

## A. Checking Battery Acid Level and Acid Density

1. The acid level and the acid density should be checked every 4,000 km according to the instructions on the service book sheets. The battery should be topped up with pure, distilled water.

A clean glass vessel and glass funnel should always be used for topping up with distilled water. The acid should be 10 mm above the top edge of the separators and 15 mm above the top edge of the plates. Topping-up with small quantities of distilled water can also be done with the hydrometer (Fig. 54 — 10/1).

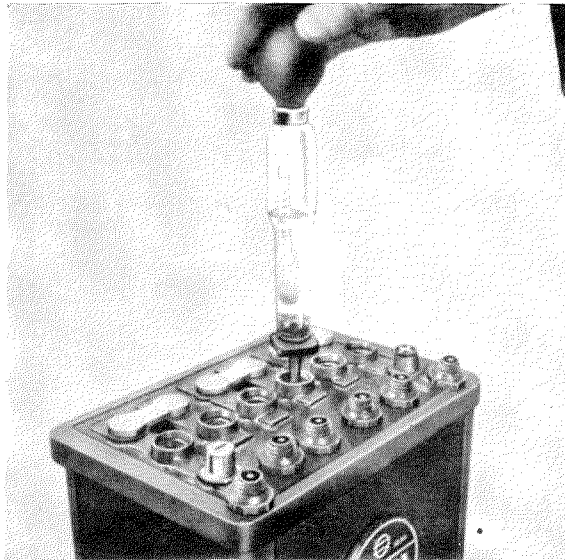


Fig. 54 — 10/1

**Note:** The work should never be carried out near a naked light owing to the danger of explosion due to the battery releasing oxy-hydrogen gas.

2. Check the state of charge of the battery by measuring the acid density.

Acid should be sucked out of the battery for this purpose by means of the hydrometer (areometer). The specific gravity of the battery acid can be read off on the scale marked on the float which is suspended in the acid. A fully-charged battery should give a specific gravity reading of  $1.285 = 32^{\circ}$  Bé (Fig. 54 — 10/2).

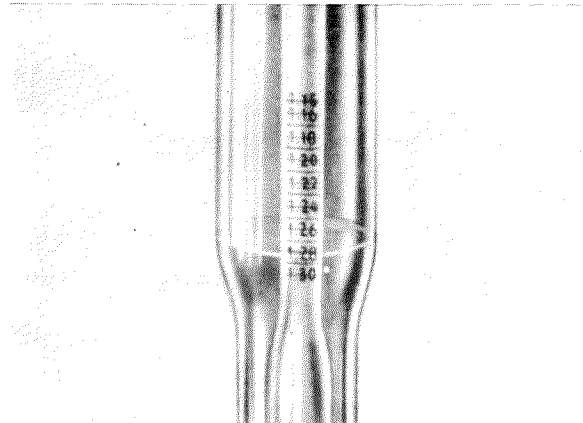


Fig. 54 — 10/2

3. The specific gravities of the battery acid, corresponding to the state of charge of the battery, are shown in the following table.

### Acid Density

Acid density, Beaumé Scale	Specific gravity	State of charge
$32^{\circ}$ Be	1.285	fully-charged
$27-25^{\circ}$ Bé	1.23—1.21	half-charged
$18-14^{\circ}$ Bé	1.14—1.11	discharged

(The specific gravities given are calculated at a temperature of  $+ 20^{\circ}$  C.)

## Acid Density (Tropics)

Specific gravity at			State of charge
20° C.	40° C.	60° C.	
1.23	1.215	1.200	fully-charged
1.16	1.148	1.136	half-charged
1.09	1.080	1.070	discharged

### B. Testing of Battery on Load

The individual cells of the battery are tested with the aid of Cell Tester 000 589 00 27 or some other suitable cell tester. These testers are fitted with a fixed resistance or sometimes with an adjustable resistance so that the cells can be tested individually at a high amperage (generally 100 to 200 Amperes). For an accurate test, the load should be suited to the size of the battery and adjusted with the aid of a variable resistance. But in workshop practice it is sufficient to use an available cell tester with a fixed resistance. The voltmeter which is incorporated in the cell tester can be used to read off the voltage drop of the individual cells under load. In the case of a fully-charged battery which is in good condition the voltage must not drop below 1.8 Volts. For the rest, the operating instructions given by the manufacturers of the tester should be adhered to.

In general, the test should be carried out in the following way:

1. Press the contact prods of the cell tester firmly on the two terminals of a cell (Fig. 54 — 10/3).
2. After a period of at most 10 seconds under load, read off the voltage on the voltmeter.

**Note:** If the battery is fully charged and is in good condition, the voltage must not drop below 1.8 Volts.

3. Check all the cells in this way.

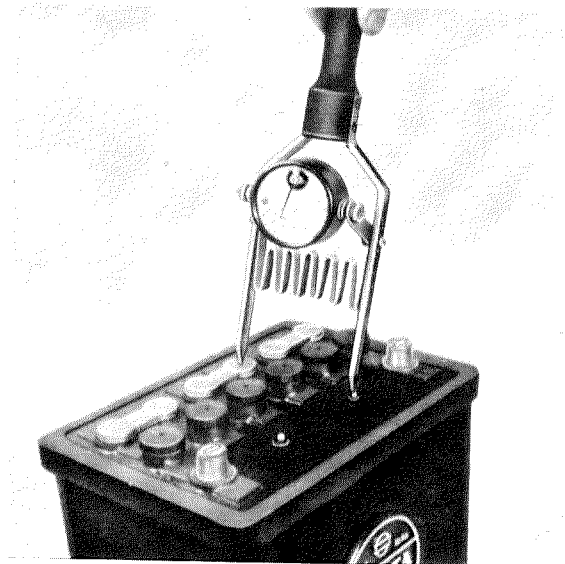


Fig. 54 — 10/3

## C. Normal Re-charging of Battery

It is absolutely necessary to re-charge a battery if the acid density has fallen below  $1.14 = 18^\circ \text{ Bé}$  (in the tropics,  $1.09 = 12^\circ \text{ Bé}$ ) or if the voltage of the individual cells has fallen to 1.8 Volts.

1. Unscrew the filler caps of the individual cells.
2. Check the acid level and if necessary, top up with distilled water.  
The acid should be 10 mm above the edge of the separators and 15 mm above the top edge of the plates.
3. Connect the battery to a charger. The positive cable of the charger is connected to the positive terminal of the battery and the ground cable of the charger to the negative terminal of the battery.
4. Charge the battery at a rate of amperes not exceeding  $\frac{1}{10}$  of the rated capacity, that is to say, at a maximum of 5.6 Amps.
- c) The charge can be considered at an end when the cells have "gassed" for a period of half-an-hour. Three readings should be taken at intervals of 1 hour to ensure that the charging voltage and the acid density show no further increase during that time. If the battery is fully charged, the cell voltage should be 2.6 to 2.7 Volts. **The voltage must be measured with the charger switched on.** When the charger is switched off, the battery voltage then drops to the normal cell voltage of 2 — 2.2 Volts.  
The acid density in a fully-charged battery should be  $1.285 = 32^\circ \text{ Bé}$  (in the tropics,  $1.23 = 27^\circ$ ). The acid density should be measured with the acid at the specified level (see Section A).

### Note:

- a) While the battery is being charged, the acid temperature must not rise above  $40^\circ \text{ C.}$  (in the tropics,  $45^\circ \text{ C.}$ ). If the acid temperature is higher, the rate of charging must be decreased and the period of charging increased.
- b) If the plates of a battery are already sulphated this can be seen from the white deposit on the plates), it should first be charged at  $\frac{1}{4}$  of the specified charging rate, that is to say at 1.4 Amps., for at least forty hours and only at the end of this period should the full charging current of 5.6 Amps. be applied. The charging process can then continue at this amperage until the battery is fully charged.
- d) **During the charge, the charging room should be well ventilated. No naked lights must be used, owing to the danger of explosion occasioned by the release of oxyhydrogen gas.**
5. Disconnect the charger and once more check the acid level.
6. Do not put on the filler caps until at least two hours after the charge.

**Note:** Any acid which has splashed or spilt over should be washed off with water or rendered innocuous by means of a soda solution or ammonium chloride. The battery should then be dried.

## D. Re-charging of Battery with Quick-charging Apparatus

If a quick charge is needed, discharged batteries can be charged at a rate which is considerably higher than the normal charging current rate. A considerable amount of time is saved in this process since a quick charge takes only approx. half-an-hour. Quick-charging, however, should not be made the rule and in any case should only **be undertaken in the case of sound batteries which have already been in use and should never be undertaken at the first charge.** Before beginning a quick charge, it is absolutely necessary to check the battery and make sure that it is in good condition. It is useless to charge defective batteries in this way since this will only increase the damage to the battery. Before charging, therefore, the battery should be repaired or alternatively, replaced by a battery which is in good order.

The modern, commercially available quick-charging plants are fully automatic. The rate and duration of charge are so arranged that it is impossible for overcharging and thus overheating to take place at all. The operating instructions for the charger which is being used should in all cases be strictly adhered to.

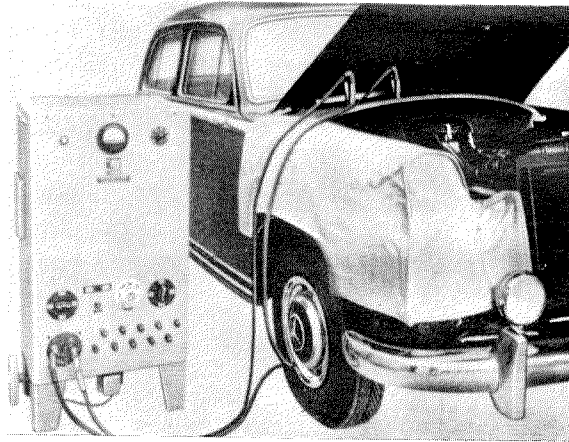


Fig. 54 — 10/4

### E. Preparation of New Batteries

New batteries are generally delivered empty. Initial charging should be carried out according to the instructions issued with the battery. The following is the general procedure adopted:

1. Unscrew the filler caps and fill the cells with chemically pure accumulator acid of a specific gravity of  $1.285 = 32^{\circ} \text{ Bé}$ . The acid should be 10 mm over the top edge of the separators and 15 mm over the edge of the plates.
2. It is absolutely essential that the battery should then be allowed to stand for 5–6 hours so that the plates can become completely soaked in the electrolyte.

**Note:** The acid level decreases somewhat during this period and in consequence the battery should be slightly agitated afterwards so that any air bubbles can escape from the cells. Then top up the cells again so that the battery acid reaches the specified level.

3. Charge the battery at a rate of 3.5 Amps. or less until the voltage of each cell has risen

to 2.5–2.7 Volts on charge and until all cells are actively gassing.

4. Measure the temperature of the battery acid from time to time. If the temperature rises above  $40^{\circ} \text{ C.}$ , reduce the charging rate.
5. After the charge is completed, check the acid density once more (specific gravity  $1.285 = 32^{\circ} \text{ Bé}$ ) and if necessary, correct. If it is necessary to top up the battery with acid or distilled water, charge the battery for a short time afterwards in order to ensure that the battery acid is well mixed and distributed.
6. The filler holes should be left open for a period of at least 2 hours – preferably even more – after the charge has been completed. Then the filler caps should be put on. Any acid which has splashed over should be washed off with water or rendered innocuous by means of a soda solution or ammonium chloride. The battery should then be dried.

## F. Laying-up of a Battery

If a battery is to be out of use for some time, the following procedure should be adopted:

1. Charge the battery according to the instructions (see Section C).
2. Coat the terminals and the cell connecting bars with acid-resisting grease, for example Bosch Ft 40 v 1.
3. Store the battery in a cool, dry room.
4. Discharge and re-charge the battery once a month. Never overcharge the battery. It should only be charged until all cells are actively gassing. Check the acid level.

**Note:** A battery that is filled with acid must never be allowed to stand uncharged since the plates will soon become unserviceable through oxidation!

If the battery is to be out of use for a considerable period

of time, the following procedure should be adopted:

5. Charge the battery according to the instructions (see Section C).
6. After charging, pour out the acid and fill up with distilled water.
7. Re-charge the battery for 6 hours and pour out the distilled water.
8. Fill up with fresh distilled water and store the battery.

**Note:**

- a) It is not necessary in this case to re-charge the battery at intervals of a month.
- b) When the battery is put into use again, it should be given the same treatment as a new battery (see Section E).