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MINISTRY OF RAILWAYS

अनुसंधान अभिकल्प एवं मानक संगठन

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RDSO STR No. RDSO/PE/STR/TL/0014-2010 (Rev.2)

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

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.IVCl.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.
4	June2020	Rev.2	Annexure II. Annexure III	• Requirement for GEL batteries added. • Design and development and R&D merged and other clause modified/corrected.

अनुमोदित
APPROVED

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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 AGM & GEL) 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 /GEL Batteries.

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

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

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ANNEXURE – 'I'

LIST OF MACHINERIES AND PLANTS FOR MANUFACTURE OF LOW MAINTENANCE 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 automatic injection moulding facility for PPCP/ABS and moulding machine for hard rubber 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 welding Shear testing machine to check the welding strength preferably with auto segregation of defective/failed cell. Automatic Shear testing machine to check the welding strength-Preferably with auto segregation of defective/ failed cell.

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 State pollution control boartd or MOU with authorized recycler approved by MOEF or State pollution control board. 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**. (Manualrecordingnot 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~~. for quantitative analysis of metal and metallic impurities of water , acid and other raw material.
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~~ Deminaralised 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 300ºC max.)
21. Weighing balance (digital) up to 150 kg with least count of 10 gm for battery
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'

COMMOM LIST OF MACHINERIES AND PLANTS FOR MANUFACTURE OF AGM AND GEL VALVE REGULATED LEADACID BATTERIES

A. Essential Manufacturing facilities

1. Programmable automatic lead oxide-manufacturing mill.

2. ~~2.~~ Automatic Gravity die casting machine for ~~Positive and~~ Negatve grids**.(Hand moulding process not permitted)**

3. ~~3.~~2. Automatic/Semi-automatic Gravity die-casting machines for terminal post, inter unit connector, poles etc.**(Hand moulding process not permitted)**

4. ~~4.~~3. Automatic paste mixing plant.

5. ~~5.~~4. Automatic pasting plant for ~~Positive and~~ Negative plates**.(Hand pasting process not permitted)**

6. ~~6.~~5. Container and Lid.

   Manufacturers may have their own injection moulding manufacturing Plant for Container and Lid ~~Plant~~. However, they may outsource the Container and Lid to other ISO certified firms, having Automatic Injection Moulding Machine (For PPCP/ABS 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. ~~7.~~6. Plate/Jar formation (with water circulating facility) plant with power back up and automatic recording facility for power interruption

8. ~~8.~~7. Jigs and fixtures to make groups of positive and negative plates.

9. ~~9.~~8. Heat-sealing plant with controlled temp, pressure & time duration.

10. ~~10.~~9. Automatic Inter cell connector welding machine for monoblock batteries.

11. ~~11.~~10. Fully equipped chemical laboratory to test various chemical ingredients of bought out material and in house processed material.

12. ~~12.~~11. Gas burners set for assembly of positive and negative plates group.

13. ~~13.~~12. ~~Distilled~~ Deminaraised water manufacturing plant.

14. ~~14.~~13. Compressor with dryer.

15. ~~15.~~14. Humidity & temp. controlled curing chamber with power back up with automatic recording facility for power interruption, temperature, humidity.

16. ~~16.~~15. Formation rectifier.

17. ~~17.~~16. Manometer.

18. ~~18.~~17. Material handling equipment i.e. Fork lifter/pallet truck etc.

19. ~~19.~~18. DG set of rating 125 KVA or above – 2 nos.

20. ~~20.~~19. Air pollution control system.

21. ~~21.~~20. Water effluent plant.

21 Lead re-cycling plant as per MOEF or State pollution control board or MOU with authorized recycler approved by MOEF or State pollution control board. The authorized recycler capacity shall be at least 50% of lead used by battery manufacture.

ADDITIONALFACILITY REQUIRED FOR AGM VRLA BATTERY

1. Automatic Gravity die-casting machines for Positive grids. (hand moulding process not permitted
2. Automatic pasting plant for Positive plates. (Hand pasting process not permitted)
3. Automatic acid chilling plant
4. Automatic acid filling plant

ADDITIONALFACILITY REQUIRED FOR GEL VRLA BATTERY

1. Pressure die- casting machines for positive spine (Hand moulding process not permitted)
2. Vibration / Slurry filing plant for filling of positive tubular plates.
3. PVC separator manufacturing plant or outsourced with ISO certified firm.
4. GEL Mixing Machine
5. GEL Filling Machine
6. Acid Damping Machine

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~~ 50 gm and up to 50 Kg with least count of 20 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.

ANNEXURE –III

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 stall submits 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.

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** & **R&D**: The firm shall have Design and Development and R&D organizational structure for the designing of batteries of required capacity and also to work on quality/performance related issue received from field ~~implement the input given by R&D~~ for trouble free long life services. In organizational structure, there shall be minimum two Engineers having Degree in / Electro Chemical / Chemical Engineering with minimum five years' experience

9. **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.

10. **Quality Audit**: The manufacture shall send the internal quality check details to RDSO oftheir 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.

11. **Handing /Storage/Delivery:** The manufacture shall have proper facilities for handlingand 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.

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

ANNEXURE IV

1. Firm should have minimum six service centers/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/GEL Batteries (Separately for LMLA/VRLA/GEL) 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 (AGM/GEL) Batteries.

3. If the firm is already approved for any of the VRLA/GEL 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 yearsof approved vendors for that VRLA Battery~~ for two years should not be more than average FRPCPY of approved vendors for that VRLA Battery Else, the firm will not be considered for the development of new type of VRLA/GEL Battery.

4. If firm is found capable to manufacture VRLA batteries in assessment, initial approval for registration shall be given only for 120 Ah or 70 Ah ~~train lighting~~ Batteries after successful prototype testing.

5. Firm's offer for developing VRLA air conditioned conventional (Non LHB) coach battery shall not be accepted till its performance for 120Ah/70 VRLA ~~train lighting~~ batteries is satisfactory ~~not only during first two years but also during the next two years~~ for the last two year.

~~5.~~6. Firm Approved for LMLA batteries if wants to develop the VRLA batteries, shall have to develop manufacturing facility separately for VRLA (AGM/Gel) 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 & AGM / Gel VRLA are in same premises.