भारत सरकार, रेल मंत्रालय

GOVERNMENT OF INDIA

MINISTRY OF RAILWAYS

सत्यमेव जयते

कर्षण संस्थापन निदेशालय

Traction Installation Directorate

TECHNICAL SPECIFICATION

BATTERY CHARGER FOR 110 VOLT BATTERY, 40 AH

FOR

ELECTRIC TRACTION INSTALLATION

SPECIFICATION NO. TI/SPC/PSI/40CHGR/0200

Issue Date:……

ISSUED BY

GOVERNMENT OF INDIA: MINISTRY OF RAILWAYS

RESEARCH DESIGNS & STANDARDS ORGANISATION

MANAK NAGAR, LUCKNOW-226011

SPECIFICATION FOR battery charger for 110 Volt battery, 40 Ah for electric traction installation

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	PREPARED BY	**CHECKED BY**	**APPROVED BY**
SIGNATURES			
DATE			
DESIGNATION	SSE/PR	DTI/ III	PEDTI

Scope

1.1 The specification applies to battery chargers for charging 110 V, 40 Ah lead acid batteries installed at unattended 25 kV traction switching stations.

1.2 The battery chargers shall be complete with all parts and accessories necessary for their efficient operation. All such parts and accessories shall be deemed to be within the scope of this specification whether specifically mentioned or not.

1.3 The "Make in India" Policy of Government of India shall be applicable.

2.0 Service conditions:

2.1 The battery chargers are intended for use in moist tropical climate in India, where the maximum ambient temperature may reach 45 deg. C in shade, the daily maximum average ambient reaching 35 deg. C, with a relative humidity reaching upto 100%.

2.2 ~~The battery chargers are required for installation in control cubicles of unattended 25 kV switching stations to keep the batteries on float charge under normal conditions. The charger shall also be suitable for effecting quick charge of a discharged battery when set to the boost charge position. The steady super imposed load on the charger will be about 100 mA.~~ The battery charger shall be provided with facility for both automatic and manual control in Float & Boost functions as to be installed at unattended 25 kV switching stations. The charger shall be suitable for effecting quick charge to a discharged battery when set to the boost charge position. It shall have current limiting facility, if the voltage control is in an automatic mode and shall cause a gradual lowering of the output voltage when the DC load current exceeds the load limiting setting. The current limiting characteristics shall be such that any overload or short circuit in the DC system shall neither damage the charger, nor cause blowing of any of the charger fuses. The charger shall have an adjustable current limiting facility, also for safe guarding the Battery. Uniform and smooth adjustments of voltage setting (in both manual and automatic modes) shall be provided. During boost charging, the battery charger shall operate on constant current mode. A lead acid charger should switch to float charge when fully saturated.

2.3 The battery charger shall have communication port for interacting with RTU. The battery charger monitoring and control feature available on the charger shall be possible from remote control center. It shall have Modbus communication with following facility.

2.3.1 Measurands (Float current, Boost current and output DC voltage information) in monitor direction. The charger should monitor the current being drawn by the cell. When this drops below the specified float current, the indication in the RCC regarding the status of battery as Fully charged shall be available.

2.3.2 Command facility to switch ON/OFF the battery charger.

2.3.3 Command facility to select Auto/Manual mode of operation.

2.3.4 Command facility for float and boost selection under manual mode of operation.

2.4 The battery charger shall be suitable for operation on 230 Volt single phase, 50 Hz supply obtained from 25 kV /230 volts, 10 kVA LT supply transformer, the primary of which is

connected to the 25 kV switching station bus bars at one end and to earth at the other. The 230 V ac supply is, therefore, subject to fluctuations of voltage between 190 V and 250 Volt.

3.0 Governing specification:

1.1 The battery charger and its main components shall comply with the following specifications which shall be applied in the manner, altered, amended or supplemented by this specification and the Indian Electricity Rules, where applicable.: -

i.	Mono-crystalline semiconductor rectifier assemblies and equipment.	IS: 4540-1968 IS: 6619-1972
ii.	Rectifier transformer	IS: 2026-1977
iii.	Mono crystalline semi-conductor rectifier cells and stacks.	IS: 3895-1966
iv.	Electrical indicating instruments	IS: 1248-1968
v.	Miniature circuit breaker	IS: 8828-1978

1.2 Any deviation from this specification calculated to improve the performance, utility and efficiency of the equipment, proposed by the tenderer, will be given due consideration, provided, full particulars with justification thereof, are furnished. In such a case the tenderer shall quote according to this specification and the deviations proposed by him shall be quoted as an alternative proposal.

2.0 Rating and other particulars:

2.1 The battery charger shall be designed for the following rating and other particulars:

i) Type	Two rate, mono crystalline semi-conductor silicon rectifier type, suitable for floor mounting.
ii) Nominal primary voltage	230 V 50 Hz ac, subject to variation from 190 to 250 V.
iii) Nominal output voltage.	110 V dc
iv) Charging characteristics: a) Trickle charge b) Boost charge:	 Adjustable between 50 m A & 500 mA in suitable steps at any voltage in the range 115 V to 135 V. Adjustable between 0.5 A and 5 A in suitable steps at any voltage in the range 100 V to 150 V.

2.2 The battery charger shall be equipped with suitable filter circuits on the output side to reduce the ripple factor of output voltage to less than five per cent at full load, when measured across a resistance load.

NOTE: Ripple factor = $\frac{\text{Superimposed AC rms voltage}}{\text{D.C. voltage (average)}}$

2.3 The battery charger shall be provided with a suitable ballast on primary side of the rectifier transformer such that 10 % increase in primary voltage under boost charge condition shall not result in an increase by more than 25 % of the maximum boost charge current to the battery. Under trickle charge condition, similar requirements shall also be met with by provision of a suitable reactor in the circuit, if considered necessary.

3.0 Construction:

5.1 The equipment shall be housed in a suitable cubicle fabricated as angle iron framework fitted with mild steel sheet panels of thickness not less than 1.6 mm. The side and rear panels shall be provided with louvers to provide adequate ventilation. Wire mesh with opening not more than 3 mm shall be provided on the inner side of the louvers for protection against entry of lizards, vermin etc.

5.2 The battery charger cubicle shall be treated with a suitable rust resisting primer paint applied on the interior and exterior surfaces followed by an application of two coats of enamel paint evenly sprayed to present a fine appearance. The colour of enamel paint applied on exterior surfaces shall be " dark Admiralty Grey", shade 632 of IS: 5-1961, and the interior surface shall be finished with white enamel paint.

5.3 The components of the battery chargers shall be appropriately mounted and identified with identification labels. The layout of major components shall permit easy access for maintenance. The charger shall be of robust construction. To assembly shall be such that it will not be affected adversely by the vibrations induced from nearby railway tracks. The clearances and creepage distances shall be in accordance with clause 4 of IS: 6619-1972. The noise level shall be kept to the minimum.

5.4 The rectifier transformer shall be double wound, vacuum impregnated, natural air cooled and liberally rated. The core shall be made of low loss silicon steel laminations. The windings shall be of copper with class A insulation. The primary winding of the transformer shall be provided with suitable taps in steps of 20 V ranging from 190 V to 250 Volt to cater for local adjustment. As an alternative to provision of tapping on primary side, voltage stabilization by ferro resonance method shall also be acceptable.

5.5 Chokes and ballast shall be of copper winding with class A insulation and shall be vacuum impregnated.

5.6 The rectifier shall be of the full wave bridge connection using silicon diodes with liberal ratings. The rectifier shall be suitably protected against overloading due to short time heavy currents drawn during closing of the circuit breakers, short circuits, over voltages and against inrush currents when charging fully discharged batteries.

5.7 The switches meters and fuses shall be flush mounted on the front panel and shall be purchased from reputed manufacturers. These shall conform to relevant Indian Standards specifications.

5.8 The voltmeters and ammeters shall be of flush mounted type of accuracy class 2.5 as per IS: 1248-2003 and shall have a scale length of not less than 60 mm.

5.0 The wiring inside the charger shall be with 1100 V grade PVC insulated copper cable having a minimum cross-section of 2.5 sq. mm & conforming to IS: 694-2010. The cables shall be suitably supported and provided with identification ferrules at the connecting points.

5.10 The ac input and the dc output terminals shall be of robust design and shall be suitable for PVC copper cable connections. The polarity of output dc terminals shall be clearly marked.

6.0 Fittings and Accessories:

The following fittings and accessories shall be provided on the battery charger:

i) A low wattage red pilot lamps on the ac side.
ii) A double pole miniature circuit breaker along with a back up slide lock type rewireable fuse on ac side.
iii) Two numbers slide lock type rewireable fuses on dc side.
iv) One moving coil voltmeter 0-150 V on dc side.
v) One moving coil ammeter 0-1A/0-10 A dual range along with shunts.
vi) One moving iron voltmeter 0-300 V on ac side.
vii) Trickle / boost charge changeover switch along with provision for automatic range selection for ammeter.
viii) Coarse and the fine rotary control and switches for trickle and boost charge.
ix) Rotary control switch for regulating current in trickle charge.
x) Rating and diagram plate.
xi) Two earthing terminals suitable for taking 8 SWG GI wires.
xii) PVC insulated PVC sheathed 1100 V grade 3 core cable with copper conducts having a min. cross-section of 2.5 sq. mm and conforming to IS: 694-2010 of 2-meter length fitted with a suitable 3 pin plug for connection to 230 V ac supply.

7.0 Type tests:

Following type tests shall be carried out on the prototype complete charger.

7.1 Tests on complete charger:

7.1.1 Visual inspection:

The proper layout, mounting, identification, connections and construction shall be checked.

7.1.2 No load test:

The test shall be carried out at all the four primary tap positions by appropriate rated primary voltage corresponding to the selected tap position. The dc output voltage at no load shall be recorded for both boost and trickle charge positions by keeping coarse and fine control switches at different steps.

7.1.3 Load test with resistance load:

The test shall be carried out at all the four primary tap positions by applying appropriate rated primary voltage corresponding to the selected tap position. An adjustable resistance load shall be connected across the output terminals and the output voltage with coarse and fine control switches at different steps shall be recorded by maintaining the load current to the set value as nearly as possible. Change in the set value of load current on account of change in output voltage at different steps shall be readjusted by simultaneously changing the load resistance. The tests shall

be carried output individually for minimum and maximum current values specified under trickle and boost charge conditions.

7.1.4 Measurement of Ripple \factor:

Ripple voltage on dc side shall also be measured during the load test (cl. 7.1.3) and the percentage ripple content shall be calculated.

7.1.5 Efficiency Test:

This test can be combined with no load test and load test for which details have been indicated in Cl. 7.1.2 and 7.1.3 respectively. For this test, input current, voltage and power on the ac side shall also be recorded at the minimum and maximum output voltages. The efficiency and the power factor shall then be computed from the test results.

7.1.6 Stability test:

test shall be carried out to ascertain that the battery charger satisfies the requirements indicated in cl. 4.3 of this specification. It shall be sufficient to carry out the test at any of the primary tap position; however, the 230 V primary tap position shall be preferred for the test. The incoming supply voltage shall be adjusted to rated voltage and coarse and fine control switches set to the maximum position in order to get maximum output voltage. An adjustable resistance load shall be connected across the output terminals and the load current shall be adjusted to the maximum rated value. The incoming supply voltage shall then be increased by +10%. Any increase in output voltage shall be offset by increasing the load current b readjusting the load resistance thereby keeping the output voltage unchanged. This increase in load current shall represent the increase the charging current to the battery, if it was connected, on account of increase in primary voltage. The test shall be separately carried out for trickle and boost charge condition and percentage increase in charging current on account of 10 % increase in supply voltage calculated.

7.1.7 Temperature rise test:

The test shall be carried out with charger in boost charge position and output voltage set to maximum. A suitable resistance load shall be connected across the output and load current shall be adjusted to the maximum rated current under boost charge, the Ambient temperature, surface temperature of transformer, chokes, ballast and diode base etc. shall be recorded every half an hour till such time the temperature is stabilized (i.e. the temp. rise will not be more than 1 deg C between consecutive hourly readings) The temp rise of transformer winding, choke and ballast measured by the resistance method shall not exceed 50 deg. C. The diode base temp. rise shall be within the prescribed value recommended by the manufacturer.

7.1.8 Insulation Resistance Test:

Insulation resistance shall be measured by using 500 V dc megger between

a) Ac line lead to earth.

b) Dc output terminals to earth.
c) Between line lead and dc output terminals.

These values shall be measured before and after the high voltage test and there shall not be any appreciable change in the measured values. The value of insulation resistance shall not be less than 50 meg. Ohms in any case.

7.1.9 High voltage test:

The charger shall successfully withstand the test voltage of 2000 V ac rms 50 hz for one minute applied between-

a) Dc output terminals and earth.
b) AC leads and earth

7.2 Test on rectifier transformer:

Following tests shall be carried out on the rectifier transformer:

7.2.1 Measurement of resistance:

Resistance of primary and secondary windings shall be measured, preferably with a bridge instrument, at ambient temp. and recorded.

7.2.2 Open circuit test:

Rated primary voltage shall be applied to the primary of the transformer and the primary and secondary voltages and no-load losses shall be recorded keeping coarse and fine control switches in different positions.

7.2.3 Short circuit test:

With the control switches corresponding to the max. current setting in boost charge position and the secondary shorted, suitable voltage shall be applied to primary to pass the maximum rated current in the primary and the primary voltage, current and power shall be recorded and the full load losses calculated. This shall not exceed the guaranteed value by more than 10 %.

7.3 Of prototype of a battery charger conforming to this specification has already been approved in connection with the previous supplies to the Indian Railways, fresh prototype testing may be waived, if it has passed the prototype test earlier and no changes in the design or material used, have been made.

8.0 Routine test:

The following routine tests shall be carried out on the complete charger.:

8.1 Visual inspection:

The proper layout, mounting, identification, connections and construction shall be checked.

8.2 No load test:

The test shall be carried out in accordance with the cl. 7.1.2 except that the tests shall be carried out only at the rated input voltage of 230 ac.

8.3 Load test with resistance load:

The tests shall be carried out in accordance with cl. 7.1.3 except that tests shall be carried olut only at the rated input voltage of 230 V ac.

8.4 Insulation resistance tests:

tests shall be carried out in accordance with cl. 7.1.8.

8.5 High voltage test:

The tests shall be carried out in accordance with cl. 7.1.9.

9.0 Technical data and drawings:

9.1 The tenderer shall furnish guaranteed performance data, technical and other particulars for the equipment offered in the proforma attached as Annexure 'A'.

9.2 The tenderer shall indicate their compliance or otherwise against each clause and sub-clause of the technical specification. The tenderer shall for this purpose enclose a separate statement, if necessary, indicating the annexure and clause reference and compliance or otherwise. Wherever the tenderer deviates from the provisions of the clause, he shall furnish his detailed. Remarks. Any clause or sub-clause of the specification not included in the statement shall be deemed to have been accepted by the tenderer.

9.3 Successful tenderer shall be required to submit the following detailed dimensioned drawings for the equipment offered as per Railways standard size of 210 mm x 297 mm or any integral multiple thereof for approval by the purchaser:

i) Outline general arrangement drawing (in three views) along with mounting dimensions.

ii) Schematic diagram of connections along with technical details of components.

iii) Cross –sectional views (showing location of major components).

iv) Table of guaranteed and other technical particulars.

After approval, six copies of approved drawings along with 2 sets of reproducible copies shall be supplied to the purchaser.

9.4 Successful tenderer shall also be required to furnish the design calculations for the rectifier transformer rating, rectifier ratings and filter circuits for approval by the purchaser.

(This supersedes the specification No. ETI/PSI/ 1(6/81)

Enclosure. 1 Annexure 'A'Annexure 'A' to the Specification No. TI/SPC/PSI/40CHGR/0200

SCHEDULE OF GUARANTEED PERFORMANCE, TECHNICAL AND OTHER PARTICULARS.

S. No.	Description	Units of measurement	Remarks
I	1. Name of manufacturer. 2. Country of origin. 3. Governing Specification. 4. Manufacturers type designation. 5. Rated primary voltage. 6. Nominal output voltage. 7. Designed capacity for charging battery of 8. Rated output voltage: a) At trickle charge for charging current varying from 50 mA to 500 mA. b) At boost charge for charging current varying from 0.5 A to 5A. 9. Declared values: a) No load loss of complete charger under b) I) Trickle c) Boost d) Full load loss of complete charger under: e) I) Trickle f) Boost g) Overall efficiency of charger at full load under: h) I) Trickle i) Boost c) Variation in max. Charging current to battery with 10 increase in supply voltage under: a) Trickle b) Boost. d) Percentage ripple content in output voltage at full load		

	with battery connected under: j) Trickle k) Boost 10. Size and type of 230 V ac incoming lead. 11. Thickness of sheet steel for charger cubicle.		
12.	Overall dimensions: a) Height b) Width c) depth	Watts	
13.	Total weight	mm	
14.	Rectifier transformer particulars: a) name of manufacturer b) Governing specification c) I) Rated input voltage. ii) Taps provided for variation. In input voltage. iii) Rated kVA. d) Type of winding e) Type of impregnated of the winding conductors. f) Type of cooling g) Class of insulation. h) Iron loss at 100 % rated input voltage. i) Copper loss at full load. j) Maximum temp. rise on boost charge (5 A) over ambient.	kg	
15.	Rectifier Particulars: a) Name of manufacturer. b) Governing specification c) Manufacturer's type designation. d) Total number of rectifier cells used. e) Method of connections. f) Repetitive peak inverse voltage. g) Rated average forward current h) Temperature rise over ambient on boost charge.		
16.	Devices used for protection of rectifier cells against: i) Oer current j) Over voltage.		

17.	Type of smooth filter.		
18.	Ammeter particulars. a) Name of manufacturer. b) Governing specification. c) Dial size and range. d) Accuracy class. e) Type of mounting.		
19..	Voltmeter particulars: a) Name of manufacturer. b) Governing specification. c) Dial size and range. i) For ac ii) For dc. .d) Accuracy class: i) For ac. ii) For dc. d) Type of mounting		
20.:	fittings and accessories. a) Miniature circuit breaker. I) make iii) Rating iv) No. of poles. v) Governing specification. b) Slide lock type fuses; i) Make ii) Rating c) Rotary control switches: i) Main ii) Rating iii) Type designation.		