Filling and Charging Moist Charged Flooded Batteries

PowerSafe® OPzS
PowerSafe® TS

EnerSys®
Power/Full Solutions

RESERVE
POWER

Contents

1. Definition of moist charged batteries

A moist charged battery is a wet, fully charged battery that has had the electrolyte removed and has a special, air-tight plug used during storage.

> Do not remove the special air-tight plugs from the moist charged batteries until ready to activate.
> Moist-charged batteries are active and electrically live at all times.
> Do not short terminal posts.

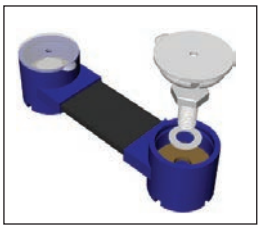
2. Delivery and storage

Cells and accessories are dispatched in wooden boxes. Electrolyte is dispatched in plastic drums which are approved for marine transportation.

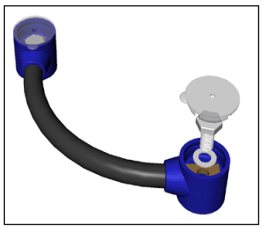
Until ready for use, a moist-charged battery must be stored in a cool, dry and clean location, away from any source of heat and protected from direct sunlight. In those conditions, moist charged cells can be stored for up to 2 years.

Accessories and tools required

Please ensure that all accessories and tools are available before starting the installation of the battery.



Rigid connector + Caps



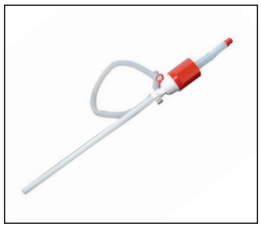
Cable + Caps

Sulphuric acid in plastic drum

Thermometer

Hydrometer

Funnel



Manual filler pump

Tool for air-tight plugs

3. Battery installation

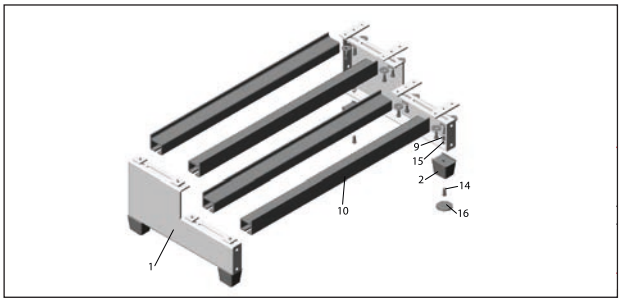
Stand assembly

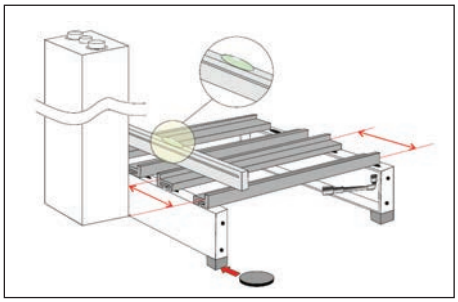
Before starting the assembly of the stand, please ensure that all stand components are available.
For a battery above 150V, insulators will be provided with the stand.

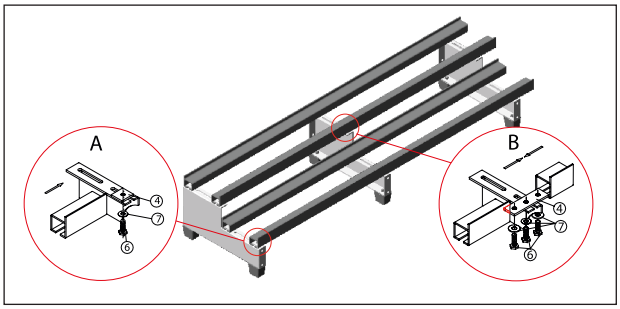
Assembly instructions

Please follow the instructions below in conjunction with the drawings below. To accomplish these operations only a 13mm spanner is required.

1. Mount and fasten insulators with bolts (9), screws (14) and washers (15) under each support (1).
2. Insert bolts (6) into washers (7) into upper slots of support (1), then screw into anchor plates (3) and connections plates (4). Do the same with the other support (see details A and B).
3. Join rails (10) and supports (1). Space rails to the correct width.
4. Tighten all bolts. Cells can now be installed.
5. Please ensure that the stand is levelled using a spirit level. If required, use the spacers provided (16).





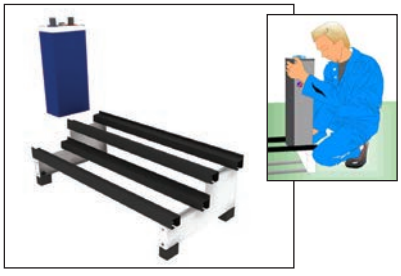


Cell installation

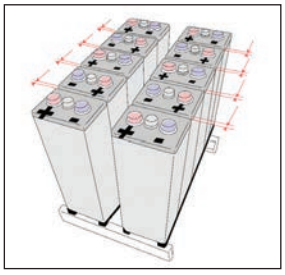
Cells should be connected in series.
Assemble the battery on the stand, ensuring that the positive terminal of one cell is connected to the negative terminal of the adjacent cell and so on throughout the battery.
Do not lift cells by their terminal posts. Use appropriate equipment (such as a raising board and a sling band) for handling standby cells.
Cells are supplied with special air-tight plugs which must be replaced with standard vent plugs (supplied separately) once cells have been filled with electrolyte.
For 4-tier stands and above, we recommend the cells are filled before being placed on the stand.
Note: the maximum fill to charge time is 12 hours (see section 4).

Please follow the instructions below.

1. Position the first cell on the stand, starting with the least accessible row. Check the alignment of the cells.



2. Install the other cells with the appropriate spacing between cells in mind.



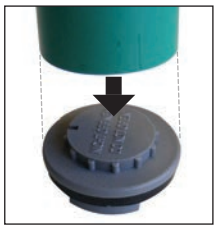
4. Putting cells into service

Filling cells

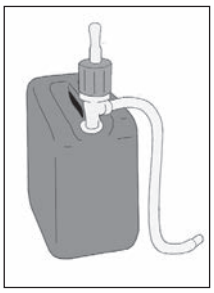
Before removing the air-tight plugs for filling the cells, please ensure that the battery charger is ready for use. Cells should be stored as received and should only be activated (i.e. filled with electrolyte and charged) when installed.

1. Remove the air-tight plugs with the special tool.





2. Fit the manual filler pump to the acid drum. Please ensure that the pump is screwed tightly into the plastic drum. The specific gravity of the filling acid (at 20°C) is 1.280.



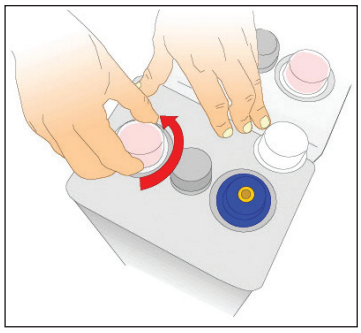
3. Raising the electrolyte drum to a level above the cell will significantly reduce the filling time.

4. Let the cells rest for 2 to 4 hours after filling.

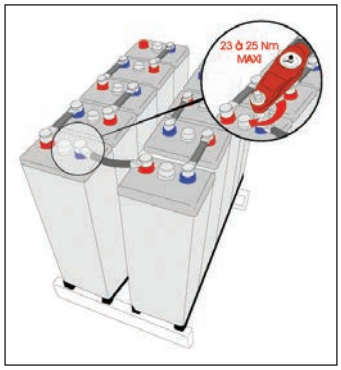
5. Once plates and separators have absorbed the electrolyte, re-adjust, if necessary, the filling level back to maximum. The charge must be started within 12 hours of the initial fill.

6. Place the standard vent plugs on the cells. Do not tighten them at this stage to avoid over-pressuring cells during the charge. Check the polarity with a voltmeter. At this point, the specific gravity will have reduced.

7. Unscrew the terminal protectors. Avoid all short circuits between terminals of opposite polarities.



8. Fit inter-cell connectors. Torque them to 25Nm.



9. After two to four hours, start the charge (see “Initial charge” section) providing the maximum temperature of the electrolyte is as per the table below.

Electrolyte Temperature	Room Temperature
30°C (86°F)	20°C (68°F)
35°C (95°F)	30°C (86°F)
40°C (104°F)	35°C (95°F)
40°C (104°F)	40°C (104°F)

10. When the charge is complete, tighten the standard vent plugs properly. The final specific gravity after charging must be 1.235 - 1.240 at 20°C (maximum level).

Initial charge

The initial charge is very important as it can affect the life and performance of the battery.
Cells must be fully charged before the battery is put into service. Charging must be continued until the specific gravity of every cell reaches between 1.235 and 1.240 at 20°C (maximum level) - see section 5.

Methods of charging	**Constant current** $I = 0.053\ C_{10}$ Example for a battery of 500Ah 500 x 0.053 = 26.5A	**Constant voltage** Voltage per cell: 2.35 Initial current limited to $0.1\ C_{10}$ Example for a battery of 500Ah 500 x 0.1 = 50A
Charging time	Typically 6 to 15 hours, depending upon storage conditions. Long or poor storage will increase the charge time.	
The charge must be stopped	If the temperature of the electrolyte reaches: - temperate climate: 40°C (104°F) - tropical climate: 50°C (122°F) 55°C (131°F) (maximum case)	
When can the charge start again?	When the temperature of the electrolyte is below: - temperate climate: 30°C (86°F) - tropical climate: 40°C (104°F)	
Note	If charging is stopped more than 3 times because of cell temperature rise, please reduce the constant current value. This will simply increase the charge time.	
End of charge	Until all cell voltages and electrolyte specific gravities (corrected to 20°C) cease to rise for three consecutive hourly readings.	
Very important	Long or poor storage will increase the time to charge. Constant current charging is preferable to ensure electrolyte consistency across the cells and a reasonable charge time.	
Cell voltage and specific gravity imbalance	Imbalances are possible after long or poor storage. Example: charging at constant voltage a battery which has been stored in poor conditions, 24 cells in which only 6 cells have been kept in good storage conditions. - charge at constant voltage 2.35 Volts per cell - maxi voltage supplied by the charger 2.35 x 24 = 56.4 Volts - the voltage of the best 6 cells rises quickly to 2.60 x 6 = 15.6 Volts - 18 cells will be in average at 2.26 Volts per cell when the battery voltage reaches 56.4 Volts 2.26 x 18 = 40.8 Volts 56.4 Volts - at 56.4 Volts, the current falls off to a very small value. With this very low float current, the charging time will be longer for the 18 cells at 2.26 Volts. Continue charging until the specific gravity of the electrolyte for all cells rise to the nominal specific gravity at maximum level.	
Note	If the temperature of the electrolyte is below 40°C, it is better to overcharge the battery rather than to keep the battery undercharged.	

Details of charge at constant voltage

The voltage is maintained at a constant fixed value per cell.
If the voltage is limited to 2.30Vpc the battery will not reach the gassing point. Ensuring that the specific gravity of the electrolyte within a cell is consistent will take longer.

Time to equalise the specific gravity

Room temperature			
20°C		35°C	
Charge voltage per cell			
2.25V	2.35V	2.25V	2.35V
Between 4 and 10 days	Between 13 and 30 hours	Between 3 and 7 days	Between 8 and 18 hours

Example:

If the room temperature is about 20°C and the initial charge is carried out at 2.35V, it will take 13 to 30 hours to fully charge the cell.
The table above applies if the specific gravity variance after filling and the rest period is below 0.010.
If the variance is higher than 0.010, the recharge at constant voltage will take longer.
In such case, it is better to recharge the battery at constant current.

Details of charge at constant current (see appendix)

The current is constant troughout the charging period.
The voltage of the battery rises during the charging period, reaching a maximum value when the charge is complete.
This value depends on:

- The charging current
- Temperature: voltage must be corrected by +0.005 Volt per degree above 20°C and -0.005 Volt per degree below 20°C

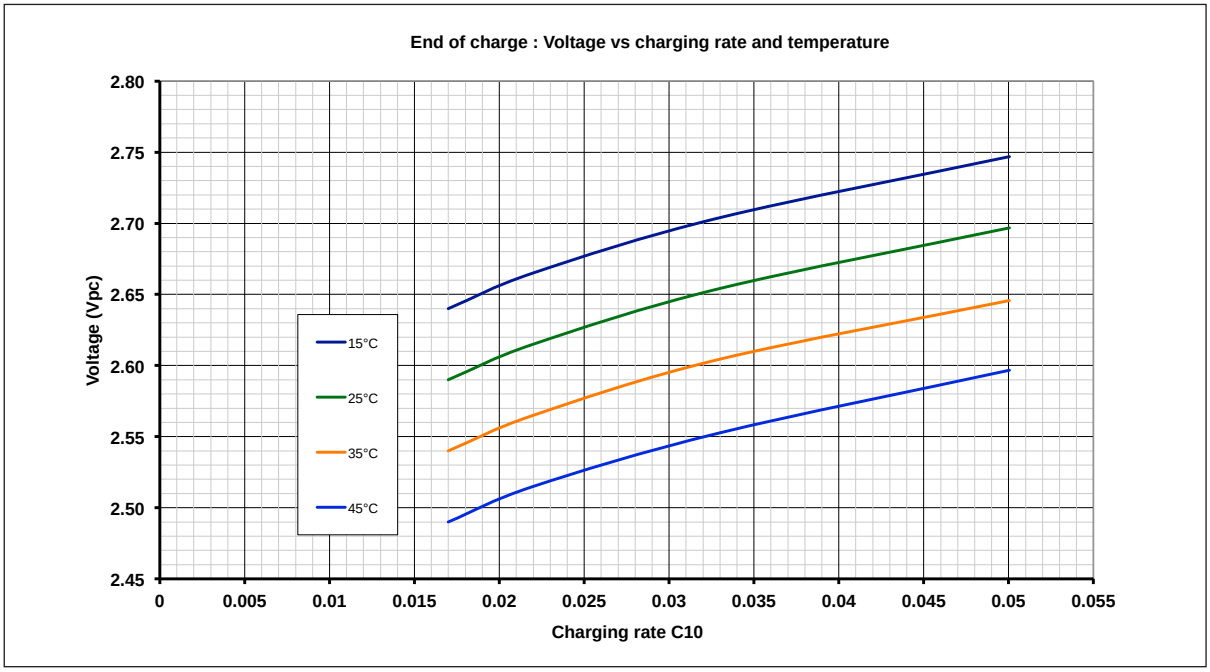
Example:
Read voltage at 27°C = 2.73 Volts
Corrected voltage at 20°C = 2.73 + (7 x 0.005) = 2.765 Volts

What happens at the end of charge?

- The temperature may rise quickly and excessive gassing maybe produced (which homogenises the electrolyte).
- Variation of the voltage at the end of charge of a cell according to temperature and charging rate.

The minimum voltage at end of charge should be as follows:

Charging rate C_{10} capacity	Minimum voltage in volts per cell for			
	15°C	25°C	35°C	45°C
0.05 C_{10} or $C_{10}/20$	2.75V	2.70V	2.65V	2.60V
0.033 C_{10} or $C_{10}/30$	2.70V	2.65V	2.60V	2.55V
0.022 C_{10} or $C_{10}/45$	2.67V	2.62V	2.57V	2.52V
0.017 C_{10} or $C_{10}/60$	2.64V	2.59V	2.54V	2.49V



5. Specific gravity reading

Final specific gravity after charging

The specific gravity (20ºC) of each cell at the end of the charge should be between 1.235 and 1.240 (maximum level).

Temperature correction

Measure the specific gravity with a hydrometer.
After reading, squirt the solution back into the cell from which it was drawn.
The nominal specific gravity at the end of the charge at the specified level is for a temperature of 20°C.
If the temperature is above or below 20°C, the specific gravity reading must be adjusted using the table below.

Specific gravity				
15°C	**20°C**	**25°C**	**35°C**	**45°C**
1.147	1.144	1.142	1.138	1.131
1.167	1.164	1.162	1.157	1.149
1.186	1.183	1.180	1.176	1.168
1.206	1.203	1.200	1.194	1.187
1.217	1.213	1.210	1.204	1.197
1.227	1.223	1.220	1.214	1.207
1.237	1.233	1.230	1.224	1.216
1.244	1.240	1.237	1.231	1.223
1.248	1.244	1.241	1.234	1.226
1.254	1.250	1.247	1.240	1.232
1.259	1.255	1.252	1.245	1.236
1.270	1.266	1.263	1.256	1.247

Example:

If at the end of charge, the specific gravity of the electrolyte reads 1.231 at 35ºC, this is equivalent to a specific gravity of 1.240 at 20ºC. This means that the cell is fully charged.

6. Safety

The battery room should be well ventilated in order to remove gases produced during charging. The gases (a mixture of oxygen and hydrogen) liberated by the cells when on charge may cause an explosion, and therefore, care must be taken not to produce sparks. Naked lights and smoking are not allowed.

The following precautions must also be taken:
During maintenance operations, do not wear clothing likely to create static electricity (for example nylon).
Do not use portable apparatus linked to an electric plug.

All installation practices and ventilation requirements must comply with EN 50272-2 and IEC 62485-2 standards and national regulations.

Safety precautions
Batteries give off explosive gasses. They are filled with dilute sulphuric acid, which is very corrosive. When working with sulphuric acid, always wear protective clothing and glasses. Exposed metal parts of the battery always carry a voltage and are electrically live (risk of short circuits). Avoid electrostatic charge. The protective measures according to EN 50272-2 must be observed.


Note operating instructions.


When working on batteries, wear safety glasses and protective clothing.


No smoking. Do not allow naked flames, hot objects or sparks near the battery, due to the risk of explosion or fire.

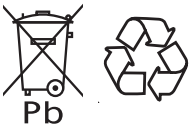

Danger. Cells are heavy. Make sure they are safely installed. Only use suitable transport and lifting equipment.


Electrical hazard.


Electrolyte is highly corrosive.


Risk of explosion and fire. Avoid short circuits.


Wash all acid splash in eyes or on skin with plenty of clean water and seek immediate medical assistance.



Recycling and disposal of used batteries
Used batteries contain valuable recyclable materials. They must not be disposed of with the Domestic waste but as special waste. Modes of return and recycling shall conform to the prevailing regulations in operation at the site where the battery is located.

Warranty
Any of the following actions will invalidate the warranty -
Non-adherence to the Installation, Operating and Maintenance instructions. Repairs carried out with non-approved spare parts. Application of additives to the electrolyte. Unauthorised interference with the battery.

Handling
Vented lead acid batteries are supplied in a moist charged state and must be unpacked carefully to avoid short-circuit between terminals of opposite polarity. The cells are heavy and must be lifted with appropriate equipment.

Discharge any possible static electricity from clothes by touching an earth connected part.

Tools
Use tools with insulated handles.
Do not place or drop metal objects onto the battery. Remove rings, wristwatch and metal articles of clothing that might come into contact with the battery terminals.

7. Appendices

Electrolyte specification

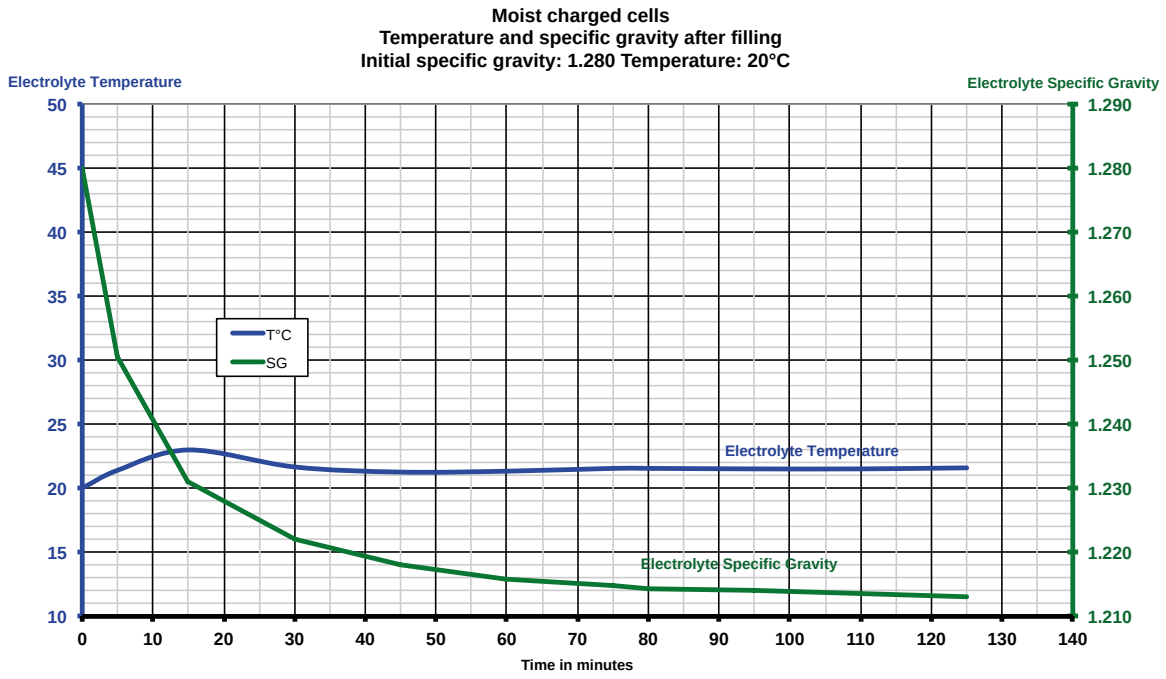
H_2SO_4 dilute sulfuric acid, specific gravity = 1.280

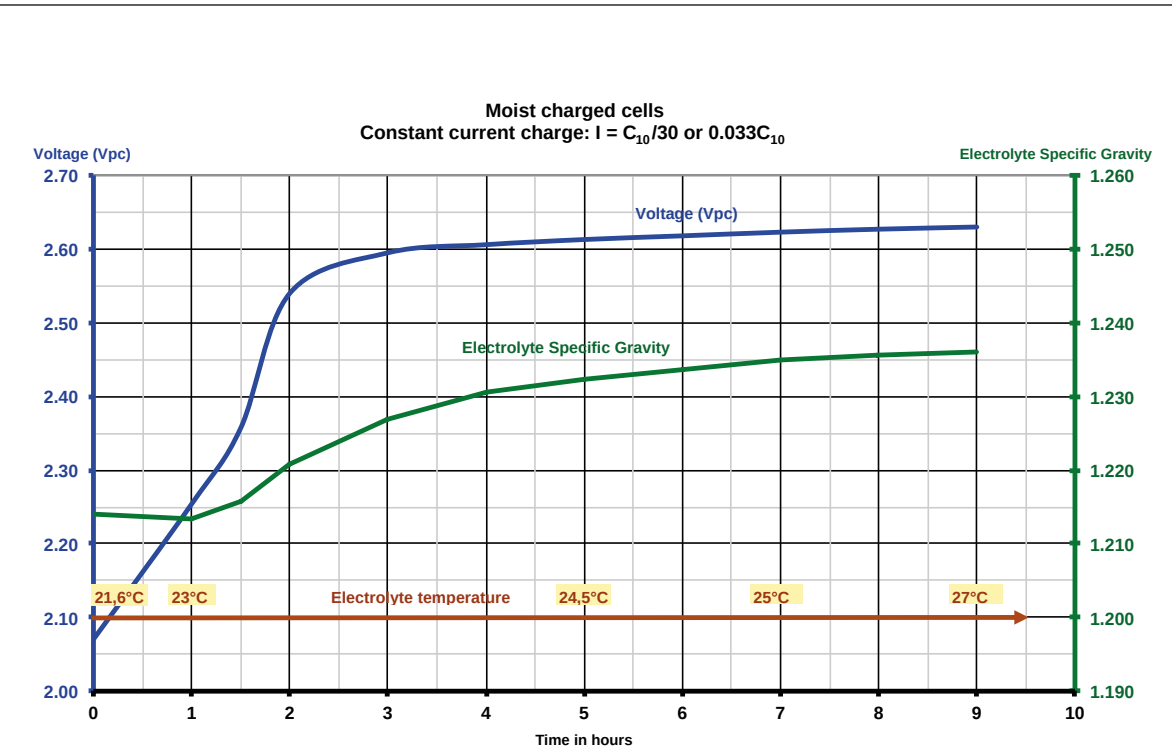
Specific gravity at 20°C	1.280 +/-0.005	
Visual aspect	Clear	
Freezing point	-66°C	
Maximum impurities (mg/l)		
Antimony	Sb	0.4
Arsenic	As	0.1
Copper	Cu	6.2
Sulphur	S	0
Selenium	Se	0.4
Iron	Fe	10.6
Zinc	Zn	2.8
Nickel	Ni	0.4
Cobalt	Co	0.4
Manganese	Mn	0.4
Platinum	Pt	0
Chloride	Cl^-	6.2
Nitrate	NO_3	4.5
Ammonia	NH_3	2.8
Anhydride sulphur	SO_2	4.5
Materials oxydisable to $KMnO_4$	-	25.4

Distilled or de-ionised water specification

Visual Aspect	Clear	
Resistivity	>60 000 Ω	
Maximum Impurities		(ppm)
Iron	Fe	5
Copper	Cu	5
Arsenic	As	1
Antimony	Sb	1
Manganese	Mn	0.1
Nickel	Ni	0.1
Chloride	Cl^-	5
Nitrate	NO_3^-	5
Lead	Pb	0
Zinc	Zn	0
Platinum	Pt	0
Potassium	K	0
Iodine	I	0
Bromide	Br	0
Phosphate	PO_4^{2-}	0
Sulphate	SO_4^{2-}	0
Ammonia	NH_4	8
pH	-	4 to 7
Dry residue at 110°C (a)		350ppm
Dry residue at 500°C (b)		250ppm
Organic matter (a) – (b)		100ppm
Total hardness: total hardness expressed as calcium carbonate (calcium + magnesium)		1°F = 10ppm

Typical charge curves





Initial charge record sheet

This record sheet must be completed during the initial charge.

Battery title:	
Battery type:	
Installed at:	Date installed:
Charge current (A):	

	Time (H) =			Time (H) =			Time (H) =			Time (H) =		
	Amps (A) =			Amps (A) =			Amps (A) =			Amps (A) =		
Cell No.	Volts (V)	Specific Gravity	Electrolyte Temp (°C)	Volts (V)	Specific Gravity	Electrolyte Temp (°C)	Volts (V)	Specific Gravity	Electrolyte Temp (°C)	Volts (V)	Specific Gravity	Electrolyte Temp (°C)

Comments:

Engineer's name:	Date:

8. Notes

Notes

Notes

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