भारत सरकार, रेल मंत्रालय

GOVERNMENT OF INDIA

MINISTRY OF RAILWAYS

कर्षण संस्थापन निदेशालय

Traction Installation Directorate

TECHNICAL SPECIFICATION

BATTERY CHARGER FOR 110 VOLT BATTERY, 200 AH

FOR

ELECTRIC TRACTION INSTALLATION

SPECIFICATION NO. ~~ETI/PSI/24(6/81)~~ TI/SPC/PSI/200CHGR/0250

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RESEARCH DESIGNS & STANDARDS ORGANISATION

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SPECIFICATION FOR battery charger for 110 Volt battery, 200 Ah for electric traction installation

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DESIGNATION	SSE/PR	DTI/ III	PEDTI

1.0 Scope

1.1 The specification applies to battery chargers for charging 110 V, 200 Ah lead acid batteries installed at unattended 132/25 kV traction sub-station.

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 rooms of unattended 132/25 kV traction substations. The charger shall also be suitable for effecting quick charge to a discharged battery when set to the boost charge position. The steady super-imposed load on the charger will be about 1 Amp. 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.

2.3 The battery charger shall be suitable for operation off 230 volt single phase, 50 Hz supply obtained from a 25 kV/230 V 10 kVA LT supply transformer, the primary of which is connected to the 25 kV substation busbars at one end and to earth at the other end. The 230 V ac supply is, therefore, subject to fluctuations. In voltage between 190 V and 250 V.

3.0 Governing Specification.

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

i)	Mono cry stalline semiconductor rectifier assemblies and equipment.	IS: 4540-1968 IS:6619-1972
ii)	Rectifier transformer	IS:2026-1977
iii)	Mono crystalline semiconductor rectifier cells and stacks.	IS: 3896-1966
iv)	Electrical indicating instruments	IS:1248-1968 IS:2419-1979
v)	Miniature circuit breaker.	IS: 8828-1978

3.2 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.

4.0 Rating and other particulars

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

i) Type	Two-rate , monocrystalline 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 0.5 Amp and 5 amp. In suitable steps at any voltage in the range 115 V to 135 V. Adjustable between 10 Amp and 30 Amp in suitable steps at any voltage in the range 110 V to 160 V.

4.2 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= superimposed AC rms voltage

DC voltage (average)

4.3 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 resistor in the circuit, if considered necessary.

5.0 Construction

5.1 The equipment shallbe housed in a suitable cubicle fabricated as angle iron framework fitted with mild steel sheet panels of thickness not less than 1.56,mm. The side and rear panels shallbe provided with louvres to provide adequate ventilation. Wire mesh with opening not more than 3 mm shallbe provided on the inner side of the louvres for protection against entry of lizards, vermin etc.

5.2 The battery charger cubicle shallbe 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 shallbe Eau-de-Nil green to shade 216 of IS: 5-1978. And the interior surface shallbe finished with white enamel paint.

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

5.4 The rectifier transformer shall be double wound, vacuum impregnated, natural air cooled and liberally rated. The core shallbe made of low loss silicon steel laminations.

The winding shallbe of copper with class A insulation. The primary winding of the transformer shallbe provided with suitable taps in steps of 20 V ranging from 190 V to 250 V to cater for local adjustment.

5.5 Chokes and ballast shallbe of copper winding with class- A insulation and shallbe vacuum impregnated.

5.6 The rectifier shallbe 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 fullyu discharged batteries.

5.7 The switches, meters and fuses shallbe flush mounted on the front panel and shallbe purchased from reputed manufacturers. These shallconform to relevant Indian Standards specifications.

5.8 The volt meters and ammeters shall be of flush mounted type of accuracy class 2.5 as p3er IS: 1248-1968 and shall have a scale length of not less than 60 mm.

5.9 The wiring inside the charger shall be with 1100 V grade pvc insulated copper cable having a minimum cross-section of 10 sq. mm and conforming to IS: 694-1977. The cables shall be suitably supported and provided with identification ferrules a the connecting points.

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

6.0 The ac inputs and the dc output terminals shallbe of robust design and shallbe suitable for PVC copper cable connections. The polarity of output dc terminals shallbe clearly marked.

6.0 Fittings and accessories

The following fittings and accessories shallbe provided on the battery charger:

i) A low watage red pilot lamp on the ac side.
ii) A double pole miniature circuit breaker along with a back up slide lock type rewirable fuse on ac side.
iii) Two numbers slidelock type re-wirable fuses on dc side.
iv) One moving coil voltmeter 0-200 V on dc side.
v) One moving coil ammeter -15A/0-30 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 fine rotary control/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 SG GI wires.

7.0 Type tests

Following type tests shallbe carried out on the prototype complete charger.

7.1 Tests on complete charger

7.1.1 Visual inspection

The proper layout, mouting, identification, connections and construction shallnbe checked.

7.1.2 No-load test

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

7.1.3 Load tests with resistance load.

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 shallbe 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 th e set value of load current on account of change in output voltage at different steps shallbe readjusted by simultaneously changing the load resistance. The tests shallbe carried out individually from minimum and maximum current values specified under trickle and boost charge conditions:

7.1.4 Measurement of ripple factor

Ripple voltage on dc side shallalso be measured during the load test (cl. 7.1.3) and the percentage ripple content shallbe 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 shallalso be recorded at the minimum and maximum output voltages. The efficiency and the power factor shallthen be computed from the test results.

7.1.6 Stability test

The 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 positions; 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 by readjusting the load resistance thereby keeping the output voltage unchanged. This increase in load current shall represent the increase in the charging current to the battery on account of increase in primary voltage if this battery was connected across the charger. The test shall be separately carried out for trickle and boost charge condition and percentage increase in charging current on account of 10 % increased in supply voltage calculated.

7.1.7 Temperature rise test

The test shallbe 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 currewnt shallbe 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 stabilised (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 shallnot exceed 50 deg. C. The diode base temp. rise shallbe within the prescribed value recommended by the manufacturer.

7.1.8 Insulation resistance test

Insulation resistance shallbe measured by using 500 V dc megger between-

a) Ac input terminals to earth
b) Dc output terminals to earth
c) Between ac input terminals and dc output terminals.
These values shallbe measured before and after the high voltage test and there shallnot be any appreciable change in the measurwed 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 shallsuccessfully withstand the test voltae of 2000 V ac rms 50 Hz for one minute applied between-

a) Dc output terminals and earth

b) Ac input terminals and earth.

7.2 Test of rectifier transformer.

Following tests shallbe carried out on the rectifier transformer:

7.2.1 Measurement of resistance.

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

7.2.2 Open circuit test

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

7.2.3 Open circuit test:

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

7.3 IF 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 had passed, the prototype test earlier and no changes in the design or material used, have been made.

8.0 Visual inspection

The proper layout, mounting, identification, connections and co0nstruction shallbne checked.

8.2 No. load test

The test shallbe carried out in accordance with the cl. 7.1.2 except that the tests shallbe carried out only a the rated input voltage of 230 V ac.

8.3 Load test with resistance load

The tests shallbe carried out in accordance with cl. 77.1.3 except that the tests shallbe carried out only at the rated input voltage of 230 V ac.

Annexure to Specification No. ~~ETI/PSI/24(6/81)~~ TI/SPC/PSI/200CHGR/0250

SCHEDULE OF GUARANTEED PEFORMANCE, TECHNICAL AND OTHER PARTICULAR

S. No.	Description	Unit of measurement
1.	Name of manufacturer	
2.	Country of origin	
3.	Standard governing specification	
4.	Manufacturer's type designation.	
5.	Rated primary voltage	
6.	Nominal output voltage.	
7.	Designd capacity for charging battery of	
8.	Rated output voltage: a. At \trickle charge for charging current varying from 0.5 Amp. To 5 Amp. b. At boost charge for charging current varying from 10 Amp to 30 Amp.	
9.	Declared values: a. No load loss of complete charger under I) trickle Ii) Boost. b. Full load loss of complete charger under: i) Trickle ii) Boost c. Overall efficiency of charger at full load under a) Trickle b) Boost. d. Variation in maximum charging current to battery with 10 % increase in supply voltage under i. Trickle ii. Boost e. Percentage ripple content in output voltage at full load with resistance load connected under: i) Trickle ii) Boost.	
10.	Thickness of sheet steel for charger cubicle.	
11.	Overall dimensions a. Height b. Width c. Depth	
12.	Total weoight	
13.	Rectifier transformer particulars:	

	a. Name of manufacturer. b. Governing specification i) Rated input voltae. ii) Taps provided for variation in input voltage. iii) Rated kVA c. Type of winding. d. Type of impregnation of the winding conductors. e. Type of cooling f. Class of insulation g. I?ron loss at 100% rated input voltae. h. Copper loss at full load. i. Maximum temp. rise on boost charge. (30 A) over ambient.	
14.	Rectifier particulars. a. Name of manufacturer. b. Governing specification c. Manufacturer's type designation. d. Total no. of rectifier cells used. e. Method of connections. f. Repetitive peak inverse voltage. g. Rated averate forward current. h. Temperature rise over ambient on boost charge.	
15.	Devices used for protection of rectifier cells against: i) Over current ii) Over voltage.	
16.	Type of smoothing filter.	
17.	Ammeter particulars. a. Name of manu facturer. b. Governing specification c. Dial size and range. d. Accuracy class. e. Type of mounting.	
18.	Voltmeter particulars: a. Name of manufacturer b. Governing specification c. Dial size and range. i. For ac j. For dc. d. Accuracy class For ac For dc e. Type of mounting.	
19.	Fittings and accessories: A Miniature circuit breaker. i) Make	

	ii) Rating iii) No. opf poles iv) Governing specification c. Slide lock type fuses i) Make ii) Rating d. Rotary control switches: j. Make k. Rating. l. Type designation.	