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Research Designs& Standards Organization
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ब्रॉड गेज डीजल इलेक्ट्रिक लोकोमोटिव के लिए निकेल कैडमियम स्टार्टर बैटरी की विशिष्टि

SPECIFICATION FOR NICKEL CADMIUM STARTER BATTERIES FOR DIESEL LOCOMOTIVES

Specification Number	MP.0.51.01.02		
Revision	3	**Month of Issue**	07/2021

Brief Description

This specification covers the supply of vented nickel cadmium batteries to be installed in Diesel locomotives and rail cars for starting application.

FOREWORD

I. This specification covers the supply of vented nickel cadmium batteries to be installed in Diesel locomotives and rail cars for starting application. The scope includes complete battery system including:

a. Nickel Cadmium battery.

b. Intercell connectors.

c. Crates.

II. This specification is intended to serve as a guideline for the development of Nickel cadmium starter batteries for Diesel locomotives. RDSO may permit any deviation considered an improvement over the existing specification.

III. Assistance has been taken in preparation of this specification from:

- IS: 10918: Specification for vented type Nickel cadmium batteries.
- IEC60623: Open Nickel cadmium prismatic Rechargeable cells.
- UIC-854R: Technical specification for the supply of Alkaline and lead acid starter batteries.
- IS: 7624: Specification for lead acid starter batteries for Diesel locomotives and Rail cars.
- Data from manufacturers of Nickel Cadmium batteries.

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LIST OF AMENDMENTS

Sl. No.	Amendment date	Revision	Amended as
1.	March'1996	1	First Issue
2.	June'2009	2	Second Revision
2.	July 2021	3	1. Amendment No. 1 of March 2010 incorporated.
			2. Clause No. 5.16 for Field trials specifically mentioned with references of guidelines of RDSO for trial period and trials quantity. Field trial performance feedback format incorporated at clause 5.16
			3. Addition of new clause 8, Title: Vendor Changes in approved status.
			4. Make InIndia policy has been incorporated at clause no. 9.
			5. Undertaking by equipment manufacturer has been incorporated at clause no. 10.
			6. Declaration of Confidentiality has been incorporated as Clause no. 11.

Contents

List of Table

1 Scope

This specification covers methods of tests, performance and other requirements of Nickel Cadmium starter batteries used as a source of energy for starting Diesel engines, lighting and other auxiliary purposes in Diesel locomotives.

2 Terminology

a) For the purpose of this specification, the definitions given in IS: 1885 (part 8)- 1965 and IS: 7624-1990 shall apply, in addition to those given below.
b) **Battery Unit**: A number cells assembled in a crate.
c) **Battery**: Two or more battery units connected in series.
d) **Nominal Voltage**: The nominal voltage of a single rechargeable Nickel Cadmium cell is 1.2V.
e) **Rated capacity**: The capacity in ampere hours is the capacity at the 5 hours (C5) discharge rate to an end voltage of 1.0V at 27deg.C.
f) **Mean terminal voltage**: Terminal voltage per cell at various stages of a discharge cycle is calculated by dividing the terminal voltage of the series of cells by the number of cells.
g) **Type tests**: Tests carried out to prove conformity with requirements of this specification, and to prove the general quality and design of a given type of battery.
h) **Acceptance tests**: Tests carried out on sample cells selected from a manufactured lot for the purpose of verifying the acceptability of the lot.
i) **Routine tests**: Tests carried out on each battery to check the requirements which are likely to very during production.
j) **Lot:** All the battery unit cells of the same type, design and rating manufactured by the same factory during the same period using thesame process and materials, offered for inspection at a time shall constitute a lot.

3 General requirements

i. The batteries for HHP and ALCo class of diesel locomotives shall be capable of supplying initial cranking current, sustained cranking current to crank the diesel engine of the locomotive and also to supply control and lighting loads for the locomotive as specified in table 1.

Table 1: Design and Construction

Sl. No.	Parameters	HHP Loco	ALCo Loco
1.	Class of locomotive	WDP4	WDM3A/3D& WDG3A
2.	Battery float voltage	74V	72V
3.	Maximum Voltage	80 V	72V
4.	Minimum Voltage	50 V	50V
5.	Nominal capacity normal charging current	155 Ah at 5 Hrs rate 30 Amps	300Ah at 5 Hrs rate 60 Amps
6.	Recommended charging voltage	1.43 to 1.6 V per cell.	1.42 to 1.45V per cell
7.	Number of cells	50	50
8.	Initial cranking current	2000A	2300A
9.	Sustained cranking current	1400A	1400A
10.	Power requirements for control and	58A	45A

11.	Lighting circuits and auxiliaries for minimum	4 Hrs	4 Hrs
12.	No of cells per battery unit	5	5
13.	Internal resistance per battery	*	*
14.	Crate Dimensions-length x width x height	*	*
15.	Weight per battery unit with electrolyte	*	*
16.	Clear space available in battery boxes		
	a) Location	Located at the center below the under frame	Under slung on long hood end and below driver's look out window on short hood end
	b) the battery box dimension in mm	1887(L)X594(W)X584(H)	Long hood (2195(L)X215(W), Short hood,725(L)X475(W)
17.	State of charge coefficient	1.008	1.008
18.	Aging Coefficient	0.9	0.9
19.	Charge Efficiency	76 %	76 %

*may be decided by the manufacturer to suit the application

ii. Battery Charging: The Auxiliary power required for battery charging is supplied by an Auxiliary Generator controlled by a Voltage Regulator to maintain a constant output voltage of 74V/72V, with a current limit setting of 122A/170A for WDP4 (EMD type) and ALCo class of diesel locomotives respectively.

iii. The batteries shall be subject to vibrations and dust in service, when installed on the locomotive. It is occasionally required to offer locomotives for export and, therefore, the safe working temperature in the cold climates shall be indicated, bringing out the additional technical features recommended for cold climate application.

iv. The batteries and its mounting arrangement shall be of robust design for traction duty and withstand satisfactorily the vibrations and shocks normally encountered in service. The vibration, shock and bump test shall be subjected to the tests defined in IEC 61373 (as per clause 10.2.11 of IEC 60571). The design and construction of the cells shall be suitable to withstand the harsh service conditions.

v. The batteries covered in this specification shall be suitable for traction application under the following environmental conditions, since these equipments will be used in diesel electric locomotives operating all over India:

Max temperature (Atmospheric)	(i) 70 ºC (under sun). (ii) 47 ºC (in shade) (Temperature inside locomotive may reach up to 60 ºC.)

Min temperature (Atmospheric)	- 5 ºC.
Humidity	90 % (Up to 100% during rainy season as per IEC 60721-3-5.
Altitude	Max. 1200 meter above mean sea level
Reference site conditions	(i) Ambient temp. 47 ºC (ii) Temp. inside engine compartment 55 ºC (iii) Altitude 160 m.
Annual rainfall	Between 1750 mm to 6250 mm. The locomotive shall be designed to permit its running at 5 Km/h in flood water level of 10.2 cm above the rail level.
Dust	Extremely dusty and desert terrain in certain areas. The dust content in air may reach as high a value as 1.6 mg / m^3.
Atmospheric conditions in coastal areas in humidity salt laden and corrosive atmosphere	All the equipments shall be designed to work in coastal areas in humid, salt laden and corrosive atmosphere. (a) Maximum PH value: 8.5 (b) Sulphate: 7 mg / liter. (c) Max. concentration of chlorine: 6 mg / liter (d) Maximum conductivity: 130 micro siemens / CM.

4 Materials and Construction

The batteries are constituted of vented nickel cadmium cells using an alkaline electrolyte, positive electrode of sintered or fibre type and negative electrode of plastic bonded type or fibre type.

4.1 General construction

Batteries are mainly composed of positive plates, negative plates, separators, cell containers, special vents and electrolyte.

Cells are assembled in battery tray, which is further fitted in to the raft.
All materials used shall be the best of their respective kind, free from flaws and defects and shall conform to the relevant Indian Standards, where applicable, also the workmanship shall be confirming to the highest accepted practice. There shall not be any impurities, which are harmful to the performance or life of a cell.

4.2 Overall Dimension and Weight

Each crate/mono block shall accommodate two or more cells. The dimensions of cell and crates/mono block shall be such as to permit accommodation of all crates / mono block within the battery boxes provided on the diesel-electric locomotive, as shown in table 1.

4.3 Cell Container

The cell container shall be of high strength alkali resistant and having insulating capacity to avoid shorting or leakage of current between plates of opposite polarity The cell container shall be made of non-porous, non-hygroscopic, industrial grade expanded polypropylene/auto impact polystyrene material. The container shall not bulge, buckle or disintegrate under the conditions encountered in locomotive operation and shall last the expected life of the battery without any adverse effect on the performance and shall provide safe sealing of electrolyte in service. The plastic cell container shall conform to IS: 1146-1981 and shall pass the tests accordingly.

4.3.1 Positive Plate

Positive plate is sintered or fibre plate type. In case of sintered plate Nickel Hydroxide active material is held within a porous substrate obtained by coating and sintering Nickel powder onto a thin perforated nickel plated steel strip. In case of fibre plate the Nickel Hydroxide active material is impregnated in the pores of the Nickel coated polypropylene fibre current collector.

4.3.2 Negative plate

Negative plate consists of plastic bonded type of fibre plate. Plastic bonded electrode cas be obtained by coating a thin perforated nickel plated steel strip with mixture of cadmium oxide with plastic binder. In case of fibre plate the Cadmium Hydroxide active material is impregnated in the pores of the Nickel coated polypropylene fibre current collector.

4.4 Separator

The separator shall consist of layers of porous membrane in between two layers of non-woven felt which acts as a barrier to the oxygen gas between the electrodes. The separator system will provide optimum balance between performance, reliability and long life.

The separators shall also be dimensionally stable and shall not deform or deteriorate at the temperature of use. Each cell shall be provided with a suitable separator guard, adequately secured to prevent damage to separators while inserting thermometers or service apparatus into a cell.
In case of sintered type batteries, the separator shall consist of layers of porous membrane in between two layers of non woven felt which acts as a barrier to the oxygen gas between the electrodes. The separator system will provide optimum balane between performance, reliability and long life. In case of fibre plate battery, the separator shall be Micro-porous sintered PVC separator.

4.5 Venting Device

Each cell shall be equipped with flame arrestor vent. This vent shall allow the escape of hydrogen and oxygen gas produced in the cell also prevents penetration of flame. The venting device shall be of the anti-splash type and shall allow the grass to escape freely but shall effectively prevent the escape of electrolyte particles or spray. Provision shall be made for drawing electrolyte samples, and for checking and servicing of the electrolyte. Vents with flame arrestor caps shall be preferred.

4.6 Terminal post and connections

Each battery unit shall be provided with terminals for inter unit connections. The manufacturer shall provide sufficient inter unit connectors made up of nickel plated copper for the units and for end connections, similar to those shown in IS: 7624-1990, with prior approval for the design from Research Design and Standards Organization. The connector covers are made of hard PVC plastic, insulating the positive and negative terminals against the short circuit from any metallic object falling on the battery**.**

4.7 Electrolyte

The electrolyte used shall be an aqueous solution of potassium hydroxide in distilled water made up to the specific gravity as specified by the manufacturer 27deg.C. It must be clear and colorless and free of noxious materials. The possible additives of the electrolyte shall be defined by the manufacturers.

5 Tests and Performance

5.1 Type tests

The tests given in table 2 shall constitute the type tests, and shall be conducted as per IS: 10918–1984 on three batteries selected at random from the lot offered for inspection. The manufacturer shall furnish a copy of proposed test schedule in advance and the schedules of General and Technical data as listed at appendix A for approval by the type-testing authority. The type tests shall be supplemented by a field test of cranking ability on a loco in actual working conditions.

Table 2: Schedule of Type Tests

Sl. No.	Test	Clause No.	Battery No.			
			1	2	3	4
1.	Physical Examination	5.4	**X**	**X**	**X**	**x**
2.	Polarity and Absence of short-circuit	5.5	**X**	**-**	**-**	**x**
3.	Air pressure test	5.6	**X**	**X**	**-**	**x**
4.	Rated capacity test (C5)	5.8	**X**	**X**	**X**	**x**
5.	Test for capacity during overcharge	5.8.2	**-**	**-**	**-**	**x**
6.	AH and WH efficiency test	5.9	**-**	**X**	**-**	**-**
7.	Cranking current test	5.10	**X**	**X**	**-**	**-**
8.	Retention of charge	5.11	**-**	**X**	**-**	**-**
9.	Evaluation of the capacity under real simulated charging	5.12	**-**	**-**	**-**	**x**
10.	Charge acceptance at constant voltage at high temperature	5.13	**X**	**-**	**-**	**-**
11.	Life test	5.14	**X**	**-**	**-**	**-**
12.	Storage test	5.15	**-**	**-**	**X**	**-**

NOTE - The batteries shall be covered by a type approval certificate from an appropriate authority. All variations in design shall be covered by separate type approval certificate.

5.2 Acceptance Tests

The following shall constitute the acceptance tests:

i. Physical examination
ii. Polarity and absence of short circuit
iii. Ampere –hour capacity
(The sampling scheme and criteria for acceptance shall company with IS: 8320:1982.)

5.3 Routine Tests

The following shall constitute the routine tests:

i. Physical examination
ii. Polarity and absence of short circuit

5.4 Physical Examination (as per Clause no.10.2 of IS : 10918–1984)

The battery shall be examined for conformity with the requirements of 4.

5.5 Polarity and Absence of short-circuit (as per Clause no.10.5 of IS : 10918–1984)

The polarity of plates in relation to that of the terminals or inter-cell connectors to which they are connected, shall be verified electrically or visually. Absence of short-circuit shall be verified by checking the terminal voltage of each cell.

5.6 Air Pressure Test (as per Clause no.10.6 of IS : 10918–1984)

The sealing of each cell of the battery shall be checked by compressed air at a pressure equal to 150 mm water. The volume of the tubes and auxiliary parts in connection with the cell under pressure shall not exceed 0.5 liter. The air pressure in the cell shall be noted 15 seconds after the supply has been disconnected. The air pressure test shall be carried out in dry uncharged condition, the electrolyte being removed for this purpose if necessary.

The air pressure shall not fall from 150 mm of water to below 120 mm of water at the end of 15 seconds.

5.7 Charging Procedure for Test Purposes

Unless otherwise specified in this specification, the charge preceding the various discharge tests scheduled shall be carried out at an ambient temperature of 27+5 deg.C and at a constant of 0.2 C5A. The duration of charge shall be 7 to 8 hours. Prior to charging the cell shall have been discharged down to a voltage of 1.0V at a constant current of 0.2 C5 A. When charging is completed, the density and level of electrolyte should be checked, if necessary, at that state.

5.8 Ampere-Hour Capacity Test (as per Clause no.10.7 of IS:10918–1984)

The battery shall be first charged as specified in 5.7. After standing on open circuit at 27+5 deg.C for not less than 16 hours and not more than 24 hours from completion of full charge, the cells shall be discharged at the same temperature through a suitable variable resistance at a constant current at specified by the manufacturer till the mean terminal voltage drops to 1.0V.

During the discharge, the following values shall be checked and noted at suitable interval:

(a) The terminal voltage of the cell or battery,
(b) The discharge current, and
(c) The temperature of the electrolyte.

The measurements shall normally be taken hourly, but the voltage shall be checked at 15 min. intervals when the mean terminal voltage has fallen bellow 1.05 V.

The capacity obtained by multiplying the rate of discharge in ampere by the duration of discharge in hours shall be the ampere-hour capacity of the cell.

On the first discharge, the battery shall give not less than 85 percent of the rated capacity C5 and not less than 95 percent of the rated capacity shall be reached within 3 discharge cycles subsequently to the initial charge.

Note: If the required capacity is reached in the first discharge, no further discharge shall be conducted.

Test for capacity during overcharge

- Charge up to 4 times capacity, 0.1 C Amperes for 40 hours.
- Capacity test as per IS 10918 is to be conducted**.**

5.9 Ampere-Hour and Watt-Hour efficiency Test

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

5.9.1 Ampere-hour Efficiency

A fully charged battery unit shall be discharged at 0.2C5 A to a mean terminal voltage of 1.0 V, careful measurements being made of the exact number of ampere-hours delivered. On the recharge the same numbers of ampere-hour are put back at the same current. A second discharge shall then be made to the same cutoff voltage as before. The efficiency of the battery unit is then calculated as the ratio of the ampere hour delivered during the second discharge to the ampere-hour put in during the charge. The charge and discharge cycles should be carried out without any rest period and at the same temperature, preferably in an air-conditioned room.

5.9.2 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 voltage shall be calculated from the log sheets for ampere-hour efficiency and watt-hour efficiency shall not be less than 80% and 65% respectively.

5.10 Cranking Current Test

After three C5 discharge cycles, the battery is tested for its starting ability at normal temperature, at both the initial and sustained cranking currents.

5.10.1 Preparation

The battery is fully charged, and the temperature of the electrolyte is adjusted to 27deg.C as measured in the middle cells, and the battery is allowed to stand for two to eight hours before commencement of each test.

5.10.2 Initial cranking test

The battery is discharged at the initial cranking current specified in Table 1. The mean terminal voltage as measured at 5 sec. and 60 sec. after commencement of discharge shall not be less than 0.9 V and 0.7 V respectively.

5.10.3 Sustained cranking test

The battery is discharged at the sustained cranking current specified in table 1.The mean terminal voltage as measured at 5 sec. and 180 sec. after commencement of discharge shall not be less than 1.0V and 0.75V respectively.

5.11 Test for retention of charge

The battery shall be fully charged according to clause 5.7 and shall then be subjected to two consecutive capacity tests in accordance with clause 5.6, the value of the initial capacity C1 being calculated as the mean of the two results thus obtained. After a complete recharge and cleaning of electrolyte from its surface, the battery shall then be left on open circuit for a period of 28 days without disturbance at a temperature of 27+5 deg.C. After 28 days storage, the battery shall be discharged in accordance with clause 5.8. The value of capacity obtained after storage is denoted as C2. The loss of capacity ‘S’ expressed as percentage is calculated from the following formula:

$$S = (C1 – C2) * 100 / C1$$

The loss in the capacity ‘S’ shall not exceed 20 percent.

5.12 Test for evaluation of the capacity under real simulated charging conditions

- Charging : The battery shall be charged at 0.4 C Amperes upto voltage of 1.47 V per cell, followed by constant voltage charging at 1.47 V per cell for 2 hours.
- Discharging: Then battery shall be discharged at 0.4 C Amperes upto 40% capacity.

- Repeat above cycle for 140 times.
- Passing criteria:
    i) Carry out residual capacity during 90th cycles after charging at 1.47V per cell by discharging at 0.2C5 (30) amps rate. The capacity shall not be less than 80% of rated capacity.
    ii) Similarly, carry out capacity during 140th cycle which shall not be less than 70% of rated capacity.

5.13 Charge acceptance at Constant Voltage at High Temperature

The battery shall be discharged at a rate of 0.2 C5 until the voltage drops to 1.0V per cell. The battery shall then be charged for 7 to 8 hours maintaining at electrolyte temperature of 50+5 deg. C, at the constant voltage of 1.425+ .005 V per cell .The charging current shall be limited to 0.2 C5. The cell shall be stored for 1 to 4 hours maintaining an electrolyte temperature of 50+5 deg.C and then discharged using a procedure similar to that described in clause 5.8. The duration of discharge shall not be less than 3 hours 30 minutes.

5.14 Accelerated Life Cycle Test

5.14.1 Conditioning Cycle

The battery shall be charged according to clause 5.7 and discharged according to clause 5.8, and the capacity obtained shall not be less than 95 percent of the rated ampere-hour capacity

5.14.2 Accelerated Life Cycle

The accelerated life cycle shall consist of cycle of charging and discharging performed at accelerated rate at an ambient temperature of 27+5 deg C in the manner described herewith.

On the first cycle, the battery shall be charged at a constant current of 0.1C5 A for a minimum of 14 hours and until there is no father voltage increase for 3 consecutive hourly readings. The battery shall be discharged at a constant current of 0.2 C5 A for 2 hours 30 minutes. On cycles 2 to 24 the battery shall be charged for 3 hours 30 minutes and immediately discharged for 2 hours 30 minutes. The charge and discharge current shall be 0.2 C5A. At the twenty fourth cycle after discharge for 2 hours 30 minutes, the mean terminal voltage shall be above 1.0V. The discharge shall be continued till the terminal voltage of any cell drops to 1.0V.

On cycle 25 the battery shall be charged at a constant current of 0.1 C5 A for a minimum of 14 hours and until there is no further voltage increase for 3 consecutive hourly reading. The battery shall then be discharged at an ambient temperature and at a constant current of 0.2 C5 A until the terminal voltage of any cell drops to 1.0V.

5.14.3 Passing Criteria

The Accelerated Life Cycle comprising cycles 1 to 25 shall be repeated until the ampere hour capacity on any twenty fifth cycle becomes less than 0.7 C5 AH. At least 500 cycles must be obtained with a capacity above 0.7 C5 AH to pass the test.

5.15 Storage Test

The battery shall be charged according to clause 5,7 before this test. The fully charged battery shall be stored at an ambient temperature of 27+10 deg C and a relatively humidity not exceeding 90 percent for a period of one year. After storage for the above period , the batteries shall be discharged according to clause 5.8 to an mean terminal voltage of 1.0V after carrying out the instructions of the manufacturer for commissioning back the battery. The AH capacity of the cell shall than be measured in accordance with clause 5.8. Not less than 95% of the rated capacity shall be reached within 3 discharge cycles subsequent to the initial charge.

5.16 Field trials

After successful prototype test and validation on locomotive, the Systems shall be subjected to field trials before clearance is given for bulk supply. The Qualifying period and Qualifying Quantity for field trials is governed by RDSO Doc.no.MP-M-8.1-1 (Latest). Feedback shall be furnished by User Railways as per prescribed format as follows :

Sno.	Loco No./Type	Battery make	Date of commissioning	Date of failure	Date of rectification	Feedback/Remark incl. comments on issues related to battery and its associated electronics if any

Performance shall be closely monitored and evaluated by Vendor controlling authority for:

i) Reliability under actual operating conditions

ii) Advantages for locomotive operation and maintenance

iii) Maintainability of the system

Notwithstanding anything that may be specified in this specification, the final responsibility for the suitability of the design shall lie with the vendor and shall carry out all modifications for satisfactory functioning during the period of field trials. Any safety related modifications issued by IR are to be carried out by the vendor.

6 Marking and Packing

6.1 Marking

(i) The batteries shall be provided with an identifying plate showing the following:

Manufacturer's name and/ or trademark
Mouth and year or manufacture
Nominal voltage
Rated ampere- hour capacity
Cell designation
Serial Number

(ii) The plate should have adequate space for the user to stamp date of commissioning.

6.2 Polarity Marking

The polarity of the terminals shall be marked for identification, with the positive terminal being identified by P or A + Sign and/ or red color mark. Marking shall be permanent and non-deteriorating.

6.3 Packing

The batteries shall be suitably packed so as to avoid any damage during transit.

7 Manual of instructions

The manufacturer shall supply instructions for commissioning the battery along with routine maintenance and overhaul instructions with every lot of 5 loco sets or part thereof. The instructions should include the procedure for predation of electrolyte and should specify its specific gravity at the standard temperature of 27 deg C. The material specification for electrolyte including permissible impurities and data for marking temperature corrections to compute the specific gravity at standard temperature of 27 deg C together with any other data the manufacture may consider useful for proper maintenance of the battery, may also be furnished.

8 Vendor changes in Approved status

All the provision contained in RDSO's ISO procedure laid down in document no. QO-D-8.1-11, dated 01.07.2020 (titled: "Vendor changes in approved status") and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contract floated by Railways to

maintain quality of products supplied to Railways.

9 Preference to "MAKE IN INDIA"

The Government of India policy on "Make in India" shall apply.

10 Undertaking by equipment manufacturer

Vendor shall provide a signed copy of the undertaking on "INFRINGEMENT OF PATENT RIGHTS". The undertaking shall be as under

> Indian Railways shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of similar components in the design & development of this item and any other factor not mentioned herein which may cause such a dispute. The entire responsiblty to settle any such dispute/matters lies with the manufacturer/supplier.
>
> Details/design/documents given by them are not infringing any IPR and they are responsible in ansolute and full measure instead of Railways for any such violations. Data, specifications and other IP as generated out of interaction with Railways shall not be unilaterally used without the consent of RDSO and right of Railways/RDSO on such IP is acceptable to them.

11 Declaration of confidentiality of submitted documents by manufacturers

While submitting a new proposal/design, manufacturer must classify their documents confidentiality declaration such as

> This document and its contents are the property of M/s XYZ (Name of the vendor) or its subsidiaries. This document contains confidential proprietary information. The reproduction, distribution, utilization or the communication of this document or any part thereof, without express authorization is strictly prohibited. Offenders will be held liable for the payment of damages. Indian Railways/RDSO is granted right to use, copy and distribute this document for the use of inspection, operation, maintenance and repair etc.

12 Appendix A:Schedule of Information

Sl.No. Description Particulars to be furnished

1. Manufacture's name.
2. Type of cells
3. Type of container
4. Manufacture's type number
5. Overall dimensions of each cell

i.e. length width x height

6. 1. No. of cells per crate
   2. Overall dimension of crate
   3. Type of crate
   4. Weight per complete with electrolyte.
   5. Weight of crate with cells &electrolyte.
7. Material of separators
   1. Construction of positive plates
   2. Construction of negative plates
   3. Electrolyte height above the top of plates
   4. Electrolyte depth below the bottom of plates
   5. Quantity of liquid electrolyte per cell
   6. Quantity of solid electrolyte per cell
8. Period recommended for renewal of electrolyte.
9. Composition of electrolyte
10. Type of electrolyte & source of supply.
11. Specific gravity of electrolyte (at 27deg C)
    (i) at the end of full charge
    (ii)at the end of full discharge
12. Internal resistance of fully charged cell (at 27deg.C)
13. Ampere hour efficiency at 5 hour rate.
14. Watt hour efficiency at 5 hour rate.
15. Rise in electrolyte temp. above 55 deg.C ambient temp. when the cells are tested continuous by full charge and discharge at normal rates.
16. Max. electrolyte temp. at which the cells will give 100% capacity, 90% capacity.
17. Characteristics curves for
    (i) End Voltage Vs Discharge Time covering full range of discharge currents.
    (ii) Charge voltage Vs Charging time for various levels of charge.
    (iii) Variation in capacity with electrolyte temperature.
    (iv) Charge acceptance at constant voltage at elevated temperature.
    (v) Effect of high temperature on End Voltage during discharge at high currents.

NOTE *- Necessary outline and layout drawings depicting details of cell, crate, container etc. shall be furnished, along with various characteristic curves specifying the performance of the cells.*