EXIDE
INDUSTRIAL

# Motive Power Batteries Installation and Maintenance Instruction

EXIDE INDUSTRIAL

Contents

Chapter 1:

1. Safety information about the product:

Caution:

This battery system generates highly explosive hydrogen which remains inside the cell for quite some time after the charging has been stopped. Do not smoke or bring a open flame or create spark in the vicinity of a battery.

Batteries contain sulphuric acid which can cause severe burns, so use protective items like apron, gloves, gumboot, goggles when working on a battery.

Flush with tap water if acid comes in contact with body parts and seek medical attention immediately.

Avoid short-circuit of battery  it can lead to explosion.

Do not allow any foreign material to go into the battery. Vent holes shall be kept closed with the vent plugs and the flip top lid shall be opened for taking hydrometer reading or adding water.

2. Safety instructions provided with the help of labels on the product for ease of understanding.

a)  It is recommended that safety instruction label with the help of pictures printed on labels be attached on the product for facilitating the understanding of the people handling the product.

Instructions on Do's & Don'ts may also be provided in text form on the label

A sample label is attached.

| Sl. No. | Symbol | Description |
|---|---|---|
| 1 |  | Follow user instructions |
| 2 |  | Wear protective<br>clothing.<br>Safety glass<br>Rubber hand gloves<br>Apron<br>Gumboots |
| 3 |  | Electrolyte is highly corrosive. |
| 4 |  | Risk of explosion, avoid short-circuits. |
| 5 |  | Avoid open flames and sparks. |
| 6 |  | Run-down accumulators must be recycled. |

EXIDE INDUSTRIAL

## DO's:

- ✔ Match the battery to the correct charger based on the manufacturer's specification. Incorrect charger can shorten the life of your battery.
- ✔ Recharge the battery daily unless the battery has been lightly discharged through under utilisation.
- ✔ Lift the battery compartment lid while charging to assist ventilation and air-cooling.
- ✔ Use only approved distilled or de-ionised battery water to top up the battery. Impurities in tap water can will have a deteriorating effect on the life of the battery.
- ✔ Keep the battery & tray clean and dry at all times.
- ✔ Keep all metal connections & bolted terminals tight and covered with a film of petroleum jelly.
- ✔ Check the condition of charging plug, socket & cable for wear and damage to insulation and burning of contacts.

## DON'TS:

- Leaving the battery in a discharged state for more than one day.
- Overcharging the battery by recharging more frequently or for longer periods than required to restore the capacity used.
- Removing the cell vent plugs when charging.
- Over-top the cells with battery water. Top up electrolyte with battery water to slightly above the separator level as shown in the fig. Over-topping causes the acid to spill out during charging.
- Using metal vessels or jugs to store or dispense battery water or acid.
- Adding acid to the cells.
- Tamper with the chargers. Any necessary setting or repair should be undertaken only by qualified personnel.

## Material Safety Data Sheet:

| A. Product & Company Identification: | |
|---|---|
| Product identity: Lead acid battery | Manufacturer's name: Exide Industries Limited<br>Address: 59E,Chowringhee Road<br>Kolkata 700020<br>Tele: 91 33 2283 2120 / 2133 / 2136 2150 51 / 2171 / 2238 - 39 |

B. International Maritime Goods Code (IMDG) for wet filled charged lead acid battery:

1. Shipping name of the product: Lead acid battery, wet, filled with acid.
2. Hazardous class: Class 8
3. UN identification: UN2794
4. Packaging group: III
5. Identification label: Corrosive

Composition Information of Ingredients:

| Component | Hazardous | % By weight | CAS Number | OSHA PEL | ACGIH TLV |
|---|---|---|---|---|---|
| Lead | Yes | 40 + / - 10 | 7439-92-1 | 0.05mg/m3 | 0.05mg/m3 |
| Sulphuric Acid | Yes | 22 + / -10 | 7664-93-9 | 1.00mg/m3 | 1.00mg/m3 |
| Antimony | Yes | 2 + / - 1 | 7440-36-0 | 0.50mg/m3 | 0.50mg/m3 |
| Arsenic | Yes | < 1 | 7440-38-2 | 0.50mg/m3 | 0.01mg/m3 |
| Copper | Yes | < 1 | 7440-50-8 | 1.00mg/m3 | 1.00mg/m3 |
| Lead dioxide | Yes | 27 + / - 5 | 1309-60-0 | 0.05mg/m3 | 0.15mg/m3 |
| Lead sulphate | Yes | < 1 | 7446-14-2 | 0.05mg/m3 | 0.15mg/m3 |
| Non-hazardous component | | | | | |
| Polypropylene copolymer | No | 6 + / - 2 | 9003-07-0 | N/A | N/A |

D. Physical & Chemical Characteristics:

Electrolyte (Sulphuric acid)

Solubility in water: Completely soluble

Appearance & odour: Clear, odourless, colourless

Specific gravity (H2O=1): 1.130 1.320

Boiling point: Approximately 235 deg C

Vapour density (Air = 1): N/A

Evaporation rate (Butyl acetate =1): less than 1.0

Vapour pressure (mm Hg ): 13

Melting point: N/A

E. Reactivity Data:

Stability: Stable

Condition to avoid: Prolonged overcharging, sources of ignition

Incompatibility (Materials to avoid): Sulphuric acid: Contact with combustibles and organic materials may cause fire and explosion. Also reacts violently with strong reducing agent, metals, strong oxidizers and water. Contact with metals may produce toxic sulphur dioxide fumes and may release flammable hydrogen gas.

Hazardous decomposition of By-Products: Sulphuric acid: Excessive overcharging or fire may create sulphur trioxide, carbon monoxide, sulphuric acid mist, sulphur dioxide and hydrogen.

Lead compounds: Contact with strong acid or base or presence of nascent hydrogen may generate highly toxic arsine gas.

F. Fire & Explosion Hazard Data:

Flash point method used: Non Flammable
Extinguishing media: Class ABC extinguisher, $CO_2$
Flammable limit for *Hydrogen gas generated during charging: LEL 4% HEL 74%
Special firefighting procedures: Cool exterior of battery if exposed to fire to prevent rupture. The acid mist and vapour in a fire situation are corrosive. Wear special respiratory protection and clothing.
Unusual fire and explosion hazards: *Hydrogen gas, which may explode if ignited, is produced by this battery, especially when charging.
Use adequate ventilation avoid open flames, sparks, or other sources of ignition

G. Health Hazard Data:

Note: Under normal condition of battery use, internal components will not pose a health hazard. The information provided hereafter for battery electrolyte (acid) and lead for exposure that may occur during battery production or container breakage or under extreme heat conditions such as fire.

Carcinogenicity:

Sulphuric acid: The International Agency for Research on Cancer (IARC) has classified “ strong inorganic acid mist containing sulphuric acid as a category I carcinogen, a substance that is carcinogenic to human beings. This classification does not apply to liquid form of sulphuric acid contained within a battery.

Inorganic acid mist (sulphuric acid mist) is not generated under normal use of this product. Misuse of the product such as overcharging, may result in the generation of sulphuric acid mist.

Lead compounds: Lead is listed as a 2B carcinogen, likely in animals at extreme doses. Proof of carcinogenity in human being is lacking at present.
Arsenic: Listed by IARC, OSHA and NIOSH as a carcinogen only after prolonged exposure at high levels.

Signs and symptoms of exposure : Acid contact may cause irritation of eyes, nose and throat. Breathing of mist may produce respiratory difficulty. Contact with eyes and skin causes irritation and skin burns. Sulphuric acid is a corrosive chemical.

Medical condition generally aggravated by exposure: Sulphuric acid mist exposure may aggravate medical conditions such as pulmonary edema, bronchitis, emphysema, dental erosion and tracheobronchitis. Pregnant women and children must be protected from lead exposure.

Emergency and first aid procedures: Sulphuric acid.

a) Flush contacted area with large amounts of water for at least 15 minutes. Remove contaminated clothing and obtain medical attention if necessary. Emergency shower should be readily available.

b) If swallowed, give large volumes of water. Do not induce vomiting, obtain medical treatment.

H. Precautions for Safe Handling and Use:

Steps to be taken in case material is released or spilled:
Sulphuric acid: Contain the spill with sand & soil and collect the acid absorbed mass of soil and sand in water tight container and send to authorized waste management agent. Then wash the spilled area with dilute water solution of neutralizing agent like sodium bicarbonate or soda ash or lime and finally with tap water. When exposure level is not known, wear NIOSH approved positive pressure self-contained breathing apparatus.

Waste disposal method: Lead acid batteries are completely recyclable. Dispose off any collected material in accordance with State or Federal regulations.

Precautions to be taken in handling and storage: Store away from reactive material as defined in section D

Other precautions: Sodium bicarbonate, soda ash, sand, or lime should be kept in same general area for emergency use. Keep away from sources of ignition during charging refer section E on generation of hydrogen gas. If a battery case is broken, avoid direct contact with internal components.

I. Ecological Information:

AQUATIC TOXICITY

Sulphuric Acid : Toxic to fish & Algae. Concentrations of 100% sulphuric acid greater than 1.2mg/L may be lethal to fish
Lower 'pH below about 4 would induce fatalities in aquatic life.

Lead compounds: No specific data

J. Control Measures:

Respiratory protection: Respirator required when PEL is exceeded or employee witnesses' respiratory irritation. (Refer section F Health hazard data)
Ventilation: Must be provided when charging in an enclosed area.
Mechanical: Acceptable at 1 to 4 air exchanges per hour or to maintain air concentrations below the PEL.
Local exhaust: Preferred
Other: Local building / fire codes may require explosion proof fans and equipment.

Do not flush lead-contaminated acid into sewer. Do not release un-neutralized acid.

Protective gloves: Acid resistant
Eye protection: Preferred safety glasses, goggles, face shield
Other protective clothing or equipment: Acid resistant aprons, boots and protective clothing.

K. Other Regulatory Information:

| NFPA Hazard rating | Sulphuric Acid | Lead |
|---|---|---|
| Health (Blue) | 3 | 3 |
| Flammability (Red) | 0 | 0 |
| Reactivity (Yellow) | 2 | 0 |

Rating scale 0 = Insignificant, 1 = Slight, 2 = Moderate, 3 = High, 4 = Extreme

Note: Concentrated sulphuric has very high affinity for water. When preparing dilute acid from concentrated acid “ Always add acid to water and never water to acid “ In the second case the whole acid will bump up leading to an explosive situation and causing accident and damage to persons and object.

EXIDE INDUSTRIAL

Chapter 2:

Principle of operation for lead acid battery :

Introduction:

a) Lead acid battery stores electrical power in chemical form and consists of multiple cells.
b) Each cell comprises of two dissimilar compounds of lead immersed in dilute sulphuric acid.
c) In its fully charged state, the active material of the positive plate consists of lead di-oxide and that of the negative plate is porous or spongy lead.
d) A lead acid battery is a “secondary battery ” which means that it can be discharged and recharged a number of times before reaching the end of its service life.

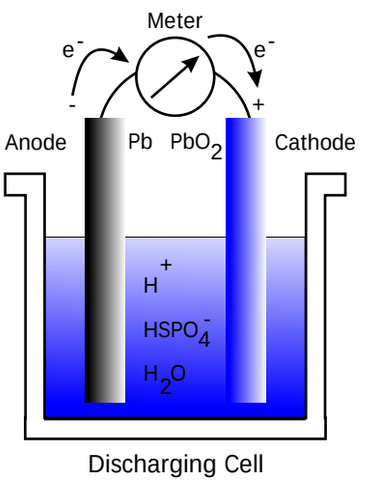
The above charge and discharge process is represented by the chemical formula given below

$$Pb + PbO2 + 2\,H2SO4 \xrightarrow{\text{Dch}} 2\,PbSO4 + 2\,H2O \qquad E_{cell} = 2.0V$$

$$\xleftarrow[\text{Cha}]{}$$

Discharge:

a) When a cell is discharged, sulphuric acid reacts with the active material on the positive and negative plate. From the reaction on the spongy lead of the negative plate electrons are liberated whilst -



Discharging Cell

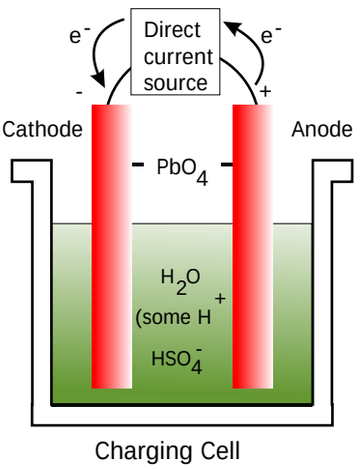
electrons are absorbed by the reaction on the lead di oxide on the positive plate. Consequently a current flows between the two plates

a) Both the plates are gradually converted into lead sulphate while consuming sulphuric acid from the electrolyte..

Charge:

a) When recharged the sulphate in the active material recombine with the excess water in the electrolyte and convert back to sulphuric acid. As a result, the S.G increases back to initial specific gravity

b) Simultaneously the lead sulphate converts to lead di oxide on the positive and spongy lead on the negative plate respectively.



Charging Cell

Gassing:

a) As the cell approaches its fully charged condition, the chemical conversion can no longer absorb all of the charging current. The surplus current results in the liberation of hydrogen in the negative plate and oxygen in the positive plate.
b) This process is commonly known as the gassing and is the primary reason why these cells need regular topping up with water.
c) As traction batteries need to be recharged within 8 12 hours it is essential to pass over the gassing voltage up to 2.65Vpc (This is not applicable for starter batteries and standby batteries). Subject to the condition, temperature and age of the cell gassing normally starts at approx. 2.35Volts per cell.
d) Gassing also has the good effect. It helps to agitate the electrolyte in the cell thereby mixing the heavy sulphuric acid with the water in the electrolyte. This phenomenon is commonly known as stratification.
e) The open circuit of a fully charged cell is approximately 2.13V. During discharge the voltage falls from 2.0V down to 1.7V for traction cells.
f) During charge the voltage will rise from approximately 2.0V to a final value approaching 2.7Vpc for traction cells.
g) The latter voltage is reached when the charging current has dropped to approximately 4-5% of the cell capacity. This is called the end of charge current.

As not all cells are equal its essential that once in every 10 days the batteries receive equalizing charge in order to get the charge condition & specific gravity in every cell the same. This will keep the battery in optimal service condition.

Topping Up with De-Ionised Water:

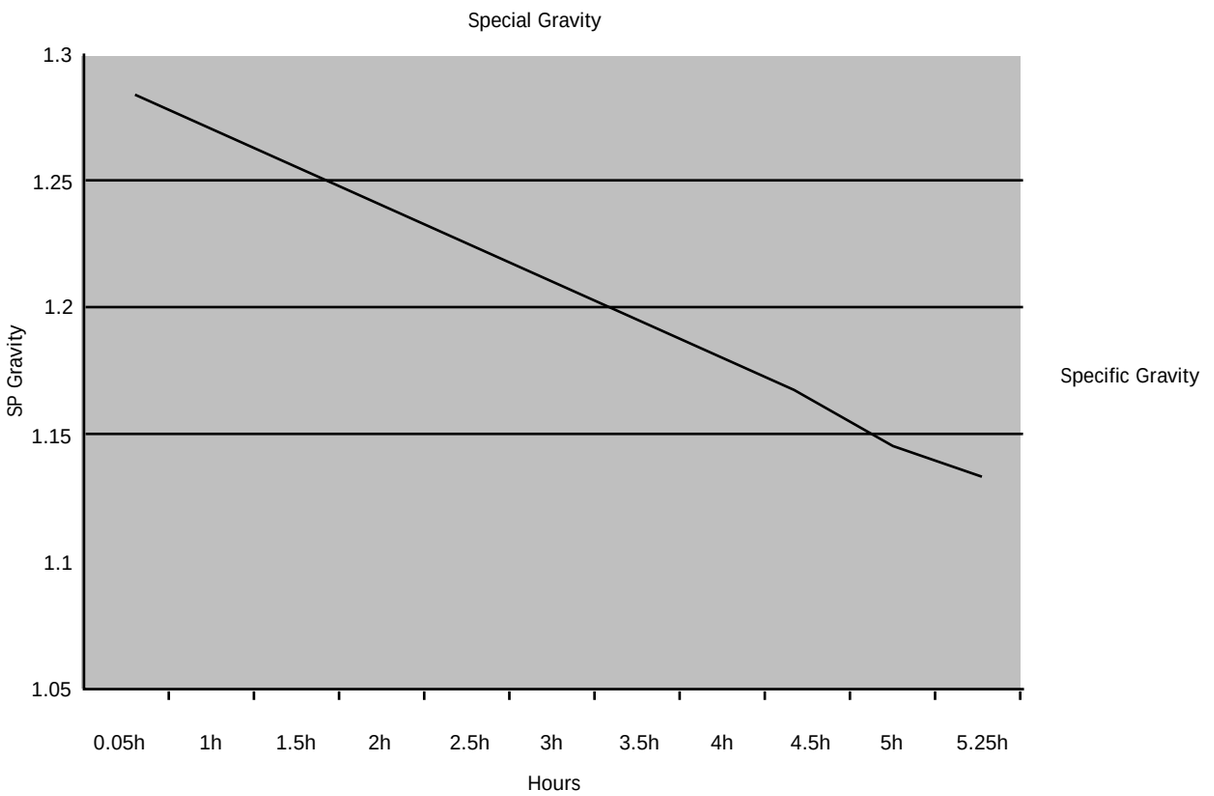
a) A discharged battery should be put on charge immediately.
b) In every cycle water gets decomposed and the electrolyte level decreases. Its essential that you top up the battery with battery grade water.
c) The topping up should be done during charge (once a week) just after the voltage is above the gassing point in order to get a homogeneous mixture of the electrolyte.

Cell Capacity:

a) Cell capacity is depended upon the discharge rate.

b) Motive power batteries are rated at the 5hr discharge rate. This means that a 500Ah battery can be discharged for 5hours at 100A to a cut off voltage of 1.7Vpc.This is the 100 percent depth of discharge condition and the specific gravity of the electrolyte will reach 1.130 level.
c) During discharge in service the battery voltage should not be allowed to drop below 1.84 volt and specific gravity of 1.160 which is the 80 percent depth of discharge condition
d) Higher or lower rates of discharge have lower and higher cut off voltage points respectively.

The extent of discharge is better indicated by specific gravity reading which has a linear relationship to extent of discharge.



EXIDE INDUSTRIAL

Life of the Battery:

a) Battery life depends on many factors of which temperature, quality of topping up water, depth of discharge (80 percent maximum 80 percent depth of discharge is equivalent to 1.160 sp gravity and 1.84 volt per cell voltage reading) proper charging and regular maintenance are of major importance.

b) The cycle life declared by the manufacturer of the battery is achievable if the following conditions are met with. (Reference testing standard IEC 60254 1)

i) Average operating temperature of 38 deg C. If the average operating temperature rises by 10o centigrade above 38o C, the available life of the battery will get reduced by 50 percent.

Remedial action Ambient climatic condition of a geographical location can not be changed and in places having hotter ambient, the life will get reduced. The other reason for high temperature is due to heat build up in the charging process. This is the I2R component in any process of electricity flow. Use of Air circulation in the electrolyte during the charge cycle can be of help. This is an optional kit available on order.Also, higher operating temperature of the battery can be avoided by maintaining multiple battery per truck. 2.5 batteries minimum to 3 batteries per truck is a recommended practice for a 24/7 operation i.e. where the operation is round the clock and for 365 days of an year. This allows the battery to cool down after charging.

ii) Quality of topping up water. Iron, Manganese and Chlorine are poisoning material for lead acid battery and through complex chemical reaction reduces the working life of the battery.
Remedial action Use water in which this chemicals are kept to a minimum level by the process known as distillation or demineralisation . Refer chapter 3 / section ( f ) for purity specification of water.

iii) Depth of discharge exceeding 80 percent of the rated capacity leads to conversion of the active material to an irrecoverable state known as 'reversal'. This is the intrinsic chemistry of the lead acid system and can not be avoided.

Remedial action Use of Battery discharge indicator which gives an alarm to the user that the battery is close to exhausted condition and needs recharging.

iv) Proper charging The wattage of electricity to be fed to the battery will be more than the wattage extracted from the battery in the previous discharge cycle. No system is 100 percent or more efficient as understood from basic thermodynamics of energy work relationship.
Ensure feeding the extra amount over the discharged Ah. With a good design and control over the battery manufacturing process, batteries of height up to 500 mm

nominal should need 15 percent extra. Cells of taller heights will need about 25 percent extra. Without this extra charge, cells in the battery will remain incompletely charged and start accumulating lead sulphate. If a battery continues to accumulate sulphate, at one point of time, it can reach a situation from where the battery will not be able to recover back and will have a permanent loss in capacity. With the age of the battery the requirement of the extra amount of charge will increase to bring back the battery to fully activated condition.

Remedial action  Select a matching charger for the battery. Take help of the dealer or the manufacturer of the battery in identification of the charger rating to ensure its suitability for the purpose.

Maintain records for the charge and discharges. Data-loggers are available now, which can log data and later on down load to computer files. Or else, manual record of the charge / discharge and other parameters of the battery be maintained and act based on the observation.

Equalising charge  In the previous paragraph, the charging inputs mentioned can be called as service charge, which is provided in between discharges. Equalising charge is basically an extended charge at a low current after the service charge, provided to bring all the cells in a battery to an equal condition of charge. Batteries should be equalised  based on the difference noted in specific gravity in the cells after charging . A new battery is expected to work with equalisation done once a month and the frequency will increase with age of the battery and may be required to be equalised once a week at the later stage.

v)  Overcharging  During the charging process , the positive plate support of the battery gets corroded. This is an unintended reaction but can not be avoided intrinsic of the lead acid battery system. Only excessive, unnecessary corrosion process can be avoided by monitoring the charging process. Use of regulated chargers will be beneficial.

Remedial action  Manual or automatic monitoring of the charging process and termination has to be done. For lead acid battery, specific gravity of the electrolyte is the best indicator for monitoring the charge as it has an almost linear relationship with extent of charge.Charging shall have to be terminated when there is no further increase in specific gravity ie all the sulphates in the plate is released back in the electrolyte. Automatic chargers have microprocessors, which calculate the derivative of the battery voltage with time and stops the charging process when the increase is found to be zero or insignificant. These chargers are known to have dv/dt function to terminate charge.

Note: The maintenance of lead acid battery being a specialized job ,users are advised to avail service from the expert. Manufacturers and their dealers offer service package in form of 'Annual Maintenance Contract', which may be availed to get better life out of the battery.

battery will not be able to recover back and will have a permanent loss in capacity. With the age of the battery the requirement of the extra amount of charge will increase to bring back the battery to fully activated condition.

Remedial action  Select a matching charger for the battery. Take help of the dealer or the manufacturer of the battery in identification of the charger rating to ensure its suitability for the purpose.

Maintain records for the charge and discharges. Data-loggers are available now, which can log data and later on down load to computer files. Or else, manual record of the charge / discharge and other parameters of the battery be maintained and act based on the observation.

Equalising charge  In the previous paragraph, the charging inputs mentioned can be called as service charge, which is provided in between discharges. Equalising charge is basically an extended charge at a low current after the service charge, provided to bring all the cells in a battery to an equal condition of charge. Batteries should be equalised  based on the difference noted in specific gravity in the cells after charging . A new battery is expected to work with equalisation done once a month and the frequency will increase with age of the battery and may be required to be equalised once a week at the later stage.

v)  Overcharging  During the charging process , the positive plate support of the battery gets corroded. This is an unintended reaction but can not be avoided intrinsic of the lead acid battery system. Only excessive, unnecessary corrosion process can be avoided by monitoring the charging process. Use of regulated chargers will be beneficial.

Remedial action  Manual or automatic monitoring of the charging process and termination has to be done. For lead acid battery, specific gravity of the electrolyte is the best indicator for monitoring the charge as it has an almost linear relationship with extent of charge.Charging shall have to be terminated when there is no further increase in specific gravity ie all the sulphates in the plate is released back in the electrolyte. Automatic chargers have microprocessors, which calculate the derivative of the battery voltage with time and stops the charging process when the increase is found to be zero or insignificant. These chargers are known to have dv/dt function to terminate charge.

Note: The maintenance of lead acid battery being a specialized job ,users are advised to avail service from the expert. Manufacturers and their dealers offer service package in form of 'Annual Maintenance Contract', which may be availed to get better life out of the battery.

EXIDE INDUSTRIAL

Chapter 3:

Preparing a battery for service:

A. The dry charged batteries are supplied charged and in dry condition without any electrolyte in the cells. (On request , batteries filled with electrolyte and ready to use can be supplied) . Each cell is closed by a transport cap , if supplied in dry condition during the storage to protect the negative plate from oxidation. Store the cells or the battery in a cool and dry place protected from moisture , rain and snow. Do not store more than two years. It is important not to remove the caps.

B. The battery installation and the charging equipment should be inspected to ensure that they are in good mechanical condition. All cables must be connected to ensure a good contact , taking care that the polarity is correct .All threaded connectors in the battery must be checked and tightened in order to ensure a reliable contact. The tightening torque shall be 25 +/- 2 Nm (Newton meter).

If the batteries are of welded connector version , the welding of the connectors shall be done in a safe place away from inflammable items and never in the battery charging floor.

C. If the cells are supplied loose, the battery has to be assembled in battery crate as per layout instructions from the customer .The filling acid shall have to comply to the specification given below.

The maximum limits of impurities in battery grade sulphuric acid and water are as follows.

| Matter | Battery Grade water | Battery Grade 2SO4 |
|---|---|---|
| **Suspended matter** | **Nil** | **Nil** |
| **Iron** | **0.1 ppm** | **14 ppm** |
| **Chlorine** | **1 ppm** | **7 ppm** |
| **Manganese** | **0.1 ppm** | **Nil** |
| **Total dissolved solid** | **2 ppm** | **Nil** |
| **Electrical conductivity at 27 ± 2oC(micro-mho / cm)** | **5 max.** | **Not applicable** |
| **PH** | **6 7.5** | **Not applicable** |

Nominal specific gravity to be obtained after charge is 1.290 at 30 deg C and the filling acid gravity shall be 20 to 30 unit less that is 1.260 to 1.270 at 30 deg C. The temperature of the filling acid shall be within 15 to 30 deg C.
Temperature correction factor for dilute sulphuric acid .

Specific gravity at 30 deg C = Sp gravity at 'T' deg C + (T - 30) X 0.0007

B. Electrolyte LevelRemove the transport caps and fill the cells with the specified acid until the stepped level in the plug basket is reached. Acid resistant filling equipment to be used. Transport caps are not to be used with the cells during charging and during the service of the battery . Once removed from the cells the transport cap shall be destroyed to prevent inadvertent usage which can lead to bursting of cell and cause accident and damage. The transport caps are to be replaced by vent plugs as shown in the picture below or watering plugs.


C. Rest period After filling the cells the battery should stand for a period of 4 hours for impregnation of the plates and separators. During the rest period check the cell polarity with a multi-meter and compare with that on the cell lid. If the multi-meter reads reverse voltage, take out the cell and replace with a fresh cell and report the defect to the manufacturer. Check the tightness of the fasteners. Place the vent plugs with level indicators. Fill in to the level shown in the picture. Connect the end terminal socket on the batteries correctly to the charger socket to avoid reverse charging. The temperature, voltage and specific gravity shall be recorded for all the cells during the commissioning charge at an hourly interval.

D. Commissioning: The first charge of the battery has to be done fully and as far as possible without interruptions. The temperature of the electrolyte must not exceed 55 deg C, and if it does the charging has to be stopped. Resume charge after the temperature comes down by 5 deg C. The completion of the charging is indicated by free gassing in all the cells and three consecutive hourly reading of voltage and specific gravity showing no change. The record for cell voltage specific gravity and temperature for all the cells have to be recorded and preserved.

The battery can be charged at constant current with the current maintained between 6 to 10 percent of the battery ampere hour till the end conditions are reached.

The battery can also be charged with a constant voltage constant current type charger .The battery shall be started in a constant potential charging mode the voltage set at 2.4 volt per cell with an initial limit current setting of 16 percent of battery ampere-hour. The charging switches over to constant current when the voltage reaches 2.4 volt and the current maintained at 6 percent of Battery Ah. The voltage picks up to 2.65 minimum for all the cells and then set at constant potential of 2.65 volt per cell till the current tapers down to 3 percent of Battery Ah. This step can be controlled through timer setting of 3 to 4 hours .The important points to note is that all the cells reaches the end of charge condition.

E. Electrolyte level and specific gravity adjustment. The specific gravity of all the cells are likely to come between +/- 0.010 Kg / L. Allow the battery to cool down and check the electrolyte level and adjust to the level mentioned. If the Specific gravity of the electrolyte is found to be higher than the specification, withdraw some quantity of electrolyte and top up with battery grade water.

F. Spilled acid must be carefully neutralized with neutralizing agent and disposed off according to the prevalent regulation in the country of use. Neutralizing agent should not go into the cells.

EXIDE INDUSTRIAL

Check list for regular checks for lead acid traction battery:

| | | | | | |
|---|---|---|---|---|---|
| Battery voltage & Ah rating: | | | | | |
| Battery serial no: | | | | | |
| Date of installation: | | | | | |
| Check Point | Check date | | | | |
| 1) Battery end terminal connection tightness | | | | | |
| 2) Connections free from sulphation | | | | | |
| 3) Top lead connectors or bolt on connectors protected with anti-sulphuric grease | | | | | |
| 4) Equal level of electrolyte in all the cells | | | | | |
| 5) Specific gravity before putting on charge | | | | | |
| 6) Specific gravity after charge | | | | | |
| 7) Temperature at the end of the charge in pilot cells | | | | | |
| 9) Date of equalising charge | | | | | |

Note: Non-adherence to these battery maintenance instructions nullifies the warranty.