

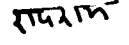



INDIAN RAILWAYS DIESEL LOCOMOTIVE WORKS VARANASI	INDEX	LOW MAINTENANCE LEAD ACID BATTERY.				
	NUMBER	DEL/SPN/193				
	PART NO.	18640011				
	DATE	15-07-98				
	PAGE	1 of 19	REV	R2	R3	
SPECIFICATION FOR LOW MAINTENANCE LEAD ACID BATTERIES FOR DIESEL ELECTRIC LOCO ENGINE STARTING APPLICATION.						
	Dy.CEE/D	DE/EL	SDO/EL	WRITTEN		

1. FOREWORD

This specification deals with Low Maintenance Lead Acid Battery for Diesel Electric Locomotive.

2. PURPOSE

The battery will be used as a source for cranking current for starting of diesel engine and supply power to the Auxiliaries and lighting circuits in Diesel Electric Locomotive. During normal running condition of the engine, the battery will be charged by the Auxiliary Generator.

3. SCOPE

This specification covers the manufacture, supply and performance requirements of the low maintenance battery for use on Diesel Electric Locomotive. A battery which requires very less topping up in actual service and topping up is not required at least earlier than 92 days when fitted in diesel locomotive. However attempt should be made to increase this period to six months. Hereinafter this battery shall be termed as low maintenance battery. The flexible inter-unit connectors shall be also in the scope of supply.

4. SERVICE CONDITION

The battery shall be suitable for cranking the Diesel Engine of the locomotive satisfactorily. The battery shall also be able to supply control and lighting loads specified for the respective locomotive for a period of not less than six hours.

The battery shall withstand satisfactorily the vibrations and shocks in the running condition of the locomotive.

5. DESIGN AND MATERIALS

- 5.1 The battery over all size shall be in Length 723 ± 5 , Width 200 ± 5 , and Height 494 ± 5 mm as per Drawing No. 10631528, Pt. No. 18640011.
- 5.2 The battery cells shall be housed in rugged, durable and heat tolerant HDPE or FRP container ~~CONFORMING TO IS:1146:1981.~~
- 5.3 The battery cell containers shall be made of polypropylene and the lid shall be heat sealed with the container to make it leak proof. The terminals coming out shall be moulded in the lid so that they are leak proof and durable. ~~The vent plug should conform to RDSO Spec. No. ELPs/SPEC/TL/09 (DEC. 1996).~~ ^{Conforming to IS:1146:1981}
- 5.4 The battery design shall be such that repairing and maintenance is easy.
- 5.5 Four cells shall be assembled in a container. Each cell shall be provided with a suitable spacer or secured to prevent damage to the cell and inter connectors. Inter connections shall be welded type so that no maintenance is required.
- 5.6 Internal construction of the cell shall be such that no damage is caused to the plates or separators when inserting thermometers or service apparatus into the cell.
- 5.7 The battery shall have the following features :

Voltage (Nominal)	8 Volt each battery.
Capacity at 10 Hrs. rate	500 AH
Initial Cranking Current	2300 A (see 8.9)
Sustained Cranking Current	1400 A (see 8.10)
Rest: pause between initial cranking cycles.	15 seconds (see 8.9)
Minimum initial cranking cycle requirements.	10 cranking cycles at ambient 27 ± 2 deg.C electrolyte temperature.
Hot Start Schedule	Initial cranking current 2534A with break away period of 2 seconds. Followed by sustained cranking current of 1800A to 1.18 volts per cell. The total duration from commencement being 80 seconds.

5.8 Overall dimensions and weight

The maximum dimensions and weight of each unit shall not exceed the figures given in Appendix B.

6. ELECTROLYTE

- 6.1 The sulphuric acid and water used for the electrolyte shall conform to IS: 266-1961 and IS: 1069 -1964 respectively.
- 6.2 The height of the electrolyte above the top of separators in fully topped condition shall be specified by the manufacturer but shall not be less than 20mm.
- 6.3 For the purposes of tests and service, the specific gravity of electrolyte in fully charged conditions corrected to 27 deg.C shall be specified by the manufacturer and shall be between 1.240 and 1.250.
- 6.4 After a full charge, the specific gravity and temperature of the electrolyte shall be measured and the specific gravity corrected to 27 deg.C using the formula.

$$\text{Where, } SG_{27} = SG_t + 0.0007 (t-27)$$

SG_{27} = Specific gravity at 27 deg.C
 SG_t = Specific gravity at t deg.C.
 t = Temperature of the electrolyte
 (See Appendix C).

7.0 RATING

- 7.1 The rating assigned to the cell or battery shall be the capacity expressed in ampere-hours (after correction to 27 deg.C) stated by the manufacturer to be obtainable when the cell or the battery is discharged at the 10 hour rate in accordance with IS: 7624-1990

8. TESTS AND PERFORMANCE

8.1 Classification of Tests

8.1.1 Type Tests

The tests given in 8.1.1.1 shall constitute the type tests.

- 8.1.1.1 For type tests, six units of each type of battery shall be drawn at random and tests shall be conducted in the sequence as indicated in the schedule below.

TABLE-I : SCHEDULE OF TYPE TESTS

TESTS	UNIT NO.					
	1	2	3	4	5	6
a) Physical examination (See 8.4)	X	X	X	X	X	X
b) Air pressure test (see 8.5)	X	X	X	X	X	X
c) Rated Ah capacity test at 10 hour rate (see 8.6)	X	X	X	X	X	-
d) Ah and Wh efficiency test (see 8.7)	-	-	X	X	-	-
e) Internal resistance (see 8.8)	-	-	X	X	-	-
f) Initial cranking current (see 8.9)	X	X	-	-	-	-
g) Sustained cranking current (see 8.10)	X	X	-	-	-	-
h) Test for retention of charge (see 8.11)	-	-	X	X	-	-
i) Test for resistance to overcharge (see 8.12)	-	-	X	X	-	-
j) Life test (see 8.13)	X	X	-	-	-	-
k) Storage test (see 8.14)	-	-	-	-	-	X
l) Water loss test (see 8.15)	-	-	-	-	X	-
m) Equilibrium float current test (see 8.16)	-	-	-	-	X	-
n) Electrolyte retention test (see 8.17)	-	-	-	-	X	-
o) Vibration resistance test (see 8.18)	-	-	-	-	X	-
(p) Tests on cell and battery containers AS PER IS:1146:1981 (LATEST).						

Note: The batteries shall be covered by a type approval certificate from DLW. All subsequent variations in design shall be covered by separate type approval certificate.

- 8.1.1.2 If any of the samples fails in the relevant type test, the testing authority may call for fresh samples not exceeding twice the original number and subject them again to the test (s) in which failure occurred. If there is any failure in the retest(s), the type shall be considered as not having passed the requirements of this standard.

8.1.2 Acceptance tests - The following shall constitute the acceptance tests.

- Initial cranking current (see 8.9)
- Sustained cranking current test (see 8.10) and
- Electrolyte retention test (see 8.17).

8.1.2.1 Sampling scheme and criteria for acceptance

The number of batteries to be selected at random from the lot shall be in accordance with Col.1 and 2 of Table 2.

TABLE 2 : SAMPLE SIZE AND CRITERION FOR ACCEPTANCE

Lot size(N)	First Stage(n)	Second Stage(n)	2n	C1	C2	C3
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Up to 50	2	2	4	0	1	1
51 to 300	3	3	6	0	1	1
301 to 500	5	5	10	0	2	2
501 to 1000	8	8	16	0	2	2
1001 and above	13	13	26	0	3	4

In order to ensure the randomness for selection random number tables shall be used see IS: 4905-1968).

The batteries selected shall be subjected to the acceptance tests in the order specified in 8.1.2.

Each of the battery selected in the first stage in accordance with Col. 2 of Table 2 shall be tested for acceptance. A battery shall be declared defective if it fails in one or more of the acceptance tests. If the number of defectives is less than or equal to C1 the lot shall be considered as conforming to the requirements of the standard. If the number of defective is equal to or greater than C2, the lot shall be considered as not conforming to the requirements of the standard. If the number of defectives in the first stage is less than C2 and greater than C1, a further sample of same size as taken in the first stage shall be taken and tested. If the number of defectives in the two samples combined is less than C3, the lot shall be considered as conforming to the requirements of this standard otherwise the lot shall be considered as not conforming to the requirements of the standard.

8.2 Temperature for Test

Unless otherwise specified, the temperature for test shall be maintained between 20 deg. C and 35 deg. C.

8.3 Equipment and Instruments

8.3.1 Voltmeter

The voltmeter used for test shall be of an accuracy class not inferior to 1.0 in accordance with IS: 1248 (Part 2) :1985. The resistance of the voltmeter used shall be at least 300 ohms per volt. The range of voltmeter used shall be appropriate for the magnitude of the voltage to be measured.

8.3.2 Ammeter

The ammeter used for tests shall have an accuracy class not inferior to 1.0 (see IS. 1248 (Part3) :1983). The range of ammeter used shall be appropriate for the magnitude of the current to be measured.

8.3.3 Thermometers

Thermometers with an appropriate scale shall be used for measuring temperatures, and one division of the graduated scale shall represent at the most 1 deg.C. The accuracy of the calibration shall not be less than 0.5 deg.C.

8.3.4 Hydrometer

The specific gravity of the electrolyte shall be measured by hydrometers provided with a graduated scale, one division of which shall represent at the most 0.005 unit of specific gravity. The hydrometer shall be accurate within ± 0.005 units of specific gravity.

8.4 Physical Examination

The batteries shall be examined for conformity with the requirements of 5 & 9.

8.5 Air Pressure Test

The sealing of each cell of the battery unit shall be checked by compressed air at a pressure equal to 70 cm of water. The volume of tubes and auxiliary parts in connection with the cell under pressure shall not exceed 0.5 liter. Air pressure in the cell shall be noted 15 seconds after the supply has been disconnected and it shall not fall below 67 cm of water.

8.6 Ampere Hour Capacity Test at 10 Hour Rate

The capacity at 10 hour rate of discharge when tested in the manner prescribed in Appendix C shall be not less than the capacity declared by the manufacturer.

8.7 Watt- Hour and Ampere Hour Efficiency Test

When tested as described in appendix D, the watt- hour and ampere - hour efficiency shall be not less than 78 percent and 92 percent respectively.

8.8 Internal Resistance Test

The internal resistance when measured in the manner described in Appendix E shall not be more than the value specified in Appendix B for the respective class of diesel locomotive.

8.9.1 After standing on open circuit for not less than 12 hours and not more than 24 hours from the completion of a full charge, the battery unit shall be subjected to cycles of discharge at the rate of initial cranking current given in Appendix B. Each discharge shall be of 15 seconds duration with an intermittent rest of 15 seconds.

8.9.2 Requirement

The battery unit tested shall meet the minimum requirements specified in Table 3.

TABLE-3 : INITIAL CRANKING CURRENT TEST (CLAUSE 8.9.2)

Initial Temperature of the Electrolyte.	Discharge current (15 sec. with 15 sec. rest)	Minimum no. of 15 sec. Cycles.	Battery Terminal Voltage	
			Initial at 5 to 7 secs.	Final
(1)	(2)	(3)	(4)	(5)
Deg. C	A	Cycles	V	V
27±2	Col 8, Appendix B	10	1.1 x n	0.8 x n
			Where n= no. of cells in series per battery unit.	

8.10 Sustained Cranking Current Test

8.10.1 After standing on open circuit for not less than 12 hours and not more than 24 hours on the completion of a full charge, the battery unit shall be subjected to a continuous discharge at the rate of sustained cranking current as given in Appendix B.

8.10.1.1 This discharge may not be taken immediately after initial cranking current test but may be preceded by one C10 discharge.

8.10.2 Requirements

The battery unit tested shall meet the minimum requirements specified in Table 4.

TABLE - 4 : SUSTAINED CRANKING CURRENT TEST

Initial Temp. of the Electrolyte.	Discharge current	Minimum discharge time	Battery Terminal voltage	
			Initial at 5 to 7 seconds	Final
(1)	(2)	(3)	(4)	(5)
Deg. C	A	Min. S	V	V
27±2	Col 9, Appendix B	4 0	1.4xn	1xn
Where n= Number of cells in series per battery unit.				

8.11 Test for Retention of charge

The object of this test is to determine the loss of capacity of a battery unit on open circuit during a specified period.

- 8.11.1 The battery unit shall be fully charged at the current specified by the manufacturer and it shall then be subjected to two consecutive capacity tests in accordance with 8.6, the value of the initial capacity C being calculated as the mean of the two results thus obtained.
- 8.11.2 After a complete recharge and after cleaning of the electrolyte from the surface, the battery unit shall be left on open circuit for a period of 28 days without disturbance at a temperature of 27±2 deg.C.
- 8.11.3 After 28 days' storage, the battery shall be discharged in accordance with 8.6. The value of the capacity measured after storage shall be denoted by C1.
- 8.11.4 After the discharge, the battery shall be fully charged at the rate recommended by the manufacturer.
- 8.11.5 The loss of capacity S, expressed as a percentage, shall be calculated from the formula:

$$S = \frac{C-C1}{C} \times 100$$

8.11.6 Requirement

The loss of capacity calculated as in 8.11.5 shall not be more than 10 percent.

8.12 Resistance to Overcharge Test

The object of this test is to determine the ability of the battery to withstand over charging.

8.12.1 The battery unit shall be charged continuously at a current $I = 0.1 \times C_{10}$ amperes where C_{10} indicates the capacity of the battery unit in Ah at 10 hour rate of discharge for a period of 100 hours. Through out this period the battery unit shall be immersed in a tank of water whose temperature shall be maintained at 40 ± 3 deg.C. The battery unit shall be so immersed that the top of the battery should be 25 mm above the water level in the tank. If several batteries are placed in the same tank a spacing of 25 mm shall be maintained between them and between the tank and the battery. While the battery is being charged, the level of the electrolyte shall be checked daily and maintained at a specified level by adding distilled water.

8.12.2 When the battery unit has been charged as specified in 8.12.1, it shall be left disconnected in the tank of water at a temperature of 40 ± 3 deg.C for a period of 68 hours. At the end of this period the battery unit shall be discharged at the rate of sustained cranking current (Col.9 of Appendix B) at the temperature of 40 ± 3 deg.C to end voltage of $1V \times n$ where n is the number of cells in series per battery unit.

8.12.3 The battery unit shall then be charged again and discharged as specified in 8.12.1 and 8.12.2 respectively. The cycle shall be repeated 6 times thereafter, that is, it shall be carried out 8 times in all. (The battery is thus subjected to a total overcharging of 80 times the rated ampere-hour capacity and to 8 checking discharges.)

8.12.4 Requirements

On each of the 8 checking discharges, the duration before the voltage drops to $1V \times n$ shall be not less than 3 minutes. The voltage at the end of discharge shall be recorded.

8.13 Life Test

8.13.1 Battery unit shall be subjected to 6 test units of the life test as prescribed in Appendix F.

8.13.2 The duration of the rapid discharge of each test unit under the conditions prescribed in F-5 shall not be less than 3 minutes.

8.14 Storage Test

The battery units shall be capable of being stored unfilled for a period of 24 months from the date of manufacture. After storage for the specified period the batteries shall meet the requirements of capacity test (see 8.6).

8.15.1 After fully charging the battery, it should be cleaned and dried. It should be weighed immediately but not exceeding one hour after drying with an accuracy of 0.05% or maximum least count of 50 gm for the balance used. Then all vent-cum-filling plugs should be closed tightly and connected to constant voltage charger keeping the voltage 2.4 volt per cell i.e. $9.6 \pm 0.05V$ for 21 days in water bath at a temperature of 50 ± 2 deg.C. Thereafter battery is removed from circuit and dried. After this it is weighed accurately.

8.15.2 The water loss shall not exceed 1.33 gm/Ah/Cell of the obtained capacity.

8.15 Equilibrium Float current test

This test shall be conducted during the initial three days (72 hours) of water loss test. The battery under test shall be kept in water bath at 50 ± 2 deg.C. Charging voltage shall be $2.4 \pm 0.05V$ per cell. The float current shall be measured and recorded. It shall not be more than 5mA/AH of the rated capacity.

8.16 Electrolyte retention test

The ability of a battery to retain the electrolyte in various critical positions. This test to be carried out as per clause 7.15 of IS 7624 : 1990.

8.17 Vibration resistance test

This test to be carried out as per clause 7.16 of IS 7624 : 1990.

9. MARKING

9.1 Every battery unit shall have the following details marked.

- | | |
|-------------------------------|-------------------------|
| a) Manufacturer's brand name. | b) Date of manufacture. |
| c) Type | d) Serial Number, and |
| e) Specific gravity. | |

9.2 Manufacturer shall provide suitable space on the battery terminal lug to enable the purchaser to stamp the date of commissioning of the unit.

10. DATA FROM THE MANUFACTURER

10.1 It is recommended that the manufacturer along with the quotation or supply shall provide the information given in Appendices G & H.

11. MANUAL OF INSTRUCTIONS

11.1 The manufacturer shall supply one copy of the instruction manual for initial treatment and routine maintenance on service, with every batch of ten sets or a part thereof ordered.

APPENDIX - A

A-1 SERVICE TEST

- A-1.1 The test is to be carried out after not less than 12 months and before 18 months from the date of supply. About 10 percent of the supply may be tested at random.
- A-1.2 After standing on open circuit for not less than 12 hours and not more than 24 hours from the completion of a full charge, the battery shall be subjected to cycles of discharge by starter motor cranking the diesel engine with its fuel line closed. The duration of each discharge shall be of 15 seconds with an intermittent rest of 15 seconds. The battery shall be capable of performing a minimum of 15 such cycles.

APPENDIX – B**DESIGN AND CONSTRUCTION**

Sl. No.	Class of locomotive and rail car	Type of transmission	Battery voltage (V)	No. of cell	Voltage of each battery unit (V)	No. of battery units	Initial cranking current (A)	Sustained cranking current (A)	Control equipt. and lighting current (A)	Internal resistance per battery unit (milli-ohm)	Length (mm)	Width (mm)	Height (mm)	Weight per battery unit with electrolyte (Kg)	Ah capacity at 10 hour rate (Ah)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	WDP-2	E	64	32	8	8	2300	1400	50	3	723	200	494	153	500
	WDG-2	E													
	WDG-4	E													

Note: E = ELECTRIC H = HYDRAULIC

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APPENDIX - C**TEST FOR CAPACITY AT THE 10 HOUR RATE**

- C-1 After standing on open circuit for not less than 12 hours and not more than 24 hours from the completion of a charge the battery unit shall be discharged through a suitable resistance at a current in amperes numerically equal to one-tenth of the rated ampere hour capacity and the discharge shall be stopped when the closed circuit voltage across the battery unit terminals falls down to $1.75 \times n$ volts, where n is the total number of cells in series in a battery unit or until the voltage across one cell has fallen down to 1.70 volts, whichever is earlier. The first measurement of this voltage shall be made 5 to 7 seconds after the beginning of the discharge.
- C-2 At this rate of discharge, hourly voltage readings may be taken until the battery unit voltage approaches $1.80 \times n$ volt after which the readings shall be taken every 15 minutes.
- C-3 On the first discharge the battery shall give not less than 85 percent of the rated capacity at C10 and the rated capacity shall be reached within 10 discharge cycles subsequent to the initial charge.
Note : If the capacity is reached in the first discharge, no further discharge shall be conducted.
- C-4 Two more discharge tests shall be carried out in accordance with C-1 and the result of the test giving maximum Ah capacity shall be taken as the 10 hour capacity.
- C-5 The battery unit shall be charged at a rate recommended by the manufacturer, immediately after each discharge.
- C-6 The capacity in Ah shall be obtained by multiplying the discharge current by the total time of discharge in hours and the product so obtained shall be corrected to a temperature of 27 ± 2 deg.C by applying the following Formula.

$$C_{27\text{deg.C}} = \frac{C_{t\text{deg.C}}}{1 + k(t-27)}$$

Where,

k

=

0.0043 for tubular positive plates and pasted positive plates.

$C_{27\text{deg.C}}$

=

Ah capacity at an average electrolyte temp. of 27 deg.C

$C_{t\text{deg.C}}$

=

Ah capacity obtained at an average electrolyte temp. of t deg.C. and

t

=

Average temperature of electrolyte during discharge (mean value of initial and final temperature).

APPENDIX - D

PROCEDURE FOR MEASURING AMPERE-HOUR AND WATT HOUR EFFICIENCY

- 1 The following method for determining the maximum ampere-hour and watt hour efficiencies shall be used.

a **Ampere- Hour Efficiency**

A fully charged battery unit shall be charged at $I = 0.1 \times C_{10}$ ampere to an end voltage of $1.75 \times n$ volts, careful measurements being made of the exact number of ampere-hours delivered. On the recharge the same number of ampere-hours are put back at the same current. A second discharge shall then be made to the same cut off voltage as before. The efficiency of the battery unit is then calculated as the ratio of ampere-hour delivered during the second discharge corrected to 27 deg.C to the ampere hour put in during the charge.

b **Watt- Hour Efficiency**

The watt hour efficiency shall be calculated by multiplying the ampere-hour efficiency by the ratio of average discharge and recharge voltages. The values of discharge and recharge voltages shall be calculated from the lot sheets for ampere-hour efficiency.

APPENDIX - E**PROCEDURE FOR MEASURING INTERNAL RESISTANCE**

- E-1 The battery unit shall be charged at the normal charging rate. After charging, the battery unit shall be discharged for one hour at 10 hour rate.
- E-2 The test shall be continued by increasing the discharge current to approximately equal to 1.5 times the value specified in Col. 10 in Appendix B (A1) and after an interval not exceeding 5 minutes, the current shall be decreased to half the value specified in Col. 10 in Appendix B (A2).

The current A1 and A2 in amperes and the corresponding battery unit terminal voltages V1 and V2 in volts, shall be measured simultaneously.

The internal resistance expressed in milli-ohm of the battery unit under test shall be calculated from the formula given below.

$$R = \frac{(V2-V1) 1000}{(A1 - A2)} \text{ milli-ohm}$$

- E-3 The internal resistance may also be measured by a direct reading meter if agreed to between the manufacturer and the purchaser.

APPENDIX – FLIFE TEST

- F-1 The life of the battery unit is defined by the number of life test units obtained under the following conditions.
- F-2 The life test is carried out on at least two batteries which have satisfactorily passed the tests in accordance with 8.4, 8.5, 8.6, 8.9, 8.10.
- F-3 The battery is to be fully charged. When fully charged, the level and specific gravity of the electrolyte of each cell shall be checked and if necessary, adjusted.
- F-4 The batteries shall then be subjected to a series of discharges and charges continuously. The discharge shall be completed in 1 hour at an average current of $I=0.035x$ sustained cranking current. The charging shall be effected during 5h at an average current of $I=0.035x$ sustained cranking current. Throughout the life test unit, the batteries shall be immersed in a tank of water, the temperature of which is maintained at 40 ± 3 deg.C. The batteries shall be so immersed that their top surface shall be not more than 25 mm above the water level in the tank. If several batteries are placed in the same tank, a distance of 25 mm shall be maintained between them. The distance between the batteries and the sides of the tank shall also be 25 mm. Distilled or de-ionized water shall be added to the cells daily during the life test to maintain the electrolyte at its normal level.
- F-5 After the last charge of series of 36 discharge – charge cycles, the batteries shall be disconnected from the circuit. They shall then remain on open circuit for 96 hours. After this open circuit stand, they shall be discharged at the rapid rate $I =$ sustained cranking current. This discharge is continued down to an end voltage of $1V \times n$. On completion of this discharge, the batteries shall be fully recharged at normal voltage. The combination of 36 discharge and charge cycles as described above together with 96 hours open circuit period, the checking discharge (rapid discharge) and the subsequent recharge together constitute one complete battery unit of life test.
- F-6 After the final life test battery unit, the battery shall not be subjected to any test.

APPENDIX - G**SCHEDULE OF DESIGN PARTICULARS**

G-1 The following design particulars are required to be supplied by the manufacturer along with the quotation or supply.

- | | | | |
|----|--|---|----------------|
| a) | Make | : | |
| b) | Type of unit | : | |
| c) | Manufacturer's nomenclature | : | |
| d) | Overall dimensions of battery unit
Length x Width x Height. | : |mm |
| e) | Weight per battery unit with
electrolyte | : |Kg |
| f) | Cell Container material | : | |
| g) | Type of positive plates | : | |
| h) | Type of negative plates | : | |
| i) | Type of separator | : | |
| j) | Maximum electrolyte temperature that
the cell/battery will withstand without
any damage. | : | |
| | 1) Continuously | : |deg.C |
| | 2) For a short period | : |deg.C |
| | 3) | : | |
| k) | Electrolyte height above the top of the
separators. | : |mm |
| l) | Clearance between plates and
bottom of the container. | : |mm |
| m) | Quantity of electrolyte per cell | : |Litre. |
| n) | Specific gravity of electrolyte for
Initial filling at 27 deg.C. | : | |
| o) | Details of initial treatment
recommended. | : | |
| p) | Material of terminal and inter unit
connector. | : | |
| q) | Internal resistance at 27 deg.C
(measured according to Appendix E) | : |milli-ohm |
| r) | Normal charging rate | : | Ampere |

APPENDIX – H**SCHEDULE OF PERFORMANCE – TYPE TEST**

- 1) Batteries offered according to this standard shall be covered by a type approval certificate from an appropriate authority. All variations in design shall be covered by separate approval certificate. Following particulars regarding the type tests shall be supplied by the manufacturer along with certificate against any quotation or supply.
- | | | |
|---|---|---|
| a) Air Pressure test (see 8.5) | : | cm of water. |
| b) Capacity test (see 8.6) | : | Ah |
| c) Ah and Wh efficiency test (see 8.7) | : | Percent |
| d) Internal resistance test (8.8) | : | milli-ohm |
| e) Initial cranking current test(see 8.9) | : | Initial volts - Number of cycles |
| f) Sustained cranking current test
(see 8.10) | : | Initial volts – min. sec duration |
| g) Retention of charge test
(see 8.11) | : | Percent loss |
| h) Resistance of overcharge test
(see 8.12) | : | Number of cycles
volts at the end of last cycle. |
| i) Life test (see 8.13) | : | Units |
| J) Storage test (8.14) | : | Ah. |
| k) Discharge curves with voltage as
ordinate(scale 10 mm to 1 volt) and
time as abscissa (scale 30 mm to 1 hr)
are to be supplied showing the
performance of cells under the following
conditions. | | |
| 1) Discharge of battery unit/batteries
at 10 hour rate. | | |
| 2) Discharge of battery units/batteries
at the initial cranking current. | | |
| 3) Discharge of battery units/batteries
at the sustained cranking current. | | |

Alteration Sheet

Alteration No.	Description	SSE/D	Approved by DyCEE/D
R2	Specification revised and retyped.	<i>21/6/2000</i>	<i>P. Rao</i> 24.6.2000
R3	Type Tests and conformity of battery and cell containers to IS:1146:1981 (LATEST) ADDED. b) Vent plug to RDSO Spec. No. ELPS/SPEC /TL/09 (DEC.1996) Added.	<i>ASL</i> 11/11/05	<i>T. G. S.</i> 11/11/05



सत्यमेव जयते
भारत सरकार
रेल मंत्रालय

S.No. 942

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

अनुसंधान अभिकल्प एवं मानक संगठन
रेल मंत्रालय

RESEARCH DESIGNS AND STANDARDS ORGANISATION
MANK NAGAR, LUCKNOW-226011

सं० आर.डी.एस.ओ./पी.ई./एस.टी.आर./टी.एल./0014-2010 (रिव. 1), संशोधन सं 1&2

RDSO STR No. RDSO/PE/STR/TL/0014-2010 (Rev. 1) with Amendment no. 1 & 2

SCHEDULE OF TECHNICAL REQUIREMENTS FOR LEAD ACID BATTERIES (LMLA & VRLA)

SN	Date of Revision/Amdt	Revision/ Amdt.	Page / Cl. no.	Remarks
1	June 2010	Rev.1		New facility added
2	Mar.2012	Amd.no.1	4 /Annex.1 (A) Cl.16 4 /Annex.1 (A) Cl.22 4/ Annex.1 (B) Cl.12 10/Annex.IV Cl.5 10/Annex.IV Cl.6	i) Automatic heat sealing machine for PE separator bag if P.E separator bag is manufactured internally. ii) One 70 KVA D.G.set and another 35KVA. (iii) Optical emission spectrometer (Optional) (iv) To check the performance for four year. (v) Common testing facility may be accepted for both LMLA and VRLA.
3	July 2017	Amd.no.2	10/Annexure IV Clause.2,3,4&5	• Revised.

अनुमोदित

APPROVED

Naiw
19.07.17

कार्यकारी निदेशक/पी.एस. एवं ई.एम.यू.

Executive Director / PS & EMU

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PREFACE

This Schedule of Technical Requirement has been prepared which lays down general guidelines for the benefit of firm seeking approval of RDSO for manufacture and supply of Low Maintenance Lead Acid (LMLA) as well as Valve Regulated Lead Acid Batteries (VRLA) used for the Rolling Stock and stationary application.

These guidelines provide information about essential minimum requirements of machinery and plant, test equipment, Quality Assurance Plan and other desired mandatory requirement for approval of manufacture of all type Lead Acid Storage Batteries.

It is expected that with these information, the manufacture will be able to make a self appraisal of the capacity available and capability of fulfillment of other condition for registration and manufacture of the batteries to RDSO's specifications before seeking approval from RDSO.

The STR covers following for registration with RDSO:

1. It contains essential M & P and, infrastructure required for manufacturing and supply. It however does not specify the capacity and quantity of the various items of equipment/components, the quantity/capacity of the M&P will depend upon the manufacturing capacity. The firm should also have the facility for storing the raw material and finished product so as to maintain them in a healthy condition.
2. It contains testing facilities required. Record of calibration will be kept for all measuring apparatus. It has to be updated & valid at the time of inspection/testing.
3. It contains Quality Assurance Plan for implementation by the firm. It will also be a prerequisite for a firm to submit QAP for according approval for supply of lead acid batteries. The broad points, which are essentially required to be covered during assessment, are given in Annexure-III.
4. It contains the condition/requirements to be fulfilled for establishing the credentials so that reliability of the product and after sells service is ensured.
5. It contains the condition/requirements to be fulfilled for development of different rating of Batteries. It has the essential guideline for manufacturing and testing facilities required for common setup of LMLA /VRLA Batteries.

The details of above are given in Annexure-I, II, III & IV.

6. This STR shall be applicable for Valve Regulated Lead Acid /Low Maintenance Lead Acid Batteries, governed/controlled by RDSO.

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LIST OF MACHINERIES AND PLANTS FOR MANUFACTURE OF LEAD ACID STORAGE BATTERIES**A. Essential manufacturing facilities**

1. Lead alloying plant to have different percentages of alloy.
2. Lead-oxide manufacturing mill
3. Pressure die-casting machines for positive Spine (Hand molding process not permitted)
4. Negative grids casting machine (Hand molding process not permitted)
5. Gravity die-casting machines for terminal post, inter cell connector, poles etc. (Hand molding process not permitted).
6. Automatic paste mixing plant for negative plates. **(Hand mixing not permitted)**
7. Automatic pasting plant for negative plates. **(Hand pasting not permitted)**
8. Humidity & temp. controlled curing chamber with power back up with automatic recording facility for power interruption, temperature, humidity.
9. Vibration plant for filling of positive tubular plates.
10. Plate formation plant with power back up and automatic recording facility for power interruption
11. Jigs and fixtures to make groups of positive and negative plates.
12. Chemical laboratory to test various chemical ingredients.
13. Gas burners set for assembly of positive and negative group plates for battery.
14. Distilled water manufacturing plant.
15. Compressor with dryer.
16. Automatic heat sealing machine for PE separator bag, if P.E. separator bag is manufactured internally
17. Container & Lid for Hard Rubber/PPCP Battery
 - i) Manufacturers may have their own facility for manufacturing of Container and Lid. However, they may outsource the manufacturing of Container and Lid to other ISO certified firms, having Automatic Injection Moulding Machine (For PPCP type) / Moulding Machine (For Hard Rubber type), but the manufacturers should have their own moulds for Container and Lid and MOU with the outsourced firm for manufacturing of container & lid.
 - ii) Bitumen compound sealing plant with controlled thermostat for Hard Rubber Container.
18. Following machines shall be fitted across the conveyer for PPCP Batteries.
 - i) Heat sealing machine with controlled temp, pressure & time duration.
 - ii) Automatic air pressure machine to check the sealing- Preferable with auto segregation of defective/ failed cell.
 - iii) Automatic hole punching machine for terminal welding.
 - iv) Automatic Inter cell connector welding machine for monoblock batteries.
 - v) Automatic Shear testing machine to check the welding strength-Preferably with auto segregation of defective/ failed cell.

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- 19 Fork lift.
- 20 Pallet truck.
- 21 Formation rectifier.
- 22 One DG Sets of rating 70 KVA (min.) and another of rating 35 KVA (Min.)
- 23 Air pollution control system.
- 24 Water effluent plant.
- 25 Lead re-cycling plant as per MOEF. or MOU with authorized recycler approved by MOEF.
The authorized recycler capacity shall be at least 50% of lead used by battery manufacture.

B. ESSENTIAL LIST OF TEST EQUIPMENT.

1. Computerized constant current battery charging / discharging (as per specification) equipment with monitoring and recording of time duration, voltage, current & temperature for electrical performance test. **(Manual recording not permitted).**
2. Fully computerized control life cycle testers with logging, monitoring of test data. (Recording time, voltage min. 6 channels, current, temp. Ah, Wh, mode and cycle step).
3. Temperature controlled A.C. test room with UPS for testing equipment
4. Container testing facilities as per IS -1146 latest.
(i.e. High voltage tester, Plastic yield test apparatus, Electro-magnetic ball drop test apparatus, izod impact tester, physical and chemical test facility).
5. Separator testing apparatus as per IS – 6071 latest.
6. Micro-porous vent plug testing arrangement (i.e. Electro-magnetic ball drop apparatus, weighing digital top pan balance capacity 200 gms with least count of 0.05 gms, fire retardant test apparatus, permeability test apparatus etc.)
7. Digital Ammeter/Voltmeter (Optional), Glass thermometers and Digital temperature indicator.
8. Multi-meter digital (DC=1000V, AC=750V, DC=10A, R=2M Ohm)
9. Constant voltage charger 0 – 15 V DC for water loss test with current voltage and temperature data logging facility.
10. Tongue tester
11. Cold chamber for zero deg capacity tests with automatic temp. control and recording
12. Optical emission spectrometer (Optional)
13. Automatic Absorption spectrophotometer or ICP (Inductively coupled plasma) to monitor the quality of acid, water etc.
14. Bitumen compound sealing testing facility.
15. Internal resistance and conductance meter.
16. Test equipment required for Fire retardant testing as per UL94 specification
17. Thermostatically controlled water tank for life cycle units.
18. Distilled water testing arrangement as per IS 1069 latest.
19. Sulphuric acid testing arrangement as per IS: 266-93.latest.
20. Heating apparatus (Hot air oven: test temperature 300°C max.)
21. Weighing balance (digital) up to 150 kg with least count of 10 gm for battery

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22. Electronic balances for chemical and components weight (capacity 1000 gms with decimal third digit.).
23. Manometer.
24. Polarity testing arrangement.
25. Short circuit – testing arrangement.
26. Shore hardness tester
27. Vernier caliper medium and large to read up to 500 mm dimensions.

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ANNEXURE 'II'

LIST OF MACHINERIES AND PLANTS FOR MANUFACTURE OF VALVE REGULATED LEAD ACID BATTERIES**A. Essential Manufacturing facilities**

1. Programmable automatic lead oxide-manufacturing mill.
2. Automatic Gravity die-casting machines for Positive and Negative grids. **(Hand moulding process not permitted)**
3. Automatic Gravity die-casting machines for terminal post, inter unit connector, poles etc. **(Hand moulding process not permitted)**
4. Automatic paste mixing plant
5. Automatic pasting plant for Positive and Negative plates. **(Hand pasting process not permitted)**
6. Container and Lid
Manufacturers may have their own facility for manufacturing of Container and Lid. However, they may outsource the manufacturing of Container and Lid to other ISO certified firms, having Automatic Injection Moulding Machine (For PPCP type), but the manufacturers should have their own moulds for Container and Lid and MOU with the outsourced firm for manufacturing of container & lid.
7. Plate/Jar formation plant with power back up and automatic recording facility for power interruption
8. Jigs and fixtures to make groups of positive and negative plates.
9. Heat-sealing plant with controlled temp, pressure & time duration.
10. Automatic Inter cell connector welding machine for monoblock batteries
11. Fully equipped chemical laboratory to test various chemical ingredients of bought out material and in house processed material.
12. Gas burners set for assembly of positive and negative plates group
13. Distilled water manufacturing plant.
14. Compressor with dryer.
15. Automatic acid chilling plant
16. Automatic acid filling machine.
17. Humidity & temp. controlled curing chamber with power back up with automatic recording facility for power interruption, temperature, humidity.
18. Formation rectifier.
19. Material handling equipment i.e. Fork lifter/pallet truck etc.
20. DG set of rating 125 KVA or above – 2 nos.
21. Air pollution control system.
22. Water effluent plant.
23. Lead re-cycling plant as per MOEF or MOU with authorized recycler approved by MOEF. The authorized recycler capacity shall be at least 50% of lead used by battery manufacture.

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B. ESSENTIAL LIST OF TEST EQUIPMENT

- 1 Computerized control constant current and constant voltage battery charging / discharging (as per specification) equipment with monitoring and recording of time duration, voltage, current & temperature for electrical performance test.
- 2 Fully computerized control life cycle testers with logging, monitoring and recording system. (Recording time, voltage minimum 6 channels, current, temperature, Ah, Wh, mode and cycle step). **Manual recording not permitted.**
- 3 Temperature controlled A.C. test room with UPS for testing equipment
- 4 Constant voltage charger (0V-15V) for water loss test with current, voltage, and temperature data logging facility.
- 5 Container testing facilities as per IS: 1146 latest. (i.e. High voltage tester, Plastic yield test apparatus, Electro-magnetic ball drop test apparatus, izod impact tester, physical and chemical test facility).
- 6 Digital Ammeter / Voltmeter (Optional), Glass thermometer and Digital temperature indicator
- 7 Battery/cell internal resistance and conductance meter.
- 8 Atomic absorption spectrophotometer / inductively coupled plasma.
- 9 Optical emission spectrometer
- 10 Safety valve testing arrangement.
- 11 Sulfuric acid and distilled water testing facility as per B.I.S. specification.
- 12 Automatic air pressure testing arrangement -Preferable with auto segregation of defective/ failed cell
- 13 Cold chamber for zero deg. capacity tests with automatic temperature control and recording
- 14 Separator testing apparatus.
- 15 Thermostatically controlled tank for life cycle test.
- 16 Shore hardness tester.
- 17 Weighing balance (digital) up to 150 kg with least count of 10 gm. for cell weight
- 18 Electronic balance for chemical (capacity 50 gm with least count of 0.01gm)
- 19 Polarity testing arrangement.
- 20 Short circuit testing arrangement.
- 21 Multimeter digital (DC=1000V, AC=750V, DC=10A, R=2M Ohm)
- 22 Tongue tester
- 23 Vernier caliper medium and large to read up to 500 mm dimensions.
- 24 Test equipment required for Fire retardant testing as per UL94 specification or latest.

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MAJOR POINTS FOR QAP:

1. **Quality Assurance Plan-** This shall cover the following and shall be prepared in RDSO's prescribed latest format.

- Incoming material
- Process control
- Product control
- System control
- List of sub vendor and inspection plan. Sub vendor also should be an ISO certified company.

2. **Organization:**

The firm shall submit the organizational structure, along with the qualification of management involved in quality assurance programme.

3. **Documentation:**

The manufacture shall maintain all possible documents and data that will help him producing consist at quality of product.

4. **Purchase of raw material:**

The supplier shall ensure that the purchased components /raw materials conform to the specified requirement and are procured only on the basis of well-prepared, technical, specification.

5. **Quality Control-Process:**

Process control checks shall be conducted through cell-evolved inspection procedure to ensure elimination of bad material at the early stage of manufacture.

6. **Inspection and Testing:**

- (i) **Receiving Material:** The manufacturer shall ensure that incoming product is not used for processed until it has been inspected or otherwise verified as conforming to specified requirements. Verification shall be in accordance with quality plan or documented procedures.
- (ii) **In process inspection and testing:** Inspect, test and identify product as required by the quality plan or documented procedures evolved on the basis of RDSO specification and other relevant specification/standard.
- (iii) The supplier shall carryout all final inspections and test in accordance with the Quality Assurance Plan or documented procedures evolved on the basis of RDSO specification and specified standard. Any change in Quality Assurance Plan (QAP) or documented procedures shall be promptly communicated to RDSO.

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7. Instruments, Measuring and Testing Equipment:

The instrument and equipment, which shall be used for testing and inspection, shall be of the required accuracy (0.5 accuracy clause) and duly calibrated.

8. Design and Development:

The firm shall have Design and Development organizational structure for the designing of batteries of required capacity and also to implement the input given by R&D for trouble free long life services. In organizational structure, there shall be minimum two Engineers having Degree/Diploma in Electro Chemical / Chemical Engineering with minimum five years' experience.

9. R & D Organization:

The firm shall indicate the organizational structure of R&D Organization along with qualification of the personnel. Firm should have at least one Graduate (B.E/Chemical) Design Engineer with experience of more than 5 years in the field of lead acid batteries or B.Sc / M.Sc / Diploma with 10 years of experience in battery field.

10. Laboratory Test House: The manufacture shall have a well equipped Laboratory/Test House to carry out various tests on the raw material, stage inspection and inspection of the finished product.

11. Quality Audit: The manufacture shall send the internal quality check details to RDSO of their sample once in six month. RDSO may also ask for testing by recognized national testing institutions for counter checking the characteristics and to ensure quality level of their product.

12. Handling /Storage/Delivery: The manufacture shall have proper facilities for handling and storage of raw material and finish product. The supplier shall control packing presentation and marking process so as to ensure conformity to the Railway requirement.

13. Traceability of record: The manufacturer shall maintain the log sheet / check list for different processes / stages of cell with proper documentations / references to link and trace the parameter details to analyse the reason for failures due to poor process / material in order to make further improvements.

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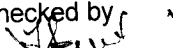
ANNEXURE IV

1. Firm should have minimum six service centres/branch offices, one each in East, West, North, South, Central and South Central regions. Qualified Engineers with 5 years of experience in similar field should be in these offices so that they can investigate reported failures.
2. For registration, only those Firms which have manufactured and supplied LMLA/VRLA Batteries (Separately for LMLA/VRLA) in the past for Rolling stock application/ traction application/ Automobile organization for minimum five years with satisfactory performance shall be accepted. However, any suppliers who are having minimum five year experience in manufacturing and supply of LMLA batteries for Railway's Rolling Stock application shall also be considered for registration for VRLA Batteries.
3. If the firm is already approved for any of the VRLA Batteries, its performance should be satisfactory i.e. there shall be no major complaints from the Railways. Its FRPCPY should be less than average FRPCPY for two years of approved vendors for that VRLA Battery. Else, the firm will not be considered for the development of new type of VRLA Battery.
4. If firm is found capable to manufacture VRLA batteries in assessment, initial approval for registration shall be given only for 120 Ah train lighting Batteries after successful prototype testing.
5. Firm's offer for developing VRLA air conditioned coach battery shall not be accepted till its performance for 120Ah VRLA train-lighting batteries is satisfactory not only during first two years but also during the next two years.
6. Firm approved for LMLA batteries if wants to develop the VRLA batteries, shall have to develop manufacturing facility for VRLA batteries. However Oxide Mill, automatic Paste Mixing, Pollution Control System, D.M. water Plant and test equipment may be common if both the plants (LMLA & VRLA) are in same premises.

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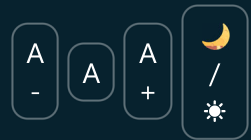
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e Marketplace

IREPS

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E-Procurement System

Government eMarketplace

Indian Railways E- Procurement System



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Vendor Directory



Organization	Indian Railway	Item/Sub-Item Description/ID/PL No	18640011
Approving Agency	--All--	Specification	
Department	--All--	Drawing	
Sub-Directorate	--All--	STR	
Reference Date	18/05/2026	Items Per Page	5

[Proceed](#)

Total : 1

Vendor Directory status as of 18/05/2026 15:05

RDSO Item ID: 3100273 , Low Maintenance lead acid Batteries for Diesel Electric loco engine starting application (8 V, 500 Ah lead acid)



#	Sub Item
1	ID: 3100273001, Low Maintenance lead acid Batteries for Diesel Electric loco engine starting application (8 V, 500 Ah lead acid)

Sub Item ID: 3100273001, Low Maintenance lead acid Batteries for Diesel Electric loco engine starting application (8 V, 500 Ah lead acid)
PL No: 18640011, **Spec:** DEL/SPN/193 Rev.03, July 98,
STR: RDSO/PE/STR/TL/0014-2010 Rev.1, **Images:** (Lead Acid Battery),
 (Total Vendor Count: 5)

3023203/2026/O/o DY.CME(W)/GRC/SER

M/s EXIDE INDUSTRIES LIMITED.- KOLKATA (ID- 2729) Regd Add. : Exide House, 59-E, Chowranghee Road Kolkata, West Bengal - 700020, India	Unit 1 Haldia Factory, P.O. Durgachak, Haldia Midnapore East, West Bengal - 721602, India Current status since - before 01/01/2020 Capacity (PA) :- 36000 Numbers
M/s MYSORE THERMO ELECTRIC PVT LIMITED-BANGALORE (ID- 1364) Regd Add. : No.62 & 36 4th main 3rd phase Peenya Industrial Area, Bangalore, Karnataka - 560058, India	Unit Mysore Thermo Electric (P) Ltd., No. 62 & 36, 4th main, III Phase, Peenya Industrial Area Bangalore, Karnataka - 560058, India Current status since - before 01/01/2020 Capacity (PA) :- 12000 Numbers
M/s THE BHARAT BATTERY MANUFACTURING COMPANY PRIVATE LIMITED-KOLKATA (ID- 1525) Regd Add. : 11 A & B Jamir Lane kolkatta, West Bengal - 700019, India	works 56, Bondel Road kolkata, West Bengal - 700019, India Current status since - before 01/01/2020 Capacity (PA) :- 12000 Numbers
M/s UNITED LEADOXIDE PRODUCTS PVT LTD-Kundaim (ID- 1541) Regd Add. : 13th , Susheela Building, 18th June Road PANJIM, Goa - 403001, India	works Plot No. 216, Kundaim Industrial Estate, Kundaim, Goa - 403115, India Current status since - 28/04/2022 Capacity (PA) :- 25000 Numbers Remarks: -

Developmental Vendors (Vendor Count: 1)

M/s CELTEK BATTERIES PRIVATE LIMITED-BANGALORE (ID- 3580) Regd Add.: 471-B, IV Phase, Peenya Industrial Area, Bangalore, Karnataka - 560058, India	works 471-B, IV Phase, Peenya Industrial Area, Bangalore, Karnataka - 560058, India Current status since - before 01/01/2020 Capacity (PA) : 2400 Numbers
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