VEHICLE SERVICING AND REPAIRING

NTQF Level II

Learning Guide 51

Unit of Competence: Identify Basic Automotive Faults Using Troubleshooting Processes

Module Title: Identifying Basic Automotive Faults Using Troubleshooting Processes

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LO1: Identify nature of the fault or problem

Instruction Sheet	Identify nature of the fault or problem

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

- Questioning techniques
- Workplace Health and Safety (WHS) requirements
- Basic Automotive system Faults
- Troubleshooting process options
- Tools and equipment's

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Apply Questioning techniques
- Observe workplace Health and Safety (WHS) requirements
- Gather Information relating to the fault
- Research troubleshooting process options
- Select and prepare appropriate tools and equipment

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 20.
3. Read the information written in the "Information Sheets 1". Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the "Self-check 1" in page 7.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to "Information Sheet 2". However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information Sheet-1	Questioning Techniques

Questioning Techniques

They are ways of asking questions for various reasons in different situations when one is searching for solutions, answers, information etc. Questions can be asked because of to gain knowledge, to clarify doubts, to know the reality or truth behind an incident, out of curiosity, to make complicated issues simpler, to resolve issues, to start a conversation, to share ideas, to make a plan, etc.

People in the workplace communicate effectively with customers in different ways of having questioning skill to know and to ask the right questions to get as much details or information as necessary.

Questioning skills helps people to gather more quality information, to learn a lot by questioning, to build better relationships and to manage problems and people effectively.

Types of questions that can be used for questioning techniques are the following: open, closed, funnel, probing, leading questions, etc.

Open and Closed questions

Open questions:

Open questions ask for elaborate / explanatory answers and they begin with what, why, how, describe, explain, where, which, when etc. It can be questions asking someone to explain what happened at a situation or place, asking why it happened, asking for details of an incident, history of some happenings, explanation about their circumstances, explanation of needs, thoughts about something, ideas and feedback.

Open questions help with a two way conversation and builds up an interest in the conversation. Some examples are

- What happened in the workplace today?
- Could you please describe about the situation?
- What do you think about this conclusion / discussion?
- Who were present at this incident?
- How it was happen?
- How did you arrive in the workplace at this time?

Closed questions:

Closed Questions have very short answers like “yes” or “no” or answers with a word or two. They are usually asked to test if someone has understood certain policies, procedures, rules, regulations, explanations, discussions, agreements or disagreements, etc. Some of the words used in closed questions are, are, do, did, could, should etc. Examples of closed questions are

- Will I get a service by tomorrow?
- Do we agree on this conclusion/recommendation?
- Are you happy with the services that we provide?
- Which is your workplace?
- Can you explain the cause?
- Would you bring your equipment on tomorrow?

Funnel, Probing and Leading questions

Funnel questions:

This type of questioning technique is used by investigators, researchers and detectives. In cases where investigations are involved, these types of questions can be used to gather information and then to narrow down to arrive at a decision. You can use a lot of closed questions at the start and then widen on to asking open questions thereby making the people feel comfortable answering your questions. An example can be

- When was the investigation made?
- Do you know the name of the person whom you spoke to?
- What sort of behavior did they exhibit?
- What was your call about?

- What questions did you ask?
- What was the response?
- Did you mention any information about a bout the problem?

Probing questions:

Probing questions are used to gather more details and information. These are asked to clarify doubts or misunderstandings. These questions will help you pull out information from people who are hiding information or avoiding from telling you something. Examples are

- What exactly is the current situation?
- Who exactly is requiring these details?
- How do you know that spare parts are needed?
- What is exactly this manual needed for?
- What types of parts do you need, how and where will you be using them?

Leading questions:

Leading questions are used to lead the person whom you are talking to. This leads the speaker to give you answers, while they know that you are giving them a choice. One has to be careful not to be manipulative while using leading questions. Some examples are

- Well, I think this spare parts looks more suitable for your services, what do you think?
- What would you prefer, A or B, as they both have similar features?

Apply Questioning Techniques

Technicians require questions for the customers during the troubleshooting processes in gathering information step to pinpoint their diagnosis process around the problem by applying questioning techniques. Through these techniques a technician questions to customer what information they want and customer's answer for the questions provided.

Example:

Question 1:

Technician: How often do you use the park lights?

Information: To judge how much service the light has given prior to failure.

Customer: About 2 hours each week.

Question 2:

Technician: What sort of driving do you do?

Information: To know if the car travels on rough roads a lot.

Customer: Mostly city driving-sealed roads.

Question 3:

Technician: Has it ever stopped working before?

Information: To see if we're hurrying a recurring fault

Customer: No

Question 4:

Technician: Have any other lights stopped working in the past?

Information: To get a history of the car's lighting problems

Customer: Yes, a tail light and one headlight, at different times

Question 5:

Technician: What did you do about those failures?

Information: To know about any work done on the lighting system prior to this

Customer: A mechanic put new globes in- he said they were blown

Question 6:

Technician: Have you noticed anything else unusual about the operation of your car's lights recently?

Information: We want to know if there have been any other symptoms such as flickering, changes in brightness etc

Customer: No

Question 7:

Technicians: Has any other work been done on the front end of the car recently?

Information: This could point to problems created during an unrelated repair, such as panel damage

Customer: No

Self-Check -1	Written Test

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

1. Describe questioning techniques.
2. What is the reason to question customer/client/colleagues in the workplace?
3. When did you provide questions in the workplace?
4. Briefly describe the following questioning techniques;
   a) Open end question
   b) Closed question
   c) Funnel question
   d) Probing question
   e) Leading questions

Note: **Satisfactory rating – above 8 points** **Unsatisfactory - below 6 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-2	Workplace Health and Safety (WHS) requirements

Workplace Health and Safety

Workplace health and safety covers the concept of the *health*, *safety* and *welfare* of all persons who may be impacted by work activities in the workplace.

WHS is the term used to describe the laws and processes that help to protect employees from death and injury while at work.

Importance of WHS

Workplace health and safety protects works by setting standards for the workplace. It provides guidelines for lifting, for working with hazardous chemicals, protective equipment's like eye protection and ear protection and limits the number of hours a person can work at a particular job (preventing injury due to fatigue/stress).

WHS legislation

WHS legislation is designed to protect workers from being injured on the job or suffering illness from unhealthy work environments. It encourages the workers to work together to resolve health and safety issues in the workplace.

WHS regulations

Describes how to prevent or minimize a risk at your workplace. Regulations set out the standards you need to meet for specific hazards and risks, such as noise, machinery, and manual handling. They also set out the licenses you need for specific activities, the records you need to keep, and the reports you need to make.

WHS codes of practice

A code of practice provides particular guides for people who have work health and safety duties. These codes give guidance on:

- Provide minimum standards for health and safety
- Effective ways to identify and manage risks.
- Provides practical guidance on how particular standards of health and safety can be achieved by using preferred method.

Policy is a written statement of organizations commitment to the Workplace Health and Safety of employees. The policy includes:

- Encourage cooperation and consultation between managers and workers

- Outline how WHS will be managed using a planned continuous improvement approach with an emphasis on hazard management
- Outline roles and responsibilities for injury management
- Be available to workers (and understood by them).

Procedures

A procedure prescribes actions that need to be executed as a sequence of activities, tasks, steps and processes that when undertaken produce the desired result or outcome. It should be developed to outline how the requirements of the policy will be met, so there may be procedures for:

- Hazard management
- Manual handling
- Hazardous substances
- Accident reporting and investigation
- Injury management

Use of tools

- Use tools only for the purpose for which they are designed and within their capacity limits.
- Always seek instruction before using an unfamiliar tool or performing an unfamiliar procedure.
- When working with fasteners use only the correct typeof tool and ensure it is a good fit. Use properly fitting screwdrivers. With nuts & bolts use spanners in the following order of priority: Ring spanner, socket spanner, open end spanner, adjustable spanner. Always use washers.
- When using spanners try to pull on them rather than push, with arm at 90^0 to the spanner.
- Look after tools, store them properly. Take extra care with measuring tools. Do not leave them lying about mixed up with general tools. Never sacrifice any tool for the sake of the job.
- Report any damaged tools and do not use until repaired or replaced.
- When using power tools ensure that the power tool has a current test tag fitted.
- Ensure that appropriate Personal Protective Equipment (PPE) is used.

- With power tools always wear safety glasses. If the machine makes loud noise wear hearing protection. If it creates dust wear respiratory protection etc. Dust extraction may be necessary
- Ensure that any safety features (such as safety guards) are fitted and used as intended.
- Exercise extreme caution with angle grinders, circular saws or any other high speed power tool.
- Ensure rags or similar are kept well clear of rotating items such as drill bits, etc.

Equipment's

- Qualified or suitably trained persons only to use.
- Typical hazards associated with machinery and workshop areas include noise, vibration, dust & vapours, moving machine parts, heavy weights, sharps, possible flying metal fragments, compressed air, gases, solvents, chemicals and electricity. Due care should be exercised where these or any other hazards are present.
- Ensure Safe Operating Procedure (SOP) has been developed for the particular machine. SOP's for standard workshop machines and some other workshop equipment (e.g. welding)
- Ensure SOP for the particular machine is read prior to use and is complied with.
- Use machinery only for the purpose it was designed and within its specified capacity limits.
- Ensure all safety features are fitted and operable.
- Always use appropriate PPE (as specified in the Safe Operating Procedure).
- Never distract the attention of a person using machinery.
- Never use compressed air for cleaning machinery or clothing.
- Do not use rags or similar near rotating work pieces or machine parts.
- Report any damage to or faults with machinery. Do not use until repaired.

Specialized Equipment

- This refers to all specialized apparatus, either purchased, custom made, or modified, often used in research & teaching areas.

- Hazards additional to those mentioned above may be found in association with specialized equipment. They may include lasers, high electric power (high voltages and/or currents, stored electrical energy (e.g. capacitors), stored potential energy (springs, weights at a height etc), radiation, magnetic fields, pressures, vacuums, extreme high/low temperatures, biological hazards, unusual gases/fluids etc. Due care should be exercised where these or any other hazards are present.
- Qualified or suitably trained persons only to use. Must be listed as an\ authorized user after verification of qualification.
- Ensure SOP for the particular equipment is read prior to use and is complied with.
- Use equipment only for the purpose it was designed and within its specified capacity limits.
- Ensure all safety features are fitted and operable.
- Always use appropriate PPE (as specified in the Safe Operating Procedure).
- Report any damage to or faults with the equipment. Do not use until repaired.
- Never attempt to alter or modify the equipment without first seeking approval.
- If equipment is modified amend the SOP appropriately if necessary.

Personal protective equipment

How to protect or take care yourself in the workshop? Protecting yourself from injury is by wearing of personal protective equipment (PPE) and clothing. These are:

- Wearing eye glasses(goggles)
- Wearing ear protection
- Wearing cap head band or hairnet.
- Wearing proper clothing, shoes, and gloves.

Use of firefighting equipment

When using a fire extinguisher, remember the word “PASS.”

P - Pull the safety pin.

A - Aim the nozzle of the extinguisher at the base of the fire.

S - Squeeze the lever to actuate the extinguisher.

S - Sweep the nozzle from side to side.

First Aid Kit: A first aid kit should include: Bandages (variety), Gauze pads, Roll gauze, Iodine swab sticks, Antibiotic ointment, Hydrocortisone cream, Burn gel packets, Eye wash solution, Scissors, Tweezers, Gloves, First aid guide

Hazardous materials

A typical shop may contain many potential hazards for those works in it. This hazard can cause injury, sickness, health impairments, discomfort and even death. Hazards can be classified as;

Chemical hazards: - caused by high concentration of vapors, gases or solids in the form of dust.

Waste hazard: - are due to substances that are the result of a service.

Physical hazard: - excessive noise, vibration, pressure and temperature.

Ergonomic hazard: - due to human comfort designs.

They are a potential hazard which may include Paint and body repair products waste, Solvents for parts and equipment cleaning, Batteries and battery acid, Mild acids used for metal cleaning and preparation, Waste oil, and engine coolants or antifreeze, Air-conditioning refrigerants and oils, Engine oil filters. When handling hazardous waste material, one must always wear the proper protective clothing and equipment which is

respirator equipment. All recommended procedures must be followed accurately. Personal injury may result from improper clothing, equipment, and procedures when handling hazardous materials. Hazardous waste materials are chemicals, or components, that the shop no longer needs that pose a danger to the environment and people if they are disposed of in ordinary garbage cans or sewers. However, no material is considered hazardous waste until the shop has finished using it and is ready to dispose of it.

Asbestos hazard

Friction materials such as brake and clutch linings often contain asbestos. While asbestos has been eliminated from most original equipment friction materials. Asbestos exposure can cause scar tissue to form in the lungs. This condition is called asbestosis. It gradually causes increasing shortness of breath, and the scarring to the lungs is permanent. Even low exposures to asbestos can cause mesothelioma, a type of fatal cancer of the lining of the chest or abdominal cavity.

Asbestos Handling (*asbestos OSHA standards and asbestos EPA regulations***)**

- *HEPA vacuum:* a special high-efficiency particulate air (HEPA) vacuum system has been proven to be effective in keeping asbestos exposure levels below 0.1 fibers per cubic centimeter.
- *Solvent spray* many technicians use an aerosol can of brake cleaning solvent to wet the brake dust and prevent it from becoming airborne. A solvent is a liquid used to dissolve dirt, grime, or solid particles. Commercial brake cleaners are available that use a concentrated cleaner mixed with water.
- *Disposal of brake dust and brake shoes*: The hazard of asbestos occurs when asbestos fibers are airborne. Once the asbestos has been wetted down, it is then considered to be solid waste, rather than hazardous waste. Old brake shoes and pads should be enclosed, preferably in a plastic bag, to help prevent any of the brake material from becoming airborne. Always follow current federal and local laws concerning disposal of all waste.

CAUTION: Never use compressed air to blow brake dust. The fine, talclike brake dust can create a health hazard even if asbestos is not present or is present in dust rather than fiber form.

Self-Check - 2	Written Test

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

1. Describe workplace health and safety.
2. What is the importance of WHS?
3. Explain WHS requirements
4. Explain how to use firefighting equipment.
5. How do you protect yourself from the workplace accidents/injuries?
6. What are hazardous materials in the workplace? How do you control them?
7. What are asbestos hazards? How does control them?

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-3	Faults

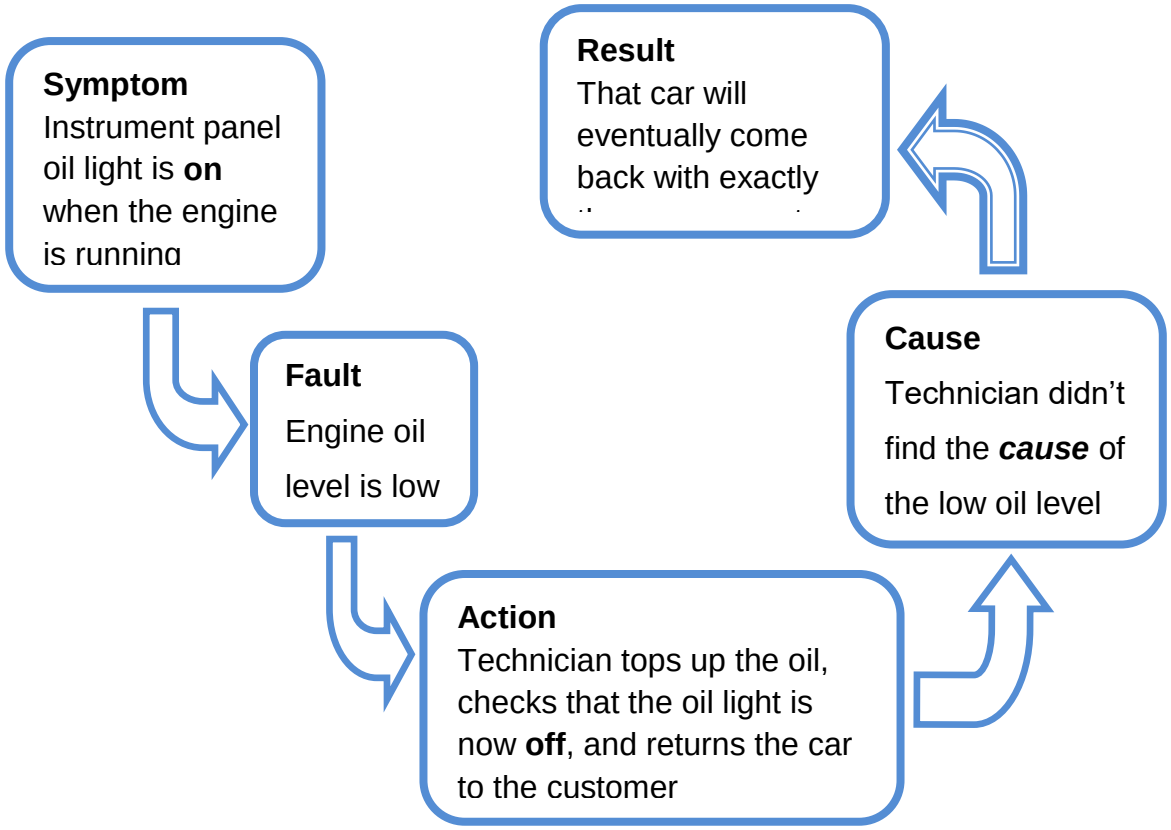
Fault

A *fault* is an abnormal condition in a system or component. Something has gone wrong which we need to identify and repair. It is the root cause of a symptom/problem.

Symptom:

A *symptom* might indicate a *fault* in a customer's vehicle, and a *faulty* (worn, broken) component might be found, but what produced that fault? Something must have *caused* that change. Finding the *cause* of the faults will allow the technician to choose the right repair to correct the fault, and prevent any re-work under warranty ('come backs').

Example**:**



Below are described some basic automotive system faults.

Lighting system faults

Symptom	Possible faults
Lights dim	• High resistance in the circuit • Low alternator output • Discolored lenses or reflectors
Headlights out of adjustment	• Suspension fault • Loose fittings • Damage to body panels • Adjustment incorrect
Lights do not work	• Bulbs blown • Fuse blown • Loose or broken wiring/ connections/fuse • Relay not working • Corrosion in light units • Switch not making contact

Suspension system faults

Symptom	Possible faults
Excessive pitch or roll when driving	• Dampers worn
Car sits lopsided	• Broken spring • Leak in hydraulic suspension
Knocking noises	• Excessive free play in a suspension joint
Excessive pitching	• Defective dampers • Broken or weak spring • Worn or damaged anti-roll bar mountings
Wandering or instability	• Broken or weak spring • Worn suspension joints • Defective dampers
Wheel wobble	• Worn suspension joints
Pulling to one side	• Worn suspension joints • Accident damage to suspension alignment
Excessive tyre wear	• Worn suspension joints • Accident damage to suspension alignment • Incorrect trim height (particularly hydro-elastic systems) • Steering/suspension geometry incorrect (may be due to out of true accident damage)

Steering system faults

Symptom	Possible faults
Excessive free play at steering wheel	• Play between the rack and pinion or in the steering box • Worn track rod end or swivel joints • Ball joints or tie rod joints worn • Column coupling loose or bushes worn
Vehicle wanders, hard to keep in a straight line	• Alignment incorrect • Incorrect tyre pressure or mix of tyre types is not suitable • Worn wheel bearings
Pulling to one side	• Defective tyre • Excessively worn components • Incorrect wheel alignment
Stiff steering	• Wheel alignment incorrect • Lack of steering gear lubrication • Tyre pressures too low • Seized track rod end joint or suspension swivel joint • Ball joints or rack seizing • Damage to steering components
Wheel wobble	• Wheels out of balance • Wear in suspension linkages • Alignment incorrect
Under steer or over steer	• Tyre pressures incorrect • Dangerous mix of tyre types • Excessive free play in suspension or • steering system

Brake System faults

Symptom	Possible faults
Excessive pedal travel	• Incorrect adjustment • Discs running out pushing pads back • Fluid leak • Misplaced dust covers • Fluid contamination • Worn or swollen seals in master cylinder • Blocked filler cap vent
Poor performance when stopping	• Pad and/or shoe linings worn • Seized caliper or wheel cylinders • Contaminated linings • Linings wet, greasy or not bedded correctly
Car pulls to one side when braking	• Seized caliper or wheel cylinder on one side • Contaminated linings on one side • Loose brakes • Greasy linings • Faulty drums, suspension or steering • Unsuitable tyres or pressures
Spongy pedal	• Air in the hydraulic system • Badly lined shoes • Master cylinder seals failing • Faulty drums • Shoes distorted or incorrectly set
Pedal travels to the floor when pressed	• Fluid reservoir empty • Failed seals in master cylinder • Leak from a pipe or union
Brakes overheating	• Shoe return springs broken • Calipers or wheel cylinders sticking

Brake judder	• Excessive disc or drum run-out • Caliper mounting bolts loose • Worn suspension or steering components • Linings worn • Drums out of round • Discs have excessive run-out
Squeaking	• Badly worn linings • Dirt in brake drums • Anti-squeal shims missing at rear of pads
Brake fade	• Incorrect linings • Badly lined shoes • Distorted shoes • Overloaded vehicle • Excessive braking
Brakes binding	• Brakes or handbrake maladjusted • No clearance at master cylinder push rod • Seals swollen • Seized pistons • Shoe springs weak or broken • Servo faulty
Fall in fluid level	• Worn disc pads • External leak • Leak in servo unit
Uneven or excessive pad wear	• Disc corroded or badly scored • Incorrect friction material
Disc brake squeal – pad rattle	• Worn retaining pins • Worn discs • No pad damping shims or springs

Engine fault

Symptom	Possible faults
Oil consumption	• Worn piston rings and/or cylinders • Worn valve stems, guides or stem oil seals
Oil on engine or floor	• Leaking gaskets or seals • Buildup of pressure in the crankcase
Mechanical knocking noises	• Worn engine bearings (big ends or mains) • Incorrect valve clearances or defective automatic adjuster • Piston slap on side of cylinder
Vibration	• Engine mountings loose or worn • Misfiring
Engine does not rotate when trying to start	• Battery connection loose or corroded • Battery discharged or faulty • Broken loose or disconnected wiring in the starter circuit • Defective starter switch or automatic gearbox inhibitor switch • Starter pinion or flywheel ring gear loose • Earth strap broken. Loose or corroded
Engine rotates but does not start	• No fuel in the tank • Discharged battery (slow rotation) • Battery terminals loose or corroded • Air filter dirty or blocked • Low cylinder compressions • Broken timing belt • Damp ignition components

	• Fuel system fault • Spark plugs worn to excess • Ignition system open circuit
Difficult to start when cold	• Discharged battery (slow rotation) • Battery terminals loose or corroded • Air filter dirty or blocked • Low cylinder compressions • Fuel system fault • Spark plugs worn to excess • Enrichment device not working (choke or injection circuit)
Difficult to start when hot	• Discharged battery (slow rotation) • Battery terminals loose or corroded • Air filter dirty or blocked • Low cylinder compressions • Fuel system fault
Engine stalls	• Idle speed incorrect • CO setting incorrect • Fuel filter blocked • Air filter blocked • Intake air leak • Idle control system not working
Lack of power	• Fuel filter blocked • Air filter blocked • Ignition timing incorrect • Low fuel pump delivery • Uneven or low cylinder compressions (maybe valves)

	• Fuel injectors blocked • Brakes binding or clutch slipping
Runs on when switched off	• Ignition timing incorrect • Idle speed too high • Anti-run on device not working • Carbon build up in engine • Engine overheating
Pinking or knocking under load	• Ignition timing incorrect • Ignition system fault • Carbon build up in engine • Knock sensor not working
Whistling noises	• Leaking exhaust manifold gasket • Leaking inlet manifold gasket • Cylinder head gasket • Inlet air leak • Water pump or alternator bearing
Rattling or tapping	• Incorrect valve clearances • Worn valve gear or camshaft • Loose component
Knocking noises	• Worn main bearings (deep knocking/ rumbling noise) • Worn big end bearings (heavy knocking noise under load) • Piston slap (worse when cold) • Loose component

Fuel System fault

Symptom	Possible faults
No fuel at carburettor or injection fuel rail	• Empty tank • Blocked filter or line • Defective fuel pump • No electrical supply to pump
Engine will not or is difficult to start	• Choke or enrichment device not working
Engine stalls or will not idle smoothly	• Idle speed incorrectly set • Mixture setting wrong • Ignition problem
Poor acceleration	• Blockage in carburetor accelerator pump • Partially blocked filter • Injection electrical fault
Excessive fuel consumption	• Incorrect mixture settings • Blocked air filter • Low tyre pressures • Incorrect CO adjustment • Ignition timing incorrect • Driving technique • Fuel injectors leaking
Black smoke from exhaust	• Excessively rich mixture • Flooding
Fuel leakage	• Damaged pipes or unions • Fuel tank damaged • Tank breathers blocked
Fuel smell	• Fuel leak • Breather incorrectly fitted • Fuel cap loose

	• Engine flooding
Incorrect emissions	• Incorrect adjustments • Fuel system fault • Air leak into inlet • Blocked fuel filter • Blocked air filter • Ignition system fault

Drive train faults

Clutch faults	
Symptom	Possible faults
No pedal resistance	• Broken cable • Air in hydraulic system • Hydraulic seals worn • Release bearing or fork broken • Diaphragm spring broken
Clutch does not disengage	• Disc sticking in gearbox splines • Disc sticking to flywheel • Faulty pressure plate
Clutch slip	• Incorrect adjustment • Worn disc linings • Contaminated linings (oil or grease) • Faulty pressure plate
Judder when engaging	• Contaminated linings (oil or grease) • Worn disc linings • Distorted or worn pressure plate • Engine mountings worn, loose or broken • Clutch disc hub splines worn
Noisy operation	• Broken components

	• Release bearing seized • Disc cushioning springs broken
Snatching	• Disc cushioning springs broken • Operating mechanism sticking (lubrication?)
Manual gearbox fault	
Symptom	Possible faults
Noisy in a particular gear (with engine running)	• Damaged gear • Worn bearing
Noisy in neutral (with engine running)	• Input shaft bearings worn (goes away when clutch is pushed down?) • Lack of lubricating oil • Clutch release bearing worn (gets • worse when clutch is pushed down?)
Difficult to engage gears	• Clutch problem • Gear linkage worn or not adjusted • correctly • Work synchromesh units • Lack of lubrication
Jumps out of gear	• Gear linkage worn or not adjusted • correctly • Worn selector forks • Detent not working • Weak synchromesh units
Vibration	• Lack of lubrication • Worn bearings • Mountings loose
Oil leaks	• Gaskets leaking • Worn seals
Drive shafts fault	
Symptom	Possible faults
Vibration	• Incorrect alignment of propeller shaft joints

	• Worn universal or CV joints • Bent shaft • Mountings worn
Grease leaking	• Gaiters split or clips loose
Knocking noises	• Dry joints • Worn CV joints (gets worse on tight • corners)
Final drive fault	
Symptom	Possible faults
Oil leaks	• Gaskets split • Driveshaft oil seals • Final drive output bearings worn • (drive-shafts drop and cause leaks)
Noisy operation	• Low oil level • Incorrect preload adjustment • Bearings worn
Whining noise	• Low oil level • Worn differential gears

Self-Check - 3	Written Test

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

1. Describe the difference between symptom and fault.
2. List the symptom and faults of the following systems.
   - 2.1. Lighting system
   - 2.2. Steering system
   - 2.3. Suspension system
   - 2.4. Engine
   - 2.5. Fuel system
   - 2.6. Drive train system

Note: **Satisfactory rating – above 8 points** **Unsatisfactory - below 6 points**

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

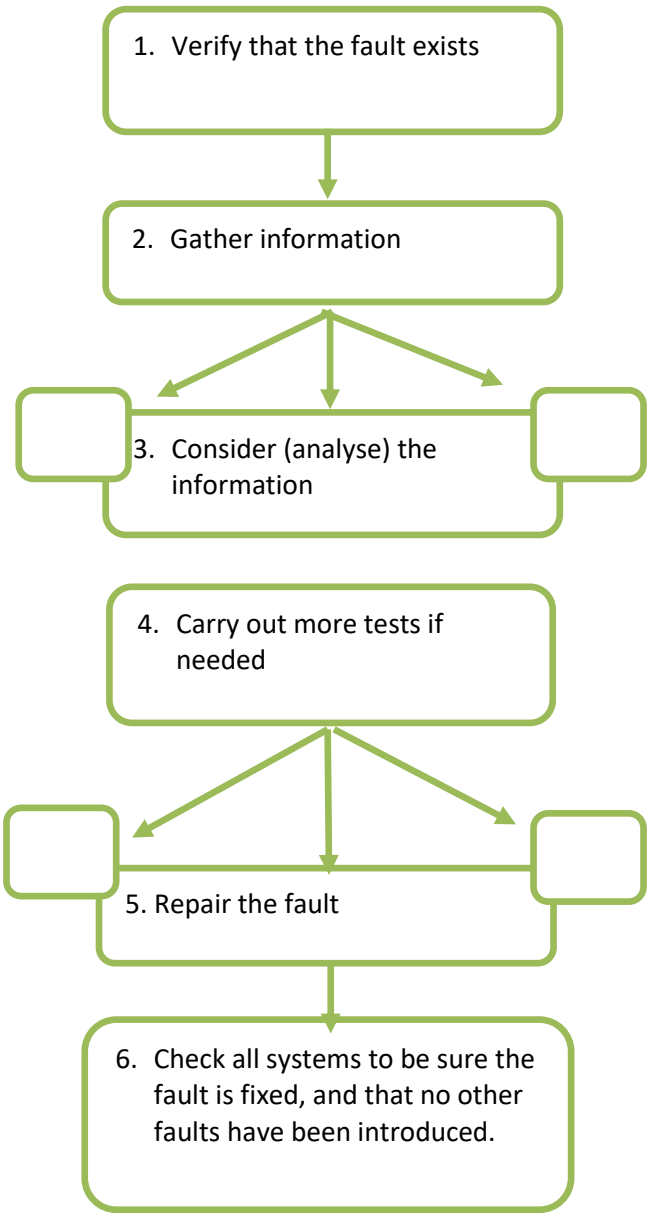
Short Answer Questions

Information sheet 4	Troubleshooting process options

There are different types of troubleshooting processes. These are listed as follows:

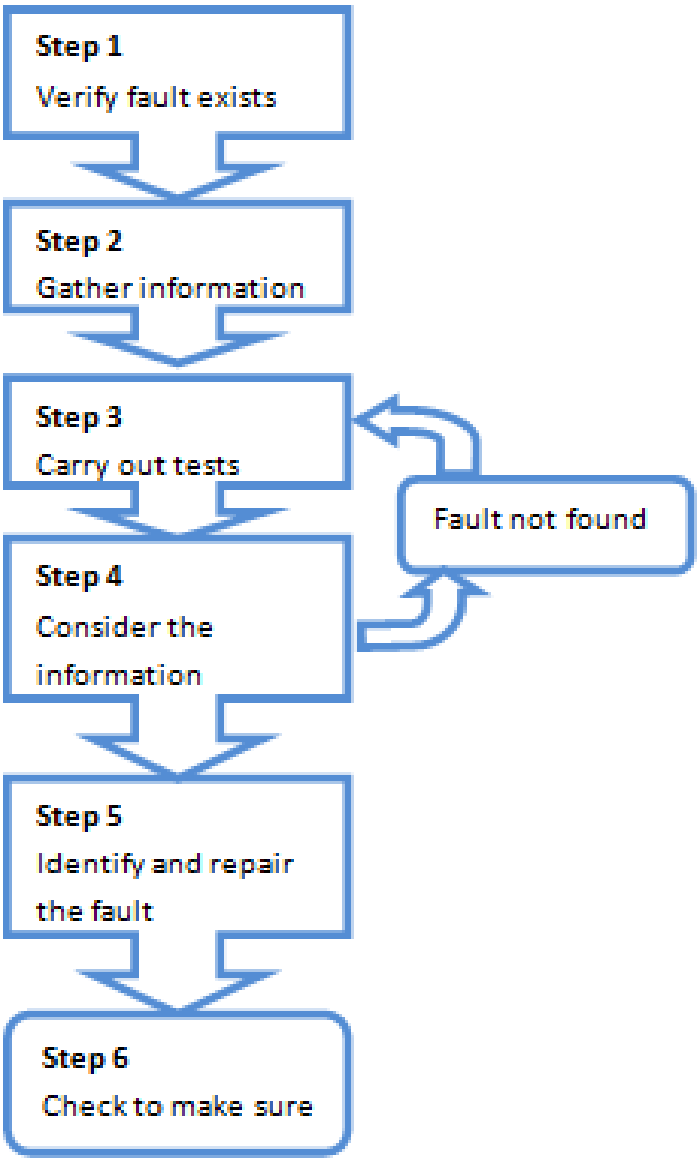
a) Step-by-step procedures:

This could be used as a general procedure to follow on other diagnosis tasks. Often you can make a few small adjustments to suit the particular job.



b) Feedback Loops:

It has a “feedback loop” which prompts you to re-test or do further tests if you don’t find the fault on the first attempt.

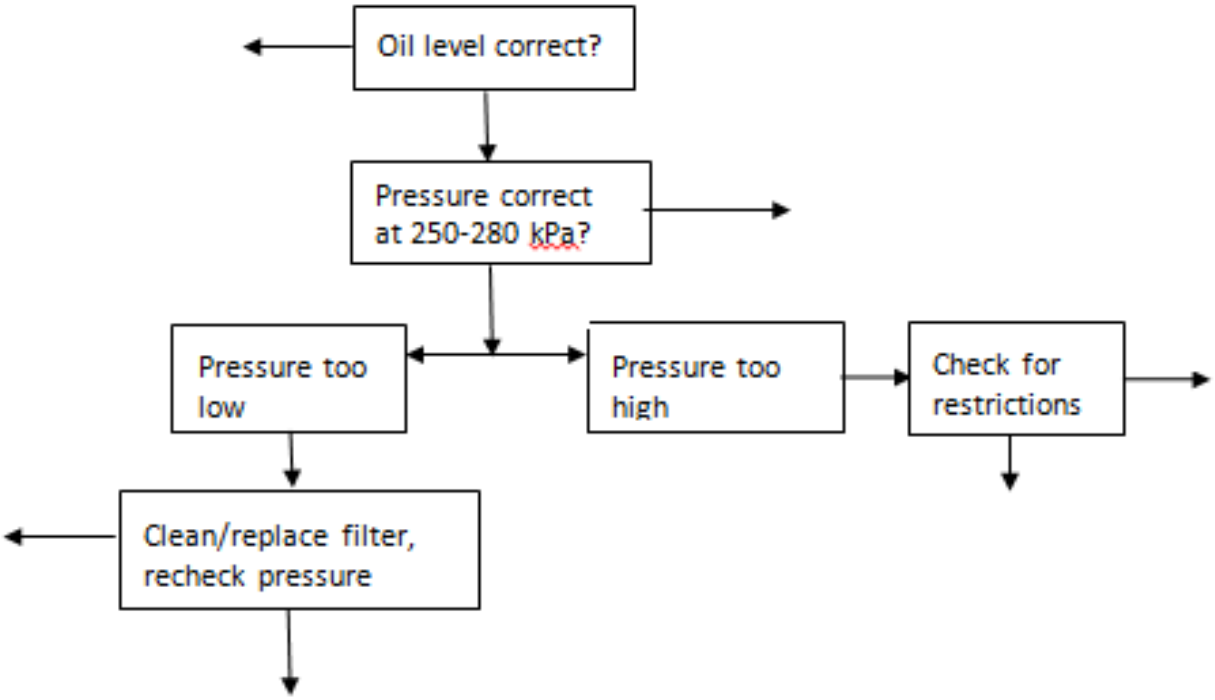


c) Branching diagnostic procedures

The diagnostic procedures discussed previously are all linear – that is, each step must be completed before you can do the next one. This approach works well for many vehicle faults, especially where the technician only has to deal with one or two systems.

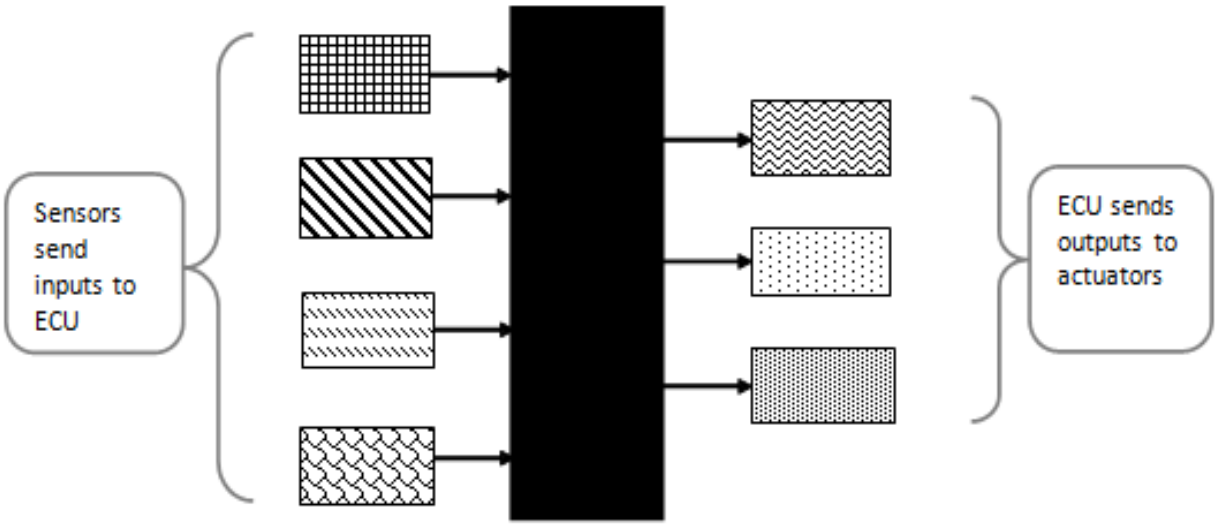
When a fault occurs in a more complex system or in a system which has connections to other systems, a branching diagnostic procedure might be used. This requires the technician to make “yes / no” or “good / bad” decisions about various components or functions of a system.

It is sometimes called a “decision tree” or a “trouble tree”. These procedures are sometimes provided by manufacturers in their workshop manuals. If the procedure is followed correctly, the technician will eventually diagnose the faulty component and be able to complete the repair.



d) Black Box’ Diagnosis procedures

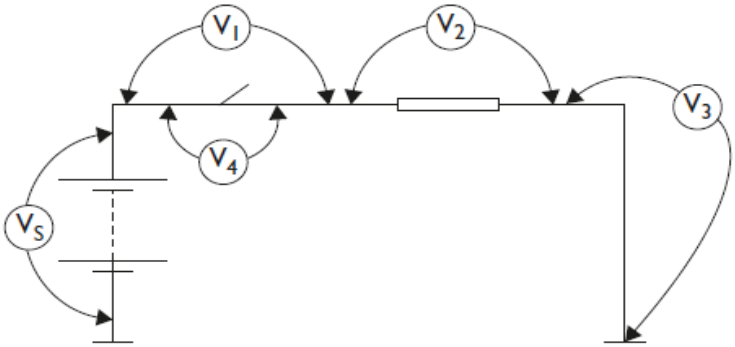
Most vehicle systems now include an electronic control unit (ECU) as a master control unit. The ECU is too complex to be repaired by the average workshop, but its functions can be fairly easily understood. It is called a ‘black box’ because we know what the ECU does, but we don’t know (and don’t need to know) how it does it.



Provide list of tests

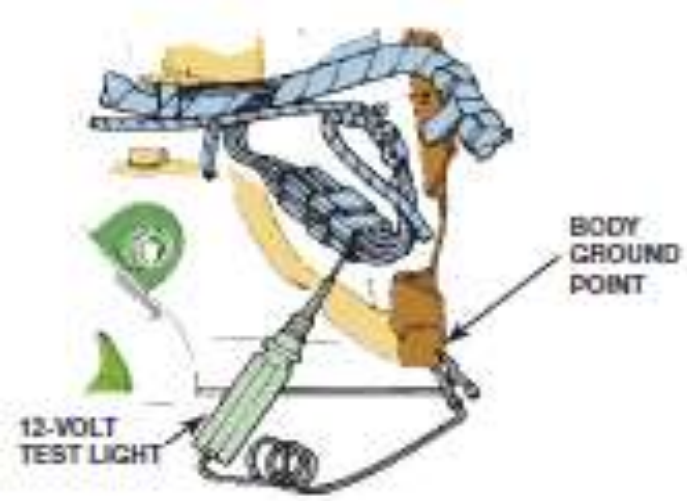
Voltage drop test

Volt drop is a term used to describe the difference between two points in a circuit; such as: about a voltage drop across a battery or the voltage drop across a closed switch.



Short circuit test

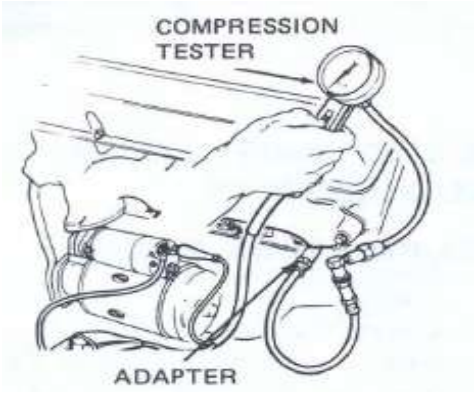
This fault will normally blow a fuse or burn out the wiring completely. Tracing a short, after looking for the obvious signs of trapped wires, is to connect a bulb or test lamp across the blown fuse and switch on the circuit. The bulb will light because on one side it is connected to the supply for the fuse and on the other side it is connected to earth via the fault. Now disconnect small sections of the circuit one at a time until the test lamp goes out. This will indicate the particular circuit section that has shorted out.



Headlight beam setting

Compression test

A compression test is carried out by cranking the engine with the throttle open and ignition disconnected, whilst reading the cranking compression with a compression gauge inserted in the spark plug hole. Expected readings for the particular engine under test. For example the pressure reach for each cylinder may be expected to read 800 kPa $\pm$ 15%



Cylinder leakage test

This test is used to pinpoint causes of leakage in a combustion chamber. Leaks can be pinpointed by listening in different places

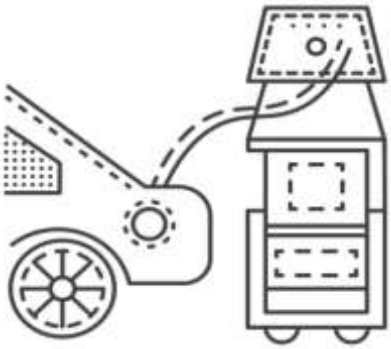
- Oil filter: leaking rings or pistons
- Air cleaner: leaking intake valve
- Exhaust: leaking exhaust valve
- Bubbles in radiator: blown head gasket or crack in head or block

The percentage leak that is allowed for the tester you are using; some allow about 15% leakages as the limit

Exhaust gas analysis

CO setting. Most modern vehicles will have settings of about 1% or less. If a 'cat' is fitted then the readings will be even lower when measured at the tail pipe

Exhaust gas emission testing is a process where test equipment is used to measure the gases produced by a car's engine. A probe is placed in the tailpipe of the car and the exhaust gases are measured following a strict procedure. The exhaust gas analyser is used for measuring 4 gases, oxygen (O2), carbon monoxide (CO), carbon dioxide (CO2) and hydrocarbons (HC) as well as calculating lambda (λ) a measure of air/fuel ratio. These measurements together provide a very accurate way of measuring the combustion efficiency of an engine.



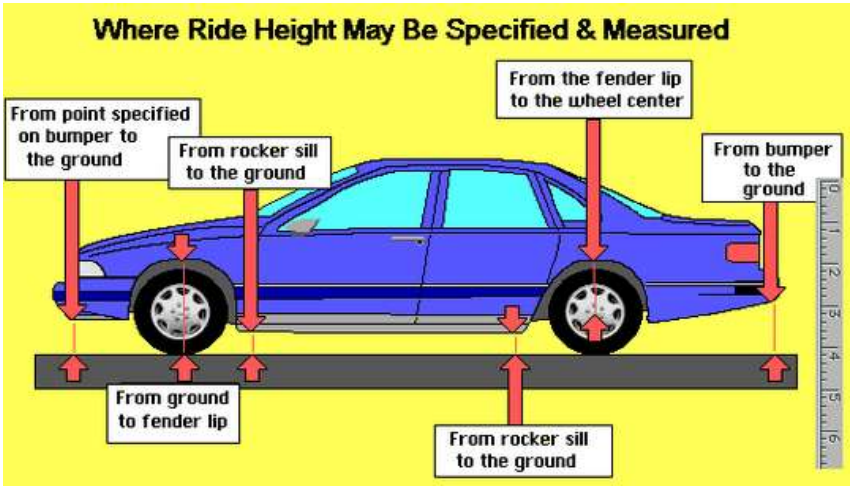
Fuel pressure test

The expected pressure readings will vary depending on the type of fuel system. Fuel injection pressure will be about 2.5 bar whereas fuel pressure for a carburetor will be about 0.3 bar.

Oil pressure test: check the pressure of the oil through the system.

Trim (Ride) height

Trim height is predetermined measurement relating to vehicle ride height. Ride height is the amount of space between the base of the vehicle tire and the level surface.



Bounce test

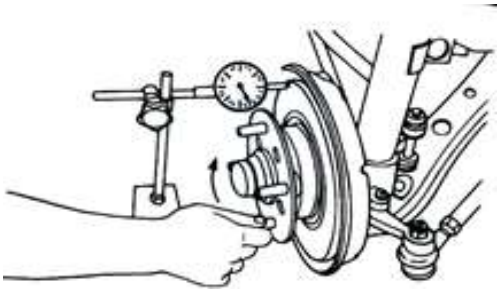
The vehicle body should move down as you press on it, bounce back just past the start point and then return to the rest position

Brake efficiency

The front or rear wheels are driven into a pair of rollers. The rollers drive each wheel of the car and as the brakes are applied the braking force affects the rotation. A measure of braking efficiency can then be worked out.

Disc run out

Dial gauge is used to check the brake disk for run out. The symptoms of this would often be vibration or pulsation when braking.



Toe in – toe out

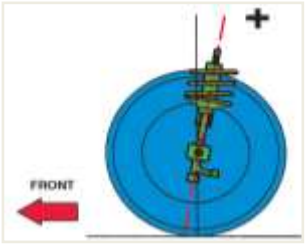
The tracking gauge is often set toe-out so that the wheels point straight ahead when the vehicle is moving.

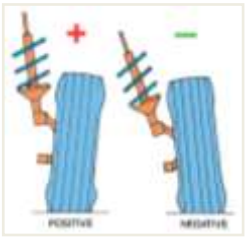
Wheel balancing

The wheel is removed from the car, fixed on to the machine and spun at high speed. Sensors in the tester measure the balance of the wheel. The tester then indicates the amount of weight which should be added to a certain position. The weight is added by fitting small lead weights.

Wheel alignment

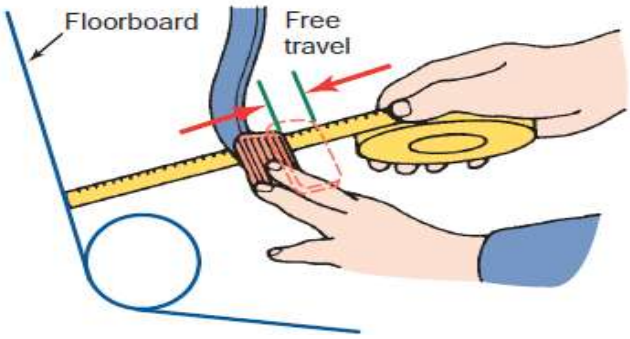
Setting of camber, caster and toe angles. Camber is the inward or outward tilt of a wheel compared to a vertical line. If the camber is out of adjustment, it will cause tyre wear on one side of the tire's tread. Caster is the degree that the car's steering axis is tilted forward or backward from the vertical as viewed from the side of the car. If the caster is out of adjustment, it can cause problems with self-centering and wander. Caster has little effect on tyre wear. Toe refers to the directions in which two wheels point relative to each other. Incorrect toe causes rapid tyre wear to both tyres equally.





Free play

To check pedal play, use a tape measure or ruler. Place the tape measure or ruler beside the clutch pedal and the end against the floor of the vehicle and note the reading. Then depress the clutch pedal just enough to take up the pedal play and note the reading again. The difference between the two readings is the amount of pedal play.



Diagnostic flow chart

Diagnostic flow charts are a quick and easy way to find the cause of a vehicle system problem from beginning to end. Example; *Lighting system diagnostic chart*

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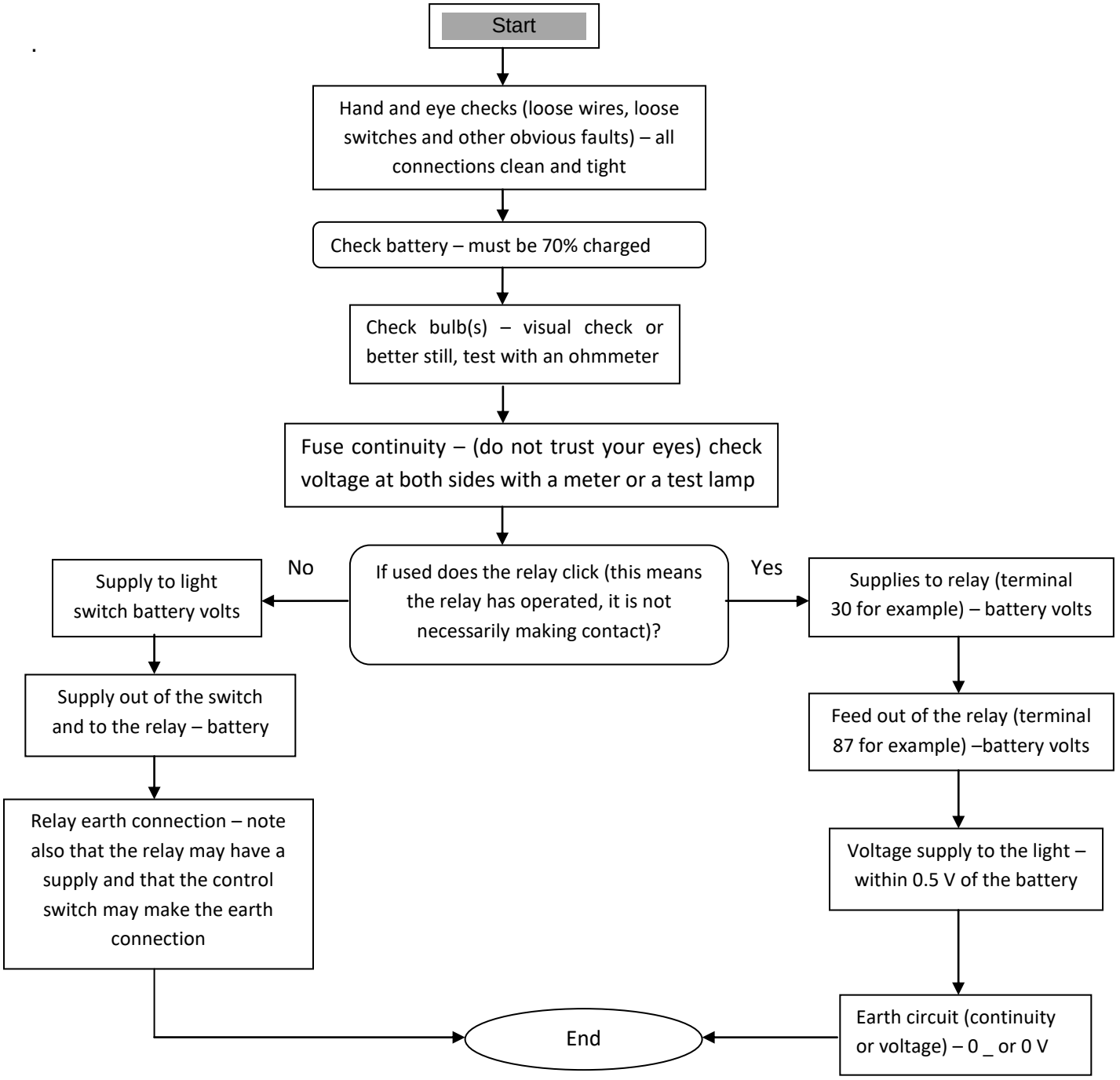


Self-Check - 4	Written test

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

1. List and Explain briefly troubleshooting processes.

2. Explain the following tests:
   - 2.1. Fuel pressure test
   - 2.2. Oil pressure test
   - 2.3. Wheel balance test
   - 2.4. Bounce test
   - 2.5. Voltage drop test
   - 2.6. Short circuit test
   - 2.7. Exhaust gas analysis
3. Describe the use of diagnostic flow chart.

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information sheet 5	Use of tools and equipment's

Tools and equipment

Screw driver used to drive in and out screws.

Wrenches are used to grasp and rotate threaded fasteners.

Oil pressure test gauge

This is a simple pressure gauge that can be fitted with suitable adapters into the oil pressure switch hole. The engine is then run and the pressure readings compared to data.

Fuel Pressure Tester

Tests the pressure of fuel delivered through the system when the fuel pump is operating.

Battery tester

It is used to test or check the condition of the battery.

Test Light

A typical automotive test light consists of a clear plastic screw driver like handle that contains a light bulb. A wire is attached to one terminal of the bulb, which the technician connects to a clean metal part of the vehicle. The other end of the bulb is attached to a point that can be used to test for electricity at a connector or wire. When there is power at the point and a good connection at the other end, the light bulb lights

Stethoscope

This is a useful device that can be used in a number of diagnostic situations. In its basic form it is a long screwdriver! The probe (or screwdriver blade) is placed near the suspected component such as a bearing. The ear piece (or screwdriver handle placed next to the ear) amplifies the sound. Take care though; even a good bearing can sound rough using this method. Compare a known good noise with the suspected one.

Multimeters

An essential tool for working on vehicle electrical and electronic systems is a good digital multimeter. Digital meters are most suitable for accuracy of reading as well as available facilities.

Exhaust gas measurement

Test exhaust using an infrared exhaust analyzer. Modern exhaust gas analyzers test five gases; Hydrocarbons (HC), Carbon monoxide (CO) and carbon dioxide (CO_2), Oxides of Nitrogen (NO_X) and Oxygen (O_2). Exhaust analysis diagnoses: Incorrect air-fuel mixtures, Engine and ignition system conditions, Operation of emission system components.

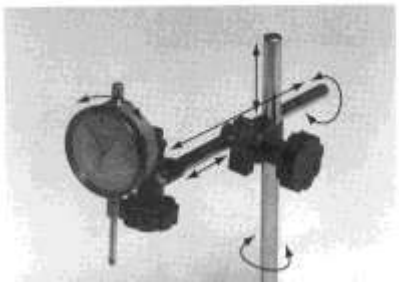
Compression tester

Compression tester measures the actual pressure the cylinder produces on the compression stroke and the difference between cylinders.

Leakage tester

A cylinder leakage test can identify what part of the cylinder leaks compressed air.

Dial indicator: - is used to measure thrust (side) clearance, run out, end play and backlash



Wheel balance: use to balance the wheel.

Self-Check - 5	Written Test

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

1. Describe the function of the following tools and equipment's
   1.1. Compression tester
   1.2. Fuel pressure tester
   1.3. Oil pressure tester
   1.4. Wheel balancer
   1.5. Dial gauge

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Operation Sheet 1	Headlight beam setting

Operation sheet title: setting headlight beam

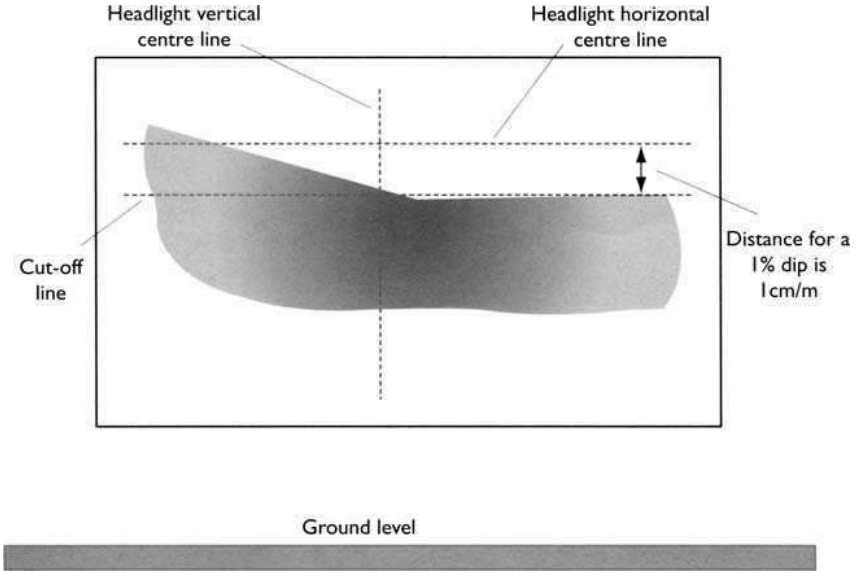
Purpose: - used to know procedures of headlight adjustment

Tools and equipment's:

- Manuals
- Headlight aimer
- Screw driver
- Wrenches
- Lamp

Procedures:

1. Park the car on level ground square on to a vertical aiming board at a distance of 10m if possible. The car should be unladen except for the driver.
2. Mark out the aiming board



3. Bounce the suspension to ensure it is level.
4. With the lights set on dip beam, adjust the cutoff line to the horizontal mark, which will be 1cm below the height of the headlight center for every 1 m the car is away from the board. The break-off point should be adjusted to the center line of each light in turn.

Operation Sheet 2	Compression test

Operation sheet title: Compression testing

Purpose: - used to know procedures of compression test

Tools and equipment's:

- Manuals
- Compression tester
- Wrenches

Procedures

1. Warm up the engine to its normal operating temperature.
2. Remove the spark plugs of all cylinders using the proper tool.
3. Disconnect terminal 15 (primary circuit) of the ignition coil.
4. Crank the engine with starting motor speed for a few seconds only this will blow out residues of combustion through the plug hole.
5. Starting from the first cylinder insert the compression tester into the spark plug hole.
6. Open the throttle valve fully to ensure that the maximum amount of air will enter the cylinder.
7. Crank the engine through 5 to 10 compression strokes.
8. Write down the maximum pressure indicated by the tester or gauge and compare this figure with the normal one given by the specification.
9. Continue with the next cylinder.

Operation Sheet 3	Bounce test

Operation title: shock absorber bounce test

Purpose: to check the condition of the shock absorber

Procedures:

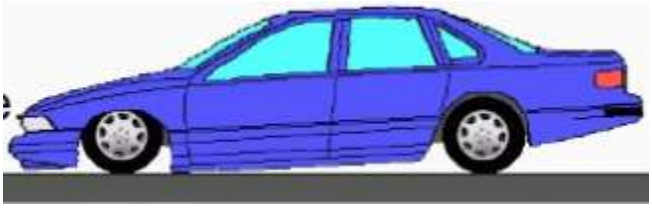
1. Place the vehicle in level road.
2. Push down on one corner of vehicle body.

3. Release the body and count the number of times the vehicle rebounds.
4. Consider the following during the test

   Good condition: no more than two rebounds

   Leaking shocks:

   - Check for sign of leakage
   - If oily and wet, replace it



Source: http://www.slideshare.net>anigavai>suspension-system

Operation Sheet - 4	Oil pressure test

Operational title: Testing oil pressure

Purpose: to check the pressure of the oil through the system.

Tools and equipment's:

- Oil pressure tester
- Wrenches

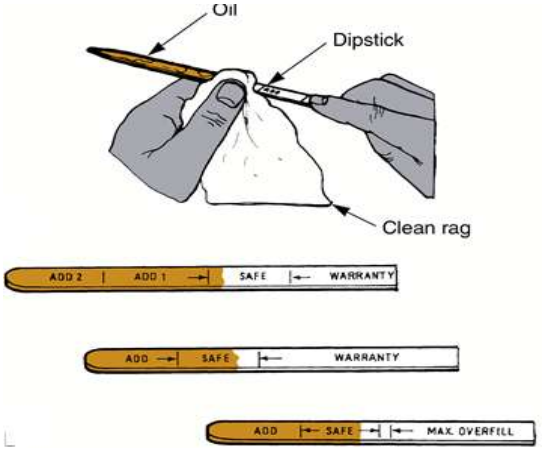
Procedures:

Step 1. Prepare the work area

Step 2. Prepare tools and equipment's

Step 3. Disconnect the electrical connector

Step 4. Check engine oil level



Step 5. Locate where the oil pressure tester is fit to engine

Step 6. Attach the oil pressure gauge

Step 7. Run the engine and test the pressure

Step 8. Analyze the result and

.

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

Task 1. Bounce test

Task 2. Compression test

Task 3. Oil pressure test

Task 4. Headlight beam test

List of Reference Materials

- *Diagnosis And Troubleshooting Of Automotive Electrical, Electronic, And Computer Systems S I X T H E D I T I O N, James D. Halderman*
- *LEARNER WORKBOOK; AURT366108A ; Carry out diagnostic procedures*
- *Automotive Technician Training (ATT) Level 1; TOM DENTON*
- *Advanced Automotive Fault Diagnosis; Second edition, Tom Denton*
- *Asbestos OSHA standards and asbestos EPA regulations*
- *Australia Act, 2011 legislation*
- *http://www.aesharenet.com.au/FfE2*
- *www.attraining.com*
- *http://www.slideshare.net>anigavai>suspension-system*