

Important: Please read this manual immediately on receipt of battery before unpacking and installing. Failure to comply with these instructions will render any warranties null and void.

	Observe the written Instructions.
	Do not smoke; avoid naked flames, sparks and other sources of ignition.
	Wear eyes protection.
	Clean all acid splashes in eyes or on skin with plenty of clean water. Then seek medical help. Acid on clothing to be washed with water.
	Electrical hazard.
	Explosion or fire hazard. Avoid any short circuit. The metal parts of the battery are always alive. Do not place tools or items on top of the battery.
	Electrolyte is highly corrosive.
	Danger. Cells and monoblocs are heavy. Always use suitable handling equipment for transportation.
	Re-cycle scrap batteries. Contains lead.
<p>Handling MASTER BATTERY TF & FTS batteries are supplied in a charged state and must be unpacked carefully to avoid very high short-circuit currents between terminals of opposite polarity. Use lifting hooks compatible with the plastic handles on the cell/monobloc.</p> <p>Keep flames away In case of accidental overcharge a flammable gas can leak off the safety vent. Discharge any possible static electricity from clothes by touching an earth connected part.</p> <p>Tools Use tools with insulated handles. Do not place or drop metal objects on the battery. Remove rings, wristwatch and articles of clothing with metal parts that may come into contact with the battery terminals.</p>	

- 6 months at 20°C
- 3 months at 30°C
- 1.5 month at 40°C

A refreshing charge shall be performed after this time at 2.27-2.29 Vpc at 20°C for 48 to 96 hours. A current limit is not essential, but for optimum charge efficiency the current output of the charger can be limited to 10% of the 3 hour capacity rating.
The necessity of a refreshing charge can also be determined by measuring the open circuit voltage of a stored battery. Refreshing charge is advised if the voltage drops below 2.12Vpc. Failure to observe these conditions may result in greatly reduced capacity and service life.

4. Installation

Install batteries in a clean and dry area. The TF & FTS battery products release minimal amounts of gas during normal operation (gas recombination efficiency > 97%). Batteries must be installed in accordance with standards (for instance EN 50272-2), otherwise in accordance with the manufacturer's instructions.

• Temperature

Avoid placing the battery in a hot place or in front of a window. The battery will give the best performance and service life when working at a temperature between 20°C and 25°C. The usual operating temperature is between -10°C and +45°C. Limits are comprised between -30°C and +45°C.

• Ventilation

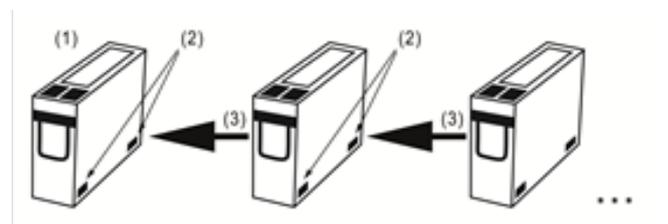
Under normal conditions gas release is very low and natural ventilation is sufficient for cooling purposes, enabling TF & FTS batteries to be used safely in offices and with electronic equipment. However care must be taken to ensure adequate ventilation when placed in cabinets. Batteries must not be placed in close cabinets.

• Mounting

MASTER BATTERY approved battery racks or cabinets are recommended when installing the cells. Assemble the rack according to instructions. Place the battery blocks or cells on the rack and arrange the positive and the negative terminals for connection according to the wiring diagram. Assure 10 mm air gap between units and between units and cabinet walls for proper airflow. The gap between the units is guaranteed by proper installation of the spacers and connectors provided by MASTER BATTERY. Check that all contact surfaces are clean and apply the block or cell connectors and the terminal screws, only provided by MASTER BATTERY. Use the provided grease to protect the terminals. Finally connect the battery terminals and fix the connector covers.

Mounting of spacers instruction (step-by-step):

- (1) Position the first battery in the rack/cabinet.
 - (2) Stick the spacers as shown on the picture.
 - (3) Position the next battery (gap guaranteed by the spacers).
- Repeat steps 2-3 until the string is completed.



Torque

Tighten the bolts to the recommended level of 8 Nm. A loose connector can cause problems in charger adjustment, low battery performance, possible damage to the battery and/or personal injury.

5. Connecting strings in parallel

For increasing battery capacity is possible parallel strings connection, if the strings consist of blocks with the same capacity. Using constant voltage chargers and ensuring that the connections made between the charger and the batteries have the same electrical resistance, no special arrangements have to be made for batteries in parallel. Provide that each string is equipped with a circuit breaker or a fuse.

1. Transport

All Batteries to be transported in an upright position. To avoid short circuits, the terminals have to be fully insulated. Batteries without any visible damages are not defined as dangerous goods if they are protected against short circuit, slipping, upsetting or damaging and packed in upright, proper and secure condition onto pallets or in wooden boxes. In case of damaged battery containers, refer to national regulations (dangerous goods).

2. Unpacking and cleaning

It is advisable to unpack all the batteries and accessories before commencing to erect and not to unpack and erect cell by cell.

All cells/units should be handled carefully, as the plastic container can be damaged or broken if allowed to fall. Under no circumstances should they be lifted by their terminal pillars.

All items should be carefully checked against the accompanying advice notes to ascertain if any are missing and also inspected to see whether any are damaged or broken. Should this happen the Sales Department should be consulted.

If unit cleaning is needed, use water damp cloth or a clean cotton or soft-tissue cloth moistened in clean water only. Never use sprays, chemicals, solvents or feather dusters.

3. Storage

Store the batteries in a dry, clean and preferably cool location.

As the batteries are supplied charged, storage time is limited. In order to easily charge the batteries after prolonged storage, it is advised not to store batteries for more than:

6. Charging

• Commissioning charge

Before use, the batteries should be charged at a constant charging voltage (with a charging current limited to 0.1C10) with one of the following method :

- Charge during 96 hours with the floating voltage between 2.27 and 2.29 Vpc in ambient temperature range between 15 to 25°C.
- Charge with the 2.40Vpc boost charge voltage during 24 hours to reduce the commissioning charging period (the battery will then be switched over to float charging, maintain the battery under floating voltage for 24 hours before any discharge test).

If the battery is to be subjected to a discharge test, in this case the test will be performed imperatively after that the commissioning charge has been carried out. Check that the battery is fully charged.

• Float voltage

The recommended float charge voltage is 2.27 volts per cell at 20°C. Usually after 6 months continuous charge at the recommended float voltage, individual cell voltages will stabilize within ±5% of the mean applied voltage.

However, individual cell voltage values outside the above tolerance may be observed without negative effect.

When the average ambient temperature deviates more than ±5°C from the reference temperature (20°C), it is necessary to adjust the float voltage as follows:

Temperature, °C	Float voltage range per cell, V
0	2.33 - 2.35
10	2.30 - 2.32
20	2.27 - 2.29
25	2.25 - 2.27
30	2.24 - 2.26
35	2.22 - 2.24
40	2.21 - 2.23

• Charging current

A discharged VRLA battery will accept a high recharge current, but for those seeking a more economical charging system a current limit of 0.1C10 is adequate. The TF & FTS range batteries accept without damage large charging currents so that only under high battery temperature conditions (T>30°C) a current limitation to 0.3C10 is recommended.

• Fast recharge

Increasing the charge voltage to 2.40Vpc with a current limited to 0.1C10 can reduce recharge times. Fast charge should be stopped after approximately 12 hours. This charge regime, in order to achieve a normal service life, must not be used more than once per month.

• Float charge ripple

Excessive ripple on the D.C. supply across a battery has the effect of reducing life and performance.

The superimposed AC current left should not exceed a value of 5A AC (rms) per 100Ah C10 cell capacity during float charge and 10A AC (rms) per 100 Ah C10 during boost charge.

• State of charge

The battery state of charge can be determined approximately by measuring the open circuit voltage after the battery has been at rest for a minimum of 24 hours at 20°C.

Voltage, Vpc	State of charge
2.14	100 %
2.10	80 %
2.07	60 %
2.04	40 %
2.02	20 %

Open circuit voltage variation with temperature is 2.5mVpc per 10°C.

7. Discharging

The VRLA cells and monoblocs must not be left in a discharged condition after supplying the load, but must immediately return to float recharge mode. Failure to observe these conditions may result in greatly reduced service life.

• Accidental deep discharging

For optimum operation the minimum voltage of the system should be related to the duty as follows:

Duty	Recommended end voltage, Vpc
5 min ≤ t ≤ 1h	1.65
1h ≤ t ≤ 5h	1.70
5h ≤ t ≤ 8h	1.75
8h ≤ t ≤ 20h	1.80

In order to protect the battery it is advisable to have system monitoring and low voltage cut-out.

Deep discharge will produce a premature deterioration of the battery and a noticeable reduction in the life expectancy of the battery.

• The effect of temperature

- on battery capacity

Correction factors of the capacity, according to the temperature, are as follows:

Discharge time	0°C	5°C	10°C	15°C	20°C	25°C	30°C	35°C	40°C
5 to 59 min	0.77	0.83	0.87	0.92	0.96	1	1.02	1.05	1.06
1h to 24h	0.83	0.87	0.91	0.94	0.97	1	1.02	1.03	1.04

- on battery life

Operation of valve regulated batteries at temperatures higher than 20°C will reduce their expected life. Life is reduced by 50% for every 10°C rise in temperature.

8. Monitoring and Maintenance

TF & FTS batteries are maintenance free, sealed, lead acid batteries and need no water addition.

The containers and lids shall be kept dry and free from dust.

Cleaning must be done only with a damp cotton cloth without man-made fibers.

WARNING - Do NOT use any type of oil, solvent, detergent, petroleum-based solvent or ammonia solution to clean the battery containers or lids. These materials will cause permanent damage to the battery container and lid and will invalidate the warranty.

Check monthly that total voltage at battery terminals is (N x 2.27 V) for a temperature at 20°C. (N being the number of cells in the battery). Make annual readings of the voltages of cells making up the battery.

Keep a logbook to record values, power outages, discharge tests, etc.

9. Technical

• Data when charging with a constant voltage

If the charger does not permit an adjustment of the float voltage in relation with the temperature, it is possible to set a float voltage value and a recharging voltage value according to the temperature ranges as indicated in the table below:

Temperature	Float Voltage	Recharging Voltage
0°C to 10°C	2.33Vpc	2.45Vpc
10°C to 20°C	2.30Vpc	2.40Vpc
20°C to 30°C	2.27Vpc	2.35Vpc
30°C to 40°C	2.24Vpc	2.30Vpc