

SECTION 55 – ELECTRICAL SYSTEM

Chapter 5 – BATTERY

CONTENTS

Section	Description	Page
55 000	Technical information	1
	Description and operation	1
55.301.040	Removal and re-installation	2
	Battery checking and maintenance	3
	Charging the battery	4
	Battery problems – Frequent causes	7

55 000 TECHNICAL INFORMATION

CHARACTERISTICS	TYPE OF BATTERY	
	JX60/JX70/JX80/JX90 models	JX95 model (optional for other models)
Voltage (V)	12	
Cold start amperage (C.C.A)	1x760	1x800
Capacity (Ah)	105	120
Number of elements	6	
Number of plates per element	16	21
Energy reserve (SAE) (min.)	160	210
Weight (kg) (lb)	25 (55.12)	35 (77.16)
Earth (ground) terminal	Negative	

DESCRIPTION AND OPERATION

Both types of battery are of the “sealed, maintenance-free” type.

105 Ah batteries are fitted on JX60, JX70, JX80 and JX90 models. The battery is positioned in front of the radiator, in the front axle support compartment (Fig. 1).

120 Ah batteries are fitted on JX95 models with cab air conditioning and are optional for JX60, JX70, JX80 and JX90 models. The battery is installed above the front axle support (Fig. 2).

NOTE: “Maintenance-free” means that the battery electrolyte, in normal conditions of use, does not leak. It could leak if the battery is loaded over 14.4 V. This, in fact, causes the water to boil due to gas formed as the battery charges up completely. It can be caused by a faulty charging system, by quick charging or topping up.

The four main functions of a battery are:

- to supply a source of electricity for starting, ignition and instrument lighting and functioning.
- to control voltage in the electrical system.

- to supply electricity when the power required is higher than that produced by the alternator.
- to support inactive loads from radio and microprocessor memory.

Each element of the battery consists of positive and negative plates, positioned alternatively, one next to the other. Each positive plate is separated from the adjacent negative plate by means of a porous insulating spacer. If one of the positive plates touches a negative plate in the element, the element will short-circuit and be irreversibly damaged. The positive plates are welded to a collecting bar and form a positive terminal. The negative plates are welded to a similar collecting bar and form a negative terminal.

Each positive plate consists of a lead grid with lead peroxide pasted to the grid holes. The negative plates consist of a lead grid with lead sponge pasted to the grid holes.

The plates are covered by an electrolyte which consists of diluted sulphuric acid solution.

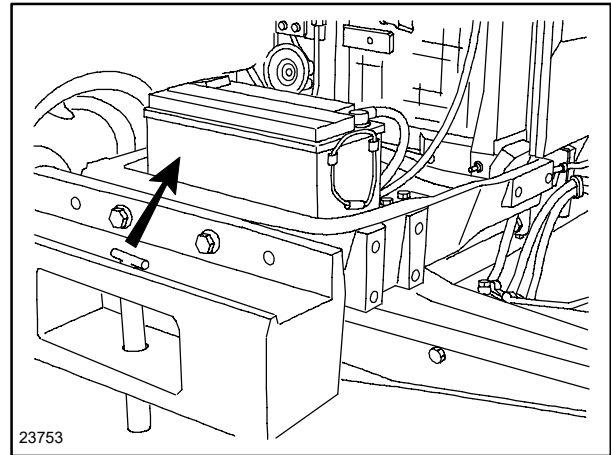
The battery casing is made of polypropylene.

REMOVAL AND RE-INSTALLATION (Op. 55 301 40)

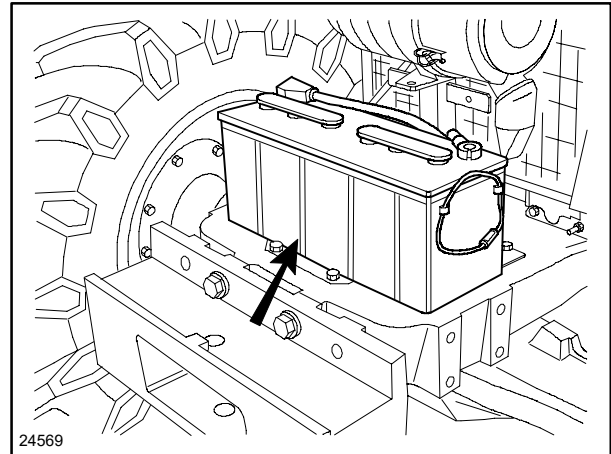
REMOVAL

105 Ah and 120 Ah batteries fitted in front of the radiator (Figures 1 and 2)

1. Lift the engine hood.
2. Disconnect earth cable (ground) from tractor structure and position it safely, away from the structure itself.
3. Slacken the bolts on both terminal clamps and disconnect the positive and negative battery cables. Make sure they do not touch the battery itself.
4. Lift the battery from the tractor by the two handles at each end of the battery.



1



2

RE-INSTALLATION

Applicable to all types of battery.

1. To re-install the battery, reverse the removal procedure, with the following precautions:
 - Check that the battery is clean, there are no signs of electrolyte leak and the breather covers are completely installed. Coat the terminals and clamps with a petroleum jelly (such as Vaseline). Do not use traditional lubricants as they can lead to electrolytic corrosion.
 - Check the battery compartment or support. The clamps should be clean and there should be no stones or other small objects, which could pierce the battery casing.
 - Check that terminal polarity is correct. Check terminal clamp connections are not too tight.
 - If a radio is installed, it will lose all saved data and will need to be reprogrammed. Electronic panels and microprocessors, for those models to which they are fitted, will not lose their memory function.

BATTERY CHECKING AND MAINTENANCE

RELATIVE DENSITY

The relative density of the battery electrolyte shows the charge level of the battery. When the battery is fully charged, the relative density of the electrolyte, at 25°C (77°F), is at least 1.280.

Alternatively, approximate charge can be measured using a digital voltmeter (± 0.01 V) as follows:

less than	10.5 V unusable battery*
less than	11.8 V flat battery
less than	12.3 V half-charged battery
more than	12.6 V fully-charged battery

* See notes to paragraph "TESTS" for instructions on how to recuperate a slightly sulphurized battery.

Battery voltage must be registered on a flat battery considering the following:

- A) the battery must be flat for at least 4 hours
- B) if the vehicle has been used recently, or if the battery has been charged recently, switch the headlights on for 2 minutes.

When a battery is flat, the sulphuric acid in the electrolyte combines chemically with the plates and this decreases the relative density of the solution.

A battery densimeter will determine the relative density of the electrolyte in an element. A reduction in the amount of sulphuric acid in the solution will show the degree of charge of that element.

The lower the temperature at which the battery operates, the more necessary it is to keep the battery fully charged. For example, a battery with a relative density of 1.225 at 27°C (80°F) can start the engine at mild outside temperatures but might not do so at lower temperatures because of lower battery performance.

Table 1 shows the effect of temperature on battery performance.

Table 1

Temperature	Fully charged battery performance
25.0 °C (77.0 °F)	100%
-4.5 °C (23.9 °F)	82%
-24.0 °C (-11.2 °F)	64%
-27.5 °C (-17.5 °F)	58%
-31.0 °C (-23.8 °F)	50%
-34.5 °C (-30.1 °F)	40%
-37.5 °C (-35.5 °F)	33%

Maximum battery life can be obtained by paying the right attention and by carrying out regular checks. The energy capacity output must not be exceeded by constant overload and charging requirements must be respected.

BATTERY MAINTENANCE

WARNING: Batteries contain sulphuric acid and generate a highly explosive hydrogen and oxygen mix during charging.

- Do not use devices producing flames or sparks to inspect the electrolyte level.
- Do not remove battery caps without protecting your hands and your eyes.

During battery maintenance, follow the steps below:

1. Keep the electrolyte level 17 mm (0.6993 in.) (over the plates. If this is not respected, the acid concentration will vary, which could damage spacers and cause a deterioration in plate performance.
2. Use distilled or de-mineralized water only. Never use tap water or rain water or water from any other source.
3. Keep the battery charged at least 75% to avoid plate sulphurization, performance loss and possible freezing at low temperatures.

4. Avoid overcharging the battery. Excessive charge will generate high internal heat which will cause grid deterioration and water loss.
5. During quick recharge, check the battery temperature does not exceed 50°C (122°F).
6. Do not add sulphuric acid to an element unless some electrolyte has been spilt. Before filling, check the solution has the correct relative density. Slow recharge is the only way to recharge the battery completely. You can use a high amperage battery charger to charge the battery with high current intensity for short periods of time. Use a slow charge to bring the battery to its full capacity.

DRY CHARGED BATTERIES

Dry charged batteries must be prepared as followed:

1. Remove the breather caps from each battery element.
2. Fill each element to the recommended level with electrolyte at a relative density of 1.260.

NOTE: *The electrolyte consists of diluted sulphuric acid, preferably at a temperature of 21° – 32°C (69.8 – 89.6°F).*

3. After filling, leave the battery to rest for 15 minutes. Check the electrolyte level and top up, if necessary.
4. Charge the battery for 4 hours at 5–8 A., checking that all the elements are producing gas freely.
5. Replace the breather caps.

CHARGING THE BATTERY

Before charging a battery:

1. Clean the battery casing and element covers carefully with ammonia diluted in warm water and clean the terminals;
2. Check the electrolyte level and, if it is below the plate level, top up with distilled water to cover the plates.

NORMAL CHARGING (TOP UP)

1. Charge the battery completely with a slow battery charger at 3 to 6 amperes for the required time. This can last 36 hours, or more, if the battery is very flat. A severely sulphated battery may not charge. When the battery is completely charged, the elements will produce gas freely and the relative density will remain constant. Disconnect the battery charger after three consecutive densimeter readings, recorded every hour, showing that relative density has stabilised.
2. When using a fast or high ampere charge, follow the manufacturer's instructions carefully. High charging amperage increases electrolyte temperature and, if the battery charger is not equipped with an automatic time or temperature switch, it can cause the electrolyte temperature to rise above 50°C (122°F). This can cause violent boiling in the battery and damage internal components.
3. Check electrolyte level in each element again and, if necessary, top up with distilled water.

WARNING: *Explosive gas is formed when a battery is charged. Do not smoke or use naked flames when checking electrolyte level. Check that the battery charger is switched off, before connection and disconnection, to avoid sparks which could ignite the gas.*

CHARGING VERY FLAT BATTERIES

To recharge a Pb–Ca maintenance-free battery we recommend using a constant voltage battery charger. For very flat batteries, charge for 48 hours, at 16 V., with current limitation (50 A. for 105 Ah and 66 A for 120 Ah).

This method is self-regulating. High current is provided at the beginning (when the battery voltage is very low). Current decreases progressively when the battery is fully charged (and its voltage is high).

If only constant voltage battery chargers are available, we recommend using voltage levels and times shown in table 2. These figures refer to very flat batteries. If the battery is only 50% discharged, use half the time shown (slow charging programme). For other conditions, reduce charging time proportionally. When feasible, use the slowest charging programme for increased battery life.

If violent boiling occurs during charging, due to gas formation or electrolyte leakage, or if the battery box

is hot (50°C (122°F) or higher), temporarily reduce or stop battery charging to avoid damaging the battery.

Table 2

	Type of battery	
	105Ah (760 cca)	120Ah (800 cca)
Slow charging programmes	25 hrs at 5A 12,5 hrs at 10A	30 hrs at 5A 15 hrs at 10A
Fast charging programmes (emergency use only)	7 hrs at 10A	10 hrs at 18A

Example 1:

Temperature below 30 °C (86 °F)
 Battery electrolyte temperature 19 °C (66.2 °F)
 Densimeter reading 1.270
 Subtract 11.0×0.004
 $\underline{5.5}$

Correct relative density = 1.262

Example 2:

Temperature above 30 °C (86 °F)
 Battery electrolyte temperature 40 °C (104 °F)
 Densimeter reading 1.220
 Add 10.0×0.004 0.007
 $\underline{5.5}$

Correct relative density = 1.227

TESTS

Before carrying out battery tests, check the breathers are not blocked, there is no rust, the breather caps are not open and the casing is not cracked.

Required testing equipment:

- Densimeter
- Battery starter tester (high amperage tester)
- Thermometer
- Battery charger

Relative density: This test shows the charge level of a battery.

1. With the float in a vertical position, note the reading.
2. Regulate the densimeter reading for battery electrolyte temperature variations subtracting 4 points (relative density 0.004) for every 5.5 °C (41.9 °F) below the temperature the densimeter is calibrated at and adding 4 points (relative density 0.004) for every 5.5 °C (41.9 °F) above this temperature.

The following examples have been calculated with a densimeter calibrated at 30 °C (86 °F).

2. Use the following table to determine the charge level.

Charge condition	Correct relative density at 15°C (86°F)	Correct relative density at 25°C (86°F)	Average battery voltage
100%	1.295	1.287	12.66
75%	1.253	1.246	12.45
50%	1.217	1.210	12.30
25%	1.177	1.170	12.00
Flat	1.137	1.130	11.84

NOTE: Relative density should not vary more than 0.025 points between cells.

4. If relative density is 1.280 or higher, the battery is fully charged and in good working condition.
5. If the correct relative density is less than 1.280, charge the battery and check the charging system, to find the cause of low battery load.

NOTE: If distilled water has recently been added, the battery must be charged for a short period of time to obtain precise densimeter readings.

If the battery has been loaded and kept still, the battery electrolyte will be thicker at the base of the elements. The battery must be shaken periodically to mix the electrolyte. This will improve charging amperage and allow more precise densimeter readings during tests.

Performance tests

Performance tests help to understand if a battery can adequately run the engine. Voltage readings show battery condition. Before carrying out the test, check the battery electrolyte level is correct and the open circuit voltage is 12.5V or more. The battery can be tested in the tractor or removed.

1. Switch the battery start tester current control to “off” (high amperage discharge tester). Calibrate the voltage selection switch to the nominal battery voltage or slightly higher. Connect the positive tester conductors to the positive battery terminal and the negative conductors to the negative battery terminal.
2. Turn the current control knob until the ammeter reading reaches half the cold start battery amperage and note the voltage reading.
 - If the reading shows 9.6 V. or higher after 15 seconds, the battery has adequate power output and can easily be charged following the normal procedure.
 - If the reading is lower than 9.6 V., battery is not satisfactory for use and the charge must be tested as follows.

WARNING: Do not leave a high discharge tester on the battery for more than 15 seconds.

Test charging: This test is only for those batteries which have not passed the performance test above.

1. Connect the positive battery charger tester conductors (high amperage discharge tester) to the positive battery terminal and the negative conductors to the negative battery terminal.
2. Connect the positive battery charger conductor to the positive battery terminal and the negative conductor to the negative battery terminal.

3. Turn the battery charger timer to more than a 3 minute charge and then back to a 3 minute charge.
4. Set the charging amperage as close as possible to 40 A.
5. After a 3 minute fast charge, read the voltmeter.
 - If the total voltage is higher than 15.5 V., the battery is not satisfactory. It is probably sulphated or worn and must be changed.

NOTE: A slightly sulphated battery can be renewed using a multiple type battery charger, with upper open circuit voltage limit of 50V. A sulphated battery has high resistance and for this reason it will be necessary to set a high voltage at the beginning to overcome resistance. At the beginning there may be no visible sign of charging. After some minutes of inactivity, a low charge will show. This is followed by a fast rise in amperage. Amperage must not exceed 14.0 A. and the battery electrolyte temperature must not exceed 50°C (122°F). When amperage stabilizes, set the voltage until amperage corresponds to 5 A. Continue this amperage until the relative density of the battery electrolyte stabilises (1.275 – 1.280 at 20°C (68°F)). This could take approximately 48 hours. Let the battery rest for 24 hours and then carry out the previously described performance test.

- If the total voltage is less than 15.5 V., check the relative density of each element and recharge the battery according to the following scale:

Relative density	Fast charge up to:
1.150 or less	60 minutes
from 1.151 to 1.175	45 minutes
from 1.176 to 1.200	30 minutes
from 1.200 to 1.225	15 minutes (slow charge only)

NOTE: When there are problems with a battery, check fan belt tension and the complete charging system.

BATTERY PROBLEMS – FREQUENT CAUSES

1. Internal open circuit.
2. Internal short-circuit.
3. Battery electrolyte leakage.
4. Grid active material separation.
5. Accumulation of sulphate crystals too big to be dispersed.

These problems are commonly caused by the following:

1. Component failure inside the elements.
2. Excessive crystal growth which can pierce the spacers and cause short circuits.
3. Excessive overload (bad charging system, high voltage fast charging, high operating temperatures).
4. Battery electrolyte freezing.
A fully charged battery freezes at -65°C (-85°F). A 50% charged battery freezes between -17°C and -27°C (16.6°F). A completely flat battery freezes between -3°C (26.6°F) and -11°C (12.2°F). Excessively fast charging and boiling caused by gas formation cause the separation of active material from the grids. Separation destroys the battery chemical function.

5. Crystals are formed when batteries are left flat. High temperature and long periods with the battery flat increase this condition. If a battery is left at room temperature for a week it can rarely be charged in the vehicle. Battery recharge requires higher constant voltage. After three weeks the battery will be permanently jeopardized and it will be necessary to follow the procedure described for "very flat batteries".

Fully charged batteries have longer a life. A lead-calcium battery discharges 3% a month. This means that in 16 months it will reach 50% charge. In the tractor, inactive load is approximately 50 mA. To forecast discharge on a vehicle not in use add approximately 8 Ah a week to this value.

It is worth noting that if a battery is weak during engine start-up, it is best to let the battery rest for two minutes. This rest time increases as the temperature decreases.

When two batteries are installed, do not use an old battery with a new one. One battery will always stop before the other one. If the battery has lasted as forecasted, charge both batteries. If one has stopped before the forecasted time due to a defect, then change only the defective battery.

