



CIVILSAFETY
SAFETY AND TRAINING

AHCMOM302 Perform machinery maintenance



Learner Guide



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Overview

AHCMMOM302 Perform machinery maintenance: this unit covers the process of maintaining machinery and equipment that is used principally in agriculture, horticulture, and conservation and land management work and defines the standard required to:

- Carry out engine / equipment checks according to operators manual and enterprise requirements.

Sections

1. Prepare for maintenance
2. Carry out engine and equipment checks
3. Carry out transmission checks
4. Maintain components and attachments
5. Completing maintenance work

Prepare for Maintenance

Introduction

Depending on the nature of the business or the site where you work, the task of performing maintenance can vary greatly and so can the range of equipment you might be asked to perform maintenance on.

You could be called on to service or undertake repair work on a large range of machines such as motor vehicles, tractors, graders, earth movers, harvesters, sprayers, seeders, mechanical pruners, and a vast array of other trailed cultivation or grass cutting equipment.

Many properties will also have motorcycles, quad bikes, side by side vehicles, small engines, mowers, chainsaws, and brush cutters. Pumps, windmills, travelling irrigators, shearing plants or generators will also require maintenance at some stage too.

Identifying faulty equipment and machinery is part of routine maintenance. Faults may be either major or minor. Deciding what kind of problem exists will determine what kind of maintenance or repairs need to be carried out.

Major problems are all maintenance tasks that need specialist maintenance personnel to fix them such as a complete breakdown or an occasional malfunction. If you think that a major problem exists there is usually a procedure to follow for reporting the problem.

Minor problems do not require specialist personnel and can usually be fixed by the machine operators or other staff. A minor fault may be present if the machine operates but production levels are reduced, or the quality of output is affected.

Tagging

When a machine breaks down or is faulty it should be tagged with a sign that warns others that the machine cannot be used until the necessary maintenance or repair has been carried out. There are two types of signs or tags used to warn workers that machines cannot be used: Danger tags and Out of Service or Caution tags. Write the fault, the date and your name on the tag and attach the tag to the machine. Tagged machinery and equipment should be placed in a location where it is not forgotten. The supervisor should be notified so that repairs or a replacement can be organised.

Locking Out

The most effective way of preventing accidental operations of faulty machinery while maintenance is carried out is by locking out. This where the keys to operate a machine – or to release the machine from a locked location – are not accessible to workers until faults have been fixed.

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Safe Work Practices

More businesses or rural properties are moving to a more professional approach to maintenance where staff are expected to work according to best practice (including safe work practices) and meet certain expectations.

Consequently, they may have in place some of the following that you will have to become familiar with and work within the boundaries of:

- Safe Operating Procedures (SOP) or Safe Work Procedures (SWP) describes the safest and most efficient way to perform a certain task. Rather than you taking on a maintenance task without really thinking about it carefully, SOP and SWP put in a series of steps that you follow when approaching a job.
- Standard Operating Procedure (SOP) are a set of step-by-step instructions to achieve a predictable, standardized, desired result. These are very similar to Safe Operating Procedures but the emphasis is on staff following a set of steps each time they do a task to achieve a desired result.
- Equipment Maintenance Records (EMR) for commonly used plant and equipment. These forms are filled in each time maintenance is performed on a particular piece of equipment. In your role as assistance you may be given the job of completing such a form.

Performance Standards

- Report any damaged machinery to your employer or supervisor and do not use it until it has been repaired.
- Guards on machinery must be kept in place
- Never distract the attention of other staff when operating machinery or tools
- Do not use any machine or tool unless you are trained and feel comfortable with the task

If unclear about the performance requirements and responsibilities, ask your supervisor to clarify them.



Performance standards may state that only suitably trained personnel can use certain machines.

Source: antarctic.gov.au

Employee Rights and Responsibilities

Work Health, and Safety [WHS]

All employees should know about their workplace’s WHS procedures.

As an employee you have a responsibility to:

- Follow your organisation’s work health and safety procedures
- Follow manufacturer’s guidelines (where available) for machinery and equipment
- Respond to a situation where someone is put at risk of injury provided that in doing so you do not endanger yourself
- Report any incidents or situations which cause you or other people injury or put you or others at risk of injury

Therefore before undertaking any workplace activities you should become familiar with any WHS procedures in your workplace that relate to the tasks you will be undertaking. It is your responsibility to follow those procedures.

Codes of Practice

Safework Australia has developed a series of Codes of Practice. These practical guides aim to achieve the standards of health and safety required under the Work health and Safety (WHS) Act. The idea is to provide employers guidance in effectively managing work and health and safety risks in the workplace. Employees should be aware that these codes can be readily accessed online should they have any queries relating to WHS in their workplace.



As an employee you have a responsibility to follow your organisation’s work health and safety procedures.

Source: agric.wa.gov.au

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State Legislation

Employees should be aware of other WHS legislation for your state, Australian Standards, and codes of practice for:

- Manual handling
- The control of workplace hazards
- The safe use of chemical and biological agents
- First aid
- The safe operation of vehicles, machinery and equipment, including the provision of guards, operating tractors, chainsaws and brush cutters, in-service safety inspection and testing of electrical equipment.

Manufacturers' Responsibilities

Manufacturers are responsible for the safe design of machinery. Anyone servicing or repairing machinery must follow the manufacturers' guidelines as laid out in their operations and service manuals.

Equipment and Tools

Many tools are required to maintain and adjust machinery.

A range of spanners should be available, because some machinery has metric components while other machines use a number of different imperial component sizes.

Machinery manufactured in Britain will normally use British or Whitworth screw threads. Unified Thread Standard [UTS] is the dominant thread standard used in the United States and Canada. ISO metric screw threads [M] are used on most modern machines manufactured in Asia and Europe.

Each system has a different method of identifying bolt, screw, nut and spanner sizes. To prevent damage, the correct size of spanner must be used.

If you do not use an adjustable spanner, carefully adjust the spanner jaw to tightly fit the nut or bolt. The spanner must be used so that the jaw is tightened against the nut when applying force to the handle.



If you do use an adjustable spanner, carefully adjust the spanner jaw to tightly fit the nut or bolt.

Tool Safety

Hand tools such as saws, hammers, screwdrivers, axes and wrenches and powered tools such as circular saws, drills and high pressure cleaners can be very dangerous if not maintained properly. They can cause serious injuries such as electric shock, finger or hand injuries, or severe eye injuries.

Broken or defective hand tools – and tools that have been incorrectly modified – are especially dangerous.

Powered hand tools can also cause physical hazards through excessive vibration and noise. They can also cause physical injuries to operators if they are not properly maintained or handled correctly.

Portable electrical tools have been responsible for many electrocutions. Such tools include electric welders, drills, angle grinders, and battery chargers.

Maintenance of these tools includes:

- Cleaning
- Lubricating
- Sharpening blades, saw chains and drills
- Replacing broken and used parts
- Replacing broken cords

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Four Stroke Engines

Generally vehicle engines are built around a set of cylinders between 6 and 15 cm in diameter. However, cylinders can range in sizes from quite small – 2cm across the top to large 100cm in diameter.

There can be two to twelve of these cylinders in an engine, but typically four, six or eight, inside which fuel burns rapidly.

Many four stroke motor bikes, motor mowers and other small stationary motors have only one cylinder.

The cylinders are made of super strong metal and sealed shut, although at one end they open and close like bicycle pump. Inside these cylinders there are tight-fitting pistons or plungers that can slide up and down.

Valve Openings

At the top of each cylinder there are two small openings that let things in or out. These ‘valves’ control what goes in or out of these openings. The valves are opened and closed very quickly. Many modern engines have more than two valves but they perform the same purpose.

The inlet valve allows fuel and air to enter the cylinder. This mixture of fuel and air comes from a carburetor. More commonly these days this mix comes by an electronic fuel-injector. The other valve is called the outlet valve and it lets the exhaust gases escape from the cylinder.

At the top of the cylinder there is a spark plug. This is an electrically controlled device that makes a spark to set fire to the fuel and air mixture.

At the bottom of the cylinder the piston (or plunger) is attached to a constantly turning axle called a crankshaft.

Operation

When you turn the ignition to start a vehicle the battery sends an electrical charge to the start motor. The middle of the starter motor engages the flywheel. The fly wheel is connected to the crankshaft; when it turns the pistons begin to move up or down depending on their placement on the crankshaft.

Some of the pistons move down inside the cylinder when the crankshaft turns and when they do a mixture of fuel and air is injected, pumped or drawn into the top of the cylinder through one of the valve openings.

Then as the crankshaft continues to turn it pushes the piston upwards again. This compresses the fuel and air mixture that has just entered the cylinder.

When the piston reaches the top of the cylinder the spark plug produces a small spark which ignites the compressed fuel and air mix. This causes a controlled explosion in the cylinder forcing the piston downwards again. At this state the engine begins to run.

The piston reaches the bottom of the cylinder the second time and it begins to move back up the cylinder again. As it does so it pushes the burnt mix of fuel and air out of the cylinder as second valve at the top of the cylinder opens.

It reaches the top of the cylinder having expelled all the burnt gas and again it begins to descend down the cylinder drawing in another mix of fuel and air to repeat the process.

This is how a typical four stroke engine works. There are four movements of each piston (either up or down) for every controlled explosion caused by compressed fuel and air being ignited by the spark plug. The same process is happening in each piston.

The turning crankshaft powers the car’s gearbox which, in turn, drives the wheels.

When maintaining a multi cylinder engine you may need to remove spark plugs and clean them (on some older vehicles or engines). As the crankshaft and pistons are integral to smooth operation of an engine you should also check the oil levels in the crankcase regularly to ensure that there is adequate lubrication occurring.

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Changing the Oil

The engine oil in a 4-stroke engine is not only used to lubricate, but it cools, seals and cleans by carrying contaminants to the sump. The oil should be changed regularly to ensure maximum life. The oil filter is usually changed at the same time.

For more information, watch the following videos:

- <https://www.youtube.com/watch?v=XK2c2YVVdlo&feature=youtu.be>
- <https://www.youtube.com/watch?v=OGj8OneMjek&feature=youtu.be>

Diesel Engines

Many four stroke diesel engines work in a similar fashion – a four stroke cycle, although some work on a two stroke cycle.

Diesel engines as mentioned earlier do not have a spark plug but rely on heat and pressure in the cylinder to burn the mixture of fuel and air.

When the piston travels up the cylinder it puts enormous pressure on this mixture of fuel and air causing it to burn. This pushes the piston back down the cylinder again powering the engine.

A diesel engine does not have a carburetor but instead has injectors that pump a mixture of fuel and air into the top of the cylinder.

Turbo Charging

A turbo charger, or turbo, is a gas compressor that forces air into an internal combustion engine. This enables the engine to create more power.

A turbocharger has a compressor powered by a turbine which is driven by the exhaust gas from the engine. It does not use a direct mechanical drive.

Turbocharging is very common on diesel engines as they are particularly suitable for turbochargers for several reasons:

- Turbocharging can dramatically improve an engines power and power-to-weight ratio
- Truck and industrial diesel engines normally run at their maximum speed. This reduces problems with turbo lag.
- Diesel engines have no engine knock. The diesel fuel is injected at the end of the compression stroke, and ignited by compression heat. Diesel engines can use much higher boost pressures than gasoline powered engines.

Tractor Power

The size of a tractor you require is really determined by the job you want it to do, and the size of the implement that can do the job.

Power ratings quoted by manufacturers of tractors are normally gross power values for the engine running at a stated engine speed, for example, 30kw at 2800 rpm. Sometimes the figures quoted for tractors are the power as measured at the PTO, these being approximately 75% that of the gross values.

The manufacturer's data sheet will specify which one applies. If you are comparing two tractors that quote similar power figures but different stated engine speeds, the tractor that delivers the power at the lower engine speed is likely to be of more use, as it will have more torque.

For more information, watch the following video:

- <https://www.youtube.com/watch?v=s2WGFELXPNg&feature=youtu.be>

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Two Stroke Engines

Two stroke engines are found in many smaller machines such as motorbikes, lawn mowers and brush cutters. However, some larger diesel engines work on a two stroke cycle.

In a two stroke engine there are no inlet and exhaust valves as in a four stroke engine. There are instead inlet and exhaust ports or holes in the side of the cylinder.

The suction and exhaust stroke (as found in a four stroke engine) are eliminated in two stroke cycle engine and consequently there are only two strokes one up and one down for every firing of the spark plug.

With the upward movement of a piston, a mix of fuel and air is drawn into the crankcase/cylinder under the piston. It remains there until the piston travels up to the top of the cylinder compressing air and fuel already in the cylinder above the piston (that was drawn into the cylinder on the previous stroke).

For more information, watch the following video:

- <https://youtu.be/LuCUmQ9FxMU>

A spark ignites the fuel air mix causing a controlled explosion pushing the piston down. As the piston travels down through the cylinder it uncovers the exhaust port and some of the exhaust gasses escape through the outlet port.

Almost simultaneously (as the inlet port is slightly lower than the outlet port) the piston exposes in the inlet port. The burnt exhaust gases from the controlled explosion in the cylinder continue to be forced out through the exhaust port in one side of the cylinder wall by a fresh charge of fuel air mix entering through the inlet port on the other side of the cylinder.

This process happens effectively because as the piston is travelling to the bottom of its stroke it is compressing the air/fuel mix in the crank case. This compression forces the air fuel mix out of the crankcase up into the cylinder via the inlet port (or transfer port). Remember that the air fuel mix entered the crankcase on the previous upward stroke.



Two stroke engines

Operating Principles

When maintaining machinery, you will often be required to operate the machinery including test driving. Before operating machinery, review the operational procedures specified in the operator's manual. If operating or testing tractors, you will need to be aware of the major operating principles and procedures as tractors have been proven to be the deadliest piece of equipment on Australian farms.

Tractors have a high centre of gravity and are susceptible to rolling over sideways on steep slopes or banks. Operators should use caution when driving on uneven ground especially if there are washouts or holes present. In this situation the operator should dismount and inspect the area where they are intending to drive.

A tractor operator should use the gears to slow a tractor when driving down a steep hill. Over-reliance on the brakes may cause the wheels to skid. The clutch should not be depressed when driving down a slope. Operators must use extreme caution in hilly country, especially when it is wet and slippery. Driving straight up or down (for example when slashing) is usually safer than driving around the side a steep hill as there is always the risk of tipping over sideways particularly if there are hidden depressions.

There is also a danger of the tractor flipping over backwards when driving up a very steep slope so it is recommended that the operator reverse up the slope. This occurs where the front of the tractor rears up and tips back over the rear axle. This only takes two or three seconds to happen. Flipping backwards can be caused by an operator attaching a steep rope, chain or something similar to the top of the three-point linkage to two or pull an object. As this is connected to a high point on the rear of the tractor it can flip. The correct connecting point for tow ropes or chains is the draw bar of the tractor which is situated at very low point at the rear of the tractor. The three-point linkage is designed for specialised attachments only. Operators should likewise use caution when driving up a steep hill. A point is reached where the engine can no longer turn the rear wheels. Instead the tractor itself begins to turn about its own axle causing it to flip over. A similar thing can happen on flat ground where the tractor is bogged where long thick log or post is laid down and attached in front of both rear wheels. Often the tractor does not have the power to turn the rear wheels and in this situation the body of the tractor and turns about the axle and flip over.

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Lifting Loads

Tractor operators should only lift using components that are specifically designed and have a rated capacity. Operators should not use unrated components or components rated for other purposes, such as towing. Only use rated lifting components and only attach to specifically designed, rated and identified lift points on the tractor.

Load ratings for the three-point linkage and the front-end loader on a tractor are determined under ideal conditions, such as being on solid, level ground and stationary. To ensure stable operation and to avoid damage to components, operators should never exceed the rated load limits and should consider the ground being travelled over and speed of travel.

Weight Distribution

The overall weight of the tractor and the way that the weight is distributed between the axles has a huge impact on tractor performance. Over ballasting a tractor wastes fuel due to increased rolling resistance and increases drive train wear and soil compaction. Under ballasting a tractor wastes fuel from excessive tire slip and causes premature tyre wear. The weight split is determined by the type of tractor and the way that implements are hitched or mounted to the tractor. Before operating a tractor, check with your supervisor that the weight distribution is suited to the work that you will be doing.

If the operator has any doubts about a situation they should not operate the machine and discuss options with their employer.



Tractors have a high centre of gravity and are susceptible to rolling over sideways on steep slopes or banks.

Source: johndeer.com.au

Carry Out Engine/Equipment Checks

Perform Routine Maintenance

For this course we will be using a header (Combine Harvester) for our examples. Always refer to the operator's manual first as procedures and access points will vary depending on the type of machinery and the manufacturer. Servicing and greasing time may also vary due to working conditions such as operating in mud and water. Extra maintenance for operating in these conditions may be mentioned in the operator's manual as well.

Routine maintenance for a 9660 Header is carried out at the following times:

- 10 hours or daily
- 50 hours or weekly
- 100 hours
- 200 hours
- 250 hours
- 400 hours or yearly
- 500 hours
- 1500 hours or every 2 years
- 2000 hours
- 4500 hours or 5 years

Routine maintenance can range from simple oil checks and fluid replacement up to large component replacement. As well as regular servicing and maintenance there may be a 'Service as needed' section for machinery components, such as air filters and water reservoirs, that will need to be cleaned or replaced as needed depending on the conditions the machinery is operated in.



Routine maintenance can range from simple oil checks to large component replacement.

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Grease and Lubrication Points

Grease is needed to keep moving parts well lubricated. If bearings are not greased they will get hot and fail. Shafts need to be greased as without grease they will run hot and wear and ultimately the machine will break down. When greasing, the general rule is 2 or 3 squirts or until grease just shows around the seal.

You need to be careful not to over-grease as this can burst the seals and then grease leaks out and dirt and dust can get into the bearings.

Grease Nipple Charts are located on each of the header. On the right hand side it is located on the guard under the fuel tank and on the left hand side it is located on the cab access ladder.

- **ALWAYS** check the operator’s manual and grease according to manufacturer’s specifications.
- **CAUTION** never lubricate or service while the machine is running.
- **IMPORTANT** recommended service intervals are for average conditions. Service more often if combine is operated under adverse conditions.



If performed correctly, lubrication will ensure the maximum possible life of any machine.

Oil and Filter Maintenance

Never start an engine that has no oil. Engine and transmission / hydraulic / hydrostatic oil levels should be checked each day. Other oil levels can be checked less frequently. Check oil levels with machinery parked on level ground for an accurate reading.

Oils and filters should be changed regularly according to manufacturer’s specifications. Service hours indicated here are approximate only and the operator’s manual should be consulted for proper service intervals.

Oil filters generally need changing less frequently than the actual oils do. Refer to the operator’s manual for guidance in this matter, since there may be one or more oil changes required before oil filters are necessarily replaced. **Oil needs to be hot when changing.** Be careful not to let the hot oil spill on you as it can scald and burn.

Place ‘DO NOT OPERATE’ tag on steering wheel and remove key. Always refill oil immediately and do not leave an engine without oil for any length of time as you do not know when somebody else may attempt to start the machine. Starting a Header with no oil in it will cause tens of thousands of dollars’ worth of damage.



*Engine oil should be checked each day.
Source: caseih.com*

Tips for changing the oil (to be done each 400 hours):

1. Turn tap to drain oil into an empty container – DO NOT spill
2. Remove oil filler cap to facilitate oil drainage and to refill the engine with clean oil
3. Make sure the oil change tap is closed before refilling
4. Check oil at dipstick after filling

Hydraulic Hoses and Systems

If any part of the hydraulic system should be disconnected for service, protect the ends of hoses, tubing and ports of components from contamination with clean, lint-free towels or clean plastic bags.

Before installing any replacement hose, flush the inside with unused diesel or an unused commercial petroleum cleaning solvent for at least ten seconds. DO NOT use water, water soluble cleaners or compressed air.

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Changing the main Hydraulic/Hydrostatic Filter (400 service hours)

Note: it is not necessary to drain the reservoir to change this filter.

1. Coat seal on new filter with oil
2. Tighten by hand, then tighten half a turn more

Changing the Hydrostatic Charge Filter (400 service hours)

1. Coat seal on new filter with oil
2. Tighten by hand, then tighten half a turn more



Hydraulic hoses must be regularly inspected and replaced if damaged or worn.

The hours between maintenance will vary between different machinery and you should consult your operators' manual to determine service intervals for the machinery being serviced.

The hours between maintenance will vary between different machinery and you should consult your operator's manual to determine service intervals for the machinery being serviced.

Work Health and Safety Guidelines

All employees should be informed by their employer / supervisor about safety in the workplace and should be trained in safe work practices. As an employee you should always listen carefully to instructions and follow the safe work practices outlines by your employer/supervisor.

If you identify a hazard in the workplace you must bring it to the attention of the employer and fellow workers, so safety measures can be put in place to control and eliminate the hazard. You, your work colleagues and your employer/supervisor will discuss safety issues and together will find solutions to problems that may exist in the work environment.

Risk Assessment

A hazard in some unsafe thing or situation that MAY harm us in some way. Once we have identified a hazard we then need to determine/estimate what may happen if something is not done to eliminate or control it. This process is referred to as 'Risk Assessment'. Whenever a person works with a machine, piece of equipment and/or tools there is danger of an incident occurring.

Before working with equipment, tools or machinery you should examine the object and make sure that it is:

- Clean
- Safe
- Fit for use and in working order
- Unbroken and undamaged



*Personal protective equipment includes high visibility clothing.
Source: Peter Henry*

Examples of workplace hazards:

- Oil spilled on the floor.
- An open container of flammable liquid.
- A shield or guard missing off a bench grinder.

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Carry out Transmission Checks

Drive and Steering Clutches

Slip Clutches

Some are pre-set and cannot be adjusted. This type of clutch can be checked for wear by removing the bolts and nuts, dismantling and making a visual inspection.

Other types of slip clutches have clutch plates. These can be serviced by loosening the bolts and nuts, then allowing the clutch to slip for a short time; this will ensure good contact between both surfaces. Retighten the bolts and nuts to manufacturer's specifications.

Steering Clutches

Do not ever loosen these nuts and bolts whilst the machine is running.

Older type machines do have adjustable steering clutch linkages. These linkages can be adjusted by undoing the lock nut then adjusting the linkage arm to specification.

Newer or more modern machines that are still using a steering wheel use a hydrostatic oil flow to drive gears in different direction which allow the machine to turn left or right.

Oil levels should be checked regularly in this type of system to ensure the machine has sufficient supply. Should you encounter any problems with this type of system, inform your supervisor.

For more information, watch the following video:

- <https://youtu.be/IW2gdhSo8sM>

Transmission Oil Checks

Always consult your operator manual for details on how often oil levels should be checked or replaced as service intervals will vary on different machinery. Your operator's manual should also contain details about what type of oils and fluids to use. The type of oils/lubricants may also vary depending on the operating conditions and temperatures that the machinery will be operated under.

Final Drive Oil – Check (400 service hours)

1. Check oil when cold
2. If oil is below plug level by 12mm or less, you do not need to add oil
3. Add oil level up to within 12mm of bottom of hole at plug



Consult the operator manual for checking and replacing of transmission oils.

Final Drive Oil – Change (2000 service hours)

1. Drain
2. Refill to within 12mm of bottom of check hole

Transmission Oil Level – Check (400 service hours)

1. Check oil when cold
2. Remove plug and check
3. Add as needed to within 12mm of bottom of hole

Transmission Oil Level – Change (2000 service hours)

1. Drain
2. Refill to within 12mm of bottom of filler hole

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Checking Wheels / Tracks

Explosive separation of a tyre and rim parts can cause **SERIOUS INJURY** or **DEATH**. Always maintain correct tyre pressure. **DO NOT** inflate the tyres above the recommended pressure.

When inflating tyres with split rims, e.g. truck tyres, use a clip-on chuck and extension hose long enough to allow you to stand to one side and **NOT** in front of or over the tyre assembly. If possible place in a safety cage.

Check tyres daily for damage or noticeable low pressure.

At least every 50 hours of operation, check tyre pressure. If tyres contain liquid ballast, use a special air-water gauge and measure with valve stem at bottom.

A small puncture in a tubeless tyre can be temporarily repaired without dismounting the tyre, thus avoiding down time during a busy season. Protect tyres from exposure to sunlight, petroleum products and chemicals. Check wheels for low pressure, cuts, bubbles, damaged rims or missing lug bolts and nuts.

Drive carefully and try to avoid rocks and sharp objects.



Always maintain the recommended tyre pressure. Source: midwaysales.com.au

Tyres should be inflated in accordance to operator's manual.

Routine Maintenance Procedures and Safety

Securely support any machine elements that must be raised for service work. Keep all parts in good condition and properly installed. Fix damage immediately. Replace worn or broken parts. **Remove any build up of grease, oil or debris. Especially when it builds up enough that it may cause problems.**

Disconnect battery ground cable (-) before making adjustments on electrical systems or welding on machine.

When servicing the cooling system only remove reservoir cap when cold and before starting the engine. Slowly loosen cap to relieve pressure. Do not remove when hot. Explosive release of fluids can cause serious burns. Avoid high pressure fluids, e.g. starter fluid, hydraulic fluid and fuel. Escaping fluid under pressure can penetrate the skin causing serious injury.

Always release pressure before disconnecting hydraulic or other lines and tighten connections before reapplying pressure. Search for leaks with a piece of cardboard not your hands. If an accident occurs see a doctor immediately. Fluid injected into skin must be surgically removed within hours otherwise gangrene can result.

Dirt, oil, chaff and crop debris in the engine compartment is a fire hazard. Therefore:

- Check and clean this are frequently
- Do not clean engine compartment whilst engine is running
- Always keep drive belt shields in place when not servicing.



Dirty engines are a fire hazard.

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Maintain Components and Attachments

Personal Protective Equipment [PPE]

The type of protective clothing and equipment used depends on the job being done and/or the types of substances being used. The labels on products being used and the relevant Safety Data Sheet will give directions concerning necessary protective equipment. Some workplaces stipulate a level of protective clothing to be worn in their workplace, e.g. high visibility clothing, broad brimmed hats, safety helmets, or overalls.

Always wear personal protective equipment [PPE] as directed. Including:

- Goggles, dust masks and earmuffs or earplugs when using air compressors
- Earmuffs and earplugs when using any loud machinery or equipment
- Eye protection when welding or grinding
- **Work boots at all times**
- Hats and sunscreen when exposed to the sun



Always wear PPE as directed.

Cleaning and Changing Batteries

Checking and cleaning batteries should be done as part of routine maintenance. Cleaning the batteries of dirt and corrosion will reduce current leakage and electrical problems.

Checking and Cleaning Batteries

1. Clean off top of batteries with a solution of baking soda and water. Top of batteries should be clean at all times
2. Check level in each cell of battery
3. Fill to bottom of filler neck with distilled water if necessary

If the battery is low, the low voltage warning light will stay on once the engine is started. If the battery is dead the engine will not start. If this happens you should first charge the battery and if this does not solve the problem the battery will need to be replaced.

The charging and replacing procedures are outlined on the following page. These apply to any type of machine battery.

For more information, watch the following video:

- <https://youtu.be/kSkbTmtBZUc>

Charging Batteries

Hydrogen gas, which is highly explosive, is produced when charging batteries. Never use a naked flame or spark near batteries.

- Always keep battery fully charged, especially during cold weather
- Only charge batteries in well ventilated areas
- Check and clean batteries as per instructions above before charging
- Disconnect both cables from terminals when charging batteries
- Use 12 or 24V charger as per manufacturer's instructions and follow charger instructions, which are located with the charger.

If you cannot find the instructions ask your supervisor.

- Never check battery charge by placing a metal object across posts
- Use a voltmeter or hydrometer
- Never store batteries directly on a concrete floor as the concrete draws the charge out of the battery (place battery on timber)



A voltmeter enables you to check the charge in a battery. Source: yourmechanic.com

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Replace Batteries

Ensure batteries are negatively grounded only by:

- Always connecting battery ground strap to negative
- Connect starter cable to positive

The positive and negative terminals are usually labelled with the (+) positive and (-) negative symbols.

If there are no labels then the positive and negative terminals can be determined by comparing the size of the terminal post. The positive (+) post is always the largest.

Reversed polarity in battery or alternator connections results in permanent damage to electrical systems.

When connecting batteries:

1. Clean battery posts and terminals
2. Connect positive terminal
3. Quickly place ground strap to negative post
 - a. Sparking must not occur
 - b. If sparking occurs, do not make connection
 - c. Check to see if battery position is reversed
 - d. If sparking still occurs, check again that all switches and accessories are off
 - e. Then check for shorts, broken wires and loose or corroded connections
4. Connect negative battery ground strap



The positive terminal is always larger than the negative terminal.

Inspecting and Servicing Belts

Introduction

Important: Ensure engine is shut down and all parts have stopped moving before attempting to do any belt inspections or replacements.

All belts should be visually inspected daily. A belt should be replaced if it breaks or is badly cracked. You will know if a belt has broken as the temperature gauge will increase rapidly and warning light/s will also come on. The procedures for replacing various belts are outlined below.

Engine Fan Belt

1. Loosen lock nut and adjustment nut
2. Push down on spring loaded idler and remove engine fan belt from pulley
3. Install a new belt by pushing down on spring loaded idler and installing belt onto pulley
4. Tighten adjustment nut until gauge aligns with washer
5. Tighten lock nut

Rotary Screen Belt

1. Pull up spring loaded idler and remove belt
2. Pull on spring idler and install new belt
3. Route as per diagram

Air Conditioner Drive Belt

The compressor is located on the front side of the engine. To change belt:

1. Release tension on the drive belt using a Y, inch breaker bar on the belt tensioner
2. Remove drive belt
3. Replace

Other Routine Maintenance Procedures

Other services that should be carried out at approximately 400 service hours or as per manufacturers specifications include:

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Inspect Seatbelt

If there is any sign of cuts, fraying, and unusual wear etc. it should be replaced. Also check mounting hardware.



Fraying seatbelts should be replaced.

Brake Fluid Level

- Do not let brake fluid come into contact with any part of the machine as it is corrosive
- Should this occur wash off with water immediately
- Look through cap
- Add brake fluid to 6mm from top
- Do not let dirt get into brake fluid

Conveyor Chain

Remove offset links (as shown in diagram A).

Header Adjustments

Levelling Header Suspension

Failure to properly level header suspension may lead to feeding problems and result in machine damage.

1. Make sure header is on a level surface
2. Raise front off the ground
3. Set turnbuckle length to 493mm (tightening the levelling screw will increase the drop from side belt to centre belt, improving feeding)
4. Lay a straight edge across the top of the attachment frame and extend it to the Front main frame
5. Measure down from the top of the main frame tube to the bottom of the straight edge (this should be approximately 140mm)
6. Distance from the main frame to the bottom of the straight edge must be the same on both sides. If height adjustment is needed:
 - a. Place block under the lead spring saddle on each side of attachment frame and lower platform onto blocks (this will take the weight off the levelling screws and allow easier adjustments)
 - b. Loosen lock nut (tightening screws raises the mainframe relative to the attachment frame, loosening screws lowers the mainframe)
 - c. Tighten lock nut
 - d. Repeat procedure on opposite side of platform
 - e. Adjust turnbuckle to desired field setting

Levelling Draper Cutter Bar to Ground

Do not use the suspension levelling screws to make this adjustment.

1. Once the suspension is levelled, check the cutter bar relationship to ground (cutter bar must be level with ground to ensure an even cut)
2. With front mounted to the header and positioned on a level surface, lower the cutter bar until it is approximately 457 mm off the ground
3. Measure the distance from the extreme left guard
4. Repeat this measurement on the extreme right knife guard to the ground
5. If there is a significant difference then the cutter bar can be levelled by levelling the feeder house mounting surface by adding or taking away shims.

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Removing Sump Pan

If side belts are in the inward position, temporarily slide to the outward position to make removal easier.

1. Remove cap bolts
2. Lift front edge of sump pan and push pan rearward toward centre draper belt
3. Lift sump pan and remove

Adjusting Draper Side Belt Position

The belt assemblies should be in the outward position for normal/dry conditions and the inward position for heavy/damp crops.

1. Loosen back sheet clamps as required
2. Remove cap bolts
3. Push side frames in or out as required up to 101-127mm (check to make sure adequate clearance to the feed drum fingers is maintained)
4. Use mounting hole seen through slot to reinstall cap bolts
5. Tighten back sheet clamps as required

Adjusting Draper Side Belt Tension

In heavy or wet crop conditions additional tension may be required to prevent belt slippage.

1. Increase belt tension only as required
2. Do not adjust face of spring more than 50mm past tensioning gauge



The header of a combine should be adjusted to suit the crop and the weather conditions.

Adjusting Draper Centre Belt Tension

1. Do not increase tensioning dimension to greater than 50mm
2. Check operation of centre draper belt and recheck belt tensioner to ensure proper tension still applied to belt

If belt remains loose or cannot be tightened appropriately, adjusting slides may be binding. Remove belt and free up nylon slides as they may have straw jamming them up or may be corroded. Apply lubricant (such as WD40) until you get free movement.



Never spray water onto a hot engine.

Servicing Machinery Safely Guidelines

Machinery Safety

- Keep all parts in good condition and properly installed
- Fix and report any machine damage immediately
- Replace worn or broken parts
- Remove any build-up of grease, oil or debris
- Always wear gloves when handling cutter bar knives
- Stand to the rear of the knife when removing or installing
- Do not attempt to service air conditioning as refrigerant gas is dangerous and under pressure
- Never steam clean or spray water on a hot engine (this could cause damage to engine parts)
- Do not start engine by shorting across starter or solenoid terminals (when normal circuitry is bypassed, machine or components may move causing injury or death)

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Welding and Painting Safety

- **Always wear protective gloves and welding mask when welding**
- Remove paint before welding or heating
- Hazardous fumes can be generated when paint is heated
- If you sand or grind paint, wear a respirator
- If you use solvent or paint stripper, remove stripper with soap and water before welding and remove solvent or paint stripper containers from your work area – they are flammable. Do not weld, solder or use an oxy-torch near pressurised fluid lines or other flammable material.
- Keep all sparks/flames away from batteries as hydrogen given off by electrolyte is explosive
- To avoid sparks, connect ground cable last and disconnect it first
- Disconnect batteries when charging them (always charge with a 12 or 24 volt charge as appropriate)
- Never disconnect the batteries with the ignition on or engine running
- Never connect jumper cables with the key switch on
- Jump start by 12 or 24 volts only, depending on manufacturer’s recommendations



Wear protective gloves, clothing and mask when welding.

Personal Safety

Always sound horn twice before starting the engine. This warns people that it is about to move and give them time to get out of the way.

Always ensure engine is isolated before carrying out any inspection, repairs or servicing.

- The isolation procedure is done by switching the engine off, ensuring it is not in gear, applying park brake, removing the key and placing the ‘Do Not Operate’ flat (kept in the red safety book) on steering wheel
- Not all organisations have the ‘Do Not Operate’ flag but the rest of the procedure still applies
- Always confirm the correct procedure with your supervisor
- Make sure safety ram stops, under feeder house and reel, are in place when servicing or repairing headers

If a hydraulic hose should break and lose oil, the front will come down very quickly. If the ram stops are not in place and someone is working under the front it will cause injury or death. Fronts weight is approximately 3 tonne.

- Always keep work area clean and dry
- Never lubricate, service or adjust machine while moving parts are rotating
- Keep hands, feet and clothing away from power-driven parts
- Securely support any machine parts that must be raised for service work
- Do not wear loose clothing or jewellery of any sort



Do Not Operate signs should be attached to the steering wheel as part of isolation procedures.

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Completing Maintenance Work

Cleaning and Maintaining Work Areas

Cleaning and maintaining workplaces can eliminate hazards and help get your job done safely and properly. Dirty and untidy workplaces can lead to accidents from hidden hazards and make it hard to find tools and materials.

Maintaining a work area involves keeping work areas neat and orderly, ensuring floors are free of slip and trip hazards, and removing waste materials such as paper, cardboard and other fire hazards.



A clean and well-maintained work area will ensure a more efficient and safe workplace.

A clean and well-maintained workplace will also:

- Reduce exposures to hazardous substance (e.g. dusts, vapours)
- Provide better access to and control of tools and materials
- Ensure more efficient equipment clean up maintenance
- Improve health through better hygienic conditions
- Provide more effective use of space
- Improve worker attitudes and morale
- Increase productivity as tools and materials will be easy to find

Some of the jobs you will need to include:

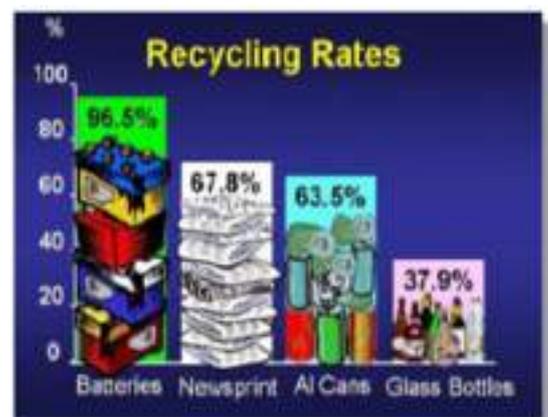
- Removing accumulated dust and dirt from machinery, benches and shelves
- Sweeping floors remove debris such as shavings, rubbish and dust
- Fixing any floor surfaces that are worn, ripped or damaged that post a tripping hazard
- Keeping aisles, walkways and stairs clear of equipment and materials and well lit
- Using drip pans and guards where spills of hazardous substances might occur such as under machinery (when spills do occur, they should be cleaned up immediately)
- Keeping tools and equipment in order by returning them promptly after use to a marked location
- Regularly inspecting, cleaning and repairing tools (a good job for a rainy day)
- Collecting, sorting and separating materials that can be recycled from those going to waste disposal facilities
- Ensuring that stored materials do not obstruct aisles, stairs, exits, fire equipment, emergency eyewash fountains, emergency showers, or first aid stations – all storage areas should be clearly marked
- Storing flammable, combustible, toxic and other hazardous materials in approved containers in designated areas that are appropriate for the different hazards that they pose

Waste Disposal

One of the major problems when maintaining machinery is the disposal of hazardous substances. Below are listed some of the common hazardous substances used in machinery maintenance and operation.

Used Oil

The impact of oil changes can be minimised by preventing the release of used oil to the environment, and recycling or reusing used oil whenever possible. Spills can be prevented by using containment around used oil containers, keeping floor drains closed when oil is being drained, and by training employees on spill prevention techniques. Oil that is contained rather than released can be recycled, thus saving money, and protecting the environment.



Batteries are highly recyclable. Source: lead-battery-recycling.com

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Spent Fluids

Machinery and vehicles require regular changing of fluids, including oil, coolant, and others. To minimise released to the environment, these fluids should be drained and replaced in areas where there are no connections to storm drains or municipal sewers. Minor spills should be cleaned prior to reaching drains. Used fluid should be collected and stored in separate containers. Fluids can often be recycled.

Batteries

Most suppliers now accept spent batteries at the time of new battery purchase. Otherwise there is an option for recycling directly through a battery reclamation facility or waste depot.

Chemical Containers

Rinsing empty containers is a good practice to adopt. Pesticide labels specify that before disposal, empty containers must be properly rinsed. Before discarding, recycling, storage or reuse, all containers rinsed and the rinsate added to the spray tank. By thoroughly rinsing empty containers at the time of use and adding the rinsate to the spray tank, you get full value from your pesticide.

In most Australian states, containers that have not been properly rinsed can be classified as hazardous waste. Discarded, unrinsed and improperly rinsed empty containers are a health risk to the people who handle them, and they can contaminate the environment. They are a potential danger to public health, domesticated animals, plants, surface and ground water, soil and wildlife.

There are local council, state and national collection and recycling scheme that assist with disposing of used chemical containers. For example, **drumMUSTER** is a national program for the collection and recycling of empty, cleaned, non-returnable crop production and on-farm animal health chemical containers.

Unused, Out-of-Date or Excess Chemicals

In each state, legislation requires that person “disposing of an agricultural or veterinary chemical must take all reasonable and practicable measures to prevent or minimise contamination, environmental harm and risks to human health and safety.” The product label must include instructions for disposal. Always read the label for advice and check with your supervisor.

Recording Maintenance Work

Maintenance records are written notes that provide documentation about the upkeep of a certain piece of equipment.

These records are useful in maintenance management because they:

- Enable businesses to ensure that their equipment is kept in good condition
- Provide businesses with a way to manage and track repair and preventative upkeep expenses
- Can help ensure that any appropriate equipment maintenance or plant maintenance has been completed so that plant operations will run smoothly
- Help avoid accidents or plant shut-downs resulting from defective equipment

Machine and workshop logs need to be filled out after any maintenance or parts replacement is carried out on machinery. Records that will need to be kept include the following:

1. Faults and defects that need repair
2. Faults that have been repaired
3. Work carried out on the machine
4. Work completed for that day or shift



Further actions or repairs required should also be reported to your supervisor.

Check with your supervisor if you cannot locate logs or record books.

All workshops will have some form of record keeping system on the maintenance work carried out.

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