EXIDE INDUSTRIAL

Construction & Maintenance of Exide make Low Maintenance 8Volt 500Ah LM Battery Type

4DS21TF

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Construction of Exide make Low Maintenance 8 Volt 500 Ah, 4DS21TF-LM Battery Complete with Safety, Initial Filling & Charging and Operation Maintenance

1.0 Construction

Rugged Tubular Positive Plates

The Positive Active Material is encased in a one piece, Multi-Tube woven Gauntlet of high tensile acid resistant polyester, with resin impregnated, combines high tensile strength with resilience and enables the electrolyte to penetrate freely whilst acting as an effective retainer for the Active material. It is also capable of withstanding the extreme stresses of expansion and contraction of the active material during regular charge / discharge encountered in service life.

1.1 Positive Spine & Bottom Bar

The Top Frame and Spines of the Positive Plate are High Pressure Casting from a corrosion-resistant low Antimony Lead Alloy. A Bottom Bar of acid-resistant Plastic, seals the tubes at the bottom and locates the spines of the grid.

1.2 Flat Pasted Negative Plates

The Flat Pasted Negative Plates are designed to match the power and long life and efficient service. The Negative active material contains proprietary additives and special expanders for long life and peak power. It is retained firmly in place by sturdy grids designed to lock it in.

1.3 Negative Grid

The casting of lead lattice with special Lead alloy, to form a skeleton, to hold the Active materials of Pasted Plates and carry the current.

1.4 Separators

The life of any battery depends very much on the quality of separators used between the positive and negative plates. The separators used in 4DS21TF are micro porous Polyethylene envelope type, strong, flexible and resistant to heat & acid, which are sufficient for usage with robust Tubular Positive Plates. The electric resistance of the separators is extremely low and electrolyte diffusion is excellent.

1.5 Cell Containers

The container is moulded type of highest quality hard rubber to withstand the toughest service condition, with high insulating strength and resistant to acids. Adequate sediment space has been provided at the base that to prevent bridging short-circuits. The containers hold a large enough electrolyte reserve, so that maintenance interval for the batteries is long.

1.6 Cell Lids

The Cell Lid is moulded of high quality PP and are flanged to form a deep through to provide an effective Heat Seal between lid and container.

1.7 Micro Porous Ceramic Vent Plugs

The vent plugs are threaded plastic plugs with micro porous ceramic dome and a baffle and expansion chamber so that the gases are allowed free passage, but all the acid spray is arrested and returned to the cell.

1.8 Separator Guard

Separator Guard of plastic protects separator while servicing of the cells is being done.

1.9 Pillar Sealing High Quality Rubber Grommets

Pillar Sealing – with high quality Rubber Grommets effectively seals all the pillars with the Lids.

1.10 Terminals

Terminals are Lug type (suitable for bolted connections) of Antimonial lead is provided on the cells.

2.0 Terminology

2.1 Ampere (AMP)

The Ampere is the unit of measurement of electric current.

2.2 Ampere – Hour (Ah)

The unit of measure of battery capacity : for example, a battery rated at 500 Ah at 10 hours rating can supply 50 Ampere for 10 hours.

2.3 Capacity

The total ampere-hours tha the battery is capable of supplying at specific rate before the voltage falls below the specified minimum. The slower the rate of discharge, the greater is the capacity of the battery, and vice versa. Capacity is always measured in ampere-hours.

2.4 Circuit

An electric circuit is the path of any electric current. A closed circuit has a complete path. An open circuit has a broken or disconnected path.

2.4.1 Series Circuit

The current to flows through one path in a series connection. Batteries are arranged in series are connected with the Negative of the first to Positive of the second; Negative of the second to Positive of the third & so on. When 8 numbers 4DS21TF-LM batteries are connected in series, the nominal voltage is equal to the sum of the 32 cell voltages or 64-Volt.

2.4.2 Parallel Circuit

The current to flow in more than one path in a parallel connection. A parallel arrangement of batteries (usually of like voltage and capacity) would have 2 to 3 strings all positive terminals connected to a

Positive conductor and all negative terminals connected to Negative conductor. Current balancing is very important.

2.4.3 Short Circuit

A short-circuits of electrical path, usually in a battery/cell. This results in a greater than normal rate of discharge and / or a reduction in cell voltage under load and would not get proper charge, till the internal short-circuit being rectified. In open Idle / open circuit condition the Cells / batteries, will be under self discharging and thus the Voltage & Specific gravity will gradually decrease, if not recharged from time to time or kept under Float condition, the cells will be sulphated.

2.5 Current

The flow of electricity, measured in amperes.

2.6 Volt

The volt is the unit for measurement of electrical pressure.

2.6.1 Nominal Voltage

The Nominal Voltage of Lead Acid Battery is 2 Volts.

2.6.2 Open Circuit Voltage

The voltage of battery when not connected to the system. It is 2.06 – 2.11 Volts per Cell for a fully charged battery.

2.6.3 Top of Charge Voltage

The battery bank when connected to Constant Current Charger at 6% rate of Current, of the Ah capacity of the battery bank. At full charge condition the voltage goes up to 2.75 volts per cell, during reaching full charge condition. The Voltage should be measured without disconnecting the Charger.

2.6.4 Float Voltage

The voltage of battery when connected with the Float Charging. It is normally 2.25 Volts per Cell.

2.6.5 Drop Voltage

The net difference in electrical pressure (Voltage) when in open circuit condition and measured in closed circuit across a resistance or impedance.

2.7 Resistance

The opposition offered by a wire or substance to the free flow of an electric current.

2.8 Corrosion

Corrosion is defined as the destruction of metals or alloys by the surrounding environment through chemical or electrochemical changes. It is noticed on the cells as accumulating of solid sulfates of the iron, copper or other metals, on the terminal area, contributing to poor electical contact.

2.9 Secondary Battery

Battery which can be recharged by passing direct current through it in a direction opposite to that of discharge.

2.10 Cycle

In a battery, a discharge and a recharge is a cycle.

2.10.1 Discharge

When a battery is delivering power, it is said to be discharging.

2.10.2 Electrolyte

Lead Acid batteries use Diluted Sulphuric Acid as the electrolyte. Electrolyte is the electrically conducting medium between the plates. The reaction.

$$PbO_2 + Pb + 2H_2SO_4 \rightleftharpoons PbSO_4 + PbSO_4 + 2H_2O$$

2.10.3 Specific Gravity (Sp. Gr.)

Specific Gravity is the measurement of density of any liquid, e.g. Sulphuric Acid in relation to pure water the Specific Gravity is 1.000. The specific gravity of sulphuric acid in a fully charged 4DS21TF-LM type battery should be 1.250±0.005 at 27°C.

2.10.4 Hydrometer

A float type instrument, housed in a glass barrel used to measure the specific gravity of the electrolyte.

2.11 Element

In a battery, a set of Positive Group and Negative Group assembled with separators is called an **Element**.

3.0 Specification of 4DS21TF-LM Exide make Battery : Table I

Battery Type	Rated Cap at 10 hrs. Rate Ah	Maximum Overall Dimensions of Each Cell			Typical Weight With Acid in Kgs.
		L (mm)	W (mm)	H (mm)	
4DS21TF-LM	500	723±5	200±5	494±5	148±3%

4.0 Initial Filling and First Charge

4.1 Electrolyte

The 4DS21TF-LM batteries are supplied in a dry uncharged condition. These require diluted battery grade Sulphuric Acid of Sp. Gr. 1.215 ± 0.005, corrected to 27°C i.e. the electrolyte for initial filling. This can be prepared by mixing concentrated battery grade Sulphuric Acid (as per IS : 266, Latest Revision) of sp. Gr. 1.840 with Water of approved quality conforming to IS : 1089-1993 / Latest Revision. Alternately, diluted Sulphuric Acid of Specific Gravity 1.215 ± 0.005, at 27°C, conforming to IS : 266-1993 / Latest Revision, is readily available, could be procured and used.

It is important that the acid and the water should be free from harmful impurities like Iron, Arsenic, Ammonia, Nitrates and Chlorides but below the specified limits as per IS : 266-1993 / Latest Revision and IS : 1069-1993 / Latest Revision, respectively.

Table II

Mixing proportion to prepare dilute Sulphuric Acid (Electrolyte) of Specific Gravity 1.215 ± 0.005, at 27°C (For Initial filling) and of Specific Gravity 1.400 ± 0.005, at 27°C (for adjustment of Service Specific Gravity after Initial charging) from Concentrated Battery grade Sulphuric of Sp. Gravity, 1.840, will be as per following :

Concentrated Acid Sp. Gravity	Diluted Final Sp. Gravity	Approx. Proportion (By Vol.) of Sulphuric Acid & Water
1.840	1.400	One part of Acid to 1.5 part of Water respectively
1.840	1.215	One part of Acid to 4 part of Water respectively

4.2 The diluting and mixing of 1.840 acid should preferably be done in Lead Lined MS or Wooden tanks. However, this may be done in Ebonite boxes or Polythene tanks if adequate precautions are taken to regulate the rate of the acid addition to a safe level, which does not generate excessive heat.

4.3 Take the estimated quantity of distilled or de-ionized water & fill in the tank. Then with utmost care add estimated quantity of Concentrated Acid at a very slow rate, while continue to stir with a Plastic or Lead Lined Wooden Paddle, for proper mixing. After complete mixing allow the acid to cool down to the ambient temperature. Stir again, check to Sp. Gravity & Temperature of Electrolyte to ascertain actual Sp. Gravity at 27°C.

NOTE : THAT WHILE PREPARING DILUTE ACIDS, THE CONCENTRATED ACID SHOULD ALWAYS BE POURED INTO THE WATER AND NEVER THE WATER INTO THE ACID.

4.4 Do not allow the acid to come in contact with skin, clothing or any other material, which it might damage. If some acid should, however, get spilled on the skin, rinse promptly with

clear water and wash with soap. Bicarbonate of soda solution (1/2 kg to 5 Litres of water) will neutralise the acid spilled on clothing or other materials. Apply until bubbling stops and then rinse with clear water.

4.5 In our country, the standard temperature for measuring specific gravity of any electrolyte is 27°C. As such, if the electrolyte temperature differs from this reference temperature while taking specific gravity readings with a hydrometer, the readings require correction.

For every 10°C above 27°C, add 0.007 or seven points to the specific gravity reading on the hydrometer and for every 10°C below 27°C, subtract 0.007 or seven points from the readings.

5.0 Initial Filling

5.1 Check the batteries for any damages / cracks, clean dry, then remove the vent plugs and fill the cells, with the previously prepared and cooled electrolyte, to max level.

5.2 Smear Petroleum Jelly on all the Inter-Cell Connectors, Terminal take-Offs and the Fasteners before starting of filling acid, to avoid corrosion.

5.3 The approximately quantity of electrolyte per cell will be 6.3 Litres of 1.215 ± 0.005 Specific Gravity for initial fillings are given in Table-III.

5.4 After filling, check the polarity of Cells and allow the cells to rest for a period of around 12 hours but not more than 24 hours.

5.5 During the rest period there will be some fall in the level of electrolyte and Specific gravity. Restore up to maximum level with more 1.215 ± 0.005 Sp. Gravity electrolyte, before putting the cells on first charge.

5.6 Now the batteries are ready for first charge.

6.0 Table III – Relevant Data for Initial Filling & Charging

Cell Type	Electrolyte for initial filling Litres / Cell Approx. quantity	Initial Filling Sp. Gravity at 27°C	First Charge		Electrolyte Final Sp. Gr. 27°C
			Constant Current DC Amps	Minimum Duration in Hours (Approx.)	
4DS21TF-LM	6.3	1.215 ± 0.005	To Charge at 30 Amps DC continuously till end of charge. Total Ah input should be min. 2500 Ah to 2700 Ah	84 to 90	1.250 ± 0.005 (Sp. Gravity to be adjusted to as the above mentioned Sp. Gr. at the end of full charge of cells.)

N.B. Rest period of 12 hours, but not more than 24 hours to be given after acid filling. To fill in acid again to make up to maximum level.

During charging the temperature of electrolyte should not exceed 50°C.

7.0 First Charge

7.1 The initial first charge consists in passing a current into the battery for a number of hours as recommended by the battery makers. It is very important that the instructions regarding initial charge be closed followed, as this charge service to complete starts it's life in the best possible condition so that it is capable of giving rated capacity and satisfactory performance from the moment it goes into service.

7.2 Select a D. C. Source of 50% higher voltage and current capacities as compared to the battery voltage and maximum current requirement. Connect the positive of the source to the Positive of the cell / battery as marked on the terminals and Negative to the Negative of the cell / battery also as marked on the terminals.

7.3 The recommended first charge current is 30 Amps DC, given in Table-III.

The total charge input should be minimum 2500 Ah to 2700 Ah.

7.4 The initial first charge to be continued at 30 Amps DC, Constant Current, up to 2.75 vpc, till the ends of fully charged conditions are fulfilled, i.e. the sulphates are released from the Plates and the Negative Plates are converted to Spongy Pure Lead (Metal). Charging of the cells at the specified rate (30 Amps DC) for minimum 83 hours as indicated in Table-III.

The Indication of Fully State of charged conditions are as follows :

7.4.1 The top of charge voltage will be 2.75 vpc and will be constant for 3 to 4 consecutive hourly readings.

7.4.2 The Specific Gravity will be constant, for 3 to 4 consecutive hourly readings, after the voltage of cells was constant at 2.75 vpc. There may be a differential of Sp. Gravity of the Cells after full charged condition. It is unlikely that all the cells will show same Sp. Gravity after first charge.

7.4.3 All cells should gas freely at 30 Amps DC Constant Current – This indicates that the Plates are saturated and whatever charging current put in causing electrolysis of water in the acid into Oxygen and Hydrogen.

7.4.4 Theoretical calculation of Minimum Ah input given to be checked.

7.5 During the charging it is not advisable to allow the temperature of the electrolyte to exceed 50°C. So should it cross 42°C, reduce the charging rate to half the value and increase time proportionately. If the temperature continues to rise towards 50°C, stop charging immediately and recommend only after the elecrtrolyte has cooled down below 42°C.

7.6 While charging there will be some fall in the level of electrolyte due to loss of water by gassing. Restore this at intervals, say 24 hours by adding required quantity of approved quality of Filling-in Sp. Gravity of Sulphuric acid into the cells.

8.0 Capacity Discharge Test

8.1 After standing on open circuit for neither less than 12 hours not more than 24 hours, after the completion of a full charge of cells, the battery shall be discharged through a suitable resistance at a 50A DC Constant Current at C_{10} discharge rate and the discharge shall be stopped when the closed circuit voltage across the battery terminals fall to 1.80 volts per cell (refer IS : 6848-1979). Under no condition the load current to be varied.

8.2 If the Batteries / Cells fails to meet 100% capacity at first discharge, but above 80 to 85%, further Charge / Discharge cycles to be continued further.

8.3 The Battery to be re-charged at Normal Charging rate at 'Constant Current' immediately after the discharge tests, in line with TABLE-IV.

9.0 Adjustment of Specific Gravity of Cells to 1.250 ± 0.005

9.1 If the Sp. Gr. is higher than specified, withdraw some electrolyte from the cells and replace with equal quantity of water. Charge for about one more hour. Check the Sp. Gr. and repeat, if necessary.

9.2 If the Sp. Gravity is lower, withdraw some (say 100ml) electrolyte and replace wit concentrated acid of Sp. Gr. 1.400 ± 0.005. Charge for about two to four hours. Check the Sp. Gravity. Repeat the process, to keep the Sp. Gravity 1.250 ± 0.005.

NOTE : After adjustment of the Sp. Gravity of the electrolyte, the cells must be gassing freely for a minimum period of two to four hours of charging. This helps in proper mixing of the electrolyte.

10.0 Operation and Maintenance

10.1 Installation

The lead acid cells while operating on Indian Railways, installed in battery boxes suspended from the under-frame of coaches, are subjected to quite strenuous conditions, which include continuous vibrations, temperatures up to 50°C, dust and moisture. Hence ensure the following :

10.1.1 See that the battery boxes are provided with drainage holes at the base. To serve a useful purpose, the exact location of the holes should be at the junction of two or more batteries when installed in the battery box.

10.1.2 See also that the battery boxes are well protected always by a good acid resistant paint both inside as well as outside.

10.1.3 Recommended to place the pre-fabricated FRP Trays on the base of the battery boxes. Wooden plank, of required thickness, impregnated with paraffin wax may also be used in the gaps between the Cells & Cradle. See that the drainage holes are kept open.

10.1.4 Now, place the charged batteries in the battery boxes, referring to the approved agreed upon layout furnished by the Engine manufacturer and Battery manufacturer.

10.1.5 Pack the free space between the battery box and the cells with wooden planks impregnated with Paraffin Wax. This in addition to serving as a secondary insulation suppresses the vibrations to the cells, when the coach is in motion.

10.1.6 Next clean the connecting faces on the cell terminals and connectors. A light buffing with a fine wire brush helps. Due care, however should be taken, not to damage the thin protective lead coating on the connectors.

10.1.7 Smear petroleum jelly on the connecting faces and fastener components.

10.1.8 Complete the mechanical and electrical connections.

11.0 Charging

Discharged batteries should be charged back at the earliest opportunity i.e. no t later than 6 hours after unloading the battery from the coach.

11.1 Bench Charging / Normal Charging

Normal current values for recharging the 4DS21TF-LM batteries on bench. In the Depot / Shed are given in Table IV & V. It is essential that to prevent excessive gassing and temperature rise, the Finishing Rate at 30 Amps DC be selected towards the end of charge, i.e. after the individual cell votage reach 2.36 volts. The battery can be judged to be fully charged, if the voltage at 2.75 vpc and Sp. Gravity readings taken at three to four consecutive hourly intervals remain constant while charging at the finishing rate.

11.2 TABLE IV : Recommended Charging Rates for 'Constant Current' recharge (Normal Charge) :

Cell Type	Normal Recharging Rates
4DS21TF-LM	50 Amps DC Constant Current Charge for 15 hours plus, up to 2.75 vpc. Always better to do at 30 Amps for 25 hours plus, up to 2.75 vpc. Note : If the temperature of electrolyte increases beyond 50 degree Celsius the charging to be suspended, till the electrolyte temperature drops below 45 degree Celsius and continue charging at 30 Amps DC Constant Current, till top of charge voltage 2.75 vpc and Sp. Gravity 1.250 + 0.005. Any lagging cells also require above charge before & after rectification.

11.3 TABLE V : Recommended Normal Charge and 'Equalising Charge' :

Cell Type	Equalising Charge Rate
	If the cell voltage of a battery bank found to be having variation of Specific Gravity and Voltage of cells, working under same charge / discharge cycle condition, it is highly recommended to give an 'Equalising Charge'. Periodical such 'Equalising Charge enhance the life & performance of Cells.
4DS21TF-LM	The process consist of charging the batteries at 30 Amps DC Constant Current charge up to 2.75 vpc and Sp. Gravity around 1.250 + 0.005 at 27 degree Celcius, followed by a Constant Current charge at 15 Amps DC (3% to 4% of rated capacity of cells) for about 16 to 24 hours. During this charge the voltage is not that important, but the Sp. Gravity will further rise and the Sp. Gravity of all cells will be 1.250 ± 0.005 near about same, by this way all the cells will be rejuvenated.

12.0 For operation, it is expected that a voltage regulator setting close to **72 Volts ± 0.5 Volts per bank of 32 cells** would serve the normal routine recharging requirements of Railways under Indian conditions. However, the exact voltage is best decided by a careful analysis of past experience under specific situations.

13.0 State of Charge

When Lead Acid cells are discharged the Sp. Gravity of the electrolyte falls and the fall is proportional to the amount of discharge that has taken place. Table-V provides an approximate relationship between the state of charge and Sp. Gravity reading in case of 4DS21TF-LM batteries can be made use of during actual service to ascertain the state of charge available at any instant.

13.1 Table IV Relation between State of Charge & Sp. Gravity, Corrected to 27°C)*

Cell Type	State of Charge*		
	Charged 100%	**Charged 50%**	**Discharged 100%**
4DS21TF-LM	1.250 ± 0.005	1.180 ± 0.005	1.120 ± 0.005

13.2 Battery Charging on Engines

Constant Potential Charging – on Service :

The proper operation and correct adjustment of the charging supply ensures trouble-free operation and life of the battery. It determines the rate and amount of charge received and thus indirectly it's temperature and water requirements.

The re-charging of the batteries is accomplished with the float charger supplying current to the battery. This current as well as any other current supplied by the battery must be restored to the battery in service.

If sufficient current is not available from the charger, the battery will run down and eventually fail to deliver required power. On the other hand, if more current than necessary is furnished, the battery life will be shortened. It is therefore highly important than the charging is proper for the service required of the battery.

The battery is float charged from a D. C source. The output of which is controlled to keep the voltage at the battery terminals at nominal value of 72 ± 0.5 volts. Under these conditions of constant voltage charging, the battery regulates it's own charging current, with reference to the state of charge.

Under normal conditions, the battery should be in a full state of charge – ready for an emergency discharge. After a discharge, the charging current will be considerably higher.

The value of the charging current, therefore, gives a rough indication of the state of charge, if charging voltage is maintained 72 ± 0.5 volts.

Note : If circumstances arise where the battery needs special charging from an external source, the current required is 50 Amps Constant Current, with a voltage capable of adjustment up to 2.75 volts per cell. The current shall be lowered to 30 Amps with 4DS21TF-LM type batteries, as soon as the start gassing, say 2.36 volts per cell. Continue charging at the finishing rate until the three consecutive hourly constant readings of voltage and Specific Gravity are obtained.

13.3 Charging Voltage

This is controlled by means of suitable regulators. Under ordinary conditions, voltage should be adjusted, as per requirement – the exact value depending upon the service required by the battery. The less the battery is called upon to delivery current, the lower the setting and vice-versa. When properly adjusted, the charger shall bring the battery to a fully charged condition promptly and then furnish only the current to maintain it fully charged. It is, therefore, very necessary that the voltmeter used is accurate. Any deviation from the Standard setting should be corrected immediately as a very small variation in voltage, produces a large variation in current. Using very accurate calibrated instruments should carry out the voltage setting.

13.4 Cleanliness

It is essential that the battery and battery box be always maintained dry and clean. Water or electrolyte spilled over the top of the cells should be wiped off at once. Should any corrosion occur anywhere in the metal work, neutralise the acid over the area with a 5% weight by volume solution of soda or freshly diluted 1:5 Ammonia in Water. Wash with clean water. After that wipe dry the parts and protect from further corrosion by applying a thin layer of Vaseline or Petroleum jelly. Painting it with a good acid resistant paint may also protect the battery box.

13.5 Equalising Charge

During actual operation of the battery, it is always under Constant Potential Charge. Under this condition a few, or all the cells in the set may get under-charged / or different state of charge, due to various reasons, e.g. initial differences between individual cells, causing differences in charge acceptance, or abnormal working conditions causing the battry as a whole to become under-charged.

If the lead acid cell remains under-charged over long periods, the resulting Sulphation in the cells may become so heavy that the cells may go beyond repair. Equalising charge is an extended charge given in order to bring all the cells in the battery bank to a healthy state.

"Equalising Charge" means to charge a battery bank at Constant Current at 6% rate of Ah capacity or 'Finishing Rate' charge up to 2.75 vpc, till fully charged – to continue charging until the Sp. Gravity of the electrolyte and Voltage of all the cells remains constant for three consecutive hourly reading. Then to continue charging at 3% rate reduced Constant Current, for 15 to 24 hours at a regular interval. The interval should be preferably once in a year or as and when the battery banks to be put on 'Bench Charge' due to some reason. The 3% rate current for 4DS21TF-LM battery will be about 15 Amperes.

13.6 Periodic Curative Discharge

A curative charge / Discharge of the cells is recommended at the end of each calendar year in service.

First, charge the batteries. Next, put the batteries on discharge at their rated C_{10} rated capacity at Constant Current. As an example, a battery type 4DS21TF-LM, will be discharged at a rate equal to 50 Amps. Suitable resistance may be used for the purpose. Note down the cell voltages. Stop the discharge when the voltage of any cells reaches 1.80 volts. Finally put back the cells at full charge condition, following the procedure given under 'Bench Charging' & 'Equalising Charge'.

13.7 Storage of Charged Batteries

Any charged batteries, even when idle, losses its capacity gradually with time due to internal losses. If these losses are not compensated for long there will be a permanent loss of capacity, so periodical recharging or keeping under 'Trickle Charge' at 2.25 vpc condition recommended.

Keep the charged cells in a healthy condition, by charging them at regular intervals of 21 to 28 days, as per the procedure given under 'Bench Charging' or under 'Trickle Charge' mode.

13.8 Battery Maintenance

Routine maintenance must take account of the following factors and maintain proper record, which are inter-related and are of equal importance.

i. Charging voltage across the battery
ii. Specific Gravity measurement
iii. Water consumption
iv. Proper cleaning

13.9.1 Inspection & Record

The batteries should not be allowed to over-charge. At the same time it should be ensured that they do not depart from the fully charged condition for the reason that partly discharged battery would not be very reliable source of power in case of emergency.

Systematic inspection programmed and carefully kept records of the operation of the battery and its charging equipment as found at each inspection is one of the best-known methods of controlling

battery maintenance. Symptoms of developing trouble can be quickly detected by regular study of the battery records card and the necessary corrective measures can be taken in time to prevent any serious trouble, which might possibly result in a service failure.

Batteries shall receive regular monthly and annual inspection in addition to any other attention that the user may desire to give or which may be necessary.

13.9.2 Monthly Inspection

Visual inspection should be done to check the signs of overheating, loose connection, Sp. Gravity of Pilot Cells. These should be checked and attended, if required. Battery Bank Voltage to be recorded.

Pilot Cells can be readily identified by selecting any cells, which should be identified, starting from the Positive Terminal end and following a regular routine of moving them, barring the end cells. The pilot cells should be rotated in order to cover all cells of a battery within a reasonable time.

Inspection should be made to see that the battery is being maintained in serviceable condition, checking of Sp. Gravity of Pilot Cells & voltage of Cells / Battery Bank. Ensure that the charging equipment is working order. The inspection should be made immediately upon the arrival of the unit at the inspection point followed by the charging is in progress. Check the level of electrolyte/ fall of Floats level, however topping up is required **once in a six months**.

If possible battery bank voltage should be recorded, while discharging with 50% of the load.

Any cell found lagging / defective should be attended at the earliest. If required inform the manufacturer for assistance. **Never store any battery in discharge condition, always put the battery on charge after discharge or after removing the lagging cells**.

13.9.3 Half Yearly Inspection

13.9.3.1 Immediately upon arrival of the unit check all the points mentioned in the Monthly Inspection, and to check the output of the Alternator charging voltage. Adjust setting if necessary and record the voltage as found and after adjustment, if required. Take specific gravity readings of all cells in a battery bank and record and also tally with the Pilot Cell readings, taken earlier. Check the level of the Floats, Add battery grade water conforming to IS 1069, in all the cells and record the quantity of topping up water per cell.

13.9.3.2 If the water consumption is more in all the cells, check the output of the Alternator / Regulator and read the battery charging voltage. Adjust the setting if necessary and record the voltage & current as found after the necessary adjustment, if required.

13.9.3.3 Measure and record level of electrolyte of each of the pilot cells. It may be possible, excess water loss due to internal short, damages or over-charge due to high setting of Voltage or Current. Corrective measures to be taken immediately.

13.9.3.4 If excessive water consumption in a particular cell / cells noticed, then check the followings :

i. Over heating of Cell / Cells.

ii. Any damages / cracks in the Cell Container & Lid.

iii. Any leakage from the loose Vent Plugs / Float Guide.

iv. Sealing failure of lid or pinhole.

v. Frequency of topping up should be recorded by the respective Railway Depots. If the interval of successive topping up of cells required in less than 6 months, then the matter should be brought to the notice of Exide Industries Limited, with reference to DEL/SPN/193.

13.9.3.5 Check the following :

a. Battery blocking – Proper Fitment of Batteries, with packing in the battery box of the Diesel Loco Engine, arrest movement & thus prevent damages.

b. Inter-unit terminal wiring and bolt, tightly connected without stress.

c. Tightness and condition of vent plugs.

d. Evidence of electrolyte leakage from any source.

e. Cleanliness : Dampness found around vents or elsewhere on covers usually contains some acid. Neutralise and remove with 10% soda solution. Large accumulation, dirt, dust, or moisture should be washed with water from a hose. While washing make, sure water is not forced into the cells, keeping the Vent Plugs tight in position.

13.9.4 Annual Inspection

A thorough battery inspection should be made once in a year or at any other time when severe trouble is indicated by poor performance. The inspection is required to make certain that the battery has been maintained in a good serviceable condition and to ensure its satisfactory service until the next inspection.

a. Chck adjustment of the voltage of the charging source as indicated in of Monthly Inspection.

b. Take Specific Gravity readings of all cells and level of electrolyte and record.

c. Record ambient temperature and electrolyte temperature of the cells.

d. Add battery grade water conforming to IS 1069 (Latest Revision), in all the cells and record the quantity of topping up water per cell.

e. Record voltages of all cells on charge. Record the charging current in amperes.

f. Record cell number with the highest and lowest Specific Gravity and voltage reading in the battery. If any deviation is noticed, locate the cause and take corrective steps / rectify.

g. Thorough cleaning of the battery should be done. Clean the battery as indicated in “monthly inspection”. Then wash top of battery with 10% solution of soda

and a Paint Brush. Of course, during such cleaning operation, it is necessary to ensure that the vent plugs are mounted on the cells so that water does not enter into the cell.

h. Any indication of corrosion in the battery compartment should be thoroughly cleaned and compartment repainted after removing the battery.

i. Capacity test of the batteries at C_{10} rate should be done as follows, during inspection or POH.

i a. The batteries to be charged at constant current of 50/30 Amps DC, up to 2.75 vpc, till Voltage and Specific Gravity readings are constant for three to four consecutive hourly readings.

i b. After finishing of full charge, 12 hours rest period to be given.

i c. The cells to be discharged at 50 ampere, using a suitable load at constant Currents till the end voltage of 1.80 Volt per cell.

i d. Any cell reading 1.80 Volt earlier should be bypassed.

i e. The batteris are to be charged again, as per clause (a), followed by an 'Equalising Charge'.

When the job is otherwise complete, ensure all connections are free of corrosion and re-check their tightness, but the Inter-Unit cable Connectors should not have tension.

13.9.5 Emergency Inspection

If battery failure or other difficulty is reported, include the following checks and tests in sequence :

13.9.5.1 Measure total voltage of battery on open circuit and under load. If this is normal, the actual failure is elsewhere than the battery.

13.9.5.2 Check all battery connections to ensure they are clean and tight.

13.9.5.3 Read and record specific gravity of all cells. If it is low as a whole, the battery has discharged due to connected either to loads when idle or to some failure in the charging. Recharge the battery with whatever facilities available. Locate the cause of the discharge condition and rectify.

13.9.5.4 Read voltage of individual cells at the same time looking for any hot cells or any other abnormal conditions.

If one or more cells are found reading low voltage, read their voltage under load and if it is quite low in comparison with other cells, which is probably the immediate cause of trouble. Replace the tray or trays containing low voltage cells with spare trays to get the battery

in service quickly. Send the tray with low voltage cells to shop for thorough inspection and repair. If the condition found at such inspection is one, which may affect or be found in the remainder of the battery, the entire battery should be attended immediately, if required with manufacturers' assistance.

14.0 Miscellaneous Instructions

14.1 General Instructions (Do's & Don'ts)

14.1.1 Do's

a. Top up as often as necessary with battery Grade Water conforming to IS-1069 : 1993 / Latest Revision.

b. Keep the Vent Plugs Clean and tightly in position.

c. To keep the electrolyte at the correct level.

d. To keep the cell / battery top and surroundings clean and dry.

e. Attend to weak cells immediately.

f. Keep all electrical connections tight. Check for any heating up.

g. Take precautions particularly during charging.

h. Take particular care not to bridge / short the terminals with spanner while tightening terminal nuts & bolts.

i. Give Equalising charges as recommended.

j. Ensure battery Box in the Diesel Loco Engine, are well ventilated.

14.1.2 Dont's

a. Do not work on battery or in Diesel-Loco Engine unless main battery leads are disconnected from line.

i. Never allow a naked flame, sparks, lighted pipe or cigarette near the battery.

ii. Leave no metallic tools / items on the tops of the cells.

iii. Do not exceed "finishing" rate when cells are gassing.

iv. Cells must not be discharged below 1.8 volts per cell and should not be kept in discharge condition for long period.

v. Avoid over charging and also over filling, to avoid spillage and accelerate corrosion.

vi. Electrolyte temperature should not exceed 50°C.

vii. If any charged cells or battery, to be kept for emergency, these should be on 'Trickle Charge' mode or periodic freshening charge to be given on regular interval, at least every 28 days, if not 20 days.

14.2 Water consumption (General Comment)

Water consumption is causd by gassing, which occurs during later part of charging; i.e. after the battery reaches about three-fourths of it's charged conditions. It is therefore very important that there should be an optimum consumption of water since this indicates that a full state of charge is being maintained.

Lower water consumption indicates abnormal conditions; e.g., either a low charging voltage or excessive non-emergency discharges in consequence of which the battery is not being kept in a charged condition. Steps should be taken immediately to eliminate the cause of low water consumption.

Water consumption markedly higher than usual suggests that the existence of a high charging voltage and this should be checked immediately and adjusted if necessary.

The 4DS21TF-LM batteries are designed for topping up every six months, under normal condition, Vent Plugs & Float-Guide kept tight in position.

14.3 Storage

If the battery is to remain unused for 1 to 3 months after commissioning, give an extended charge at a current of 30 Amps from an outside D. C. source / Charger and remove main loads from the battery terminals. Subsequently, give an extended charge at least once in every 28 days. Keep plates submerged in electrolyte by adding pure distilled water to the prescribed height. Before using the battery again, give it an extended charge until the Specific Gravity and Voltage remain constant for 3 to 4 consecutive hourly readings.

15.0 Instruments and Tools

Some important instruments and tools that are necessary for proper maintenance of battery are listed below :

15.1 **Digital Multi-meter** : To enable readings of individual cells as well as total battery and generator / alternator voltages. Should be calibrated at regular interval or should be compared with a standard meter periodically to ensure accuracy, (conforming to 0.5 class in accordance with IS 1248:1983).

15.2 **Syringe Hydrometer** : A clean and accurate syringe hydrometer suitable to read Specific Gravity readings from 1.100 to 1.300 should be used, (Accuracy of Calibration shall be within 0.005 unit of Specific Gravity).

15.3 **Thermometer :** An accurate thermometer of 0°C to 100°C range should be used to read the electrolyte temperature, (One division of graduated scale shall represent 1°C).

16.0 Spare Batteries – Storage and Maintenance

16.1 **General care :** Spare charged battery should be stored in a clean, cool dry place given regular freshening charge every 28 days or keep on 'Trickle charge' mode at 2.25 volts per cell. Proper house keeping & care should be taken. A clean, cool dry place, free from dust and debris should be ideal and selected for storage space. Keep them with vent plugs on.

16.2 **Testing :** Spare charged batteries should be checked at regular monthly intervals to determine the Specific Gravity. Batteries should be charged before the Specific Gravity drops 30 points below the specified fully charged readings. Temperature affects the need for charges.

16.3 **Charging :** When charging is required, use the finishing rate. Continue charging until free gassing occurs. Charging should not be suspended until Specific Gravity (corrected for temperature) of majority of the lowest cells has risen to the maximum and has shown no further rise for three consecutive hourly readings.

17.0 Conclusion

The life and performance of lead acid batteries mainly depends on correct initial filling and charging (IFC) duly monitored. If monitoring during IFC done, at that point we could find the defective or lagging cells and do the needful. If a battery bank have defective cells from the beginning this will affect the healthy cells also, as the charging / discharging Current will be more.

The most vital point is the **care and maintenance**, which will definitely increase the life and performance of Diesel Loco battery.

Exide Industries Ltd., Hosur

IMPORTANT NOTICE FOR CUSTOMERS

1. Lead acid batteries contain Lead & Sulphuric Acid which are highly toxic and extremely hazardous for health and environment.
2. Lead poisoning affects the Central Nervous System causing irreversible retardation and subsequent death.
3. Unauthorised smelters tend to pollute the air and ground water with these toxic substances during smelting.
4. To safeguard Society, the Government of India has notified as under :-

   "It shall be the responsibility of the consumer to ensure that used batteries are not disposed of in the manner other than depositing with the dealer, manufacturer, re-conditioner or the designated collection centres".
5. Hence, please do not discard the battery in a trash bin or give / sell to a non-authorised person.
6. It is mandatory for our authorised dealers to accept a used battery and to provide corresponding rebate on purchase of new battery.
7. Please note that violation of these guidelines may lead to legal action / prosecution by Government Authorities.

EXIDE INDUSTRIAL

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