# SPECIFICATION P-132:88
# (UDC 621-355)

## STATION BATTERIES



**P A K I S T A N**
**WATER & POWER DEVELOPMENT AUTHORITY**
**DESIGN (T&G) DEPARTMENT**

# SPECIFICATION P-132:88

# STATION BATTERIES

## Amendment No.2 Dated 21.07.1995

**1. CLAUSE – 1**

The existing text is replaced with the following:

"This specification described enclosed type lead-acid batteries of Plante or pasted type for stationary service in floating system. Unless otherwise indicated in the bid enquiry, the bidders may offer the battery of either type. For purpose of bid evaluation the quoted price of pasted type battery, shall be compared with "weighted price" of pasted type battery, which shall be taken as 1.5 times its quoted price".

**2. Clause 5.2.1**

The existing text is replaced with the following:-

"The positive plates of the cells shall be either plant type or pasted type. The plante type battery shall conform to B.S.6290 Part-2 (latest version). For pasted type batteries the weight of active material on positive plate shall neither be less than 12 grams/ampere-hour nor shall constitute more than 35% (by weight) of the finished dry plate. The grid weight shall be approximately 52% of the total weight of the plate".

**3. Clause 10.3**

Add following sub – clause 10.3.4

"10.3.4 Composition Test

10.3.4.1 The test shall be made on one cell, drawn at random from the offered lot to verify the following:

a) Weight of lead used in grids of the plates.
b) Weight of the active material used in the plates.
c) Weight of outer frame and lugs.

10.3.4.2 In case, the measured weights are less than those indicated in approved date, two more cells shall be subjected to the test and the lot shall be accepted if both the cell pass the test"

**4.** The following data may be added at the end of schedule of technical data for 220 volts type B and schedule of technical data for 110 volts type A batteries.

| | | |
|---|---|---|
| 1- | Total weight of finished dry positive plate | _____gram |
| 2- | Weight of +ve plate grid (without active material) | |
| | i) With lug | _____ gram |
| | ii) Without lug | _____gram |
| 3- | Weight of active material in the completed +ve plate | _____gram |
| 4- | No. of +ve plates in a cell | No._____ |
| 5- | AH capacity per +ve plate | _____AH/+Plate |
| 6- | Active material per +ve plate | _____Gram/AH |

# SPECIFICATION P-132:88

# STATION BATTERIES

## Amendment No.1 Dated 22.10.1989

**Clause No. 5.1.2:** First line of the clause is replaced with the following:

" The batteries shall be of Plante Type or Reinforced grid type plates assembled in shock".

**Clause No. 5.2.1:** The existing text is replaced with the following:

"The positive plates of cells shall consist of pure lead lamellae with plante formation or Reinforced grid type having total weight 65 gm/A.H. capacity. The plates will have more than 65% pure lead. The battery with Reinforced grid shall have grid weight more than 50% of the weight of the finished dry plate and outer frame with lug shall be about 21% of the grid weight".

**Clause 10.2.5:** The existing text is replaced with the following:

" The cell shall be fully charged and placed on a constant float voltage of 2.20 volts until the current into the cell has reached a constant minimum value over six consecutive hourly readings. The charging current shall not exceed a value equal to 0.5 mA/A.H. at 25°C for the new batteries and 0.5 mA/A.H. to 0.75 mA/A.H. throughout the battery life time.

**Clause 11.1.7.23(b)** The existing text is replaced with the following:

" (b) i) Weight of lead in each plate.
ii) Weight of grid in each plate.
iii) Weight of frame with lug in each plate"

# C O N T E N T S





## PRINTING HISTORY:


FIRST APPRVED 14TH FEBRUARY, 1980

FIRST REVISION 24TH OCTOBER, 1988

AMENDMENT NO. 1 DATED 22ND OCTOBER, 1989

AMENDMENT NO. 2 DATED 21ST JULY, 1995

# SPECIFICATION P-132:88
# (UDC 621.355)

# STATION BATTERIES

## 0. FOREWORD

0.1 This specification has been prepared by the Design Department (T&G) of WAPDA.

0.2 This Specification is intended for the procurement of material either in loose form or for grid stations works on 'turn-key' basis, and does not include all the necessary provisions of a contract.

0.3 This Specification is subject to revision as and when required

## 1. SCOPE

This Specification describes enclosed type lead-acid batteries for stationary service in floating system.

## 2. DEFINITIONS

2.1 Battery

A battery is a group of cells interconnected to produce the system nominal voltage.

2.2 System Nominal Voltage

It is the voltage by which the DC power system of a sub station is designated.

2.3 On-Load Voltage

The difference of potential existing between the terminals of cell or battery when it is delivering current.

2.4 Open-Circuit Voltage

The difference of potential existing between the terminal of a cell or battery when the external circuit is open.

2.5 End-Point Voltage

The minimum on-load voltage at which discharge of a cell or battery is considered to be complete.

2.6 Discharge Capacity

It is the ability (expressed in ampere hours) of a cell or battery to deliver to an external circuit a given current for a specified period of time (called the rate of discharge) at a specific temperature of the electrolyte while maintaining the on-load voltage above the end-point voltage.

2.7 Plate Group

An assembly consisting of either positive or negative plates together with group bar.

2.8 Group Bar

A lead alloy bar to which are burned the plate lugs of a plate group.

2.9 Plate Lug

A projection of a plate used for connecting it to the group bar.

2.10 Element

An assembly in which positive and negative plate groups are interleaved such that plates of opposite polarity are electrically separated from each other by micro porous material.

2.11 Terminal Post

A projection of a plate group which protrudes through the cover and is used for connecting a plate group of a cell to that of adjacent cell.

2.12 Intercell Connector

A metal bar or link used to join externally the terminal posts of cells in series or parallel arrangement.

2.13 Terminal Connector

A lug provided on the terminal posts constituting battery's main positive and negative terminals for making connection to external electric circuit.

## 3. SERVICE CONDITIONS

The batteries shall be installed indoor on wooden racks under the following service conditions.

3.1 Ambient Temperature

| | |
|---|---|
| Maximum | 50 deg C |
| Maximum mean over any 24 hours | 45 deg C |
| Mean in any year | 30 deg C |
| Minimum | -10 deg C |

3.2 Relative Humidity

The relative humidity may range from 0 to 100 percent. The maximum values of the ambient temperature and humidity, however do not occur simultaneously. During the monsoons high humidity may persist for many days at a time along with temperature from 30 deg C to 40 deg C.

3.3 Altitude

Installation upto 1000m above sea level.

## 4. RATINGS

4.1 The batteries shall be designated as types A & B by their voltage and ampere-hour ratings which shall be as follows:

| | | BATTERIES | |
|---|---|---|---|
| | | **Type** (A) | **Type** (B) |
| 1. | System nominal voltage , (Volts) | 110 | 220 |
| 2. | Nominal voltage of cell, Volts | 2.0 | 2.0 |
| 3. | Open circuit voltage of cell at full charge, Volts | 2.055 | 2.055 |
| 4. | Number of cell in battery | 55 | 110 |
| 5. | Rated discharge capacity at 10 hour rate to end-point voltage of 1.85 Volts per cell. Ampere-hours | 150 | 300 |

4.2 The rated discharge capacity is based on the electrolyte temperature of 25oc and specific gravity (25oC) of 1.215+_0.01 and shall be available after not more than a 4 cycles of charge and discharge. For a battery operating on full floated route, the rated discharge capacity shall be consistently attained within two year.

## 5. CONSTRUCTION

5.1 General

5.1.1 The batteries and racks shall be manufactured in compliance with this specification and approved drawings.

5.1.2 The batteries shall be Plante type assembled in shock-proof containers made of clear plastic, and shall be supplied complete with electrolyte, intercell connectors, terminal connectors, wooden racks with inter-tier and inter-row connections and the accessories listed in clause 7.

5.1.3 The batteries shall be of compact design. The construction shall ensure minimum self-discharge and low internal resistance. Adequate measures shall be taken for prevention of internal short-circuits and protection of the element against mechanical damage.

5.1.4 The material used in the construction of the batteries shall be new and free from all defects which may affect the reliability, impair performance, shorten their life expectancy or render them unserviceable.

5.1.5 The positive active material shall be essentially lead dioxide and the negative active material shall be sponge lead. The batteries shall not contain any reclaimed active material.

5.1.6 The construction shall be such as to facilitate inspection, testing and maintenance during service. The maintenance shall be limited to infrequent topping up with pure water.

5.1.7 The average service life of the batteries shall not be less than fifteen years. There will be no fall-off in the rated discharge capacity during the lifetime. End of service life shall be the time when the battery is no longer able to deliver at least 80 percent of its rated discharge capacity.

5.1.8 The batteries shall be of a design for which authenticated tests data can be made available by the manufacturer in sufficiency to show

that batteries of like design have been on test for at least 10 years and that the condition of the test battery at the present time would indicate that the condition of the test battery at the present time would indicate that the battery will reach a useful life of 15 years.

5.2 Positive Plates.

5.2.1 The positive plates of the cells shall consist of pure lead lamellae with plant formation.

5.2.2. The arrangement of plates in the cells shall ensure that all the surfaces of plates are worked equally so that there is no distortion or buckling of the plates. The plates shall invariably be covered with glass wool mats or uniform thickness to minimize the shedding of active material in normal use.

5.3 Negative Plates

5.3.1 The negative plates of the cells shall be of pasted grid type designed to give balanced performance with the positives and have a useful life commensurate with that of the later.

5.3.2 The plate grids shall be cast from corrosion resistant lead antimony alloy and be of such design as to securely hold and retain the active material paste in place and in complete electrical contact with the grids and to ensure uniform distribution of the current throughout the mass of active material.

5.3.3 The plates shall have rugged construction free from defects such as bends, cracks, surface pits and summary gaps between the active material and the grid mesh.

5.4 Separators.

5.4.1 The separators shall be made of micro porous non-corrosive rubber or plastic free from all harmful organic impurities. They shall have good insulation and mechanical strength and be strongly resistant to action of electrolyte and the temperature prevailing in the cell and retain their properties throughout the life of the battery.

5.4.2 They shall permit free diffusion of the electrolyte to the active materials of the plates and may be ribbed or corrugated on the side adjacent to the positive plates to add to the free circulation of the electrolyte.

5.4.3 The height and width of the separators shall be greater than those of the plates to prevent short circuit due to formation of lead moss across edges of adjacent plates.

5.4.4. Adequate provision shall be made below the filling hole of the cells to avoid damage to separators likely to be caused by the insertion of the hydrometer.

5.5. Group Bars

Plate of like polarity in each cell shall be burned integrally to the respective group bar; the group bars shall be of such design, size, and strength as to be adequate electrical conductors and mechanical supports for the respective plate groups.

5.6 Containers

5.6.1 The containers shall be molded in strong, impact-resistant, transparent plastic of high insulating strength. The material shall be completely impervious to the corrosive effects of the electrolyte.

5.6.2 They shall be large enough to enclose the element while providing ample space above and below the element. The space above the element must be adequate to ensure long intervals between topping-ups.

5.6.3 They shall be deeply ribbed in the base to provide a support for the element as well as sediment space sufficient to collect all the active material which will settle therein during the life of the cell so that during this period there will be no contact between the deposited sediment and the plate.

5.7 Covers

5.7.1 The covers shall be molded in hard rubber or composition material commercially approved for the application. The material shall be strong enough to prevent cracking or warping during the life of the battery.

5.7.2 The joints between the covers and container and all covering openings other than the vents shall be gastight and effectively sealed against leakage of electrolyte. The seals between he terminals posts and the cover shall be made either by pressing against a vulcanized rubber gasket or by burning the terminal posts to lead in the holes. The joint between the cover and the walls of container shall be filled with bituminous or equivalent acid-resistant sealing compound to provide an effective acid-proof seals. The compound shall adhere well to the parts applied, and shall maintain perfect seal without cracking or deformation through a temperature range of 0o to 60oC.

5.8 Vent Plugs

5.8.1 Vent plugs shall be either screw or bayonet type or other type suitable for intended application.

5.8.2 They shall be of the non-spray type i.e. they shall allow the gases to escape freely but prevent the leakage of the acid fumes. The required baffling may be provided in the cell, vent or plug. They shall be explosion proof to ensure safe operation in service free from danger of ignition of internal gases by external flame or spark.

5.9 Terminal Posts

The terminal posts shall be of corrosion-resistant lead-antimony alloy and have ample cross section for the current duties incident to the intended application.

5.10 Inter-cell Connectors

5.10.1 Inter-cell connectors shall be bolted type made of corrosion resistant lead alloy or lead-plated copper and be covered with plastic insulating sheaths. They shall not obstruct the filling vent.

5.10.2 They shall be designed to carry current in amperes equal to five times the rated discharge capacity without any significant voltage drop or heating.

5.10.3 The bolts, nuts and washers shall be made of lead plated brass or acid-resistant stainless steel.

5.11 Inter-tier Connections

Inter-tier connections and jumpers etc., shall be well protected against corrosion and be of a type, flexibility and current carrying capacity suitable for the service intended.

5.12 Terminal Connectors

Suitable solder less terminal connectors made of lead-plated copper and having approved dimensions of the flat and hole shall be supplied for connection of the battery's main positive and negative terminals to the cable.

## 6. ELECTROLYTE

6.1 Sufficient quantity of the electrolyte shall be supplied for first filling of the batteries. The electrolyte shall be aqueous solution of sulphuric acid, arsenic, and other impurities that will give rise to misindiction of specific gravity, impair the battery performance or shorten its life.

6.2 Owing to the tropical climate, the electrolyte of lower specific gravity shall be used and for satisfactory operation, the batteries shall not require electrolyte having full charge specific gravity measured at 25 deg C of more than 1.215 ± 0.01.

6.3 Following temperature correction shall be applied to the specific gravity value at a temperature different from 25 deg C.

$$Sc = So + (t - 25) \times 0.0007$$

Where

Sc is the sp. gravity corrected to the reference temperature of 25 deg C

So is the sp. Gravity observed at a temperature of t deg C

t is the temperature of electrolyte (deg C)

## 7. ACCESSORIES

7.1 The following maintenance accessories and tools shall be supplied with each battery.

1. Portable hydrometer syringe, two (sp. Gravity range 1.000 to 1.280 in steps of 0.005)
2. Thermometer, -10oC to 50o C, one
3. D.C. Voltmeter 0-3V, one
4. Anti-corrosive grease (100 grams)
5. Plastic jug – 2 liter, two
6. Funnel – 180mm dia, two
7. Syringe – 180mm dia two
8. Accessories Box, one
9. Wrench, two
10. Service Manual, one

7.2 Besides above, any other tool or accessory which is required for use with or maintenance of the batteries shall also be supplied

## 8. RACK

8.1 Suitable wooden racks shall be supplied with the batteries. They may either be floor stand type or tier-stand type. Step stands may not be used. The manufacturer shall submit the details and drawings of the proposed arrangements for mounting the cells for approval of WAPDA.

8.2 The racks shall have adequate rigid construction suitably stiffened by supports and braces etc., to support the weight of the mounted cells without undue vibration bending or loosening of the parts. They shall be simple and easy to assemble at site. Adjustable insulating pads shall be provided for precise leveling of the lugs.

8.3 The configuration of the cells on the racks shall be such as to afford free and full access to the service personnel to every individual cell. In any case the cells shall not be arranged in more than two tires and more than two rows on one rack.

8.4 An intercell spacing of about 10mm shall be provided between the cells in a row by means of intercell spacers. The spacing between two rows may not be less than 30mm. The underside of the bottom longitudinal runners shall be not less than 100mm above the floor. Arrangements shall be provided to restrict the movement of the cells on the rack. Side and end rails shall be provided to prevent the cells from falling off the rack.

8.5 For batteries of type B, two separate racks may be used with a clear space between them of not less than 0.6 meter.

8.6 The racks shall be treated with a protective finish of no less than two coats of acid resistant enamel on all surfaces and finished in gray colour. They shall be additionally treated for protection against fire and vermin. The workmanship shall be first class and the finish shall conform to good commercial practice.

## 9. MARKING

9.1 A nameplate shall be supplied for each battery. The nameplate shall be made of lead or other corrosion-resistant material and be suitable for attaching to the battery rack or hanging on the wall. It shall have at least the following legibly marked on it in English. The markings shall be durable.

1. Name or trade mark of the manufacturer.

2. Manufacturer's type designation of the cells.

3. Number of cells.

4. Rated discharge capacity with reference to discharge rate, temperature, specific gravity and the end-point voltage.

5. Recommended float voltage.

6. Recommended boost voltage/maximum finishing charge current.

7. Month and year of manufacture.

8. Purchase Order No. and date.

9.2 The items 1 & 2 mentioned in clause 9.1 shall be marked also on individual cell nameplates permanently fixed to the covers. Alternatively these may be embossed or indented on the covers or imprinted on the containers.

9.3 A set of numeral stickers having an adhesive coating on their back shall be supplied for identifying cells 1 to 55 or 1 to 110 depending upon the type of the battery.

9.4 Each cell shall be indelibly marked with two electrolyte level markings (min & max) such that, with cells mounted on rack, the level can be seen by the service personnel.

9.5 The polarity of the terminal posts shall be plainly and durably marked on the cover as ' + ' & ' - ' or 'POS' and 'NEG'.



## 10. TESTS

10.1 The batteries supplied under this specification shall be a product regarding which the manufacturer can make available complete records of tests to establish the fact that batteries of like design and rating manufactured by him under exactly similar conditions of manufacture have successfully met all test requirements laid down in this specification and proved satisfactory for the intended duty.

10.2 Type Tests

10.2.1 Following type tests shall be performed on one of the batteries of same type designation as per clause 4.1.

1. Discharge capacity test (clause 10.2.2)
2. Efficiency test (clause 10.2.3)
3. Self-discharge test (clause 10.2.4)
4. Float Current test (clause 10.2.5)
5. Cycle test (clause 10.2.6)
6. Chemical composition test (clause 10.2.7)

10.2.2 Discharge Capacity Test

10.2.2.1 The cells selected for discharge capacity test shall be assembled into a battery as in service and fully charged in accordance with the instructions of the manufacturer. AT the end of the charge, the level and specific gravity of the electrolyte of each cell shall be checked and, if necessary adjusted.

10.2.2.2 After standing on open-circuit for one to two hours from the end of the charge (the steady open-circuit voltage of the cells shall not be below 2.0 volts), the battery shall be discharged at 10-hour rate, i.e. a continuous current numerically equal ( in amperes) to one-tenth of the rated discharge capacity shall be drawn from the battery, and the discharge shall be terminated when the voltage across the terminals of any one cell has fallen to 1.85 volts. During test the temperature of electrolyte in each cell shall be maintained as close as reasonably practicable to 25 degC and shall be within limits of 10 degC & 40 degC.

10.2.2.3 The voltage across individual cells and the temperature and specific gravity of the electrolyte shall be measured during discharge (at intervals not exceeding 1 hour) and at the completion of discharge. When the voltage at battery terminals has fallen below 1.9 volts per cell, the voltage may be checked at 15 minute intervals.

10.2.2.4 The test discharge as mentioned above shall be taken as first discharge and the discharge capacity in Ampere hours obtained on this discharge and corrected to an equivalent capacity at reference temperature of 25 degC as per clause 10.2.2.7 shall not be less than 90% of the specified discharge capacity.

10.2.2.5 Upon discharge to the end-point voltage of 1.85 volts, the difference in voltages of individual cells shall not exceed plus 0.1 volt.

10.2.2.6 The battery shall be immediately recharged in accordance with manufacturer's instruction sand three more discharge tests shall be carried out as described above. The discharge capacity obtained on the last discharge test and corrected to 25 degC shall not be less than the specified discharge capacity.

10.2.2.7 In case when the average temperature of the electrolyte during discharge differs from 25 degC, the actually developed discharge capacity shall be reduced to the discharge capacity at 25 degC by the following formula:

$$C_{25} = \frac{C_t}{1 + 0.008\,(t - 25)}$$

where

$C_{25}$ is the discharge capacity reduced to the reference temperature of 25 degC.

$C_t$ is the actually developed discharge capacity.

$t$ is the average temperature (deg C) of the electrolyte during discharge, which shall be determined as the arithmetical mean of the temperature measurements carried out during the discharge.

0.008 is the assumed temperature coefficient of discharge capacity.

10.2.2.8 The hydrometer used for measurements of specific gravity of electrolyte shall be provided with a graduate scale, one division of which shall represent at the most 0.005 unit of specific gravity. The accuracy of the calibration shall not be less than 0.005 unit of specific gravity.

The ammeters and voltmeters used for measurements of current and voltages shall be permanent magnet moving coil type of an accuracy class not below 0.5 and the measuring range such that the readings can be taken in the late third of the scale.

The thermometer used for measurements of temperature of electrolyte shall have graduate scale, one division f which shall represent at the most 1 degC. The accuracy of calibraction shall not be less than 0.5 degC.

10.2.2.9 Complete type test report incorporating the necessary details of the above test shall be supplied.

10.2.2.10 The performance of first test discharge (clause 10.2.2.4) is mandatory. However, authenticated test results furnished in evidence that the battery meets the requirements of clause 10.2.2.6 may be accepted in lieu of actually charging and discharging the battery to verify the discharge capacity.

10.2.3 Efficiency Test

The battery which has been given full charge (clause 10.2.2.1) subsequent to a discharge shall be discharged at 10 hour rate to 1.85 volts per cell (clause 10.2.2.2). The battery shall be recharged at 10 hour rate until 111 percent of the capacity realized on previous discharge is returned to the battery. It shall then be discharged at 10 hour rate shall not be less than that obtained on previous discharge, corrections for temperature variations, if any, having been performed as mentioned in clause 10.2.2.7.

10.2.4 Self-discharge Test

The battery shall be fully charged as before and then allowed to stand on open-circuit in an ambient temperature of between 24 degC & 32 degC for a period of 14 days. At the end of this period the specific gravity of each cell shall be measured. Any cell of the battery shall not show a specific gravity drop in excess of 0.015. This assume an average capacity less of one percent per day based on rated discharge capacity.

10.2.4.1 Certified test results of the tests done by the manufacturer on batteries of name, type and rating may be accepted (clause 10.1) in lieu of actually performing the tests mentioned in clauses 10.2.3 & 10.2.4.

10.2.5 Float Current Test

The cell shall be fully charged and placed on a constant float voltage of 2.20 volts until the current into the cell has reached a constant minimum value over six consecutive hourly readings. The current shall not exceed a value equal to 0.2 mA/AH at 25 degC for the new batteries and 0.2 mA/AH to 0.3 mA/AH throughout the battery life time.

10.2.5.1 Certified test results done by the manufacturer on batteries of the same type and rating may be accepted (clause 10.1) in lieu of actual performing the test only for the batteries which have completed their half life.

10.2.6 Cycle Test

The test shall be made in accordance with I.E.C. Publication 254-1 (1983) sub clause 14. The cycling performance shall be more than 500 cycles.

10.2.6.1 Certified test done by the manufacture on batteries of same type and rating may be accepted. If the manufacturer has sufficient data to prove that his battery will have more than 500 cyclic life (clause 10.1) in lieu of actually performing the tests mentioned in clause 10.2.7.

10.2.7 Chemical Composition Test

The test shall be made in Laboratory to check the composition of material used in positive plates, negative plates, separators and to verify the following:

i) Weight of lead used in grid of each plate.

ii) Quantity of active material used in each plate.

iii) Antimony and other materials used for making alloys of the grid

iv) Impurities in the electrolyte.

10.2.7.1 Certified test results done by the manufacturer on batteries of the same type and rating may be accepted in lieu of actual performing the test.

10.3 Sample Tests (Cells)

Following sample tests shall be carried out on 2 sample cells drawn at random from a lot consisting of up to 50 cells of same type and discharge capacity. Should a sample cell be found defective the tests shall be repeated on a double amount of sample cell be found defective the tests shall be repeated on a double amount of samples drawn from the same lot and if any cell of the latter sample gives unsatisfactory results, the lot shall be rejected.

10.3.1 Visual Examination

The material, construction and markings shall be inspected for checking conformance with clause 5&9. The cells showing any deviation which has not been approved, rough spots, absence of any of the component parts, loose or corroded terminal posts, loose or broken seals, un-satisfactory vent plugs, leaking or distorted containers or covers or any other signs of defects or damage inside or outside the cells shall be rejected.



10.3.2 Checking of Dimensions and Weight

The number of cell plates, and the overall dimensions and weight of the cells shall be checked for their agreements with the approved drawings.

10.3.3 Heat Endurance Test

The cells with the electrolyte at the correct level shall be subjected to a temperature of 60°C for 24 hours. After cooling they will be examined and there shall be no evidence of the flow or deformation of the dealing compound, leakage of electrolyte or any other defective development.

10.4 Sample Tests (Racks)

Following sample tests shall be carried out on 4% of the racks offered for acceptance of same type and design, but minimum one. Should a sample rack be found defective the tests shall be repeated on a double amount of samples drawn from the same lot and if any rack of the latter sample turns out to be un-satisfactory the lot shall be rejected.

10.4.1 Checking Dimensions

The dimensions and other details of the racks shall be checked to verify their conformance with the approved drawings.

10.4.2 Visual Examination

The racks shall be inspected visually for checking conformance with clause 8. The cells may be physically mounted on the rack in the approved arrangement scheme in order to ascertain that various requirements of clause 8 are fully met.

## 11. DRAWINGS & DATA

11.1 Bid Data

Following information shall be supplied with the offer. Failure to supply the information shall make the offer liable to rejection:

1. Complete technical description of the offered battery in the form of manufacturer's catalogues and brochures etc. covering material and construction of each part of the cell.

2. Drawings or pictures showing cutaway views of the cell with various parts duly labeled. Material of the parts shall also be indicated on the drawings.

3. Drawings showing necessary dimensions of cells, terminal posts, inter-cell connectors and weight etc.

4. Typical charge and discharge characteristics curves showing cell voltages versus time for various rates of charge and discharge, and corresponding changes in specific gravity. The curves shall also be supplied showing (A) discharge capacity as percentage of the nominal discharge capacity at different discharge rates from 1 second to 10 hours, and (b) state of charge as a percentage of ampere hours previously taken at different charging currents. Effect of temperature variation on the discharge capacity of the cell at various rates shall also be indicated.

5. Details of mounting arrangement alongwith drawings of the rack indicating the dimensions, weights, assembly details, material and finish. Details of treatment for protection against corrosion, vermin and fire etc., shall also be supplied.

6. A list of reference indicating the names of the countries to whom the batteries of the offered type and design have been supplied alongwith year of supply.

7. The particulars of the battery mentioned below as applicable:

| | | | | |
|---|---|---|---|---|
| 1. | Name of manufacturer | | | |
| 2. | Type of cell | | | |
| 3. | Number of cells | | | |
| 4. | Discharge capacity at 25 degC and; | | | |
| | i) | 10 hour rate to end-point voltage of | VPC | AH |
| | ii) | 5 hour rate to end-point voltage of | VPC | AH |
| | iii) | 3 hour rate to end-point voltage of | VPC | AH |
| | iv) | 1 hour rate to end-point voltage of | VPC | AH |
| | v) | 30 minute rate to end-point voltage of | VPC | AH |
| | vi) | 1 minute rate to end-point voltage of | VPC | AH |
| | vii) | 1 second rate to end-point voltage of | VPC | AH |
| 5. | Specific gravity of the electrolyte (25 degC) | | | |
| | i) | At filling in the cells | | |
| | ii) | Before commencement of discharge | | |
| | iii) | at the end of discharge | | |
| 6. | Recommended starting rate of charge | | | Amps |
| 7. | Recommended finishing rate of charge | | | Amps |
| 8. | Recommended float charging voltage | | | VPC |
| 8(a) | Float current of the fully charged battery with float voltage/cell as per (8) above | | | mA/AH |
| 8(b) | Float current of the fully charged battery completed 5 years service with float voltage/cell as per (8) above | | | mA/AH |
| 9. | Recommended boost charging voltage at finishing rate | | | VPC |
| 10. | Ampere-hour efficiency based on 10 hour rate of discharge at 25 degC | | | % |
| 11. | Total internal resistance of the battery at the terminal connectors, i.e. including the resistance of inter-cell connectors, inter-tier and inter-row connections, in fully charged condition | | | Milli ohm |
| 11(a) | Cycle stability | | | cycles |
| 12. | Type of cell construction, enclosed or open | | | |
| 13. | Number of positive plates and overall dimensions(without plate lug) | | | |
| 14. | Type of construction of positive plate | | | |
| 15. | Number of negative plates and overall dimensions (without plate lug). | | | |
| 16. | Type of construction of negative plate | | | |

| | | | |
|---|---|---|---|
| 17. | Material of container with thickness of wall and base and whether transparent or not | | |
| 18. | Material of cover | | |
| 19. | Material of plate grids | | |
| 20. | Material of separators, and their height, width and thickness | | |
| 21. | Material of inter-cell connectors | | |
| 22. | Quantity of electrolyte per cell (sp.gravity 1.2.15 ± .01) | | Litres |
| 23. | Weight of assembled cell: | | |
| | i) | With electrolyte (sp. Gravity 1.215 ± .01) | kg |
| | ii) | Without electrolyte | kg |
| 23(a) | Total weight of: | | |
| | i) | Positive plate | |
| | ii) | Negative plate | |
| | b) | Weight of lead in each plate | |
| | c) | Weight of active material in each plate | |
| | d) | Impurities in the Electrolyte | |
| 24. | Total dimensions of assembled cell: | | |
| | i) | Height including terminal posts | mm |
| | ii) | Width | mm |
| | iii) | Depth | mm |
| | iv) | Drawing No. | |
| 25. | Number of racks | | |
| 26. | Material of rack | | |
| 27. | Arrangement of cells on rack | | Tiers X rows |
| 28. | Colour of rack | | |
| 29. | Overall dimensions of rack: | | |
| | i) | Height | mm |
| | ii) | Length | mm |
| | iii) | Depth | mm |
| | iv) | Drawing No. | |
| 30. | Details of accessories | | Please attach list |
| 31. | Details of spare parts recommended to be order with the battery | | Please attach list indicating item wise prices |
| 32. | Whether delivered uncharged or dry-charged | | |
| 33. | Guaranteed life expectancy | | Years |



11.2 Approval Data

Following drawings and data shall be supplied for approval before manufacture/delivery of the batteries and racks.

1. The information required vide paras 2,3,5 & 7 of clause 11.1

2. Drawings of nameplate indicating also the material of the plate and details of marking.

3. Dimensions drawing of the terminal connectors.

4. Complete delivery list per battery.

5. Service manual containing instructions for installation, initial charging and maintenance during service.

## 12. PACKING

12.1 The cells shall be delivered in complete battery sets. Each battery consignment shall be shipped with all the accessories required for complete assembling of the battery.

12.2 The individual cells and the accessories shall be packed in suitable packing boxes in accordance with manufacturer's standard packing for ocean shipment. The electrolyte shall be packed separately but shipped along with the consignment of the battery.

12.3 Each packing box shall bear name or trade mark of the manufacturer and type of packed goods and contain a complete packing list indicating the names and quantities of the packed items.