

**MICROTEX<sup>®</sup>**

# Traction Power<sup>™</sup> Battery System User Guide



## Installation and Maintenance Instruction for Traction Battery

**Microtex Energy P Ltd**

42 & 43, II Main, II Phase, Peenya Industrial Area, Bangalore - 560 058, India.  
Tel : 080 2839 2380 Fax : 080 2839 7243 email : info@microtex.in  
www.microtex.in

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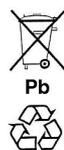
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# Safety information and do's & do-not's for Lead Acid Traction Battery

## Nominal Data information

1	Nominal capacity	C5 – See name plate
2	Nominal voltage	2,0V x No of cell in the battery – See name plate
3	Final discharge voltage	1.85V/Cell or specific gravity of electrolyte 1.170 at 30 Deg C.
4	Nominal S.G. of electrolyte	1.29kg/l at full charge
5	Volume of acid required per cell	As provided in the table of the catalogue
6	Nominal temperature	30°C
7	Nominal electrolyte level	Acid should be seen at the plug basket well. ( Refer figure 1 )
8	Hazard classification	Corrosive group 8 UN Number 2749

## Safety information

 <p>Pay attention to the operation instruction. Work on batteries to be carried out by trained personnel only!</p>	 <p>Risk of explosion and fire, avoid short circuits! Caution: Metal parts of the battery are always live. Do not place tools or other metal objects on the battery!</p>
 <p>Use protective glasses and clothes when working on batteries. Pay attention to the accident prevention rules.</p>	 <p>Electrolyte is highly corrosive.</p>
 <p>No smoking! Do not expose batteries to naked flames, glowing embers or sparks, as it may cause the battery to explode.</p>	 <p>Batteries and cells are heavy. Ensure secure installation! Use only suitable handling equipment e.g. lifting gears.</p>
 <p>Keep children away!</p>	
 <p>Acid splashes in the eyes or on the skin must be washed with water. In case of accident consult a doctor immediately! Clothing contaminated by acid should be washed in water.</p>	 <p>Batteries with this sign must be recycled and returned back to the manufacturer. Batteries which are not returned for the recycling process must be disposed of as hazardous waste! As per applicable rules in the users country.</p>

## **Do's & Do not's for traction battery**

### Do's:

- Read the instruction manual carefully before using the battery.
- Allow trained personnel only to work on a battery.
- Use protective clothing and safety gears when working on a battery.
- Use insulated tools only to work on the battery.
- Match the battery to the correct charger. Undersize charger will reduce the backup & life of the battery.
- Ensure correct polarity while connecting to charger and machine.
- Put discharged battery immediately on charge.
- Batteries kept idle shall be charged at eight weeks interval.
- Remove the battery compartment lid while charging.
- Charge batteries in ventilated place having exhaust fan.
- Contact Microtex for calculation of exhaust fan capacity.
- Use water to top up the battery.
- Refer specification provided in this manual for purity of water and acid.
- Top up at the end of charge cycle and never on a discharged battery.
- Charge the battery to gas freely for at least one hour after topping up.
- Keep the battery & tray clean and dry at all times.
- Check terminal connections & bolted terminals tightness periodically.
- Keep the battery firmly secured to the truck and avoid vibration.
- Use petroleum jelly or antisliphuric grease to protect metal parts.
- Top metal connections shall always have plastics shrouds on them.
- Consult Microtex Energy Pvt Ltd for charger selection.

### Do not's:

- Do not leave a battery in discharged state.
- Do not over-discharge the battery. Use battery discharge indicator.
- Do not overfill the cells while topping up.
- Do not keep the vent plug lid open during charging and discharging.
- Do not add tap water to the battery.
- Do not top up in discharged state.
- Never add acid for topping up.
- Do not use metal vessels for holding acid or acid contaminated water.
- Never smoke in the battery charging room.
- Avoid flames and hot works like welding, gas cutting in charging room.
- Do not break a live circuit at the terminal of the battery.
- Do not drop tools or other metal parts on the battery.

## Chapter 3

### 1. Commissioning of Traction battery for users doing assembly themselves with Microtex Traction cell

**1.1 Commissioning of battery built with dry uncharged cells** – After assembly of the cells with correct polarity arrangement, proceed towards commissioning of the battery. Coat all the terminals with petroleum jelly or anti-sulfuric acid grease before fixing the connectors. Batteries built with bolted connections shall be tightened with a torque wrench at a tightening torque of 30 Newton meter. Open the vent plug lids. Fill the cells with 1.250 specific gravity (S.G) measured at 30 Deg C. After filling the cells, allow the battery to stand for a minimum period of 24 hours. Top up the cells, if required, acid should be seen in the bottom of plug basket well (Refer to Figure 1 at the end of this manual). Check the voltage between two end terminal – if the voltage reading matches the battery voltage, the cells have been positioned correctly. If not, check the cells for proper sequence of polarity.

Connect the battery with correct polarity (Refer figure 3 at the end of the manual) to a matching charger. Consult Microtex Energy Pvt Ltd for charger selection. A constant current charger is preferred for initial filling and charging. Charge with a current equal to 5 to 10 percent of C5 Ampere-hour rating of the battery. Record voltage, specific gravity and temperature measured in three pilot cells at two hourly interval and hourly interval once the cell voltage reaches 2.4V. The temperature shall not exceed 55 deg C at any point of charging. Reduce the charging current if the temperature has a tendency to go above 55 deg C. The charging shall be with two current steps. First step with 5 to 10 percent of C5 and as the voltage of the cells reaches to 2.4 per cell (also indicated by vigorous gassing) reduce current to 3 percent of C5. Selection of current value depends on the temperature rise in the cell.

The charging shall be continued at 3 percent of C5 till four consecutive half-hourly readings of voltages and specific gravity checked in the pilot cells shows no appreciable change. The specific gravity at the end of this charge will come around 1.280 to 1.290. Top up the acid level as in figure 1. Top up the level while the battery is still on charge.

Wash the battery with tap water keeping the vent plug lids closed. Allow the acid in the cell to cool down and the battery to drip dry. Check the voltage and specific gravity and record them in the record book provided with the battery. These readings become the first-off reading for monitoring the battery health hereafter.

Hereafter, do not add acid to the battery – topping up will be done with battery grade water of specification given below. The battery is ready for use.

After few cycles of use, the specific gravity will increase and shall be maintained at 1.290 +/- 0.005 for rest of the life of the battery.

**Users are requested to study all the instructions carefully for safe use of the battery and getting best working life from the battery.**

#### Specification of water and acid for use in Traction battery

Sl no	Items	Water	Acid
1	Suspended matter	Nil	Nil
2	Iron	0.1 ppm	10 ppm
3	Chlorine	1 ppm	3 ppm
4	Manganese	0.1 ppm	Nil
5	Total dissolved solid	2 ppm	Nil
6	Electrical conductivity in micro mho / cm	5 max	Not applicable

Reading specific gravity of sulphuric acid and the correction for temperature: The acid gravity is read by the hydrometer and the temperature is read by a mercury-in-glass type thermometer.

Avoid parallax error by keeping the acid level in the hydrometer in the same level of the eye. (Refer to figure 2 at the end of this manual).

The correction is done by adding 0.0007 in case of acid being at a temperature higher than the reference temperature and subtracting 0.0007 in case the acid is at lower temperature than the reference temperature for each deg C. Suppose we measure a batch of acid as 1.250 at 40 deg C, the corrected specific gravity at 30 deg C for that particular batch of acid will be -  $1.250 + (40-30) \times 0.0007 = 1.257$ .

So, the generalised formula is

$$\text{S.G. (30 deg C)} = \text{S.G. (t deg C)} + (t - 30) \times 0.0007$$

Where, t is the temperature of the acid

S.G. (30 deg C) = Specific gravity at 30 deg C

S.G. (t deg C) = specific gravity measured at t deg C.

## **1.2 Commissioning of batteries built with wet charged cells**

Do the battery building process as in 1.1 except you do not fill with acid. Connect the battery to the matching charger taking care of polarity. Start charging with 5 to 10 percent of C5 rating current and reduce the charging current to three percent when the cell voltage reaches 2.4 volt. Charge further, till four consecutive half hourly reading shows no change for specific gravity and voltage. Top up the level with water if required. (Refer figure 1 for level). Charge for at least an hour after addition of water.

Temperature management will be same as done in 1.1. Record of cell voltage and specific gravity shall be done as recommended in 1.1.

## **1.3 Commissioning of batteries received in filled and charged condition**

The battery should be inspected to ensure that it is in perfect physical condition.

The charger cables must be connected to ensure a good contact, taking care that the polarity is correct. Otherwise battery, vehicle or charger could get damaged. Refer figure 3 at the end of this manual.

The level of the electrolyte must be checked. If it is below the anti-splash cup or below the top of the separator it must be topped up to the height as shown in Fig.1. Top up with purified water as specified in this instruction manual. If the gap is 8 weeks or more, between manufacturing date and commissioning date of the battery, provide an equalizing charge according to 2.3.

Note: If the battery is used for trial on trucks, locomotive or any other equipment and the battery has been discharged, give a full charge according to 2.2 b, before starting the commissioning of the equipment.

## **1.4 Commissioning of batteries received in dry uncharged condition.**

Follow the procedure as in 1.1.

## Chapter 4

### 2. Operation

Follow safety instruction as instructed in this manual. Be sure that all venting holes are open and not sealed or covered. Electrical connections (e.g. plugs) must only be closed or opened in 'no current flow' condition (current equals zero).

#### 2.1 Discharging

**Deep discharges beyond 80% shall be avoided to achieve the optimum life from the battery.** The truck shall be provided with a battery discharge indicator (BDI) to read the extent of discharge and avoid over discharge. In case the truck does not have a BDI, arrange to get a BDI fitted to the truck. The 80% level of discharge corresponds to an electrolyte specific gravity of 1.170 kg/l. Discharged batteries must be recharged immediately and must not be left in discharged state. **This, also apply to partially discharged batteries.**

#### 2.2 Charging

Only direct current must be used for charging. All charging procedures shall be in accordance with the instructions provided in this manual.

##### a) Operational charge

Microtex recommends charger which can fully charge the battery. Several methods of charging is available and one good method is using an IU1a-characteristic. In the first I-step the current recommended is 10 to 15 percent of the C5 Ah rating of the battery. The battery needs no current limitation but a soft start is recommended. The first 'I-step' is finished, when the charging voltage reaches the value of the U-step.

In the U-Step the normal preset voltage is 2,40V/cell at 30°C. To avoid excessive water decomposition and gassing at higher temperatures, the voltage should be reduced with -0.003V/C, to get 2.34V/cell at 50°C. To shorten the charging time at low temperatures the voltage has to be increased by 0.003V/C.

T / °C	-30	-20	-10	0	10	20	30	40	50	55
U / V	2.58	2.55	2.52	2.49	2.46	2.43	2.40	2.37	2.34	2.31

The second 'I' step is started when the current decreases to 3 percent of the battery Ah rating in the U-step. The selection of the current value in both the 'I' steps depends on the ambient temperature. There are few methods of termination of the charge like 1) time based 2) dv/dt based 3) Amper-hour balancing.

**Please consult Microtex for Charger selection.**

##### b) Maintenance charge

Connect the battery to a charger suitable for the size of battery. When charging, proper provision must be made for venting of the charging gases. Battery compartment lids must be opened or removed during charging. The vent plug lids should remain on the cells in closed position and not required to be opened up, except for reading specific gravity and temperature in the cells.

With the charger in switched off mode, connect the battery, ensuring correct polarity between the power plugs, that is positive to positive, negative to negative – (refer figure 3). Now, switch on the charger. During charging the temperature of the electrolyte rises by about 10°C, so charging should only begin if the electrolyte temperature is below 45°C so that it does not overshoot the maximum limit of 55 deg C.

The minimum electrolyte temperature of batteries should be at least +10°C before charging, otherwise full charge will not be achieved. Use the following charging parameters:

Initial current	Final current	Charging factor
(10 – 15) % of C5 Ah rating of the battery	(3 – 5) % of the C5 Ah rating of the battery	1,15 – 1,25

A charge is finished when the specific gravity of the electrolyte and the battery voltage remain constant for two hours (measured at 30 minutes interval).

The specific gravity of the electrolyte depends on temperature (see 2.5). The final charging voltage depends on temperature, too. The correction factor is 0,003V/C. Example: 2,65V at 40°C equals 2,68V at 30°C.

Towards the end of the charging, check level of the electrolyte (refer figure -1) and top up with water of purity as given in this manual, till the level reaches the bottom of the plug basket (refer figure 1). Allow the battery to be on charge for at least an hour after adding the water so that the water mixes up with the acid and is uniform along the height of the cell.

### 2.3 Equalising charge

Equalising charge is used to safeguard the life of the battery and to maintain its performance. They are necessary, if the acid density of the cells varies by more than 0,01kg/l and the charging voltages vary by more than 0,05V from average. It is advised after repeated deep discharges, repeated incomplete recharges. Equalising charges are carried out following normal full charging. The charging current must not exceed 5% of the C5 Ah. The equalising charge is completed, if the acid density and voltage of all single cells do not increase by more than 0,005kg/l or 10mV within 2 hours. This takes normally 8-12h. In case of sulphated batteries, a charge with 3% of C5 Ah over 1-2 days may be required.

Make sure that the temperature does not exceed 55 deg C. Interrupt equalising charge, if necessary if the temperature goes above 55 deg C. At the end, check level of the electrolyte (refer figure 1) and top up with water quality as mentioned earlier. Clean and dry the surface of the battery at the end of topping up.

Use Auto-fill system to take care of spillage of acid while topping up.

**Record the cell voltages, specific gravity and temperature after every equalisation charge. This has to be done for all cells in the battery. Warranty will be void in case this data is not available at the time of warranty claim.**

### 2.4 Temperature

An electrolyte temperature of 30°C is specified as the nominal temperature. Higher temperatures shorten the life of the battery and lower temperatures reduce the capacity available. Difference of 10 deg C in the average operating temperature affects the life performance by 50%.

**55°C is the maximum temperature limit for traction battery and is not the temperature for continuous operation.**

## 2.5 Electrolyte

The rated specific gravity (S.G.) of the electrolyte is related to a temperature of 30°C and at the nominal electrolyte level in the cell in fully charged condition.

Higher temperature reduce the specified gravity of the electrolyte, lower temperature increase it. The temperature correction factor is -0.0007 kg/l per °C, e.g. an electrolyte specific gravity of 1,283kg/l at 40°C corresponds to an S.G. of 1.29 kg/l at 30°C. The electrolyte must conform to the purity level as mentioned in this manual.

## 3. Maintenance

**Record maintenance work done on the battery in the record book provided with the battery. Readings of specific gravity and cell voltage and temperature must be recorded for all cells after every equalising charge. No warranty claim shall be accepted without these records.**

### 3.1 Maintenance sequence

Follow the maintenance sequence and interval as provided in the following sections of the manual.

#### 3.1.1 Every month

**Check specific gravity and voltage of all the cells and record in the record book provided with the battery.**

- Check the electrolyte level.

Normal electrolyte level is up to the bottom of the plug basket well (refer figure 1). Add water of purity as recommended in the earlier sections.

Measure the insulation resistance of the battery with the help of a 'Megger' tester between the terminals and tray body. Values above 100 Mega Ohm is acceptable. When values are observed lower than 100 Mega Ohms, wash the battery with tap water thoroughly and allow the water to drip and air-dry. Keep all the vent plug lids in closed position while washing. Soak the water and clean the top surface of the battery. Wait for 2h or more for drying and repeat the insulation measurement.

Note: Important - Water from the washing of the battery will be acidic and should be neutralised with alkaline material like Calcium oxide or Sodium Carbonate before discharging to public drainage or be disposed off as per the rules applicable in the user's country.

#### 3.1.2 Every 3 months

- Check the battery for any corrosion mark on the steel container, connectors and end terminals. Clean the sulphates from the corroded locations and cover up with anti-sulphuric acid grease.

#### 3.1.3 Every 12 months

Check and record the acid densities of all cells. In case the specific gravity is below nominal value and/or single cells are less than average by 0,01kg/l , perform a maintenance charge according to 2.2 b). If after the maintenance charge, the acid density is not uniform in all cells, add an equalizing charge (2.3).

#### 3.1.4 Change of cell

Only a trained person should be allowed to do cell replacement in a battery and conduct repair work. Contact Microtex if required.

### **3.1.5 Storage**

If batteries are taken out of service for a long period, they should be stored in the fully charged condition in a dry, ventilated room. To ensure the battery is always ready for use, follow the charging method below:

Provide Equalising charge as detailed in 2.3 at an interval of 8 weeks.

### **4. Malfunctions**

**4.1** If after full charge the cell voltages and acid densities are varying, perform an equalizing charge.

**4.2** If after the equalizing charge single cells remain by more than 0,05 kg/l behind the average, they have to be changed.

**4.3** If the acid density of the majority of cells is behind the nominal value by 0,02 – 0,05kg/l, the battery is possibly sulphated. In this case, charge with 3% of C5 Ah rating of the battery over several days to remove the crystalline lead sulphate.

**4.4** If the insulation value has fall below acceptable level, clean the surface of the battery. If this is not sufficient, wash the battery and let the wash water drain out of the drain-holes at the bottom. If drain holes are not provided – a tube can be inserted to the base through any convenient location at the top and connected to a vacuum pump for sucking out the acidic water.

## Chapter 5

### 5. Trouble shooting

#### 5.1 Low battery capacity

Probable cause

- Charger failure, battery badly charged
- Discharged battery
- Aged battery
- Cell/cells in short circuit
- Poor or no commissioning after storage
- Electrolyte pollution

Consequence

- Reduced operation time
- Failure detection and prevention
- Control charging system
- Cut off the loads, if the truck or locomotive is not in service
- Contact Microtex for further advise.

#### 5.2 Abnormal water consumption

Probable cause

- Charger failure or incorrect setting of gassing voltage.
- Cell/cells in short circuit
- Electrolyte leakage
- High environmental temperature

Consequence

- Drying out of cells
- Heating of the battery
- Higher risk of hydrogen ignition

Failure detection and prevention

- Control charging system
- Check temperature
- Check electrolyte level
- Check battery voltage and individual cell voltage
- Clean the battery crate
- Replace cell if required

#### 5.3 Battery overheating

Probable cause

- Cell/cells in short circuit
- Loose connections
- High environmental temperature

Consequence

- Lower operation time
- Fire and smoke evolution
- Failure detection and prevention
- Routine maintenance
- Control charging system
- Check electrolyte level

## 5.4 Ground fault indication

Probable cause

- Earth leakage current through electrolyte spillage and or metallic dust
- Metallic pieces between cell and crate
- Damaged crate

Consequences

- Local heating, fire and smoke evolution
- Reduced operation time

Failure detection and prevention

- Clean the battery and the battery compartment
- Change any damaged cell or damaged tray



**Consult Microtex Energy Pvt. Ltd.,  
for  
Battery Charger size selection  
and  
Annual Maintenance Contract**

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