AUTOMOTIVE TECHNICIAN TRAINING

PRACTICAL WORKSHEETS | LEVEL 3

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TOM DENTON

ROUTLEDGE

Automotive Technician Training: Practical Worksheets Level 3

Automotive practical worksheets for students at Level 3

This Level 3 student worksheets book contains tasks that help you develop practical skills and prepare you for assessment. The tasks also reinforce the automotive theory that you will learn online and in the classroom. Each worksheet covers individual topics in a step-by-step manner, detailing how to carry out all the most important tasks contained within the syllabus. Alongside each of these worksheets is a job card that can be filled in and used as evidence towards your qualification.

- Endorsed by the Institute of the Motor Industry for all their Level 3 automotive courses.
- Step-by-step guides to the practical tasks required for all Level 3 qualifications.
- Job sheets for students to complete and feedback sheets for assessors to complete.

Tom Denton is the leading UK automotive author with a teaching career spanning lecturer to head of automotive engineering in a large college. His range of automotive textbooks published since 1995 are bestsellers and led to his authoring of the Automotive Technician Training multimedia system that is in common use in the UK, USA and several other countries. Tom now works as the eLearning Development Manager for the Institute of the Motor Industry (IMI).

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Automotive Technician Training

Practical Worksheets Level 3

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Practical Worksheets – Level 3

Introduction

The purpose of this worksheets book is to provide a range of practical activities that will enable you to develop your abilities as a technician. The tasks are aligned with recognized vocational qualifications. However, there are far more tasks within this workbook than are required by the awarding body for the achievement of a Vocationally Recognized Qualification – because the more you practise, the more skills you will develop.

The worksheets are presented as three separate books at Level 1, Level 2 and Level 3 to follow the recognized qualifications. Within each level there are tasks for the major automotive areas: Engines, Chassis, Transmission and Electrical. The tasks range from component identification to removal and refit at Level 1 and 2, and diagnosis of complex system faults at Level 3.

A blank job card and assessor report are provided with each worksheet. This should be copied and then filled in alongside the task you are completing, including all relevant details regarding the vehicle, the fault and the rectification procedure where appropriate. You should write down a description of the work that you did to complete the task including any technical data that you sourced, any difficulties that you encountered and how you overcame them. If you had any health and safety issues to address, i.e. disposal of waste materials or clearing up spillages, this will help demonstrate your competence. By completing job cards thoroughly at this stage of your career as a technician, you will be well prepared for the time when you are required to complete job cards in the workplace. This can be very important, for example, if a warranty job card is not accurate then the manufacturer will not pay for the claim. An example of a completed job card is shown on page 7.

For teacher/lecturers, this work book more than covers the requirements for Vocational Qualifications. Using the following tracking document you can note progress and also cross-reference the highlighted worksheets that directly relate to the awarding body required practical tasks.

Tracking

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Important notes about practical work

Safety

Working on vehicles is perfectly safe as long as you follow proper procedures. For all of the worksheets in this book you must therefore:

> Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with all appropriate safety and environmental regulations.

There are some specific recommendations below but you should also refer to the other textbooks or online resources for additional information.

Personal protective equipment (PPE), such as safety clothing, is very important to protect yourself. Some people think it clever or tough not to use protection. They are very sad and will die or be injured

Eye protection and gloves in use

long before you! Some things are obvious, such as when holding a hot or sharp exhaust you would likely be burnt or cut! Other things such as breathing in brake dust, or working in a noisy area, do not produce immediately noticeable effects but could affect you later in life.

Fortunately the risks to workers are now quite well understood and we can protect ourselves before it is too late. In the following table, I have listed a number of items classed as PPE (personal protective equipment) together with suggested uses. You will see that the use of most items is plain common sense.

Equipment	Notes	Suggested or examples where used
Ear defenders	Must meet appropriate standards	When working in noisy areas or if using an air chisel
Face mask	For individual personal use only	Dusty conditions. When cleaning brakes or if preparing bodywork
High visibility clothing	Fluorescent colours such as yellow or orange	Working in traffic such as when on a breakdown
Leather apron	Should be replaced if it is holed or worn thin	When welding or working with very hot items
Leather gloves	Should be replaced when they become holed or worn thin	When welding or working with very hot items and also if handling sharp metalwork
Life jacket	Must meet current standards	Use when attending vehicle breakdowns on ferries!
Overalls	Should be kept clean and be flame proof if used for welding	These should be worn at all times to protect your clothes and skin. If you get too hot just wear shorts and a T-shirt underneath
Rubber or plastic apron	Replace if holed	Use if you do a lot of work with battery acid or with strong solvents
Rubber or plastic gloves	Replace if holed	Gloves must always be used when using degreasing equipment
Safety shoes or boots	Strong toe caps are recommended	Working in any workshop with heavy equipment
Safety goggles	Keep the lenses clean and prevent scratches	Always use goggles when grinding or when any risk of eye contamination. Cheap plastic goggles are much easier to come by than new eyes
Safety helmet	Must be to current standards	Under vehicle work in some cases
Welding goggles or welding mask	Check the goggles are suitable for the type of welding. Gas welding goggles are NOT good enough when arc welding	You should wear welding goggles or use a mask even if you are only assisting by holding something

Also, as well as your own protection you should always use a protection kit for the vehicle: floor mats, wing covers and seat covers for example.

Tools and equipment

To carry out any work you will need a standard toolkit and in some cases additional 'special' tools will be required. Make sure you have access to all necessary equipment before starting work. A few examples are mentioned below but you should also refer to the other textbooks or online resources for additional information.

Using hand tools is something you will learn by experience, but an important first step is to understand the purpose of the common types. This section therefore starts by listing some of the more popular tools, with examples of their use, and ends with some general advice and instructions.

Toolkit

Practise until you understand the use and purpose of the following tools when working on vehicles.

Hand tool	Example uses and/or notes
Adjustable spanner (wrench)	An ideal stand by tool and useful for holding one end of a nut and bolt.
Open-ended spanner	Use for nuts and bolts where access is limited or a ring spanner can't be used.
Ring spanner	The best tool for holding hexagon bolts or nuts. If fitted correctly it will not slip and damage both you and the bolt head.
Torque wrench	Essential for correct tightening of fixings. The wrench can be set in most cases to 'click' when the required torque has been reached. Many fitters think it is clever not to use a torque wrench. Good technicians realize the benefits.
Socket wrench	Often contain a ratchet to make operation far easier.
Hexagon socket spanner	Sockets are ideal for many jobs where a spanner can't be used. In many cases a socket is quicker and easier than a spanner. Extensions and swivel joints are also available to help reach that awkward bolt.
Air wrench	These are often referred to as wheel guns. Air-driven tools are great for speeding up your work but it is easy to damage components because an air wrench is very powerful. Only special, extra strong, high-quality sockets should be used.
Blade (engineer's) screwdriver	Simple common screw heads. Use the correct size!
Pozidrive, Philips and cross-head screwdrivers	Better grip is possible particularly with the Pozidrive but learn not to confuse the two very similar types. The wrong type will slip and damage will occur.
Torx®	Similar to a hexagon tool like an Allen key but with further flutes cut in the side. It can transmit good torque.
Special purpose wrenches	Many different types are available. As an example mole grips are very useful tools as they hold like pliers but can lock in position.
Pliers	These are used for gripping and pulling or bending. They are available in a wide variety of sizes. These range from snipe nose, for electrical work, to engineers pliers for larger jobs such as fitting split pins.
Levers	Used to apply a very large force to a small area. If you remember this you will realize how, if incorrectly applied, it is easy to damage a component.
Hammer	Anybody can hit something with a hammer, but exactly how hard and where is a great skill to learn!

General advice and instructions for the use of hand tools (taken from information provided by Snap-on):

- Only use a tool for its intended purpose
- Always use the correct size tool for the job you are doing
- Pull a spanner or wrench rather than pushing whenever possible
- Do not use a file or similar without a handle
- Keep all tools clean and replace them in a suitable box or cabinet
- Do not use a screwdriver as a pry bar
- Look after your tools and they will look after you!

Information

Before starting work you should always make sure you have the correct information to hand. This can be in the form of a workshop manual or a computer-based source.

The worksheets in this book are a general guide so make sure the correct information, procedures and data for the particular vehicle you are working on are available before you start work.

Autodata online information

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Job card: example

Technician/Learner name & date	Make and model	VIN no.	Reg. no.	Job/task no.
John Doe	Ford Mondeo	1M8GDM9A_KP042788	ABC 123	100
Customer's instructions / Vehicle fault		**Mileage**	67834	

Carry out minor service – change oil and filter.

Inspect brakes.

Check for rattle underneath when accelerating.

Work carried out and recommendations (include PPE & special precautions taken)

PPE worn – boot, gloves and overall, VPE – wing covers, floor mats and steering wheel cover. Followed service checklist, full under bonnet check of belts, for oil, fuel and coolant leaks. Drained oil and replaced filter, torque new filter to 15Nm as per manufacturer's instructions, filled engine with 6 litres of engine oil. Old engine disposed of in oil drum and filter placed in specific filter bin.

Full under vehicle check, hoses, brakes pipes, all steering and suspension components – all ok. Found detached exhaust mounting – this would cause the knock the customer complained of, replaced mounting.

Checked brakes, pads and discs ok 30% wear on pads.

Requires 2 front tyres, have notified customer but they will go to Kwikfit.

During the service a quantity of oil was spilled on the floor, I covered the spillage with granules and left them to soak the oil up. I then cleaned the granules up and disposed of them in the correct bin. Finally I mopped the floor to ensure that it was properly clean.

Parts and labour	Price
3 hours @ 22.50 per hour	£67.50
Oil	£18
Oil Filter	£6.80
Exhaust mounting	£14
Total	£106.30

Data and specifications used (include the actual figures)

Oil filter torque – 15Nm, Wheel nut torque – 160Nm, 6.0 litres of engine oil

Assessor report: example

Assessment outcome		*Passed (tick ✓)*
1	The learner worked safely and minimised risks to themselves and others	✓
2	The learner correctly selected and used appropriate technical information	✓
3	The learner correctly selected and used appropriate tools and equipment	✓
4	The learner correctly carried out the task required using suitable methods and testing procedures	✓
5	The learner correctly recorded information and made suitable recommendations	✓

Assessor name (print)	Tick	Written feedback (with reference to assessment criteria) must be given when a learner is referred
PASS: I confirm that the learner's work was to an acceptable standard and met the assessment criteria of the unit	✓	*Candidate worked in a very organised manner.* *Work area was kept clean and tidy throughout, tools returned to toolbox once used and oil and filter disposed of correctly.* *Good communication regarding further work requirements found during the task.* *Assessment criteria met, well done.*
REFER: The work carried out did not achieve the standards specified by the assessment criteria		

Assessor Name (Print)	Assessor PIN/Ref.	Date
Jane Jones	1234	29/02/17

The section below is only to be completed by the learner once the assessor decision has been made and feedback given to learner

I confirm that the work carried out was my own, and that I received feedback from the Assessor	Learner name (Print)	Learner signature	Date
	John Doe	J Doe	29/02/17

Engines

Worksheet 1: Vehicle inspections

Procedure

- General visual inspection – listen for abnormal noises.
- Check brake operation and pad/disc condition – record thickness.
- Check tyre tread depths.
- Torque wheel nuts – include torque figures and calibration date of torque wrench.
- Additional items – see manufacturer's schedule depending upon type of inspection – pre- and post-work, PDI, PPI, pre-MOT, VHC or post-repair.

Job card

Technician/learner name & date	Make and model	VIN no.	Reg. no.	Job/task no.
Customer's instructions/vehicle fault		**Mileage**		
Work carried out and recommendations (include PPE & special precautions taken)				

Parts and labour	Price
Total	
Data and specifications used (include the actual figures)	

Assessor report

Assessment outcome		*Passed (tick ✓)*
1	The learner worked safely and minimised risks to themselves and others	
2	The learner correctly selected and used appropriate technical information	
3	The learner correctly selected and used appropriate tools and equipment	
4	The learner correctly carried out the task required using suitable methods and testing procedures	
5	The learner correctly recorded information and made suitable recommendations	

	Tick	Written feedback (with reference to assessment criteria) must be given when a learner is referred
Pass: I confirm that the learner's work was to an acceptable standard and met the assessment criteria of the unit		
Refer: The work carried out did not achieve the standards specified by the assessment criteria		

Assessor name (print)	Assessor PIN/ref.	Date

Section below only to be completed by the learner once the assessor decision has been made and feedback given			
I confirm that the work carried out was my own, and that I received feedback from the Assessor	**Learner name (print)**	**Learner signature**	**Date**

Worksheet 2: Carry out exhaust gas analysis using an exhaust gas analyser

Procedure

- Set up the exhaust gas analyser in accordance with the manufacturer's instructions. Observe all setting conditions – clean air, running time, basic checks for contamination and filter changes.
- Run the engine up to normal operating temperature and drive to analyser test area. Insert the exhaust gas probe into the exhaust tail pipe or extraction system probe adapter. Ensure that the probe is inserted to the recommended depth (about 300 mm or 12 inches).
- Run the engine at idle and observe and record the readings for gases on the analyser screen.
- Run the engine at about 2500 rpm and observe and record the readings for gases on the analyser screen.
- Compare the readings with the idle readings and with statutory requirements or manufacturer's data.
- For statutory test certification procedures using an approved gas analyser, follow the on-screen prompt sequence for entering the vehicle data and for connecting the exhaust gas probe and the engine speed tachometer, and in some cases measuring the engine temperature.
- Continue to follow the prompt sequence to carry out the test. The result may be given as a pass or fail or as a set of gas percentage (%) values and lambda value for comparison with statutory regulations (different sets of values are used for different years of manufacture).

Job card

Technician/learner name & date	Make and model	VIN no.	Reg. no.	Job/task no.
Customer's instructions/vehicle fault		**Mileage**		
Work carried out and recommendations (include PPE & special precautions taken)				

Parts and labour	Price
Total	
Data and specifications used (include the actual figures)	

Assessor report

Assessment outcome		*Passed (tick ✓)*
1	The learner worked safely and minimised risks to themselves and others	
2	The learner correctly selected and used appropriate technical information	
3	The learner correctly selected and used appropriate tools and equipment	
4	The learner correctly carried out the task required using suitable methods and testing procedures	
5	The learner correctly recorded information and made suitable recommendations	

	Tick	Written feedback (with reference to assessment criteria) must be given when a learner is referred
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Assessor name (print)	Assessor PIN/ref.	Date

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I confirm that the work carried out was my own, and that I received feedback from the Assessor	**Learner name (print)**	**Learner signature**	**Date**

Worksheet 3: Remove and replace electronic distributor – strip and reassemble

Procedure

- Disconnect battery ground lead. Turn engine to align timing/TDC marks. Remove distributor cap.
- Note position of the rotor to the distributor body and of the body to the engine. Compare with manufacturer's data. Disconnect multiplug to amplifier unit. Disconnect vacuum hose where fitted. Undo and remove, if necessary, distributor clamp bolts – pull out distributor. Inspect drive gear. Undo vacuum unit securing screws and connection to distributor base plate (circlip or hook). Pull out vacuum unit feeding base plate linkage through hole.
- Follow manufacturer's instructions for the removal and replacement of the pulse generator. Remove base plate to access centrifugal advance weights and springs. Remove, inspect and replace as necessary. Lubricate all parts and reassemble in reverse order with new springs if required.
- Reassemble pulse generator, check, and adjust air gaps with non-ferrous feeler/gap gauge if appropriate (depends on type).
- Undo and remove amplifier module securing screws and remove module. Before refitting, coat the rear face of the amplifier module with silicon grease. Fit module and then fit and tighten the securing screws. Reconnect internal wiring between pulse generator and amplifier. Reassemble vacuum unit to distributor base plate and distributor body.
- Refit distributor to engine ensuring distributor to engine and rotor to distributor alignments are correct. Refit distributor clamp and securing bolts, leave finger tight, refit distributor cap and spark plug leads. Refit battery ground lead.
- Run engine and adjust ignition timing using a stroboscopic timing light and engine tachometer. On some electronic control systems, a timing adjustment connector is disconnected or terminals in the diagnostic socket are bridged in order to set the ignition timing. Reconnect on completion. Check system with an engine analyser or test equipment on completion. Road test and check engine performance.

Job card

Technician/learner name & date	Make and model	VIN no.	Reg. no.	Job/task no.

Customer's instructions/vehicle fault	Mileage

Work carried out and recommendations (include PPE & special precautions taken)

Parts and labour	Price
Total	

Data and specifications used (include the actual figures)

Assessor report

Assessment outcome		Passed (tick ✓)
1	The learner worked safely and minimised risks to themselves and others	
2	The learner correctly selected and used appropriate technical information	
3	The learner correctly selected and used appropriate tools and equipment	
4	The learner correctly carried out the task required using suitable methods and testing procedures	
5	The learner correctly recorded information and made suitable recommendations	

	Tick	Written feedback (with reference to assessment criteria) must be given when a learner is referred
Pass: I confirm that the learner's work was to an acceptable standard and met the assessment criteria of the unit		
Refer: The work carried out did not achieve the standards specified by the assessment criteria		

Assessor name (print)	Assessor PIN/ref.	Date

Section below only to be completed by the learner once the assessor decision has been made and feedback given			
I confirm that the work carried out was my own, and that I received feedback from the Assessor	**Learner name (print)**	**Learner signature**	**Date**

Worksheet 4: Remove and replace and adjust OHC tappets with shim/spacer adjustment

Procedure

- Run engine and listen for abnormal noises from top of engine. Check for misfire/cylinder balance. Disconnect battery earth/ground cable. Remove cam-housing cover.
- Measure with feeler gauges all valve clearances at the 'back-of-the-cam' (heel) position. Record all dimensions and note if inlet or exhaust have different clearances specified.
- Remove the camshaft – follow the manufacturer's instructions. Lift out the cam followers and keep in exact order.
- Working with one follower at a time, remove and measure with a micrometer the thickness of the spacer/shim. Record the dimension and then add or subtract a correction to give the correct clearance.
- Select a replacement spacer/shim to the corrected dimension. Measure with a micrometer to check that it is correct and fit to follower.
- Repeat with all other followers.
- Lubricate all followers before and during assembly with clean engine oil. Refit into bores over valves – keep in strict order.
- Refit the camshaft and tighten securing bolts to specified torque/sequence. Check all valve clearances are now correct – if not strip and rectify any errors. Reassemble and recheck.
- Rebuild and check that the engine starts and runs. Listen for correct operation. Road test and recheck.