

ALTM.	DATE	DESCRIPTION	SIGNATURE	REMARKS
A	15-3-80	REVISED CLASSES 10, 41, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 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2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2		

Sheet - 1 of 2

DETAILS OF ALTERATIONS

77
Sheet
2A

ALTRG	DATE	DESCRIPTION	SIGNATURE	REMARKS
F	06-8-02	MAKE OF FASTENERS & SPRING WASHERS SPECIFIED DWS NO. CLW/ES/N-22, SH-2/W-22, SH-4/W-22.	<i>Cam</i> <i>6/8/02</i>	WDR. CEN/DOO LMS CEN/DOO DT. 4.3.02
G	12.8.2004	TYPE OF CAPACITOR OF DAMPING NETWORK SPECIFIED.	<i>Alu</i>	WDR. RPH/DOO LETTER NO. BL/2.2-100 DT. 23-08-2004

**SPECIFICATION FOR
SILICON RECTIFIER
FOR WAG-7 & WAP-4
LOCOS**

WDR. RPH (WDR.)
DT. 08.08.04

DESIGN IN CHARGE
WDR. RPH
CHITARANJAN LOCOMOTIVE WORKS
WDR. RPH, INDA
WDR. NO. CLW/ES/N-22/02
RMR/DATE:

C O N T E N T S

- 1.0 Scope of contract.
- 2.0 Governing Specification.
- 3.0 Service Conditions.
- 4.0 Technical Specification.
- 5.0 Inspection & Tests.
- 6.0 Special Instruction to Tenderers.
- 7.0 Guarantee.
- 8.0 List of enclosures.

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SPECIFICATION FOR
SILICON RECTIFIERS
FOR WA6-1 & WA6-4

770-005-181

Technical Specification
for WA6-1 and
WA6-4 Silicon Rectifiers
with 1000V rating
and 10A current

770-005-181

1.0 Scope of Contract.

This specification covers the manufacture and supply of silicon rectifiers with ~~silicon~~ one line for installation on 25 KV, AC or DC Electric Locomotives of the Indian Railways.

2.0 Governing Specification

- 2.1 Assistance has been taken for preparation of this specification from IS:7788. Materials/components to be used in the manufacture of the unit shall comply with the latest Indian Standards Specifications.
- 2.2 Any deviation from this specification with a view to improve the performance, utility and efficiency of the equipment proposed by the manufacturer will be given due consideration if full particulars with justification thereof are furnished. It may however be noted that due to limited availability of space in the locomotive and the necessity to ensure interchangeability with the existing equipment, changes in the overall and mounting dimensions shall not be allowed.

Enclosure : Tenderer should offer a proven design and details for calling stock application.

3.0 Service Conditions

- 3.1 The silicon rectifiers shall be suitable for working satisfactorily in an ambient temperature varying from 5 to 40°C with a maximum relative humidity of 100% and at an altitude up to 1000 metres above sea level and in dusty atmospheric condition.
- 3.2 The silicon rectifier and the equipment used shall be of robust design suitable for traction duty and withstand satisfactorily the vibration and shocks normally encountered in service as indicated below :-

- (a) Max. vertical acceleration :- 1.0 g
- (b) Max. Transverse acceleration :- 2 g
- (c) Max. longitudinal acceleration :- 2.5 g
- (d) g being acceleration due to gravity

This is in con. of clause 2.1.2 of IS: 2111.

4.0 Technical Specification

- 4.1.0 In each locomotive two silicon rectifier modules are provided. Ratings of each module which is connected to three traction motors in parallel is given below,

<div> <div>Spec. Code</div> <div>Rev. No.</div> </div>	SPECIFICATION FOR SILICON RECTIFIER FOR NAGY AND KAD-4 LOCOMOTIVE	 25.3.84 (10/1) 1000 100 100	TENDERER FOR STOCK APPLICATION Date: 25.3.84 CONTRACTING AUTHORITY NAME M/s. SAIL, NEW CL/25/84-100 1000 100 100
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- at ambient temperature -- 100°C
- (d) Junction of module -- $17\text{ m}^2/\text{sqm}$ at 25.5 mm diameter
 at any position on
 length. Shall meet below
 tests
- (e) The module shall be liberally designed for voltage and current ratings specified above. The cell arrangement shall be suitable to -
- the voltage having corresponding to
 - (1) Max. peak open-circuit voltage at 25.5 mm and 100°C
 - (2) Switching surge voltage (not less than 10% of the no-load open-circuit voltage at 25.5 mm and 100°C). However the surge time of surge shall not be less than 4000. This surge voltage shall have some fluctuation of maximum line voltage to 20 mm.
 - (3) Lighting surge voltages and surge voltage having maximum voltage.
- (f) The module shall be installed in a -
- (1) Direct current switching rating for class 6.1.1.27 and maximum specified protection set value. However the factor of safety shall not be less than 1.7
 - (2) Short circuit current after continuous rating of 1700 A at 25.5 mm (maximum 100 A and as per class 6.1.1.27).
 - (3) Manufacturer shall submit their calculations along with tender, short circuit current when short circuit takes place before anything inside. They should state the surge surge will also have ~~unacceptable~~ internal short circuiting to will be made based on each emergency situation. Module should withstand this current.
 - (4) Operation with one ~~diode~~ bridge rectifier as per class 4.1.1.1.27 above.
 - (5) Maximum junction temperature of diode at worst service condition shall have a thermal margin of 10°C over the declared junction temperature of the diode.

SPECIFICATION FOR
 SILICON RECTIFIER
 FOR 12.75 kVA

12.75 kVA
 (12.75 kVA)

Technical kit given by
 CHITTARANJAN LUXURATIVE WORKS
 NEW DELHI 11001
 NEW NO. : C/W/82/P-588
 DATE :

4.1.2 Main Design Features:-

- a) For the purpose of design, the temperature of cooling air during the 1-minute transient shall be taken as 40°C and a further temperature of 10°C may be assumed as rise in the specific cooling air temp. 50°C shall be considered as cooling air temperature.
- b) A voltage unbalance of 10% for diodes less than five in series and a current unbalance of 50% shall be assumed for diodes less than five in parallel and 10% shall be assumed for five and more than five diodes in parallel. The following protective devices shall be provided:-
 - a) AC and DC voltage surge diverters (or) surge arrester, voltage limiter, arcflash suppressor etc.,
 - b) Bulk storage capacitor and voltage sharing resistor if required across diodes.
 - c) Air flow valves for ventilation fan/cooling and circuit breaker in rectifier diodes motor circuit with reverse air and thermal overload protection.
 - d) Current transformers in the AC input circuit duly connected inside the rectifier cabinet.
- c) **ii) a) Mainframe base/bridge base with amplifier base and substructure to give full load indication on the rectifier module and diode bank. This is not applicable for base-free design.**
 - b) Any other additional equipment if provided necessary.
- c) **iii) Substructure may quote converter design without bulk storage capacitor and potential divider resistor where diode diode per rating has been used and AC damping unit suitably designed to take care of bulk storage protection. The detailed calculations for voltage-derating with AC damping capacitors shall be submitted, in case the bulk storage capacitors have been eliminated a voltage-derating unit has been offered without any service experience, a limited number of converters will be tried out in service before acceptance for series production. The converters designed with capacitor are still per rating must be provided with full damping unit and potential divider resistor across each diode.**

4.1.3

- a) Each locomotive shall have two rectifier module and each module shall contain diodes connected in bridge. Each rectifier module shall be provided with its own smoothing reactor in series and the AC per per shall supply power

Rev- Control	SPECIFICATION FOR SAXON RECTIFIER FOR WAG-7 & WAG-4 LOCOMOTIVES	 J. K. SAXENA (Sr. Asst. Engr.)	Reviewed and given acceptance Date 01.05.2011 CHITARANJAN GOLOVATSKY WORKS PLOT NO. 1, G/LM/22, H-20/2 New Delhi-110028
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- to three traction motors connected in parallel. The
 over voltage and over current protection for each
 rectifier bridge have been provided.
- 20 In case of overvoltage protection failure the Defective
 Rectifier bridge shall be isolated through motor protection
 and the locomotive operation shall be maintained with three
 traction motors isolated.
- 21 The proposed power circuit is enclosed in 20 Fig. No. 20
 20/1/12. The silicon rectifier bridge shall be of the
 three phase converter which delivers 3 phase 400V AC.
 Frequency power is 50 Hz, nominal 111V and maximum 120V.
 The output of the three converter has a phase difference of 120°.
 at 50 Hz. Under overvoltage condition the rectifier bridge can
 stop in line for about 10 seconds. The proposed system shall be
 provided with a suitable 4 phase circuit breaker having
 vacuum and thermal protection.
- 22 The supply for control circuit is from a battery of nominal
 110V DC with a range of variation from 90 to 130V DC.

3.1.1 Data of equipment :

a) Traction Motor

Manufacturer	M/s. GEC/GE
Year	2010
Rating	
- Continuous	800 HP, 1400, 1400, 800 HP.
- Max. load	800 HP, 1400, 1400, 800 HP.
Maximum field current	15.7A
Min. field strength	34.5V
- Armature	2,000V AC
- Field winding	2,000V AC
- Commutating coil	2,000V AC

b) Transformer

Manufacturer	GE, Mumbai, India, Power Transformer Co., Chennai, India, India.
Type	

SPECIFICATION FOR
 SILICON RECTIFIER
 FOR WAG-5 &
 WAP-4 Locomotives

Approved
 (By: GEC/GE)

Formulation for power equipment
 that can be
 CHITTARANJAN LOCOMOTIVE WORKS
 WEST BENGAL, INDIA
 Date: 20.12.2010 / 20.12.2010
 Rev: 001

Rev
 001

Rating	Rated output VA	Open circuit voltage	Turnover voltage
1000 VA	1000	200V	200
2000 VA	2000	200V	200
3000 VA	3000	200V	200
4000 VA	4000	200V	200
5000 VA	5000	200V	200
6000 VA	6000	200V	200
7000 VA	7000	200V	200
8000 VA	8000	200V	200
9000 VA	9000	200V	200
10000 VA	10000	200V	200
11000 VA	11000	200V	200
12000 VA	12000	200V	200
13000 VA	13000	200V	200
14000 VA	14000	200V	200
15000 VA	15000	200V	200
16000 VA	16000	200V	200
17000 VA	17000	200V	200
18000 VA	18000	200V	200
19000 VA	19000	200V	200
20000 VA	20000	200V	200

Maximum open circuit
secondary voltage at
21.5 VA line and 1000 Hz.

Percentage impedance
voltage with full
secondary winding
connected (approx)
21.5 VA (1000 Hz).

100 VA 200V 200V of 100
VA and 200 VA 200V.

at 1000 VA output with secondary winding -

This is not in the scope of supply but will be provided by
CIN. Details are given below:

(i) Rated voltage 1, frequency - 1000 Hz, 50 Hz

(ii) Rated maximum output - 1.5 VA

(iii) Tag on wet output transformer - The maximum 1000 VA (1000
VA) output voltage

30 months/years -

Construction - International Electrotechnical
Commission

Type - M-10

Rating per unit

- Resistance at 1000 VA - 200 VA

- Resistance at 2000 VA - 100 VA

- Resistance at 1000 VA - 1000 VA

1000

SPECIFICATION FOR
SILICON RECTIFIER
FOR WAB-7 AND WAB-4
LOCOS

Dr. C. K. (10)

FORWARD FOR WAB-7 AND WAB-4
CHITTARANJAN ELECTROTECHNICAL WORKS
1000 BANGALORE

WAB NO. - 1000/1000/1000/1000
Date DATE:

- [illegible]

- h) varying magnitude and TC set point on the set point in
part flow.

He was supplied along with the equipment needed at
Jamaica House, and the following information was furnished
to the U.S. Navy on 10/11/1971 and 11/10/1971.

6. 3. 1. 1. Derivation and verification

- [illegible]

- [illegible]

- iii) All electrical equipment, including that of Motor, its accessories and wiring shall be of high quality using copper terminals, standard fuses, wires, cables, cables and other accessories as always used electrical installations and facilities.

- 101 The location and direction of all new bars and its bar
bars shall be as per the map No. 100/198-100/198. The
location of existing bars in or between shall be revised.
consequently.

50. All wiring shall be done with high quality materials
 51. and shall be done in accordance with the latest edition of the
 52. National Electrical Code. The contractor shall be responsible for
 53. obtaining all necessary permits and for the cost of the same.
 54. The contractor shall be responsible for the cost of the materials
 55. and labor for the installation of the wiring.

11. All the components, insulators, valves, pipe class and used for fabrication of facilities shall be with suitable insulations level for service application and shall be able to withstand high operating temperatures, vibrations etc. without any deterioration. Insulating material shall be of ISO of 15000 of 1982.

SPECIFICATION FOR
SILICON RECTIFIER
FOR WAG-7 AND WAG-4
LOADS

Kabupaten Klaten
 Kecamatan Klaten
 Desa Klaten
 Jember, 10 Mei 2018
 Kepada: Kepala Desa Klaten
 Di: Kantor Desa Klaten
 Dengan: Surat Keterangan
 Nomor: SK/10/2018
 Tanggal: 10 Mei 2018

(c) Year and month of manufacture.

(d) Voltage and current(input/output) ratings.

(e) No of devices and type of device used.

(f) A name plate showing name, factory, electrical ratings, serial no. at the top of front cover.

5.0 Inspection and tests : WAP-4/WAG-15.1 Draws & Tests for the draws are given in Annexure-III
Enclosed with this specification.5.2 Assembly & Tests for the Rectifier sub-assembly is
given in Annexure-IV. Tests shall be conducted at intervals of five years. (C)6.0 Special Instructions to Tenderers.6.1.0 Tender Papers :6.1.1 The tenderer shall submit 4 copies of his complete tender
and these shall be marked "Original", "Duplicate" and so on.6.1.2 Tender shall be accompanied by the following documents
without which they will be treated as incomplete and
liable to be rejected.i) Data, particulars etc. of the equipment offered as
per the form as given in Annexure-V.

ii) Deviation if any.

iii) Clausewise comments on the specification.

iv) List of recommended spares for maintenance of the
equipment beyond the warranty period.v) Sufficient information to prove that the manufac-
turer has adequate facilities and capacity to manu-
facture and test the equipment offered.6.2.0 Technical Documents6.2.1 Successful tenderer shall furnish all the assembly, sub-
assembly and component drawings in quadruplicate for
approval before prototype subunits are manufactured. All
the technical documents shall be furnished to the Chief
Electrical Engineer (Gen)/CEM/Chittaranjan. It is also a
condition of the contract that once prototype is approved,
contractor shall not change his source of supply of sub-
contractor for the purchased components/sub-assemblies
without the prior approval of CEM.

SPECIFICATION FOR
WILSON RECTIFIER FOR
WAG-1 AND WAP-4 TRIMT.S. S. S. (A/C)
T. D. C. Y. D.TENDER FOR WILSON RECTIFIER
WAG-1 AND WAP-4
CHITTARANJAN LOCOMOTIVE WORKS
WAG-1 AND WAP-4
WAG-1 AND WAP-4
WAG-1 AND WAP-4
WAG-1 AND WAP-4

6.2.1 Successful test results shall include and include the following dimensions along with the sample of first batch of components.

- i) Type test results .. 4 copies.
- ii) Test results .. 2 copies.
- iii) Performance test .. 25 copies.

7.0 WARRANTY

The guarantee for the assembled silicon rectifier shall be 36 months from the date of commissioning of the locomotive or 36 months from the date of shipment whichever is earlier. In respect of silicon diodes, the guarantee shall be 36 months from the date of commissioning or 36 months from the date of shipment whichever is earlier.

8.0 LIST OF DOCUMENTS

104

- i) Drawing-1 : Technical particulars of current transformer (CT).
- ii) Drawing-2 : Outline of current transformer.
- iii) Drawing-3 : Reliability assurance specification.
- iv) Drawing-4 : Quality assurance testing of silicon.
- v) Drawing-5 : Test results of silicon rectifier assembly.
- vi) Drawing-6 : Reliability assurance of components offered to be furnished by the vendor.
- vii) Drawing-7 : Outline drawing of silicon rectifier.
- viii) Drawing-8 : Assembly drawing of silicon rectifier.
- ix) Drawing-9 : All drawing notes.
- x) Drawing-10 : All working drawings.
- xi) Drawing-11 : Model calculations.
- xii) Drawing-12 : Regulated circuit.

9.0 ISO CERTIFICATION

CLM reserves the right to procure the item from ISO certified manufacturer only.

SPECIFICATION FOR
SILICON RECTIFIER
FOR MAG-7 AND MAP-4
LOCOMOTIVES

W. S. S. S. S. S.
201. 100. 100

Formulation for silicon rectifier
for MAG-7
CHITTARANJAN LOCOMOTIVE WORKS
201. 100. 100
W. S. S. S. S. S.
201. 100. 100

ATTACHMENT 1

Page 10

TECHNICAL SPECIFICATIONS OF CURRENT INSPECTIONS

1. [<u>XXXXXXXXXX</u>] Current Transformer for 2. [<u>XXXXXXXXXX</u>] All other transformers 3. [<u>XXXXXXXXXX</u>]	
4. Application	Used with key primary to operate overcurrent relay for protection of all other transformers
5. Highest system voltage (kV)	5.4
6. Current Rating	4000A
7. Rated frequency	60 Hz
8. Rated output	30 VA
9. Accuracy class	0.5
10. Accuracy limit factor	5
11. Power frequency, 1 min test voltage	
(i) between primary & earth frame & secondary being connected to earth	II 3.00
(ii) between secondary & earth the frame being connected to earth	III 1.00
12. Rated short time thermal capacity	25 times the rated primary current
13. Rated dynamic current	25 times the rated primary current
14. Limiting dimensions and window openings	As indicated in G.N. 50-5/1
15. Class of insulation	40
16. Impregnation class	100°C
17. Drawing & Specification	G.N. 50-5/1
18. [<u>XXXXXXXXXX</u>] 19. [<u>XXXXXXXXXX</u>]	20. [<u>XXXXXXXXXX</u>] 21. [<u>XXXXXXXXXX</u>] 22. [<u>XXXXXXXXXX</u>] 23. [<u>XXXXXXXXXX</u>] 24. [<u>XXXXXXXXXX</u>] 25. [<u>XXXXXXXXXX</u>] 26. [<u>XXXXXXXXXX</u>] 27. [<u>XXXXXXXXXX</u>] 28. [<u>XXXXXXXXXX</u>] 29. [<u>XXXXXXXXXX</u>] 30. [<u>XXXXXXXXXX</u>] 31. [<u>XXXXXXXXXX</u>] 32. [<u>XXXXXXXXXX</u>] 33. [<u>XXXXXXXXXX</u>] 34. [<u>XXXXXXXXXX</u>] 35. [<u>XXXXXXXXXX</u>] 36. [<u>XXXXXXXXXX</u>] 37. [<u>XXXXXXXXXX</u>] 38. [<u>XXXXXXXXXX</u>] 39. [<u>XXXXXXXXXX</u>] 40. [<u>XXXXXXXXXX</u>] 41. [<u>XXXXXXXXXX</u>] 42. [<u>XXXXXXXXXX</u>] 43. [<u>XXXXXXXXXX</u>] 44. [<u>XXXXXXXXXX</u>] 45. [<u>XXXXXXXXXX</u>] 46. [<u>XXXXXXXXXX</u>] 47. [<u>XXXXXXXXXX</u>] 48. [<u>XXXXXXXXXX</u>] 49. [<u>XXXXXXXXXX</u>] 50. [<u>XXXXXXXXXX</u>] 51. [<u>XXXXXXXXXX</u>] 52. [<u>XXXXXXXXXX</u>] 53. [<u>XXXXXXXXXX</u>] 54. [<u>XXXXXXXXXX</u>] 55. [<u>XXXXXXXXXX</u>] 56. [<u>XXXXXXXXXX</u>] 57. [<u>XXXXXXXXXX</u>] 58. [<u>XXXXXXXXXX</u>] 59. [<u>XXXXXXXXXX</u>] 60. [<u>XXXXXXXXXX</u>] 61. [<u>XXXXXXXXXX</u>] 62. [<u>XXXXXXXXXX</u>] 63. [<u>XXXXXXXXXX</u>] 64. [<u>XXXXXXXXXX</u>] 65. [<u>XXXXXXXXXX</u>] 66. [<u>XXXXXXXXXX</u>] 67. [<u>XXXXXXXXXX</u>] 68. [<u>XXXXXXXXXX</u>] 69. [<u>XXXXXXXXXX</u>] 70. [<u>XXXXXXXXXX</u>] 71. [<u>XXXXXXXXXX</u>] 72. [<u>XXXXXXXXXX</u>] 73. [<u>XXXXXXXXXX</u>] 74. [<u>XXXXXXXXXX</u>] 75. [<u>XXXXXXXXXX</u>] 76. [<u>XXXXXXXXXX</u>] 77. [<u>XXXXXXXXXX</u>] 78. [<u>XXXXXXXXXX</u>] 79. [<u>XXXXXXXXXX</u>] 80. [<u>XXXXXXXXXX</u>] 81. [<u>XXXXXXXXXX</u>] 82. [<u>XXXXXXXXXX</u>] 83. [<u>XXXXXXXXXX</u>] 84. [<u>XXXXXXXXXX</u>] 85. [<u>XXXXXXXXXX</u>] 86. [<u>XXXXXXXXXX</u>] 87. [<u>XXXXXXXXXX</u>] 88. [<u>XXXXXXXXXX</u>] 89. [<u>XXXXXXXXXX</u>] 90. [<u>XXXXXXXXXX</u>] 91. [<u>XXXXXXXXXX</u>] 92. [<u>XXXXXXXXXX</u>] 93. [<u>XXXXXXXXXX</u>] 94. [<u>XXXXXXXXXX</u>] 95. [<u>XXXXXXXXXX</u>] 96. [<u>XXXXXXXXXX</u>] 97. [<u>XXXXXXXXXX</u>] 98. [<u>XXXXXXXXXX</u>] 99. [<u>XXXXXXXXXX</u>] 100. [<u>XXXXXXXXXX</u>]

TECHNICAL SPECIFICATION NO.
CLP/SL/T-4/A
WITH SACSCH NOS.
CLP/SL/SS-1/7-4/A

SPECIFICATION FOR
CURRENT TRANSFORMING
FOR
OVERLOAD TRIPPING
RELAYS
FOR USE IN 25 KV, SINGLE PHASE, 50 CYCLES
ACBT LOCOMOTIVES.

OFFICE OF THE M.C.E.E. (DGS & DMT)
CHITTARANJAN LOCOMOTIVE WORKS
CHITTARANJAN
WEST BENGAL
INDIA

A	By: CSE/V.	Sheet No. 8 special condition added.	Date/18	
Rev.	Authorise	Description	Date	INITIAL

SPECIFICATION FOR CURRENT TRANSFORMER FOR 25 KV SINGLE PHASE 50 CYCLES ACBT Locomotives.	BY: N. K. (CSE) BY: CSE: 10	Person to give where CLP/SL/SS-1/7-4/A CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA BRING REMARKS:
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LIST TO CONTENTS

- 1.0 Scope of the contract.
- 2.0 Service conditions.
- 3.0 Submission of Tender Quotation.
- 4.0 Approval of samples.
- 5.0 Conditions of contract.
- 6.0 Technical Documents and Drawings to be furnished by the supplier as part of the contract.
- 7.0 Guarantee.
- 8.0 Technical specification.
- 9.0 S t a n d a r d.
- 10.0 Drawings accompanying the specifications.
- 11.0 T e s t s.

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card
series
can

SPECIFICATION FOR CURRENT TRANSFORMER FOR 60 011000 RECTIFIER 0110-017.	0110.0(0110) D/C 001 (10)	Report for the series class 100, 100 CHETANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA 001/01/10-017 001/01/10-017
---	------------------------------	---

4.0 SCOPE OF THE CONTRACT.

- 4.1 This specification covers the manufacture and supply of current transformers described in para 2 for installation on the 15 kV Single Phase, 50 C/Hz, A.C. Electric Locomotives of the Indian Rlys.

2.0 SERVICE CONDITIONS.

- 2.1 As the current transformers covered by the specification are mounted on locomotives they will be subject to considerable vibration and buffing shocks during service.
- 2.2 The current transformer shall be suitable for working satisfactorily in an ambient temperature varying from 0°C to 60°C and a maximum relative humidity of 100%. The locomotive shall be working in an altitude upto a maximum of 1000 meters above mean sea level.

3.0 SUBMISSION OF TENDER DOCUMENTS.

- 3.1 All tender quotations must be submitted in duplicate.
- 3.2 The tenderer shall intimate furnish the following along with the quotation.
- Technical literature in duplicate and drawing in six copies.
 - Full technical particulars as per data given in Annexure I enclosed.

4.0 SHIPPING OF SAMPLES.

- 4.1 The supplier shall make available at least two prototype for inspection and tests at his works and where the Sr. Chief Electrical Engineer (Design), Chittaranjan and Controller of Stores, Calcutta as and when he is ready with the prototype and necessary testing and measuring apparatus and facilities for carrying out the tests.
- 4.2 After the above tests, if it is considered necessary by the Sr. Chief Electrical Engineer (Design) or his authorized representative to carry out any further tests at trials of the prototype at Chittaranjan, the supplier will arrange for the same by the quickest method.

..... 77.

Specification for Current
Transformers for 15 kV Single
Phase 50 Hz AC.

By (Name)
(Signature)

Refer to para 4.0
also see, see
CHITTARANJAN LOCOMOTIVE WORKS
WEST BENGAL, INDIA
Drawing: CDR/EL/T-1/100/1
Reference:

Rev
Cable

Rev
Cable

- 4.2 Any shortcomings or defects in the design and workmanship shall be pointed out after the tests, to enable the manufacturer to incorporate the necessary improvements before full manufacture is commenced, without affecting the guaranteed deliveries or guaranteed performance.
- 4.4 Any testing and approval by the purchaser of the design, working drawing and prototype shall in no way relieve the supplier of his responsibilities under the terms of the contract for the equipment supplied.
- 4.5 The supplier shall not offer any commencement of series production to the Inspector authorized under the contract until the prototype has been finally approved.

5.0 CONTENTS OF CONTRACT.

- 5.1 The standard I.S.I.-conditions of contract will be applicable for the supply of the current transformers.

6.0 TECHNICAL DOCUMENTS AND DRAWINGS ETC TO BE SUPPLIED BY THE SUPPLIER AS PART OF THE CONTRACT.

- 6.1 The following drawings and documents shall be supplied by the supplier.

1. TYPE TEST REPORT OR CERTIFICATE.

This shall be supplied in standard 'A4' size of sheets with punched holes for filing. It shall be suitably enclosed in a cover. Type test reports shall have to be signed both by the supplier's engineers and ISI's engineers or the Director of Inspection at the same way. 2 copies of the type test report shall be supplied.

11. ROUTINE TEST CERTIFICATE.

This shall be supplied in standard 'A4' size of sheets with punched holes for filing. Routine test certificates shall be submitted along with individual C.T. in 2 copies.

11.2. WARRANTY.

The supplier shall submit at least 10(ten) copies of drawings for each type of current transformer ordered on him within two weeks from the date of receipt of Purchase Order to Dy.Chief Electrical Engineer(Gen. & Dev.) for approval. Any discrepancy/

SPECIFICATION FOR CURRENT
TRANSFORMER FOR 400 KILLOVA
ROUTINE TESTING.

DESIGNED BY
IN CHARGE

Refer to the name
of the
CHITAMPUR LOCOMOTIVE WORKS
WEST BENGAL, INDIA
WORKING
REMARKS:

- c) Manufacturer's serial number and/or type designation.
- d) Rated transformation ratio.
- e) Rated frequency.
- f) Highest system voltage.
- g) Insulation level.
- h) Rated short time thermal current with associated rated time and rated dynamic current.
- i) Class of insulation.
- j) Rated accuracy limit factor following the corresponding output and accuracy class.

8.5 Typical Marking.

The current transformers covered under this specification are single ratio transformers and terminal markings shall be as indicated in Fig.1 of Appendix 'D' to IS:1702 (Part 1) 1964 which is shown below.

9.0 CITATIONS

- 9.1 IS:1702 Pt. I and Pt. III 1964 shall apply in respect of the design, manufacture and testing of the current transformer subject otherwise stated. The various articles used in the manufacture of the current transformers shall also conform to the relevant Indian Standard Specification.

10.0 DRAWINGS

- 10.1 Drawing Nos. CIX/IS/18-1/73 and CIX/IS/18-2/73 are enclosed for guidance of the tenderer. Dimensions indicated in the drawings are in mm.

11.0 TESTS

- 11.1 The current transformers shall be type and routine tested as per clauses of Pt. I of IS:1702 and clauses of Pt. III of the above IS. The type and routine tests shall be as under.

11.2 Type Tests

- a) Verification of terminal markings and polarity (as per Cl. 6.2 of IS:1702(Part-1) 1964).

...../7/

draw
checked

drawn
by

SPECIFICATION FOR CURRENT TRANSFORMER FOR 61100V NOTIFICATION: R1158-242.	T.Y.K.H. (M/J) BY G.E. 10	Refer to per where drawn and CHITTHARAN LOCOMOTIVE WORKS BEST PRICE, BANGALORE EXTD. CIX/IS/18-1/73 SYNOPSIS
---	------------------------------	---

- b) High voltage Power - Frequency test on primary winding under the conditions prescribed in Annexure-1.
- c) High voltage power frequency test on Secondary winding under the conditions prescribed in Annexure-1.
- d) Over voltage withstand test (as per Cl. 5.5 of IS:1700/Part-I, 1964).
- e) Determination of current error, phase displacement and composite error as per Clause 5.5 of IS:1700/Part-III, 1964.
- f) Short time current test (as per Clause 5.6 of IS:1700/Part-I, 1964).
- g) Temperature rise test (as per Cl. 6.7 of IS:1700/Part I, 1964).

4.3 Routine Tests-

- a) Verification terminal marking and polarity (as per Cl. 5.2 of IS:1700/Part-I, 1964).
- b) High voltage power frequency test on primary winding under the conditions prescribed in Annexure-1.
- c) High voltage power frequency test on Secondary winding under the conditions prescribed in Annexure-1.
- d) Over voltage withstand test (as per Cl. 5.5 of IS:1700/Part-I, 1964).
- e) Determination of current error, phase displacement and composite error as per Cl. 5.5 of IS:1700/Part III, 1964).

...../B.

SPECIFICATION FOR CURRENT TRANSFORMER FOR UP 2112200
NOTIFICATION NO.115-102.

20/11/64
BY: GSE/IN

Forward by the works
class 2nd, 1st
CHITTARANJAN LOCOMOTIVE WORKS
WEST BENGAL, INDIA
MEMO: GSE/IN-1/102
REMARKS:

APPENDIX - 2

Sl. No.	Description	Current Transformer for Silicon Rectifier
	Abbreviation	Units
1.	Application	Used with hot cathode to operate overlaid relay for protection of silicon rectifiers.
2.	Highest system voltage kV (RMS)	2.4
3.	Current Rating	4000/5
4.	Rated frequency	50 C/S
5.	Rated output	30 VA
6.	Accuracy class	3 Pa.
7.	Accuracy limit factor	5
8.	Power frequency, 1 min. test voltage	
	i) Between primary and earth, from 5 sec. may being connected to earth.	ii) 5 kV.
	ii) Between secondary & earth the frame being connected to earth.	iii) 2 kV.
9.	Rated short time thermal current	50 times the rated primary current.
10.	Rated dynamic current	87 times the rated primary current.
11.	Insulation dimensions and windows	As indicated in D.K.M. 1
12.	Temperature rise	100°C

...../B.

SPECIFICATION FOR CURRENT
TRANSFORMER FOR 4P SILICON
RECTIFIER BR150-402.

DRG/RA/WH/1
ON OCT. 83

Revised by the design
when ever and
CHATTARANJAN LOCOMOTIVE WORKS
WEST BENGAL, INDIA
DRAWING NO. CDR/WH/T-402/2
FORGATE

SPECIAL INSTRUCTIONS - Once a prototype is approved the contractor shall change his source of supply of sub-components for purchased components and sub-assemblies without CEM's approval.

NEW
COND.
NEW
COND.

	BY CCE (S)	<p>Station for this section when you see CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA ADDRESS: Telephone: <i>CLW/10/10-33/8</i></p>
--	------------	--

RELIABILITY ASSURANCE
SPECIFICATION
FOR
SINGLE PHASE MOTOR CONVERTERS
FOR
TRACTION APPLICATION

SPECIFICATION FOR
SINGLE PHASE MOTOR CONVERTERS FOR
TRACTION APPLICATION

100 100 101

TECHNICAL AND QUALITY ASSURANCE
SHEET NO. 101
ELECTRICIAN INSPECTOR'S SIGNATURE
DATE: 11/10/80

100 100 101

RELIABILITY ASSURANCE SPECIFICATION FOR SINGLE PHASE POWER CONVERTERS FOR TRACTION APPLICATION

1. INTRODUCTION

The power converter design, assembly and manufacture shall be as per MIL-STD-14567, 'Specification for Single Phase Traction Power Converters' and as modified by the tender specification. In addition, it shall also comply with this Reliability Assurance Specification. This Reliability Assurance Specification supplements various special requirements from the point of view of detailed design, specification of components and assembly gear and above those covered in MIL-STD-14567. *Clause 14567, to be used with.*

The Reliability Assurance Specification also lays down the code of marking the assembly, layout, wiring, etc. with a view to ensure the highest level of reliability and durability under the severe service conditions of traction application.

1.1 Bus-bars

1.1.1 The busbars shall be of electrolytic copper as per MIL-STD-14567.

1.1.2 The bus-bars shall be tin-plated. The tin-plating shall be done after bending, drilling holes, etc. and bus-coupler shall not be used any where. The same tin-plating shall be as per MIL-STD-14567 and thickness of the plating shall not be less than 2 micro-meters.

1.1.3 Joints in bus-bars shall be avoided as far as possible. In case joints are to be provided, the joints shall be away from the hot portions.

1.2 Sharp bends

1.2.1 Sharp bends in the bus-bars must be avoided. The inner radius of cold bend should be 30% as possible, but not less than the following:-

(in Radius 'D')


annealed electrolytic copper	2 x T
hard drawn electrolytic copper	3 x T (except annealed)

T = Thickness of diameter of the flat or rod

1.2.2 The above limits of bend radius shall apply not only to thick bus-bars, but also to thin wires, such as resistor and capacitor leads, etc.

1.2.3 Where it is not possible to accommodate the radius specified above, specific approval for deviation shall be obtained from CDR.

...

Rev. 12	SPECIFICATION FOR SINGLE PHASE TRACTION POWER CONVERTERS	 P-15-00000-22 Rev. 12-12-78	Formulation and design drawings when done by Development Engineering Section and when done when done by Design Section
---------	--	---	---

4.3.1 The area of device seat on the heat sink shall have ground surface finish and flatness to minimize mounting resistance due to surface problems. Flatness and surface finish shall be as follows -

Surface flatness	Total Indicator Reading (TIR) to be held from 0.0005 to 0.001 mm
Surface Finish	less than 1.600 micrometers

4.3.2 Current collection through the heat sink is to be avoided. To make it as self-evident as the heat sink device mounting surface and current collection contact area shall be suitably treated to prevent electrical arcing. Full details of the proposed treatment shall be furnished to CM at the time of detailed evaluation of design for approval.

4.3.3 In air radiation heat transfer and also corrosion protection, the heat sink surface shall be suitably treated to high vacuum without the use of painting or plating or any other process. Full details, along with the test results, shall be furnished at the design evaluation stage for approval.

4.3.4 The converter shall be suitable for case temperature from 25°C to +55°C. The case temperature rise shall not exceed 25°C under the design current and voltage rating of the converter.

4.4 Fuses

4.4.1 Fuses suitable for semiconductor application complying with IEC 269-1 shall be used. The fuse shall be protected from ambient temperature rise.

4.4.2 Fuses with built in signalling arrangement are not to be used. Separate signalling fuses shall be used.

4.5 Assembly of the heat sink and device

4.5.1 In case of this type of device, the design of the clamping system shall be such that the required clamping force must be applied perpendicular to the flat surface. The clamp shall be provided with a mechanical force gauge to indicate what force is applied as well as to indicate that the set force (or particular device has been applied). Individual clamp arrangement shall be provided for each assembly and not a common clamp for the stack.

4.5.2 In case of flat base devices, pressure given at mounting using with safety latches shall be provided between the base and the mounting studs so that the spring pressure plate engages first when proper mounting pressure is applied.

4.5.3 Mounting arrangement of the device shall be such that the pressure is uniformly distributed over the total contact area. The pressure shall be applied in a staggered fashion such as tightening of opposite corners to one half of the recommended torque and then finally apply the necessary remaining torque in the same staggered fashion.

APPROVED FOR THE CUSTOMER
DATE: 1995.04.20

20.04.2005
(10) 045 (1)

REVISIONS AND QUALITY ASSURANCE
DATE: 20.04.2005
REVISIONS AND QUALITY ASSURANCE
DATE: 20.04.2005

20.04.2005
REVISIONS AND QUALITY ASSURANCE
DATE: 20.04.2005

2.1. Recommended without exception provisions for the affected device type shall be determined by suitable tests and full details of which shall be furnished to CSB.

2.2. In order to optimize the contact between mating surfaces of the device and test item, suitable "lubricant compound" shall be used to fill up the voids between the mating surfaces before connecting. The lubricant compound shall have low thermal conductivity and shall seal the joint against moisture.

3. Cables

3.1. Single strand solid wires shall not be used for interconnection between components/sub-assemblies. All inter-connections shall be with multi-stranded flexible insulated cables other than as mentioned in 3.2.

3.2. Multi-strand multi-stranded cables insulated with PTFE sheath/ rubber sheath shall not be used.

3.3. Minimum size of the wires shall be 28 AWG (0.32 mm) for power and 30 AWG (0.25 mm) for signal.

3.4. PTFE (Poly Teflon Fluoropolymer) insulated cables as per specification of Appendix II shall be used for all inter-connections to the receiver circuit board signalling device.

3.5. Microwave cables as per CSB's Spec. No. CSB/MS/C-001/0 (as amended from time to time) may be used for all other locations.

3.6. The voltage grade shall be 5 KV (at) for driving and address circuits and 750 V for verification wires and other auxiliary circuits.

4. Terminal Board

4.1. The design of the terminal board shall have the approval of CSB. The design shall generally comply with the following:-

- i) The size of the connection studs shall have adequate current ratings and the minimum size shall not be less than 2x2.
- ii) The studs shall be cadmium plated steel as per MIL-STD-883C (Part II).
- iii) Prevention of insulation barriers between the terminals.
- iv) Instead of using the electrical connection shall be when the contact plating finish is not passed through the insulation barrier.

4.2. Terminal board shall be made of 0.0625 inch thick of 0.0625 inch thick material.

4.3. The board shall be 2.0 inch wide and 1.0 inch high. It shall have 100 pins and 100 pins. The terminals may be attached by providing copper connection strips.

APPROVED FOR
SIGNED CERTIFICATE FOR
DATE: 1 MAR 2000

(SIGNED)
(SIGNED)

TERMINAL BOARD SPECIFICATION
DATE: 1 MAR 2000
SIGNED: [Signature]
DATE: 1 MAR 2000

REVISION: 1.0

9. Wiring Layout

9.1 The quality of workmanship and layout of the wiring shall be of the highest standard so as to ensure long life of wiring as well as to prevent deterioration/damage of insulation in service. For the layout of wiring the following guidelines will be kept in view:

- a) Complete separation of low, medium and high voltage wires shall be ensured.
- b) Only wires of same potential will be insulated together. The cables of different voltages shall be separately bunched and routed.
- c) As far as possible, all wires, which are temporarily unenergized, shall be bunched separately and no permanently energized wire should be included in this bunch.
- d) The positive and negative wires in the circuit shall be separately bunched.
- e) Sharp bends shall be avoided in the wiring layout. The allowed insulator minimum radius of the bend shall be at least 10 times the outer diameter of the cable.
- f) Wherever the cables/wires travel through holes, stiffeners, cut ways, etc., suitable rubber grommets shall be provided. The grommets shall be specified such that they do not get dislodged during vibration, shocks and bumpings experienced in service.
- g) All the cable runs shall be suitably supported by insulated stiffeners or laid-in cable routing.
- h) The cable bunches shall be neatly tied up with straps at periodic intervals. In order to have neatness and easy maintenance, the number of wires in each bunch shall not exceed ten.

9.2 Cable Bunching

All wires shall be monitored and provided with cable ferrules of approved type and/or use of cable terminations. The bunching shall be suitable and unalterable. The use of metallic lashing/rope, etc. is prohibited. Separate codes of marking shall be followed for low, medium and high voltage cables and the selected wires shall have the approval of the purchaser.

1-4-4-4

the series	SPECIFICATION FOR SILICON RECTIFIER FOR VAR 1.2 1000V 4.0A	 10/10/2017 10/10/2017	INSTRUCTIONS FOR THE WORKMAN 10/10/2017 INSTRUCTIONS FOR THE WORKMAN 10/10/2017 10/10/2017
the series			10/10/2017 10/10/2017 10/10/2017

TESTING METHOD FOR THE CAPACITORS

1. Resistor, fixed, with axial, through shrouded contacts

- a) Short time overload

Test - The resistors shall be subjected to an over voltage which will result in 10 times rated wattage for 5 seconds. DC resistance shall be measured after the resistor has cooled down to room temperature.

Specification - There shall be no evidence of arcing, burning or shorting. Change in resistance value shall not exceed 5% at 25°C.

- b) Life Test

Test - DC resistance shall be measured at 25°C. Resistor will be loaded with rated power in an ambient of 70°C for a period of 100 hours. In forced ventilation it to be specified.

Specification - Change in resistance value shall not exceed 5%. No evidence of mechanical damage.

2. Capacitor

- a) Thermal Shock

Test	Temp. Rise	Time	Temp. Fall	No. of cycles
1	10 sec	30 sec	- 25°C	
2	1 sec	1 min	+ 25°C	
3	30 sec	30 sec	25°C	3 cycles
4	1 sec	1 min	+ 25°C	

Specification - The capacitor shall withstand the stresses of high and low temperatures without any visible damage.

- b) Life Test (Operating temp. is)

Test - Each capacitor shall be subjected to the specified voltage and rated temperature for a period of 100 hours.

Specification - The change in the capacitance shall not exceed a 5% at 25°C. The capacitance value shall be within the specified tolerance even after the test.

2) Also spec. re type enclosed on sheet

PREPARED BY DATE	SPECIFICATION FOR CAPACITORS VALUE & WATTAGE	DRAWN BY DATE	APPROVED BY DATE
	(Signature) DATE	(Signature) DATE	(Signature) DATE

TECHNICAL SPECIFICATIONS FOR FIVE GAUGES

1. Operating Conditions : Temperature - 25°C to $+150^{\circ}\text{C}$
Voltage variations should be approved based on application field.
2. Specification : The wire shall fully conform to IS 12 of 1974-1982 for winding design, construction and testings.
3. Material of the conductor : High conductivity annealed and tinned/wire coated with Sn/Pb - stress coated wire as per IS 12116.
4. Insulation : Polyethylene-ethylene (PEE).
5. Construction : The insulation shall be provided as tape wound or slotted. The insulation thickness shall be sufficient to withstand electrical, thermal deterioration under extreme operating conditions.
6. Colour : Black / Orange.

APPROVED FOR THE
SPECIAL AGENT
FOR THE
10/10/10

10/10/10

Signature and date of approval
Date: 10/10/10

INSTRUCTIONS CONCERNING THE
10/10/10

10/10/10

REVISED 10/1/81

REQUIREMENTS FOR WAGON
REQUIREMENTS FOR WAGON BODY

1. GENERAL

1.1 This specification covers components used on various wagon bodies in rolling stock. Special applications are as under:

1. SAC network connected on the main transformer primary side called as Feeding Network.
- (ii) SAC network connected on the dc side on the output side of the main rectifier called the 'DC Feeding Network'.
- (iii) SAC network connected across individual strokes of the main rectifier called as bridge network.
- (iv) SAC network with adjacent winding connected on the tertiary side of the main transformer, called the 'Tertiary Network'.

1.2 Insulation has been defined from the following standards in the preparation of this specification:

- (i) IS:3031-1966 - Specification for fixed capacitance paper dielectric capacitors for HV.
- (ii) IS:3032-1978 - Specification for power capacitors.
- (iii) IS:3033-1966 - Basic classification and mechanical handling tests for electronic components.

2. SERVICE CONDITIONS

2.1 The components shall perform satisfactorily under the following service conditions generally met with in electric rolling stock of Indian Railways:

SPECIFICATION FOR WAGON
REQUIREMENTS FOR WAGON-2 &
WAGON-4 LOCOS.

Wagon (Wagon)
 (Wagon) (Wagon)

For use for wagon
 Wagon, Wagon
 CHITTARANJULI LOCOMOTIVE WORKS
 WEST BENGAL, INDIA

Wagon
 Wagon: CHITTARANJULI/10/20/81

- 1) The equipment is subjected to sinusoidal vibrations, with frequency varying from 5 Hz and 100 Hz and with amplitude 'a' expressed in ms given as a function of 'f' by the equation:

$$a = 15/f \text{ for values of 'f' between } 5 \text{ Hz and } 10 \text{ Hz,}$$

$$a = 150/f^2 \text{ for values of 'f' between } 10 \text{ Hz and } 100 \text{ Hz}$$

The maximum accelerations of shocks are equal to 50 m/s^2 in each of the 3 directions longitudinally, transversely and vertically.

- 12) Ambient air temperature varying from 5°C to 40°C
 13) Relative humidity ranging from 100%
 14) Heavy atmospheric conditions with storms at all times inside the vehicle
 15) altitude not exceeding 1000 m above mean sea level

3. WATER AND HYDRAULIC SYSTEM

3.1 The underbody shall be of a crystallized laminated structure of water as plastic film as a combination of both, closed in a metal container and is covered with a mineral or unsoluble synthetic oil of high viscos and sealed hermetically.

3.2 The underbody shall be of one piece with absorption foam.

3.3 The damping arrangement shall consist of a coil as the former with hydraulic oil, the cylinder and also shall be provided a discharge diameter of 40mm and will have 40mm dia.

3.4 The hydraulic shall be mounted on the vertical locators with the vertical transport diameter as under:

locators with free
vertical to vertical

1000 millimetre depending on
the diameter

air with free
vertical to vertical

100 to 1200 depending on
the diameter

SPECIFICATION FOR SILICON
RECTIFIER FOR WAP-3 &
WAP-4 LOCOM.

DRG/IN/0010
BY GEE IN

Prepared by the person
who has, who
CHITTARANJAN LOCOMOTIVE WORKS
WEST BENGAL, INDIA
REMARKS: *CL/ES/12/8*

- 3.1 The terminal shall be suitable for both soldering and 'clip-on' connections.
- 3.4 The components shall be protected during service by self-healing protection by means of which the electrical properties of a component after local breakdown of its dielectric are automatically and essentially restored to their values before the breakdown.
- 3.7 The capacitor shall be provided with built in heat protection device so that if thermal overload occurs, the capacitor should be switched off automatically and thereby preventing any possible damage resulting from the overload.
- 3.8 Packing shall be as per Clause 5.1 of IS:4022-1968.

4. DEFINITIONS

- 4.1 For the purpose of this specification, definition as included in Clause 2 of IS:4022 shall apply, except that 'Rated Voltage' shall mean the r.m.s. value of 50 Hz ac voltage that can be continuously applied to the terminals of a capacitor at an ambient temperature of 50°C.

5. TABLES

i) Capacitance	As specified by the purchaser.
ii) Tolerance on capacitance.	± 5%
iii) Rated voltage	As specified by the purchaser.
iv) Self healing category.	Typ. as per IS:4022-1968.
v) Possible ambient temperature range	- 25°C to +55°C
vi) Reliability rating	100,000 hours with less than 1% failure in break or short circuit mode.
vii) Instability of capacitance with time	± 5% in 100,000 hours.
viii) Test voltage terminal to terminal	7.1kV (Duration 1 sec)

SPECIFICATION FOR SILICON
RECTIFIER FOR WAS-7 &
WAP-4 LOCOS.

WAP/LOCOS/1
BY GCE/III

Refer to pay order
Dated 20.05.73
CHITRAHARAN LOCOMOTIVE WORKS
MYSUR, KARNATAKA
WAP/LOCOS/1
REMARKS: CLAS/24/A-35/E

<u>T e s t</u>	<u>Clause applicable</u>	<u>Remarks</u>
i) Visual examination	8.2 of IS:2893-75	
ii) Dimensions	8.7 of IS:2893-75	
iii) Capacitance	7.3.1 of IS:4633-1968	Tests to be done at rated voltage.
iv) Tangent of loss angle.	9.6 of IS:2893-75	Test to be at rated voltage and 50 c/s
v) Voltage proof (high voltage)	7.3.3 of IS:4633-1968	Test voltage shall be 2.35 UR for 2 seconds.
(a) Between terminals.		
(a) Between terminals connected together.	7.3.9 of IS:4633-1968	Test voltage shall be 7.2 UR subject to a min. of 3 kV for 2 seconds.
vi) Insulation resistance	7.3.4 of IS:4633-68	
vii) Inductance	Appendix C of IS:4633-68	Inductance shall be less than 500 μ H
viii) Robustness of terminations.	8.4.3 of IS:4633-68	
ix) Soldering	7.4.4 of IS:4633-68	
x) Rapid change of temperature.	7.5.3 of IS:4633-38	The upper temperature shall be + 85°C.
xi) Sinusoidal vibration.	7.4.5 of IS:4633-68	Severity III of Table 2 of IS:589-61
xii) H w p	7.4.6 of IS:4633-68	40 \pm 4000 times.

SPECIFICATION FOR SILICON
RECTIFIER FOR WAG-7 &
WAF-4 Locom.

DRYDEN (MPL)
BY CODE 58

Review by the works
shop and by
CHITTARANJAN LOCOMOTIVE WORKS
MUSKAT, BOMBAY
REVISION
REMARKS: 58/10/75/13/16

T a b l e		Class	Remarks
		Clause/Annexure	
vi)	Condition testing	7.4.7 of IS:4033-60	
vii)	Dry test	7.5.1.2 of IS:4033-60	Upper temperature shall be 80°C.
vi)	Dry test (accelerated) first cycle.	7.5.1.3 of IS:4033-60	
vii)	C o l d	7.5.1.4 of IS:4033-60	The lower temp. shall be -20°C
viii)	Dry test (accelerated) remaining cycles.	7.5.1.6 of IS:4033-60	Severity should suit category 2.
viii)	Final measurements after tests vii, viii, vii and viii.	7.5.1.7 of IS:4033-60	-de-
xix)	Dry test - long term exposure	7.5.2 of IS:4033-60	-de-
xx)	Endurance	7.7 of IS:4033-60	Severity should suit type-1.
xxi)	Self healing.	7.5.7 of IS:4033-60 and Appendix F of IS:4033-60	
xxii)	Salt mist.	7.5.4 of IS:4033-60	
xxiii)	Shock test.	7.6 of IS:4033-60	

6.2 Acceptance Tests.

The schedule of acceptance tests shall be as per clause 7.1.2 of IS:4033-60 but these tests will be carried out as per clause 6.7 above.

6.3 Routine Tests.

The schedule of routine tests shall be as per clause 7.1.3 of IS:4033-60, but these tests will be carried out as per clause 6.7 above.

SPECIFICATION FOR SILICON
RECTIFIER FOR WAF-7 &
WAF-4 LOCOM.

WAF-7 (WAF)
BY GSE (H)

Refer to the above
spec. for WAF
CHITTARANJAN LOCOMOTIVE WORKS
WEST BENGAL, INDIA
WAF-7
FORWAF-7
CLW/MS/MS/2/2

5.3 In case of bulk orders, the lot offered for type testing and inspection shall be at least 50% of the total order.

5.4 The programme of the type tests on the samples selected shall be as per Appendix-4.

5. Validity of the type approval

5.1 The type approval for a particular device shall be temporary for a period of two years. Complete type tests as per item 5 will be repeated before the expiry of the approval to demonstrate conformity of the production of the CB, subjected to complete type test programme may be carried off or modified programme may be presented.

5. Manufacturer's quality assurance programme

5.1 It is at the manufacturing stage, from becoming in such that the reliability is to be achieved before the delivery of starting with the choice of supplier for the components and materials with increasing inspection, in-line process control, processing other measures taken, and at time processing and testing of ability assurance testing. It is, therefore, incumbent upon the manufacturer to lay down quality control programme to monitor the manufacturer furnish the quality assurance programme proposed to be followed at the time of the approval of the design, any changes made subsequently will be notified, prior checks shall be carried out from time to time by the representative of the responsible implementation of the quality assurance programme.

5. Routing Table

5.1 Routing table indicating sequence and turn-up rate shall be carried out on all orders as per provided by the manufacturer. The manufacturer will have separate routing for those routing table carried out on the device, which will be made available for reference time of the representation of CB.

5.2 A certificate, as per the following programme shall be furnished for each sublot as per the lot of the check plates provided in respect of routing table.

Certified that all the plates from No. _____ as per the enclosed serial number used for the assembly of the sublot.

5.3a. _____
Signature of Manufacturer/Agent No. _____
Name _____ have been subjected to the full type testing test, and comply with the declared limits of the machine significant characteristic of the device.

5. Some cases of the Routing Table

5.1 The program of the testings from each sublot offered for type testing, checked up at random by the representative of the responsible authority, shall be subjected to routine tests, as indicated in

REGISTRATION FOR
ROUTING TABLE NO. 100

1000 5 1000 1000

1000 5 1000 1000

ROUTING TABLE NO. 100

1000 5 1000 1000

1000 5 1000 1000

4-12-12
10
1000
SUBMITTAL to members of the representatives of the interested authorities.

5.2 In case the testing, set of 100 samples has been set down and tested with the declared characteristics, the following procedure shall be followed:

- a) In case more than one lot is offered for acceptance, then 100 of the samples will be taken as sample from each of the various supplies and subjected to similar testing. In case any lot fails this test out of these samples then that lot will be rejected immediately; then the whole offering lot shall be taken as rejected.
- b) In case all the sample devices as per 5.1 test above meet with the specifications, then the particular article will only be taken as rejected, recommending that as done by the firm before offering it for acceptance.

5.3 In case of failure of the devices during full scale charge capacity for more than the duration is a year, the approval for the device may be taken as withdrawing.

6. Periodical sampling life tests

6.1 Routine tests to be carried out on 1000 devices are safety electrical insulation properties for a duration of the order of long tested distribution. These tests, however, do not ensure total electrical and mechanical reliability of the device. It is, therefore, necessary to carry out periodical sampling life tests as to verify that the complete manufacturing process ensures quality of the devices. Following sampling life shall be followed for devices:

- a) Two devices from each article will be selected as sample to the representatives of the interested authorities.
- b) After every six months, the 10 devices out of the selected will be subject to the following tests in addition to all the routine tests in the schedule of representation of "IS / 10142/1972".
 - i) Thermal cycling (Test No. 1)
 - ii) Load test (Test No. 2)
 - iii) Shocking life (Test No. 3)

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4.3 In case any defect, not of those of machine, does not mean the work test, then further acceptance of car lot shall not be done, till the matter is investigated by the firm and necessary improvements in the manufacturing process implemented. The firm will be expected to type test results before clearance for further supplies is accorded by CMA.

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14. Reliability of test

15. Shocking life

16. Environmental tests

16.1 Burn test

16.2 Corrosion

17. Shock and vibration

18. Dimensions of the transformation

TRANSFORMATIVE TESTS

19. Operating life

20. Sleep-maintenance

21. Additional details of the tests covered by IEC60700-1:1995

Following additional details shall apply for the tests covered by IEC60700-1:1995.

21.1 Test No. 2 Forward voltage drop (FV)

The FV grouping shall be classified based on their peak group corresponding to each rated device current rating. It will be verified that the characteristics in addition to the specified FV Group.

21.2 Tests No. 3 & 4 Reverse Characteristics

In case of true test as per clause 10.1.3, full reverse characteristics shall also be specified on the specification.

In case of routine test as per clause 10.1.4 reverse characteristics shall be specified on the specification and also the free from defects. The leakage current corresponding to FV rating of the device shall be recorded.

21.3 Test No. 5 Thermal cycling

The test shall be conducted as per clause 10.1.5 of IEC60700-1:1995. The test shall be conducted for 20,000 cycles and the parameters shall change. The test shall be further extended till any of the parameters exceed the limit value/abnormal variation is noticed on the device table.

All the parameters that may be affected by the test i.e. forward voltage drop, reverse leakage current, thermal resistance, etc. shall be specified and recorded at the beginning of the test and thereafter every 1000 cycles till no change in parameters is noticed. The moment any change is noticed, the parameters shall be checked after every 1000 cycles till the change in one parameter is found beyond limit or device.....

SPECIFICATION FOR
SILICON RECTIFIER FOR

100V 1A 100V 1A

100V 1A 100V 1A

100V 1A 100V 1A

Parameters are given in the table below

Parameters are given in the table below

Parameters are given in the table below

Parameters are given in the table below

validity. The test will be considered satisfactory in case there is no change in the values recorded for the device under test in the 3 readings.

3.4 Test Shall Be Carried Forward current

The test will be carried out with 50V reverse voltage applied before the current is passed.

3.5 Test Shall Be Carried Back

The forward characteristic, reverse characteristic, thermal resistance, etc., shall be measured at the beginning and at the end of the test. The test will be considered satisfactory in case there is no change in the value of the parameters recorded for the device under test at the beginning.

3.6 Test Shall Be Carried Humidity test

The test shall be carried out with 50V reverse voltage applied for the type test.

4. General test and control by INCTE - 1971

4.1 General test

These tests will be carried out by applying rated peak reverse voltages for 1/2 of 1000 hours (minimum) under various inrush current conditions equal to the maximum rated junction temperature for a period of 10 days. Leakage current shall be measured at the beginning of the test and then checked after every 7 days. The test will be considered satisfactory in case no change of leakage current takes place.

Leakage test - This test shall be carried out on every device in the same way as type test, but for a period of 10 hrs.

4.2 Continued tests

4.2.1 Test Shall Be Carried

This test will be carried out as per IS: 15000 (Part IV) 1970 with the following details:

Temperature	Temperature of 50 ± 2°C and relative humidity of 95% ± 5%
Duration	The device shall be placed with the base facing upwards.
Duration	11 days
Final measurement	

SPECIFICATION FOR
SILICON RECTIFIER FOR
PULSED POWER

1
P. N. S. S. S.
P. N. S. S. S.

Continued for 1000 hours
under 50V reverse voltage
with 100A peak current
at 50°C and 95% humidity
for 11 days

Insulin-like responses before and after the test.

This test shall be carried out as per clause 26 of the CTS. The duration of the test shall be 48 hours. The result shall be subjected to visual examination for corrosion of the shackle, etc. at the end of the test.

This test shall be carried out generally on the above 25 of the 500 (thirty five) electronic equipment used on rail vehicles with the following description:

The details of the test will be carefully specified. The owner/contractor shall declare the tensile strength of the steel and the steel load shall be at least 2 times the declared tensile strength.

This text will be copied into the review under the following heading conditions:

- 15.1 limited to the maximum rated forward current;
15.2 maximum permissible peak voltage applied;
15.3 at rated case temperature.

The test will be carried out for a period of 30 days. All the personnel, viz. forward engine crew, weapons loading crew and turret engineer shall be recruited at the beginning of the test and also released after every 7 days. The test will be conducted until a failure is not found in any of the subsystems for the entire test.

[illegible]

THIS TEST PLAN

AMENDED - 1

Page 1

The samples selected for type testing as per clause 4.1 shall be submitted to the various tests as per the following plan:

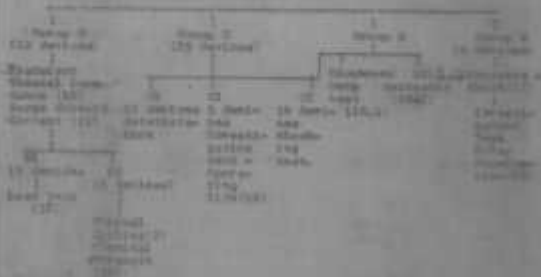
TABLE 1

1. For all samples of the sample lot of 40:

Visual and mechanical inspection
 verification of dimensional characteristics
 performance

Tests Nos. 1, 2, 3, 4, 5, 6, 7 & 8

Specified Test No. 10



Note: The same figures after the column number of samples to be submitted to various tests. The actual number of samples to be submitted to the sample lot is the same throughout.

SPECIFICATION FOR
 LUGS, RECTIFIED FOR

Tested for type testing
 Date: 10/10/2010
 Location: 10/10/2010

10/10/2010
 10/10/2010

10/10/2010
 10/10/2010

3.5.2 General

3.5.1 The tests provided to be carried out on the rectifier assemblies are indicated in this chapter. These shall include type tests and routine tests on rectifier assembly, tests on diode bridge and regulation equipment, rectification of control circuits after installation and commissioning tests. For other associated equipment components, relevant IEC, IEC or Performance's standards specifications shall be followed.

3.5.2 The Designer shall specify the proposed test schedule given in subsequent chapter and specify the relevant declared values and limit values for each test for the different equipment.

3.5.3 Tests on Silicon Rectifier Assemblies

3.5.3.1 Tests on Silicon Rectifier Assemblies

3.5.3.1 Tests on Silicon Rectifier Assemblies

1. Rectification Air-Flow Test

This test shall be carried out on the unit at the ambient temperature in order to measure air flow through the unit passing through the various components under test. The test shall be carried out on completely assembled rectifier with input and output voltage supply of 100V.

- (a) Rated voltage V_d
- (b) Test voltage of 1.1 V_d
- (c) A voltage of 1.1 V_d
- (d) A voltage of 1.1 V_d a few minutes only.

The measured values shall not be below the values declared in the specification of the rectifier unit.

The test may also be carried out to check the effectiveness of the cooling system on the rectifier assembly, by using the influence of heat sink and water. The method of performing these tests shall be agreed to between test and manufacturer.

DESIGNER'S SIGNATURE AND NAME
DATE

[Signature]
DATE

REVIEWER'S SIGNATURE AND NAME
DATE
REVIEWER'S SIGNATURE AND NAME
DATE

Test Tests

Test Test

1. Mechanical Vibration and shock tests

The completely assembled rectifier - one of its sub-assemblies, as agreed between user and manufacturer, shall be subjected to mechanical vibration and shock tests to the values as indicated under service condition clause No. 3.1.0 of this specification.

2. Temperature Rise test of diode r-

with normal ventilation, the rectifier shall be loaded at a continuous unidirectional current corresponding to design continuous rating of silicon rectifier assembly i.e. 1500 Amps for a period till steady state value of diode base temperature is obtained, the recorded value shall not exceed the limit value of junction temp. of diode after correcting base temp. for an ambient of 50°C and a further temp. of 15°C may be assumed as rise in the rectifier cooling air duct.

1) Temperature Rise test

Same as type test No. 2

iii) Temperature Rise test of busbar r-

Busbar temperature to be recorded at a unidirectional current of 7500 Amps for 10 minutes followed by 25% Amps continuous current. The temperature of the busbar is again recorded when steady state is reached. The recorded busbar temperature shall not exceed the limit of 100°C after correcting the temperature for an ambient of 50°C.

Temperature should specifically be checked at the contact points of the diode skin.

4. Soaring Stress tests

as per drawing in cell

- ⑤ This test shall be carried out with some bridge diodes and keeping the battery diode in circuit, by loading the silicon rectifier assembly to standing duty given in this specification. This test is applicable to rectifiers provided with bridge diode only.

Specification for Silicon
rectifier per drawing in cell
4000

11/11

Order by the user
WESTERN ELECTRONIC WORKS
WEST BROMWICH, ENGLAND
22/7/64

Test Data

Section Test

1. Current Distribution Test

During temperature rise test at maximum output corresponding to designed P.O. rating or certified, the current distribution of the parallel connected frames shall be measured. During the tests, the internal assembly of the motor or other circuit contacts to the rails in wheel position and should not be disturbed for testing measurement.

2. Current Distribution Test

Done as type test
No. 1.

the
Card
with
Data

END OF TEST
DATE 11/20/58
BY 1010 2 1010 4 1010 6

[Signature]
BY 1010 2 1010 4 1010 6

Page 10 of 10
END OF TEST
DATE 11/20/58
BY 1010 2 1010 4 1010 6

Test Data

Test Data

The appropriate way to take up
some of the most common or
by measuring voltage drop across
the leads.

Test may be subject to various
conditions.

6. Voltage Distribution Test

7. Voltage Distribution Test

Same as type test No. 6

The voltage distribution across
the series connected leads shall
be measured with a high resistance
multimeter and high voltage leads
representing the voltage across
the leads for design purposes
and a test lead of approximately
10 ft.

7. Series Voltage Test

8. Insulation Test

By means of applying a potential
up to 100,000 V to a voltage
level corresponding to peak
voltage of surge arrester,
the surge arrester shall be sub-
jected to impulse voltage test
by discharging this capacitor
across the arrester in series
to resistance.

Before applying the test
voltage the device shall
be checked to ensure
that high voltage is not
applied across the device,
the test voltage
shall be 100,000 V.

9. Surge Current Test

Surge current shall be
applied to the device
and the test voltage shall be 100,000 V.

10. Surge and Withstand Test

11. Surge and Withstand Test

The test shall be performed
as per clause 10 of the standard
and under 100 kV of 1000 A.

11.1. Surge current

11.2. Withstand voltage

11.3. Surge current

11.4. Withstand voltage

12. Surge Current Test

12.1. Surge current

12.2. Withstand voltage

After partial restoration and
after a maximum load of
1000 A, the device shall be
subjected to a short circuit
level of 1000 A for a
period of 100 s.

The test voltage shall be
checked previously checking
at 100 kV and increasing to
full value in not less
than 10 sec.

<p>11-10-75</p>	<p>11-10-75</p>	<p>11-10-75</p>	<p>11-10-75</p>
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The above results test is recorded by means of an oscillograph.

Stator test

a) Stator test as per Fig 1 should be carried out between an inverter and an ammeter assembly after short circuiting of stator and winding (winding not removed from).

b) When given short/circuit shall also be tested for stator test assembly at a short test winding of 10 ohm for one phase.

(Transmission and surface die factor test.)

Stator Short-circuit test

Stator short-circuit test shall be carried out on all three phase stator/winding used in the assembly of stator or winding in accordance with relevant test. Test sample should pass both temperature and surface dielectric test after stator short-circuit.

These test results are verified for a number of test results.

The test line between stator short-circuit terminals and the stator winding at the winding shall satisfactorily meet test results.

(c) Same as type test 10 (a)

Checking of induction motor and associated circuit

This test shall be carried out to verify that various induction, control signals and transmission in stator motor circuit are properly functioning.

5.1.0 Tests on rectification and stalling conditions

a) Test on stator motor test.

a) Type 2 stator test.

These tests shall be carried out under 100% test condition.

b) Induction test on stator motor assembly.

The test shall be carried out as given under induction test for stator motor assembly.

c) Checking of control operation.

The stator should start and run at rated speed without any abnormal vibrations. The stator shall be run for rated voltage (U_n) , $1/2 U_n$, $3/2 U_n$.

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VIRUDUPETTA

10/1/2010
(10/1/2010)

Signature for stator motor test
Signature for stator motor test
Signature for stator motor test

Signature for stator motor test
Signature for stator motor test
Signature for stator motor test

For start-up and 5.75 Hz for a few minutes and check for any abnormalities.

4. Duration of air flow relay

The function of air-flow relay shall be checked by manual operation and also by switching off the blower supply wire.

5. Checking the maximum operating of blower motor

The current of blower motor under full load shall be verified for correct functioning.

5.1 Test on after incorporation for modified connections

All components viz. resistors, capacitors, relay, ammeters, fuses, wires, cables, insulating materials etc. shall comply with the relevant Indian Standards Test and service tests on incorporation shall be agreed to in between manufacturer and the manufacturer.

5.2 Tests after installation of rectifier on transformer

The routine tests to be carried out on modified modified machine at the following checks and tests

a) Check on correct assembly of rectifier components and electrical drawings.

b) Check on the correct operation of auxiliary machines including pumps, functional tests and other accessories.

c) Insulating resistance test before conducting Malenka test with a suitable megger of 1

1.1) 500 V for power circuits.

1.2) 1000 V for circuits below 500 V rms.

d) Malenka tests shall be carried out with an oil bath thermometer with 1/2 Hz frequency, with a voltage of 6 V applied between the lower circuit and earth, and between main circuit with earth circuit. The test-piece should test voltage shall be 500 V and 1000 V for 10.5 Hz circuit. The test voltage shall be of sinusoidal wave form and shall be applied for a period of 1 minute.

Insufficient for
testing machine for
"10.5 Hz" test
1.1.1.1

1.1.1.1
1.1.1.1.1
1.1.1.1.1.1

Insufficient for test machine
1.1.1.1.1
1.1.1.1.1.1
1.1.1.1.1.1.1

1.1.1.1.1.1.1
1.1.1.1.1.1.1.1
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SECTION 1

DATA, FACTS, AND FIGURES OF THE UNITED STATES OF AMERICA
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DATA

FACTS

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CONTENTS

ON
PAGE

A-1.6 Information data, particulars, drawing and design of equipment and components which are to be furnished by the Supplier are given below:-

A-1.7 DRAWINGS

- (1) General layout of the locomotive, showing indication the location and mounting of various unitised & associated equipment offered under this specification.
- (2) General internal layout and assembly sequence of the unitised sub-assembly, separate sub-assembly drawing for block/bracket/plate assembly work, number etc.
- (3) Descriptive features of the design offered, complete with complete long section and relevant power circuit and control circuit diagrams.
- (4) General features of the design offered.
- (5) Full particulars of positive mechanical system including installation details and the protective level provided by the mechanical system.
- (6) Particulars and design details of the blow-off system and protective and pump.
- (7) A complete list of parts, components and raw materials proposed to be imported and their manufacturers.
- (8) A complete list of parts, components of raw materials proposed to be provided from indigenous sources and their manufacturers.
- (9) Complete technical data of various unitised including design details, mounting components and other associated work.
- (10) Test test report of design, if already conducted by the firm.

A-1.8 TECHNICAL DATA SHEET

The following technical data concerning design shall be furnished

- (1) Material
 - (1.1) Type of material - (a) Mild steel (b) High speed
 - (1.2) Type of stress & ultimate tension
 - (1.2.1) Mild steel (a) Mild steel (b) High speed
 - (2) Material strength factor for design stress half value
 - (2.1) Mild steel - 1.5 and 1.75 times in the case of steel.
- Factor of safety at 1.5/1.75.

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OF VIOLETS

and (3) Joseph L. Sweeney, president of

- Total average value
- Peak value
- Value more conditions

001113 Transmission: 1120'4 SW well storage.

www.elsevier.com/locate/jmb

Figure 1

Smiling surface

DOI: 10.1002/for

ex) $\text{Methoxy} \rightarrow \text{OCH}_3$ (at ortho pos. of

- Heat rate(P/W) at specified cooling air velocity.

286.3 *Tridacna* Herms2 *Lepidoptera* *Notura*

- *Stipa*

TABLE 2. Reassessing production systems.

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- *Eligible*
- *Length of stay*

It's not even playing longer for some.

a) Mean resistance of slide (kN) $\times 10^3$
Frequency $\times 10^3$ (Hz)

4) Isolates from manufacturing process & surface fluids.

NOTE) Data of diode saturation component is W_{diode} , hole storage, capacitor and potential divider network.

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base)  Your data/storms0801.xlsx
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1997

- a) Date/Year
- b) Rated current/voltage
- c) Current versus time curve for full wave & half wave (including time current characteristics)
- d) Arc voltage characteristics
- e) Total I²t characteristics
- f) Max continuous current w/o ambient temperature rise
- g) Total I²t let through at maximum prep

A.3.6 TECHNICAL DATA OR DESCRIPTION ASSEMBLY


Technical data concerning rectifier assembly indicated below shall furnished:

- i) Cell arrangements:
 - Series
 - Parallel
 - Commutation bridge/push-pull
- ii) Number of cells:
 - per bridge/push-pull
 - per commutation
- iii) Switching current rating of rectifier at rated voltage and ambient temperature of:
 - 50°C
 - 60°C
 - 75°C

with all healthy cells and one string isolated if applicable.

- iv) Short time current rating of rectifier at 60°C ambient and 10°C at temperature in the cooling duct for:
 - 1 min.
 - 2 min.
 - 3 min.
 - 5 min.
 - 10 min.

with all healthy cells and one string isolated if applicable.

date checked	SPECIFICATION FOR RECTIFIER RECTIFIER OF WAG-7 LONGHONG C. WAG-7/1000	 (Signature) 20-57-62	Inspection and quality assurance Date: 20-57-62 LONGHONG C. WAG-7/1000 20-57-62 20-57-62 20-57-62
-----------------	---	--	--

- v) Size of rectifier vehicle and equipment layout drawing.
- vi) Detail characteristics of protective devices used and blowout motor size.
- vii) Detail specifications for protective devices used for protection against surge voltages, voltage fluctuation level and effective value.
- Surge arrester
- air discharge equipment
- earthing conductors
- air discharge equipment
- surge hole storage equipment
- surge potential divider resistor
- viii) Test results for checking defective cells/faults or string in the rectifier and functions achieved.
- ix) Diagram showing connections between cells/faults/well check and other components in a vehicle.
- x) Characteristics of blowout motor and for operating voltage 240, 300, 415 and 500 v.
- xi) Characteristics and type of protective equipment used for blowout motor and ventilation failure.
- xii) Weight of complete equipment with its auxiliary.

4.4.2 Test results:

The following calculations shall be submitted by the tenderer, along with their offer:

- 1) Calculation for number of cells in series and parallel.
- 2) Calculation for number of cells in series based on:
 - repetitive voltage,
 - switching surges,
 - lightning surges.
- 3) Calculation of number of cells in parallel based on:
 - Duty cycle and short circuit capacity for period as specified under clause No. 4.1.1.1 (IV) or 4.1.2.1 (V)
 - Starting duty cycle and short circuit capacity with one (1) string/bridge as specified as specified under clause 4.1.

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	PREPARED BY DATE	PREPARED BY DATE

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- [illegible]

WIND CALCULATIONS FOR 20,000 AMPERES

4. No. of Cells required in series

1) Repetitive Voltage

No. of cells * Peak Rep. No. load volt at 20,000 AMP

V R M

W R M * Permissible peak repetitive average voltage of diode at rated junction temperature.

2 * 100 safe voltage for diodes.
* 100 derating factor if no diode is specified and in series.

2) Excessive Current

No. of cells * I_A Peak Rep. no load voltage at 20,000 AMP
V R M

V R M * Non-repetitive peak reverse voltage of diode at rated junction temperature.

Note * The W R M shall also be compared with peak frequency peak reverse voltage of diode structure.

5. No. of cells in parallel

(A) 1) Designed rectification rating of 2000A/2000V-1000A for tube design & 2000A for diode free design.

No. of cells * $\frac{I_{avg} \times 0.8}{I_A \times 1.4}$

Where 0 * Derating factor - 100 for diodes & 80 for tube in parallel or 80-85 for diode (as derated by manufacturer) for diodes & 80-85 for tube in parallel. *See also Table 1.*

I F (AV) * Average forward current of the diode at 75°C ambient temp with linear air velocity of 4 metres /min.

* Designed continuous current of rectifier.

...

<p>REVISION</p>	<p>1) SPECIFICATION FOR 20,000 AMPERES FOR WINDING WAP-1000V</p>	<p>2) 1000V</p>	<p>3) 1000V</p>
<p>REVISION</p>	<p>1) 1000V</p>	<p>2) 1000V</p>	<p>3) 1000V</p>

11. Short Circuit Calculations

a) Before smoothing reactor

$$I_{sc} = I_{sc} \text{ at } 100 \text{ MVA } \times \frac{100}{100} = 100 \text{ MVA}$$

$$I_{sc} = I_{sc} \text{ at } 100 \text{ MVA} \times \frac{100}{100} = 100 \text{ MVA}$$

I_{sc} = Isc at 100 MVA rating of transformer

$$I_{sc} \text{ at } 100 \text{ MVA} = \frac{100}{100} \times \frac{100}{100} = 100 \text{ MVA}$$

$$\text{Referring to secondary side} = I_{sc} \times \frac{100}{100} = 100 \text{ MVA}$$

$$I_{sc} = I_{sc} \text{ at } 100 \text{ MVA} \times \frac{100}{100} = 100 \text{ MVA}$$

Where I_{sc} is short circuit power factor of transformer which transformer shall specify.

$$\text{Peak value of short circuit current} = \frac{100}{100} \times (I_{sc} \text{ at } 100 \text{ MVA}) \times \frac{100}{100} = 100 \text{ MVA}$$

$$1) \text{ No. of devices in parallel} = \frac{100}{100} \times \frac{100}{100} = 100 \text{ MVA}$$

$$2) \text{ No. of devices in parallel} = \frac{100}{100} \times \frac{100}{100} = 100 \text{ MVA}$$

Where I_{sc} is limiting value of forward peak load current of diode for 100 MVA at rated junction temperature.

b) Short circuit current at 100 MVA

$$1) \text{ No. of diodes provided in parallel (free free design) and diode size (free design)} = \frac{100}{100} \times \frac{100}{100} = 100 \text{ MVA}$$

Where I_{sc} is limiting value of forward current of diode for 100 MVA at rated junction temperature.

$$2) \text{ RMS value of short circuit current (conduction angle to be indicated)} = \frac{100}{100} \times \frac{100}{100} = 100 \text{ MVA}$$

* is the factor for conversion asymptotic value

Contd.....

11. Short Circuit Calculations Before smoothing reactor I _{sc} = I _{sc} at 100 MVA × 100/100 = 100 MVA I _{sc} = I _{sc} at 100 MVA × 100/100 = 100 MVA I _{sc} = Isc at 100 MVA rating of transformer I _{sc} at 100 MVA = 100/100 × 100/100 = 100 MVA Referring to secondary side = I _{sc} × 100/100 = 100 MVA I _{sc} = I _{sc} at 100 MVA × 100/100 = 100 MVA Where I _{sc} is short circuit power factor of transformer which transformer shall specify. Peak value of short circuit current = 100/100 × (I _{sc} at 100 MVA) × 100/100 = 100 MVA	1) No. of devices in parallel = 100/100 × 100/100 = 100 MVA 2) No. of devices in parallel = 100/100 × 100/100 = 100 MVA Where I _{sc} is limiting value of forward peak load current of diode for 100 MVA at rated junction temperature. b) Short circuit current at 100 MVA 1) No. of diodes provided in parallel (free free design) and diode size (free design) = 100/100 × 100/100 = 100 MVA Where I _{sc} is limiting value of forward current of diode for 100 MVA at rated junction temperature. 2) RMS value of short circuit current (conduction angle to be indicated) = 100/100 × 100/100 = 100 MVA * is the factor for conversion asymptotic value
--	---

5 cycle RMS value of diode
external current junction
temperature (conduction
angle to be indicated).

$$= \frac{I_{TAV}}{5}$$

Max of diodes in parallel
(fuse free design) and
min in one phase design).

$$= \frac{1000 \pm 2}{1.5 \times 10^{10} \text{ (V/A)}}$$

c) Junction Temperature Calculations

- I_F (A) = Threshold Voltage.
 R_F = Slope Resistance.
 R_{TH} (JA) = Thermal Resistance Junction
to ambient.
 I_F (AV) = Average forward current of
the diode at 0 Hz.
 Power loss (PF) = I_F (AV) \times R_F + I_F (AV) \times KI^2 , R_F
 K = Form factor
 T = $PF \times R_{TH}$ (JA) $^{\circ}\text{C}$
 T_{J2} = final junction temp = $T_0 + T^{\circ}\text{C}$

The period shall be based on duty cycle indicated in
specifications. Calculation methods for time varying load
conditions shall be submitted in accordance with Paragraphs of
specification of the device.

d) Fuse selection based on

i) Continuous rating

$$I_F$$
 (AV) per fuse = $\frac{1000}{2 \times N}$
 N = No. of diodes in parallel
 $1000 = I_F$ (AV) \times form factor.

ii) Behaviour short circuits - Safety Flash over

$$I_{SC}$$
 per fuse = $\frac{I_{SC}}{N}$
 N = No. of diodes in parallel

iii) Behaviour short circuit isolation of defective diode

$$\text{RMS Value of } I_{SC} \text{ current} = \frac{I_{SC}}{N}$$

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ON 11/1/2013 BY 60324

(p. 2/2/2/2/2)
No. 100, 100

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WASHINGTON, D.C. 20505-1204
FORM NO. 1 (2/78) 1-1
GPO : 1978 O - 311-111

2) Each current let thru" in the fuses after
in fault conditions

$$I_{SC} \quad (N+1) \times I_{FW}$$

N = No. of cells in parallel.

I_{FW} = Surge rating of diode at rated
junction temperature for 10 ms.

3) I²t value let thru" in the fuses

$$I^2t \text{ (fuse)} \quad (N+1)^2 \times I^2t \text{ (diode)}$$

N = No. of cells in parallel.

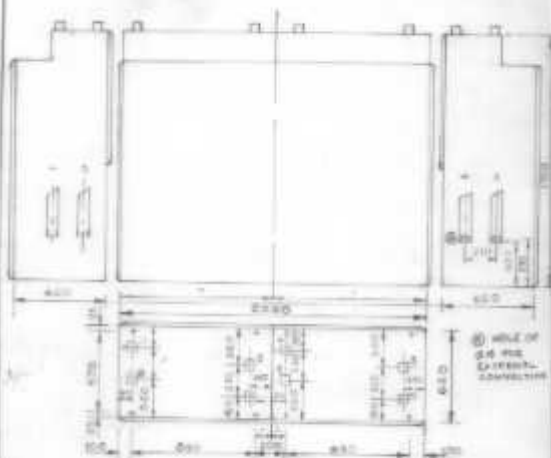
Notes: Factors to be considered for calculations

- 1) Derating Factor for fuses - 0.88
for ambient temp.
- 2) Derating Factor - 1.0
- 3) Derating of fuses for
variable load. - 0.8

INSPECTION FOR DESIGN
RECTIFIER FOR
PAGE 7 AND DRAWING 100

10/10/71
100-100-100

FORWARD FOR QUALITY INSPECTION
100-100-100
SHTTANANAN LUN-INSITHE 10000
CALL 100-100-100
100-100-100
100-100-100



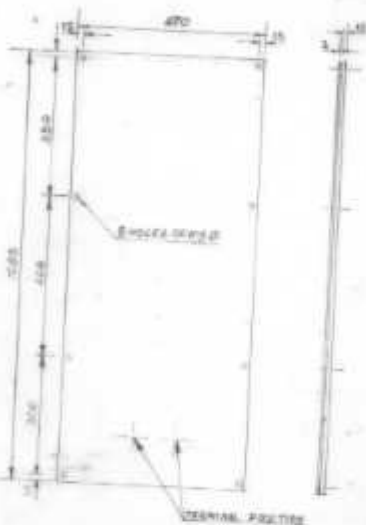
- All types of high static fasteners including spring washers shall be of steel or stainless steel. No zinc plated fasteners or nuts are used.
- All types of spring washers shall be of 'force' type only.

OUTLINE DIAGRAM
OF SILICON RECTIFIER
FOR WAP-4

CHITTARANJAN LOCOMOTIVE WORKS
NETAL, WEST BENGAL, INDIA

Order No. C/1015/20-1-10-12

DR 14



* All types of high speed locomotives including spring mounted
shall be of either 1/2 inch or 1/4 inch diameter rods or
1/2 inch rods.

All types of spring mounted shall be of 'steel' rods only.

WGS-7 & WGS-8
AC DAMPING PANEL

WGS-7 & WGS-8
(for 100 (H))

LOCOMOTIVE AND RAILWAY EQUIPMENT
DIVISION
CENTRALIZED LOCOMOTIVE WORKS
1001 WHEELING ROAD
WHEELING, W. VA.
CLASSED/REV. 2/11-23
REVISION 1



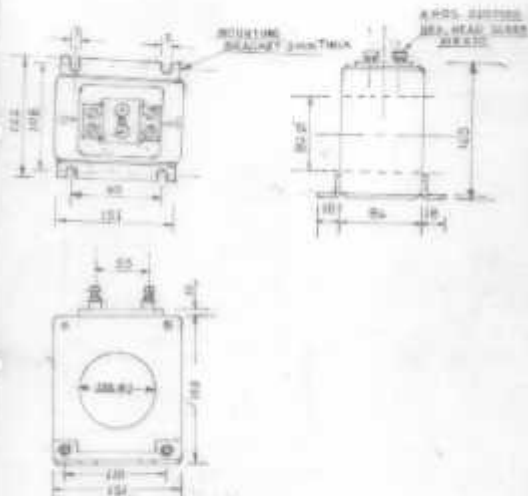
- * All types of high density Indians including spring water
shall be of either of 2 kinds, M's. Indian or
M's. Indian.
All types of spring water shall be of 2 kinds only.

1080 J. L. Lutz et al.

IC EARTHING CAPA-
CITOR ASSLY.

for. cas. (2)

CHITTARANJAN LECTURATIVE WORKS
1987 BANGALORE, INDIA
ISBN 81-7030-134-4

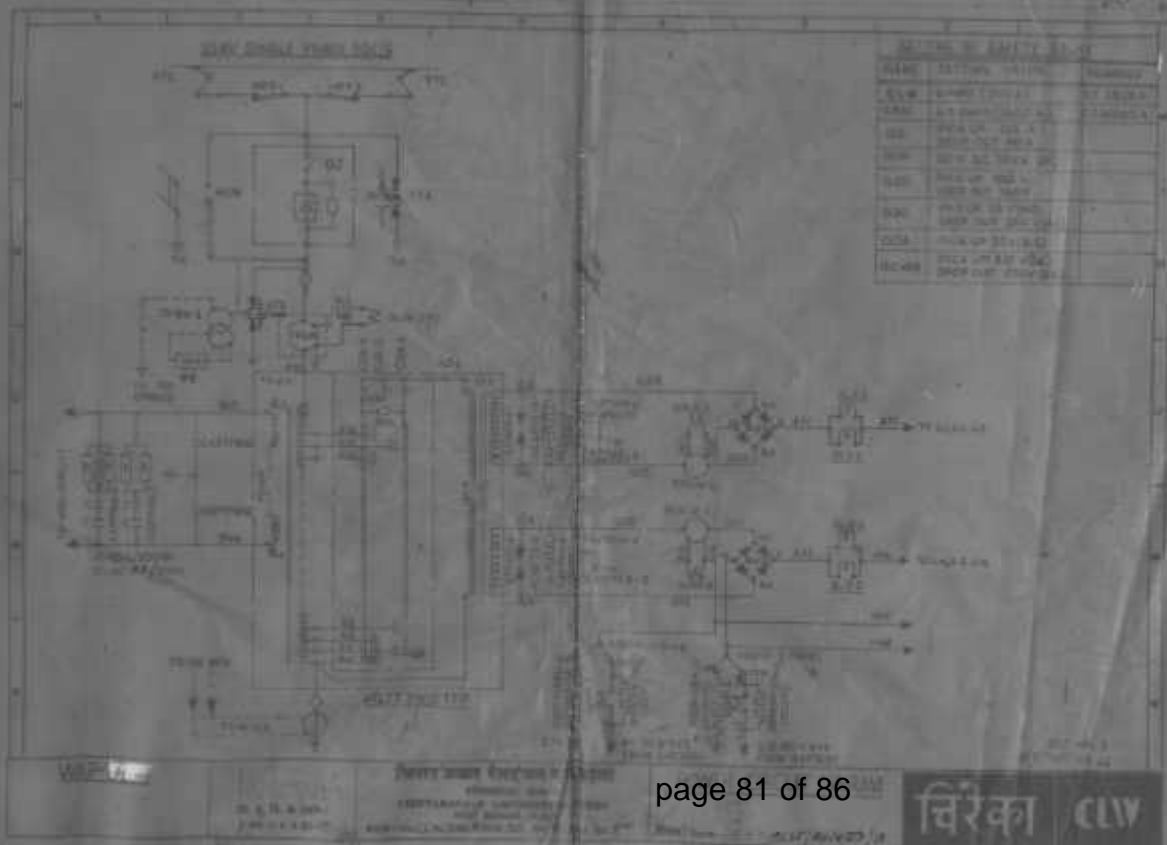


CURRENT TRANSFORMER (K21A)
RATON-4000/5

SPECIFICATION FOR
SILICON RECTIFIER FOR
NAP-4 & NAG-7
LOCOS

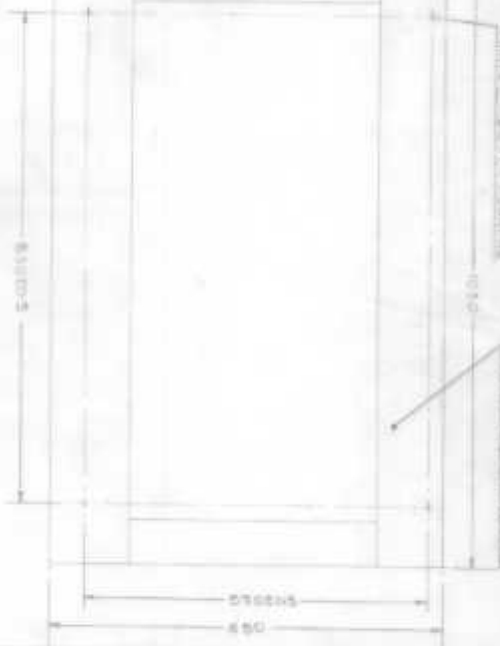
Handwritten signature
DR. G. S. S. S. S.
DR. G. S. S. S. S.

TECHNICAL SPECIFICATION
DR. G. S. S. S. S.
CHITTARANJAN LOCOMOTIVE WORKS
WEST BENGAL, INDIA
W.D. NO. 15840-CLW/K21A/5/03307
REV. DATE:



4 MOUNTING DIMENSIONS

FROM FRONT VIEW



DATE
BY
CHKD

MOUNTING DIMENSIONS
FOR
SILICON RECTIFIER

11/12
BY, CEE(D)

Drawn by P. V. S. S. S. S.
SRI LANKA LOCOMOTIVE WORKS
WEST BENGAL, INDIA
Rev/NO. 001/001/001/001/001/001
Rev/DATE: 20-1-20

Sl. No.	Appellation	Rating & Price Rs.	Remarks/Qty
1.	A.C. Damping & D.C. Damping	(1) 25H/25V 25/25V 512001 100 (2) 25H/25V 25/25V 512001 100	25H/25V 25/25V 512001 100
2.	A.C. Damping	2.47H/25V 25/25V	2.47H/25V 25/25V
3.	Hole Storage	2.47H/25V 25/25V	2.47H/25V 25/25V

* 1. A.C. Damping 25H/25V 25/25V 512001 100
 2. D.C. Damping 25H/25V 25/25V 512001 100

SPECIFICATION FOR
 SILICON RECTIFIER FOR
 25V 25V 25V

TYPE: 25V
 25V 25V

ORDER TO THE SUPPLIER
 25V 25V 25V
 ORDER TO THE SUPPLIER
 25V 25V 25V