in class the following:

- Why is engine lubrication necessary?

- What are the steps to be followed while checking the lubrication system?
- Leakages in lubrication systems.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of engine lubrication		
Able to list general steps during checking engine lubrication system		

Session 6: Tuning of engine cooling system

Relevant Knowledge

You must have observed in your room/home that whenever there is rise in ambient temperature we switch on the fan, AC to reduce the temperature. It becomes comfortable to do our routine work. Similarly our vehicle also works on the principle of cooling during running.

Cooling system in a car protects the engine from overheating. Cooling system removes 30% of the heat of the engine. An efficient cooling system keeps the engine protected. Rise in engine temperature may causes over heating of engine, which changes its performance. Components of the engine will get distorted and reduce its life. Hence, it is necessary to check the functioning of the cooling system at specified intervals. One must always use good quality coolant for car engine. The coolant level must be checked at least once a fortnight. During summers, it must be checked more frequently.

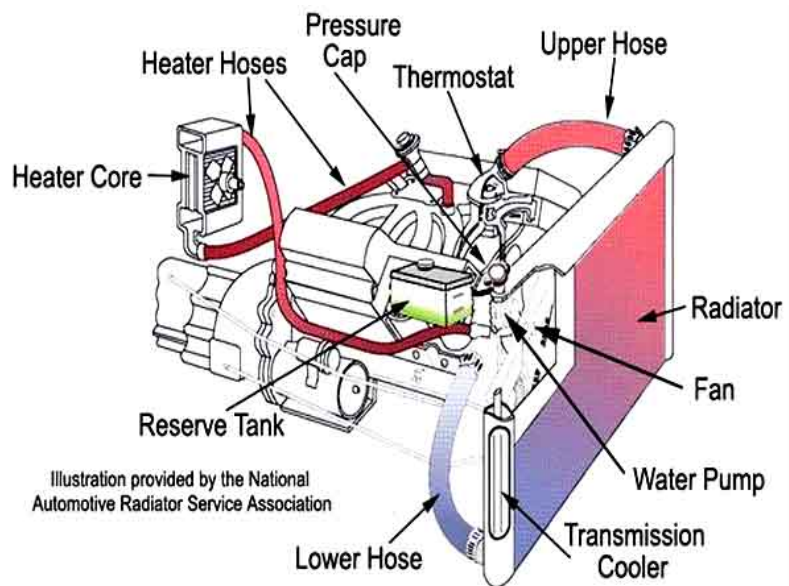


Fig : Automobile Cooling System

Steps involved in checking the cooling system

Reading of temperature Gauge:

Temperature gauge is fixed on dash board which regularly monitors the variation in engine temperature. Moderate temperature of engine is 75-80 degree centigrade which needs to be constantly maintained.

Parts of Cooling System

The cooling system includes the engine's water jacket, thermostat, water pump, radiator and radiator cap, cooling fan (electric or belt-driven), hoses, heater core and overflow tank.

Checking Circulation of water in cooling system

- Switch off the ignition switch of vehicle
- Remove the negative terminal from the battery
- Turn the upper radiator cap slowly and allow the stem /water vapors' to release from the radiator.
- Turn the radiator cap and remove the cap from the neck of the radiator
- Connect the battery terminal and switch on the ignition.
- Run the engine at idle speed
- Inspect the circulation of water in the radiator.
- Circulation of water should be observed as rate of inlet must be equal to rate of outlet of coolant.
- This shows healthy running of coolant system.

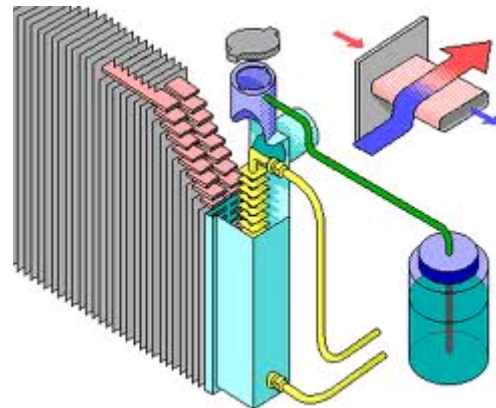


Fig : Cooling Circulation

Checking of Coolant Leakage

- Inspect coolant tank and its connections.
- Inspect radiator hose clips for looseness and if notice leakage, tighten the clips.
- Check hose pipe for distortion/ deterioration and replace.
- Inspect radiator cap, neck and radiator core for coolant leakage.
- Inspect for torn thermostat housing gasket for leakage.
- Inspect for water pumps seal and gasket for leakage of coolant.

Setting of cooling fan belt tension

- Inspect belt for cracks, cut deformation, wear and cleanliness. If necessary, change the belt
- Check belt tension as 6—7 mm as deflection
- To adjust the belt to tight or loose, change the position of the alternator
- Tighten belt adjusting bolt and alternator pivot bolt

Session 6: Tuning of engine cooling system**Exercise: Assignment**

1. List the steps used in tuning of cooling system.

S.No.	Steps used

2. Prepare a line diagram of cooling system of a vehicle.

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Session 6: Tuning of engine cooling system

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. _____ is used for cooling the vehicle.
2. Normal temperature of engine is in the range of _____ and _____.
3. Percentage of heat removed by cooling system is _____ %.

Session 6: Tuning of engine cooling system

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for tuning of engine cooling system.

Part A

Share importance of cooling of a vehicle.

Part B

Discussed in class the following:

- Why is cooling necessary?
- What are the steps to be followed while checking the functioning of the cooling system?
- Leakages in cooling systems.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of cooling		
Able to list general steps during checking cooling system		

Session 7: Tightening of Fastener (Nuts/Bolts/Screw)

Relevant Knowledge

As you know that, the engine is a complex piece of machinery in which different components are assembled by using different types of fasteners. Due to power production, transmission of power, variation in speed and load, vibration leads to loosening of fasteners. This may change the stability of components and lead to development of bending. Further, it may develop scratches, cracks, and may cause leakage of coolant and gases etc. It will affect the engine performance.

(A) Tightening of Cylinder Head, Induction manifold and Exhaust Manifold

To avoid the combustion gases, it is necessary to tight cylinder head in following manner

- Remove the tappet cover from cylinder head
- Remove the rocker arm assembly
- Slowly remove the pushrods (overhead valve mechanism)
- Use specific size of socket spanner with appropriate torque wrench.
- Use strictly the service manual as per the prescribed sequence.
- Tighten the cylinder with specified torque.



Fig : Cylinder Head

Induction Manifold

Loose induction manifold may create vacuum leakage which leads to supply lean mixture which may causes hesitation in engine running.



Fig : Induction Manifold

- Tighten the induction manifold using specific size of socket spanner with appropriate torque wrench.
- Use strictly the service manual as per prescribed sequence.
- Inspect the induction manifold gasket.

Exhaust Manifold

Loose induction manifold may cause emission leakage and lead to cause blackening of bottom of body and may catch fire



Fig : Exhaust Manifold

- Tighten the exhaust manifold by using specific size of socket spanner with appropriate torque wrench.
- Use strictly the service manual as per prescribed sequence.
- Inspect the exhaust manifold gasket.

Material and Tools requirement for tightening of fastener

- Socket spanner
- Tommey bar
- Extension bar/rod
- Torque wrench
- Torque wrench socket

Session 7: Tightening of Fastener (Nuts/Bolts/Screw)

Exercise: Assignment

1. List the torque required for tightening of fasteners using service manual

S.No.	Name of component	Tightening Torque
1.		
2.		
3.		
4.		

2. Prepare a poster showing tools used in tightening of fasteners

Session 7: Tightening of Fastener (Nuts/Bolts/Screw)

Answer the following questions

(Use additional sheets of paper if necessary)

A. Fill in the blanks

1. Tightening is required to avoid _____.
2. Inlet manifold is used for _____.
3. Exhaust manifold is used for _____.

B. Tick the correct answer

1. Mallet is made of
 - A. Iron
 - B. Wood
 - C. Steel
 - D. Aluminum

Session 7: Tightening of Fastener (Nuts/Bolts/Screw)

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for tightening of fastener (nuts/bolts/screw)

Part A

- Share importance of tightening the fasteners

Part B

- Discussed in class the following:
- Why tightening is important?
- What are the different types of tools used in tightening of fasteners?
How to set the torque wrench

Steps used in tightening.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to tighten the cylinder head, induction and exhaust manifold		
Able to identify general tools used to handle the fasteners		

Session 8: Engine Timing (Tuning)

Relevant Knowledge

To run the engine smoothly it is necessary to supply fuel by opening and closing the inlet valve, similarly it is also needed to remove the exhaust gases at right time from the cylinder. The movements of the valves are related to the crankshaft revolution and engine (otto) cycle. It is necessary to check and set valve timing.

For the process of combustion, it is necessary to ignite the charge by using sparkplug at the right time. Plug should ignite the charge at end of compression stroke. There is a need to set the ignition system in relation to rotation of crankshaft. Thus, check and set ignition timing.

Stroboscope Lamp/Gun:

Stroboscope is an instrument used to make a cyclically moving object (our flywheel) appears to be slow-moving or stationary. Stroboscopes are used in timing lights to dynamically set the ignition timing of an Otto cycle combustion engine. The timing light is connected to the ignition circuit (mostly inductively) and used to illuminate the timing marks with the engine running. The apparent position of the marks, frozen by the stroboscopic effect, indicates the current timing of the spark in relation to piston position



Fig : Stroboscope Lamp/Gun

Those tools come in various shapes, most in gun- or torch shape. All need a power supply (230V or 12V) and they have a pickup unit (mostly an induction clamp to be put around the HT cable for impulse pickup)

In new modern vehicles, we use multipoint fuel injection system. In the process of combustion of fuel injection system, it is necessary to inject the fuel by using fuel injector. The fuel injector will inject the fuel at right time at appropriate pressure at end of compression stroke. There is a need felt to set the injection timing (FIP) system in relation to rotation of crankshaft. Thus, check and set fuel injection trimming.



Fig :Tuning

Timing will maintain total functioning of the engine and governs the fuel economy.

Steps for checking of valve timing

- Remove the timing cover
- Check the alignment of the following
- Turn the crankshaft pulley with transmission belt and mark on the pulley must align with crankcase mark.
- At the same time camshaft pulley mark must align with crankcase marking. This indicates proper valve timing.

Steps for checking of ignition timing

- Connect the stroboscope connection as per manual.
- Now hold stroboscope lamp near the fly wheel and run the engine at idle speed
- Check timing mark on the flywheel matches with pointer of crankcase housing at a same time lamp must glow, shows the alignment.
- This indicate proper ignition timing

Steps for checking of injector timing

Check the alignment the FIP timing with camshaft gears/pulley which ensures injection timing

Session 8: Engine Timing (Tuning)**Exercise: Assignment**

1. Visit the service centre and check the valve timing, ignition timing and injection timing of four types of vehicle.
2. Prepare a poster showing valve timing, ignition timing and injection timing of a vehicle.

**Session 8: Engine Timing (Tuning)**

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. Valve timing is used for _____.
2. Ignition timing helps _____ in an engine
3. Injection timing are used in _____.
4. Stroboscope helps in _____ of ignition timing.

Session 8: Engine Timing (Tuning)**Checklist for Assessment Activity**

Use the following checklist to see if you've met all the requirements for engine

timing (tuning).

Part A

- Share importance of different timings related to engine performance.

Part B

Discussed in class the following:

- What is meaning of timing?
- What are the different between ignition and injection timing?
- Name tool used in checking engine timing.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of timing in engine coolant		
Able to check the ignition, injection and valve timing		

Suggested Reading

Books

Title	Author	Publisher
Automobile Engineering Vol I	Kirpal Singh	Standard Publishers
Automobile Engineering, Vol II	Kirpal Singh	Standard Publishers
Text Book of Automobile Engineering	Rajput R K,	Laxmi Publications
Automobile Engineering	R. K. Singal	S. K. Kataria and Sons
Automobile Engineering Theory	Kapil Dev	Computech Publications
Automobile Engineering,	K. M. Moeed	S. K. Kataria and Sons

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