There is a definite relation between machinery use and machinery cost. The more a machine is used, the higher the cost will be. The higher the usage, the more repairing needs to be done. Thorough maintenance can prevent unexpected repairs. The proper balance between maintenance and repairs as well as keeping track of costs, will result in more economical machinery use.

MACHINERY COST

PART III

6. MAINTENANCE AND REPAIRS

CHAPTER OBJECTIVES:

- ***To introduce the reader to the meaning of maintenance and repairs;***
- ***To describe the various components that needs to be maintained;***
- ***To explain the different types of services;***
- ***To discuss the scheduling of a proper maintenance program.***

Effective machinery maintenance is an important part of farm management. Inadequate maintenance will lead to increased repair cost, shortened working life, decreased trade-in value and increased downtime, thus reducing profits.

Machinery should be checked regularly for cracks, loose bolts and worn parts. A walk-around inspection of the machine each morning before starting work, like a pilot's pre-flight check, is a good idea and can reveal many small faults before they cause a major problem.

Maintaining and repairing a machine serve three purposes:

- It keeps the machine in a workable condition so that operations of an appropriate quality can be done;
- It preserves assets in a satisfactory condition;
- It reduces the cost of lost production due to breakdowns.

It is necessary to understand the meaning and difference of maintenance and repairs. They both have a huge impact on machinery costs, and eventually machinery management.

6.1. THE PROPER BALANCE

Keeping a machine in a good working order involves two approaches namely prevention, in the form of regular maintenance, and cure, in the form of repairs. Preventative maintenance is an attempt to avoid a breakdown because the latter will hold up production and can lead to yield losses. However, no matter how good the maintenance program is, the unexpected breakdown will still occur but the farmer must manage his machinery to get the most economical balance between maintenance and repairs. The actual amount spent on these two items will depend on factors like:

- The type of enterprise;
- Equipment size;
- Annual hours of use;
- Operator ability; and
- Maintenance programs.

Maintenance

Preventative maintenance is important to avoid and anticipate failure or replacement. If preventative maintenance can prevent a breakdown, which may hold up operations for several days, then the time and money was well spent.

It should also be kept in mind that badly maintained machines are not efficient. They use more fuel and oil and probably achieve less output in hectares per hour. The cost of performing an operation could increase by as much as 5% by just allowing continued use of worn tires or by poor ballasting as it causes wheel slip to increase above acceptable levels. Preventative maintenance also becomes more important with complex machines, and those that are to be kept over a long period before trade-in.

Maintenance planning is essential in overall farm management. Major servicing and overhauls can be programmed for off-peak periods to have the machine ready when required. Planning also allows the farmer to take advantage of special deals on parts that is due for replacement in the near future.

Repairs

The real cost of a breakdown is not easy to determine. The direct costs, such as parts and labour, are easily accountable. However, the timeliness cost of lost production is difficult or even impossible to calculate.

Another factor regarding repairs is "*Who does the repairs?*" Modern machines require specialised skills and tools. Repairs by unskilled operators can lead to increased downtime and continuing problems caused by incorrect adjustments. While the labour charged by a mechanic may seem an unnecessary expense, each repair job and the costs associated with it, must be considered carefully.

Excessive repairs can firstly be avoided by proper preventative maintenance. Metal fatigue will however rise with machinery usage. The latter can only be avoided with a thorough replacement policy, as being discussed in a later chapter.

6.2. WHAT TO MAINTAIN

The following points concern basic services and maintenance. They should be outlined in some detail in the tractor manual. More complex repairs should be discussed with the tractor dealer.

Engine lubrication

It is important to use the oil that is specified by the engine manufacturer and maintain it at the correct level. Lubricating oil serves four functions in the engine:

- Wear protection provides a film between rubbing surfaces;
- Sealing assists the piston rings to seal between cylinder wall and piston;
- Cooling carries heat away from the cylinder walls, pistons and valves;
- Cleaning reduces the formation of deposits on cylinder walls.

Various additives are used by oil companies to achieve these aims, and oils are produced to meet strict specifications.

Cooling system

The cooling system must be serviced regularly to maintain its efficient operation. Inspect radiator hoses for damage and deterioration of the rubber. Check the fan belts for wear or damage and maintain correct tension. Loose belts cause overheating and wear, while over tightening reduces water pump bearing life.

Correct operating temperatures give maximum fuel efficiency with minimum wear. Overheating, a faulty radiator pressure cap and internal or external leaks can cause the loss of coolant.

A faulty thermostat can cause overheating or slow warm-up. Operating the engine without a thermostat causes excessive engine wear during slow warm-up and in some engine designs it may cause overheating under load.

Once a year, or as recommended by the manufacturer, the cooling system should be drained, flushed and refilled with clean water and a quality coolant-conditioner. To prevent clogging of the water passages it is important that only clean water is used for filling and topping up the radiator.

Air intakes

Follow the service times and methods given in the manual. Blowing from the inside with a low-pressure air can clean dry type elements, or some types may be washed in water and detergent. Avoid tapping the element on a hard surface to dislodge dust, as this can damage it.

After cleaning, inspect the element for damage and distortion and if suspect, replace it with a new part. A new element may sound expensive but is much cheaper than an engine overhaul.

Oil bath air cleaners are still used, especially on older equipment. These must be serviced regularly and the frequency of service must be increased in dusty conditions. Empty the pan and wash out all the old oil and dirt. Refill with new engine oil to the level marked on the bowl.

Check fittings in the air induction systems regularly, as a small crack in a pipe, or a hole in a hose between air cleaner and engine, can allow enough dust to get in during a day's work to ruin the engine.

Battery/electrical

Check the operation of circuits and the battery condition regularly, and inspect the wiring for insulation damage. Check the level of the battery electrolyte weekly and top up if necessary with distilled water. Battery life will be reduced if the level is allowed to get below the top of the plates, while overfilling will cause acid to be discharged through the vents to the top of the battery and surrounding area.

Ensure the battery hold-downs are secure, and clean corrosion from hold-downs, terminals and battery cradle. Initial corrosion build-up can be flushed away with hot water. Wipe the rest off with a cloth soaked in baking soda and water, and finish with a clean damp cloth. Never tap terminals onto the battery posts, as this will damage the battery. Inspect cables for broken wires and replace if necessary, to avoid starting problems.

The battery should be removed and regularly charged if the machine is to be stored for some time. Remember that the gasses produced are explosive and charging must never be carried out near sparks or flames.

Fuel system

Keep water and dirt out when refuelling and change the filters regularly. Sediment traps should be drained weekly. If a trap is not fitted, consider fitting one.

Refuelling should be done at the end of the day to prevent condensation forming in the fuel tank as the machine cools. The system should be checked frequently; repair any leaks immediately. Leaking fuel is a fire hazard and cost money.

Inspect fuel lines to ensure that they are clear of the engine and chassis, to prevent rubbing. Brazing can repair lines that have cracked or rubbed through.

Transmission and drive trains

Check the oil regularly and add oil to the correct levels. Change oil and replace filters at the specified periods and carry out adjustments as set out in the handbook. If air coolers are fitted, the fins must be kept clean to allow excess heat to be dissipated. Make sure to follow the manufacturer's recommendations when selecting oils and greases.

Hydraulics

These may be built into the transmission system or may be a separate unit. Regular inspections should be made for leaks and damage to hoses. If reusable couplings are fitted, hose repairs may be carried out on the farm. Make sure all the rubber and metal particles from the bore of the hose are clean before fitting it to the machine.

Quick release couplings are a common source of dirt in the hydraulic system. They must be cleaned before connection to make sure that they will not be damaged and cause contamination of the oil. Rubber or plastic caps are readily available for protecting the couplings when they are not connected and should be used.

Hydraulic oil can be contaminated by dirt, water and metal particles and must be changed at regular intervals. Replace the filter at the same time, as a blocked unit reduces flow. This can cause cavitations in the pump, resulting in very costly pump repairs.

When new or repaired equipment is connected, oil will be needed to fill the system. Additional oil will be needed to top up the hydraulic reservoir.

When equipment is to be used on two or more tractors, the hydraulic oils must be compatible. If one tractor has a transmission mounted pump and another has an external system using engine oil, changing the implement between tractors will cause the transmission oil of the first machine to be contaminated with engine oil from the second. This can result in a costly breakdown.

Grease points

Make sure that the grease gun nozzle and the nipple are wiped clean before applying grease, and replace damaged or missing nipples. Any nipple that is hard to reach may be replaced with a longer or angled one to make servicing easier. It may be possible to use a short flexible line and mount the nipple in a more accessible position. Choose only good quality grease and oil products, as recommended by the machinery dealer or oil company agent for the particular machine.

Tires

Tires should be checked weekly with an accurate gauge and maintained at the

pressures recommended by the manufacturer. Excessive pressure gives a hard ride, reduces traction and increases tire wear, while low-pressure causes flexing, resulting in damage to the sidewalls of the tire. When checking tire pressure, also look for cuts and cracks. Small cuts should be repaired before they spread and ruin the tire. The valve cap should always be replaced to keep dirt out of the valve.

Oil, grease or chemicals spilled on a tire should be washed off immediately. When a machine is to be stored for some time, jack the tires off the ground or move it every few weeks to prevent deformation of the tire at the ground contact area.

Belt drives

V-belts must be maintained at the correct tension and kept clean. Oil and grease reduce belt life, while dust allowed to build up in pulley grooves causes belt slippage and pulley wear. Over-tightening of belts places excessive loads on the shaft bearings, leading to premature failure, while loose belts tend to slip, causing overheating and wear.

If correct tensions are not given in the manufacturer's manual, adjust to give 15 mm deflection per metre distance between pulley centres when the belt is pressed by hand. New belts should be checked for tension after a few hours running, as initial stretching can cause the belts to become slack.

Housing

Machinery is expensive and depreciates rapidly when exposed to the elements. Therefore, suitable machinery sheds should be a feature of every farm. Having a workshop area in the shed, with concrete floor and storage space for tools and spare parts, makes servicing quicker and much more pleasant. It also enables maintenance and repairs to be carried out during wet weather when other farm operations are halted.

6.3. TYPE OF SERVICES

The maintenance of machinery should be executed at regular intervals. Some of the above-mentioned items need more maintenance than others. For this reason, the maintenance schedule should make provision for different types of services. These services are normally described in the owner's manual of the machine.

The following points describe the typical services for a tractor:

Type A

The first service is a very basic service and will only include the replacement of the machine oil and its filter.

Type B

The next service will expand a bit on the first one and will include the type A service as well as the replacement of the hydraulic oil filter and the fuel filter. The valves can also be adjusted during this service.

Type C

A type C service will also include the type A service. It will furthermore include the replacement of the hydraulic oil filter and the adjustment of the valves, as well as the replacement of the gearbox oil filter and the adjustment of the torque. The air filters will probably also need to be replaced during this service.

Type D

The type D service will include a type A service and a type C service. In addition, the injectors will be inspected and replaced if necessary, as well as the turbo checked and the transmission oil and filter replaced.

Type E

A major service will include type A and type D. During the type E service, the fuel pump will also be calibrated and the tires replaced.

Table 6.1 summarises the different kind of services for proper tractor maintenance.

TABLE 6.1: TYPICAL MAINTENANCE OF A TRACTOR

Type of service	Hours	Description
A	150	Replace machine oil Replace machine oil filter
B	450	Type A service Replace hydraulic oil filter Replace diesel filter Adjust valves
C	900	Type A service Replace primary air filter Replace secondary air filter Replace air conditioner filter Adjust valves Adjust torque
D	1800	Type A services Type C service Replace transmission oil Replace transmission filter Inspect injectors Inspect turbo
E	4000	Type D service Calibrate diesel pump Replace tires

Table 6.1 reflects the different services that should be done at regular intervals to maintain a tractor properly. The replacement of tires is part of the type E service but should be replaced when the need arises. It could also be necessary to replace the battery at about 2000 hours.

6.4. SCHEDULING SERVICES

Manufacturers set out comprehensive maintenance schedules in their machinery manuals and these should be carefully followed. Planning is necessary so that routine maintenance is as far as possible done at times when the machine is not required for farm operations. Machines subject to seasonal use, for example harvesting equipment, should be serviced and cleaned before going into storage, to ensure that they are ready for operation when required.

An actual service schedule for a tractor, used on a South African farm producing corn and wheat, is reflected in Table 6.2. This is done in accordance with the type of services explained in Table 6.1.

TABLE 6.2: SERVICE SCHEDULE FOR A TRACTOR

Hours	Type of service	Date	Actual hours
150	A	05/02/1997	136
300	A	07/03/1997	312
450	B	05/05/1997	448
600	A	04/06/1997	595
750	A	07/08/1997	760
900	C	06/10/1997	901
1050	A	03/12/1997	1020
1200	A	07/02/1998	1211
1350	B	12/03/1998	1344
1500	A	08/05/1998	1489
1650	A	14/06/1998	1655
1800	D	09/08/1998	1803
1950	A	03/10/1998	1951
2100	A	06/12/1998	2106
2250	B	03/02/1999	2243
2400	A	11/03/1999	2414
2550	A	05/05/1999	2555
2700	C	12/06/1999	2721
2850	A	04/08/1999	2853
3000	A	03/10/1999	3008
3150	B	02/12/1999	3147
3300	A	03/02/2000	3297
3450	A	11/03/2000	3451
3600	D	05/05/2000	3606
3750	A	12/06/2000	3742
3900	A	04/08/2000	3908
4050	E	03/10/2000	4029

The tractor in Table 6.2 is used for an average of 1,000 hours per year. The table reflects the service schedule for the first 4,000 hours. The pattern will most likely repeats itself for the next 4,000 hours after which a major overhaul may become necessary. However, this farmer can avoid the major overhaul by replacing the tractor before that time.

6.5. CONCLUSION

The farmer must be able to distinguish between maintenance and repairs in order to understand the costs of each one, explained later in another chapter. The first one is preventative while the latter is to solve a breakdown. Preventative maintenance can be managed with the assistance of a service schedule and the anticipated cost can be calculated easily as the parts that need to be replaced are known and their prices can be determined.

It is not so easy to calculate the cost of repairs beforehand. The farmer is trying to avoid just that by following a proper maintenance schedule and any occurrence of an unexpected breakdown will be out of the normal order and probably not included in the budget. Furthermore, the downtime will also cause a timeliness cost. In a way of speaking only, the farmer must: "*avoid repairs at all cost!*" The only way to eventually avoid this is to follow a proper maintenance schedule, backed up by a good replacement strategy.

6.6. REFERENCES

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