



Section C

Electrics

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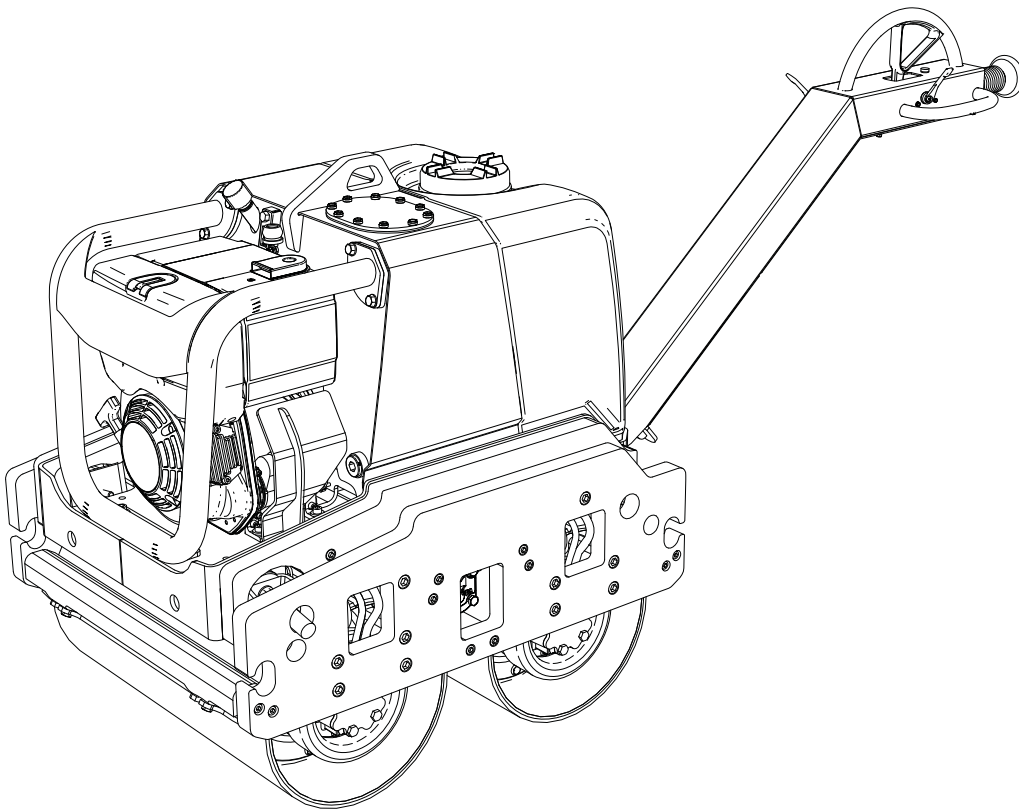
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Section C - Electrical

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Section C - Electrical

Contents

Page No.

Technical Data

Electrical System

Battery

Table 1.

Type	12 V 45Ah
Dimensions	L (221) x W (136) x H (220) mm

Charging System

Table 2.

System Type	12 Volt, negative earth
Alternator	14 - 14 A (DC) at 12V



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Electrical System

Introduction

The HATZ engine installed on the VMD70 and VMD100 has an electric start as an option. The starter battery is installed behind the engine. The starter battery is recharged by an alternator built in to the engine.

A keyswitch is used to operate the starter motor. There is a charge warning light and buzzer fitted to indicate that there is voltage output from the alternator.

Refer to HATZ engine manual for more information on the engine electrical system.

WARNING

Keep metal watchbands, and any metal fasteners on your clothes clear of the positive (+) battery terminal. Such items can short between the terminal and nearby metalwork. If that happens you could get burned.

Make sure that the fuel filler cap is tightly fitted. Clean up any spilt hydraulic fluid in the battery area.

8-2-3-5

WARNING

If you try to charge a frozen battery, or jump start and run the engine, the battery could explode. Do not use a battery if its electrolyte is frozen. To prevent the battery electrolyte from freezing, keep the battery at full charge.

0125

WARNING

Battery Terminals

The machine is negatively earthed. Always connect the negative pole of the battery to earth.

When connecting the battery, connect the earth (-) lead last.

When disconnecting the battery, disconnect the earth (-) lead first.

INT-3-1-9

CAUTION

Except in an emergency, do not use the battery isolator to switch OFF the engine. Failure to comply may result in damage to the electrical circuits.

INT-3-2-13

WARNING

Battery Gases

Batteries give off explosive gases. Keep flames and sparks away from the battery. Do not smoke close to the battery. Make sure there is good ventilation in closed areas where batteries are being used or charged. Do not check the battery charge by shorting the terminals with metal; use a hydrometer or voltmeter.

INT-3-1-8

WARNING

Electrical Circuits

Understand the electrical circuit before connecting or disconnecting an electrical component. A wrong connection can cause injury and/or damage.

INT-3-1-4

WARNING

Always disconnect the battery before starting any work on or near to the electrical system. This prevents injury and damage.

MD-1-7-1

WARNING

Make sure that the engine cannot be started. Disconnect the battery. Disconnect the earth lead first.

ENG-6-2

WARNING

Batteries give off flammable gas which if ignited could cause the battery to explode. Do not smoke near the battery. When jump-starting from another machine, make sure the two machines do not touch. This prevents any chance of sparks jumping from one machine to the other.

7-2-3-4

DANGER

Electrolyte

Battery electrolyte is toxic and corrosive. Do not breathe the gases given off by the battery. Keep the electrolyte away from your clothes, skin, mouth and eyes. Wear safety glasses. See FIRST AID - Electrolyte (MAINTENANCE section) for first aid treatment.

7-1-1-5

- 1 Make sure that the test leads are plugged into the correct sockets. The black test lead should be plugged into the black socket (sometimes, this socket is also marked by a "-", or "E" or marked as "COMMON" or "COM"). The red test lead should be plugged into the red socket marked with "+", "V" or "Ω".
- 2 When making measurements ensure that the test probes have a good clean contact with bare metal, free from grease, dirt, and corrosion as these can cause a false reading.
- 3 When measuring voltage: Make sure that the correct range is selected, that is set the selector to a value equal to or greater than that you are about to measure. e.g. If asked to measure 12 Volts, set the selector to the 12V range. If there is no 12V range, set the selector to the next range higher, 20V for instance. If the meter is set to a range that is too low, it may be damaged. e.g. setting to the 2V range to measure 12V.

Measuring DC Voltage

- 1 Select the correct range on the multimeter.
 - a On the FLUKE 85.
Turn the switch to position **1-B**.
 - b On the AV0 2003.
Move the right slider switch to position **2-A**, and the left hand slider switch to the appropriate range.
 - c On an analogue meter.
Turn the dial to the appropriate DC Volts range.
- 2 Connect the black probe to the nearest available suitable earth point, usually this will be the starter motor earth, the battery negative, or the chassis. Connect the red probe to the wire or contact from which you are measuring the voltage.

Measuring Resistance

- 1 Make sure there is no power to the part of the circuit you are about to measure.
- 2 Connect one probe at one end of the component or wire to be checked and the other probe at the other end. It does not matter which way round the two probes are placed.
- 3 Select the correct range on the multimeter.
 - a On the FLUKE 85.
 - i Turn the switch to position **1-C** and check that the W sign at the right hand side of the display window is on. If the F sign is on instead, press the blue button **1-G** to change the reading to Ω. Touch the meter lead probes together and press the **REL**³ key on the meter to eliminate the lead resistance from the meter reading.
 - b On the AV0 2003.
 - i Move the right hand slider switch to position **2-B**, and the left hand slider switch to the appropriate Ohms (Ω) range.
 - c On an analogue meter.
 - i Move the dial to the appropriate Ohms (Ω) range.

Measuring Continuity

- 1 Make sure there is no power to the part of the circuit you are checking for continuity.
- 2 Connect one probe to one end of the component or wire to be checked and the other probe to the other end. It does not matter which way round the two probes are placed.
- 3 Select the correct range on the multimeter.

a On the FLUKE 85.

Turn the switch to position **1-C** and check that the beeper symbol appears at the left hand side of the display window. If the F sign is on instead, press the button labelled **1-F** in the meter drawing.

If there is continuity in the circuit, the beeper will sound. If there is no continuity (open circuit), the beeper will not sound.

b On the AVO 2003.

Move the right hand slider switch to position **2-B**, and the left hand slider switch to position **2-C**.

If there is continuity (i.e. very low resistance) between two points the buzzer will sound.

c On an analogue meter.

Turn the dial to the lowest Ohms (Ω) range.

If there is continuity (i.e. very low resistance) between two points the needle will move across fully (or almost fully) to the right hand side of the scale.

Measuring Frequency

The AVO 2003 and the analogue meter are not capable of measuring frequency, therefore a Fluke 85 digital multimeter must be used.

- 1 Insert the black plug into the COM socket on the meter and attach the probe to the nearest suitable earth point on the chassis, for example, the battery negative terminal.
- 2 Insert the red probe into socket **1-J**.
- 3 Turn the selector switch to position **1-A** and depress **1-G** repeatedly until **1-F** is highlighted on the top row of the display.
- 4 Press button **1-H** once.
- 5 Touch or connect the red probe to the frequency source to be measured. Press and hold button if an average reading is required.

Testing a Diode or a Diode Wire

A diode wire is a diode with male connector fitted on one end and a female connector fitted on the other end. The diode is sealed in heatshrink sleeving.

1 To test a Diode or a Diode Wire

a On the FLUKE 85.

- i Turn the switch to position **1-D**.
- ii Press the **HOLD** button and check that the **H** sign appears at the top right hand side of the display window.
- iii Connect the black probe to the end of the diode with a band or to the male connector of the diode wire. Connect the red probe to the other end of the diode or diode wire. If the beeper does not sound the diode or diode wire is faulty.
- iv Connect the red probe to the end of the diode marked with a band, or to the male connector of the diode wire, the black probe should be connected to the other end of the diode or diode wire. If the beeper sounds or the meter does not read **O.L.**, the diode or diode wire is faulty.
- v Press the **HOLD** button and check that the **H** sign disappears from the right hand side of the display window.

b On the AV0 2003.

- i Move the right hand slider to position **2-A**, and the left hand slider switch to position **2-C**.
- ii Connect the black probe to the end of the diode marked with a band, or to the male connector of the diode wire, the red probe should be connected to the other end of the diode or diode wire. If the Avometer does not buzz the diode is faulty.
- iii Connect the red probe to the end of the diode marked with a band, or to the male connector of the diode wire, the black probe should be connected to the other end of the diode or diode wire. If the Avometer does not read "1" the diode is faulty.

c On an analogue meter.

- i Select the Ohms 1000s (1k) range.

Connect the black probe to the end of the diode marked with a band, or to the male connector of the diode wire, the red probe should be connected to the other end of the diode or diode wire. The meter should read 20-400 k Ω , if it reads more than this the diode is faulty.

- ii Select the Ohms 100s range.

Connect the red probe to the end of the diode marked with a band, or to the male connector of the diode wire, the black probe should be connected to the other end of the diode or diode wire. The meter should read 300-400 Ω , if it reads less than this the diode is faulty.

Battery

TC-001_3

Maintenance

To ensure that the battery provides optimum performance the following steps should be observed:

- 1 Make sure that the electrical connections are clean and tight. Smear petroleum jelly on connectors to prevent corrosion.
- 2 When applicable - never allow the electrolyte level to fall below the recommended level - 6 mm (1/4 in) above the plates. Use only distilled water for topping up.
- 3 Keep the battery at least three quarters charged, otherwise the plates may become sulphated (hardened) - this condition makes recharging the battery very difficult.

Extra precautions must be taken when bench charging maintenance free batteries, they are more prone to damage by overcharging than the standard type of battery:

- Never boost-charge a maintenance free battery.
- Never charge a maintenance free battery at a voltage in excess of 15.8 Volts.
- Never continue to charge a maintenance free battery after it begins to gas.

WARNING

Batteries give off an explosive gas. Do not smoke when handling or working on the battery. Keep the battery away from sparks and flames.

Battery electrolyte contains sulphuric acid. It can burn you if it touches your skin or eyes. Wear goggles. Handle the battery carefully to prevent spillage. Keep metallic items (watches, rings, zips etc) away from the battery terminals. Such items could short the terminals and burn you.

Set all switches in the cab to OFF before disconnecting and connecting the battery. When disconnecting the battery, take off the earth (-) lead first.

Re-charge the battery away from the machine, in a well ventilated area. Switch the charging circuit off before connecting or disconnecting the battery. When you have installed the battery in the machine, wait five minutes before connecting it up.

When reconnecting, fit the positive (+) lead first.

First Aid - Electrolyte

Do the following if electrolyte:

GETS INTO YOUR EYES

Immediately flush with water for 15 minutes, always get medical help.

IS SWALLOWED

Do not induce vomiting. Drink large quantities of water or milk. Then drink milk of magnesia, beaten egg or vegetable oil. Get medical help.

GETS ONTO YOUR SKIN

Flush with water, remove affected clothing. Cover burns with a sterile dressing then get medical help.

5-3-4-3_1

Testing

This test is to determine the electrical condition of the battery and to give an indication of the remaining useful 'life'.

Before testing ensure that the battery is at least 75% charged (SG of 1.23 to 1.25 for ambient temperature up to 27°C).

Ensure that the battery is completely disconnected from the vehicle.

Connect up the battery tester as follows:

- 1 Set the CHECK/LOAD switch **4-A** to OFF.
- 2 Set rocker switch **4-B** to the battery voltage (12V).
- 3 Connect the red flying lead to the battery positive (+) terminal and the black flying lead to the battery negative (-) terminal.
- 4 Set the CHECK/LOAD switch **4-A** to CHECK to read the battery no-load voltage which should be at least 12.4 volts.

- 5 Set the CHECK/LOAD switch **4-A** to LOAD and hold down for 5-10 seconds until the meter reading stabilises. The reading should be at least 9 volts.

Note: Do not hold the switch in the LOAD position for more than 10 seconds.

- 6 ⇒ [Table 1. Fault Diagnosis \(C-12\)](#), if the foregoing tests are unsatisfactory.

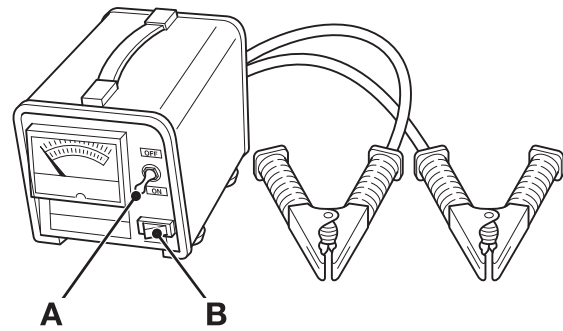


Fig 4. Battery Tester

Table 1. Fault Diagnosis

Battery Tester Readings	Remedy
1 CHECK: 0 - 12.6 Volts LOAD: less than 6 Volts	Renew battery
2 CHECK: 6 - 12.4 Volts LOAD: less than 9 Volts and falls steadily but remains in yellow zone.	Recharge and re-test. If tests still unsatisfactory renew battery.
3 CHECK: less than 10 Volts LOAD: less than 3 Volts	Indicates battery has been over-discharged and unlikely to recover. Renew battery.
4 CHECK: more than 11 Volts LOAD: 6 - 10 Volts steady	Charge battery which will probably recover.



Specific Gravity Testing

The specific gravity of the electrolyte gives an idea of the state of charge of the battery. Readings should be taken using a hydrometer, when the electrolyte temperature is 15°C (60°F). If the battery has recently been on charge, wait approximately one hour (or slightly discharge the battery) to dissipate the surface charge before testing.

Readings should be as tabulated and should not vary between cells by more than 0.04. A greater variation indicates an internal fault on that particular cell.

If the electrolyte temperature is other than 15°C (60°F) a 'correction factor' must be applied to the reading obtained. Add 0.07 per 10°C (18°F) if the temperature is higher than 15°C (60°F) and subtract the same if the temperature is lower.

Table 2. Specific Gravity at 15°C (60°F)

	Fully Charged	Half Discharged	Fully Discharged
Ambient temperature up to 27°C (80°F)	1.270 - 1.290	1.190 - 1.210	1.110 - 1.130
Ambient temperature above 27°C (80°F)	1.240 - 1.260	1.170 - 1.190	1.090 - 1.110

Battery Charging System Precautions

Obey the procedures below to prevent damage to the alternator and battery.

- 1 Ensure that the battery negative terminal is connected to the earthing cable.
- 2 Never make or break connections to the battery or alternator, or any part of the charging circuit whilst the engine is running. Disregarding this instruction will result in damage to the regulator or rectifying diodes.
- 3 Main output cables are 'live' even when the engine is not running. Take care not to earth connectors in the moulded plug if it is removed from the alternator.
- 4 When arc welding on the machine, protect the alternator by removing the moulded plug (or if separate output cables fitted, remove the cables).
- 5 If slave starting is necessary, connect the second battery in parallel without disconnecting the vehicle battery from the charging circuit. The slave battery may then be safely removed after a start has been obtained. Take care to connect batteries positive to positive, negative to negative.



Battery

Removal and Replacement

Removal

- 1 Park the machine on firm level ground.
- 2 Turn the engine OFF and allow it to cool.
- 3 Remove the water tank. → [Water Tank \(□ B-2\)](#)
- 4 Disconnect the battery.
- 5 Undo the battery clamp nuts and lift the clamp clear of the battery.

Important: Take care not to short the battery clamp across the battery terminals.

Important: Batteries are heavy. Take care when lifting/handling batteries.

- 6 Remove the battery from the machine.

Replacement

Replacement is the reverse of the removal procedure.