

TENDER SPECIFICATION  
NO. CLW/ESB-36  
A/C

## ENCLOSURES

1. DRG. No. CLW/ESK-1R-36/ALT-C
2. DRG. No. CLW/ESK-1R-36/ALT-C
3. DRG. No. CLW/ESK-1R-36/ALT-C

## TOTAL No. OF SHEETS IN THIS SPECIFICATION

ALT	B	C						
SHEETS	16	17						

SPECIFICATION  
FOR

HEAVY MOUNTED NATURALLY COOLED DBR FOR WAP-4 LOCOMOTIVES

DESIGNED BY  
DN (S&E) ELECTRICAL ENGINEERING,  
CHITTARANJAN LOCOMOTIVE WORKS,  
773 CHITTARANJAN - 717444,  
DIST: BURDWAN, WEST BENGAL, INDIA.

SPECIFICATION FOR HEAVY  
MOUNTED NATURALLY  
COOLED DBR FOR WAP-4  
LOCOMOTIVES.

DN, CEE (D)

CHITTARANJAN LOCOMOTIVE WORKS  
WEST BENGAL, INDIA.




NO. CLW/ESB-36/ALT-C  
DATE: 24/08/2004

APPROVED

CHAND

DES.

## DETAILS OF ALTERATIONS

ALT. NO.	DATE	DESCRIPTION	SIGNATURE	REMARKS
B	31.05.2004	Specification revised		Specification revised based on RDSO's letter No.EE/1-2-2004 dt. 07.05.2004.
C	20.06.2004	1. Clause No. 4.17 & 4.23 added. 2. Dwg No. CI.WORK/20-M-ALC. enclosed.		Specification revised based on RDSO's letter No.EE/1-2-2004 dt. 06.06.2004.
DATE	SPECIFICATION FOR ROAD MOUNTED NA PUSALY COOLED DIESEL WAP-4 LOCOMOTIVES		 DY. CH. (D)	CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA. NO. CI.WORK/20-M-ALC. DATE: 20/06/2004

REVISION

CHANGED

DATE

## TECHNICAL SPECIFICATION NO. C/SSR-36 FOR ROOF MOUNTED NATURALLY COOLED DRIVE FOR WAP-4 LOCOMOTIVES.

### 1. SCOPE

- 1.1 The Elastic Frating Machine (EFM) covered by this specification required to be fitted on the roof of WAP-4 type Electric Locomotives to control a mass of 14018 tonnes (18 coach WAP loaded train) on a continuous downgrade of 1 in 200 at a speed of 40 kmph with continuous braking current of 215 Amps without any speed gain.

Further the EFM shall also be capable to reduce the speed of a 24 coach train from its normal running speed 110/100 kmph to 40 kmph with different gear ratios as mentioned in clause 2.0.

- 1.2 Any deviation from the standard laid down with a view to improve the performance, safety and efficiency of the equipment will be given due consideration provided full particulars with justification are furnished by the tenderer. However, no deviation in the specified overall and mounting dimensions will be allowed. However, contractor has a right to accept or reject any offer without any justification submitted to the firm.

### 2.0 SERVICE CONDITIONS

- 2.1 The Elastic Frating Machine now covered by this specification will be suitable for working satisfactorily for ambient temperature varying from 5 deg. C to 35 deg. C with a maximum relative humidity of 100% in altitude upto 1000 metres above mean sea level and in dense atmospheric conditions.

- 2.2 The machine shall comply with its mounting arrangement will be robust and so designed as to able to withstand satisfactorily the following vibrations and shocks normally encountered in Indian Day.

i) Max. vertical acceleration	-	1.0 g
ii) Max. longitudinal acceleration	-	1.0 g
iii) Max. transverse acceleration	-	1.0 g

(1'g' being acceleration due to Gravity)

- 2.3 The vibrations in all axes shall be such and the frequency of vibration is between 1 Hz to 20 Hz. The amplitude 'A' expressed in millimetres is given as a function of 'f' by the equation:

$$A = \begin{cases} -25f & \text{for values of 'f' from 1 Hz to 10 Hz} \\ -200f^2 & \text{for values of 'f' exceeding 10 Hz and up to 20 Hz} \end{cases}$$

SPECIFICATION FOR ROOF MOUNTED NATURALLY COOLED DRIVE FOR WAP-4 LOCOMOTIVES.



REV. 001 (10)

CHITRAKOOTAN LOCOMOTIVE WORKS  
WEST BENGAL, INDIA.

NO. C/SSR/36/ALT-C  
DATE: 24/08/2004

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ADVISOR

- 2.4 In the direction corresponding to the longitudinal movement of the vehicle, the equipment is to withstand for 10 minutes to 50 Hz vibration of such a value that the root-mean-square is equal to 1.0 g (amplitude  $\sqrt{2} = 0.707$  mm/s).
- 2.5 The elements and accessories of equipments shall not exhibit harmful resonance for the equipment in the above range.
- 2.6 Whenever the clearance mentioned in clause 4.1 (a) & (b) are not possible to maintain, insulating sheet shall be provided of Grade (P 1) as IS-10097 of ISRO.

### 3.0 TECHNICAL SPECIFICATIONS

- (i) One lot – an assembly of Dynamic Brake Resistance for 6 Traction Motor, based on two identical frames, each containing resistance for 1 T.M. with following details:
- |  |   |                            |
|--|---|----------------------------|
| (ii) Continuous rated current of resistance for each traction motor at a train speed of 40 kmph.   | : | 515 Amperes.               |
| (iii) Resistance value per traction Motor at working temp.   | : | 0.5 Ohms                   |
| (iv) Material for resistor grids   | : | 60% Fe, 15% Cr and rest Fe |
| (v) Total heat dissipated in the DBR corresponding to 515 Amperes heating current.   | : | 796 KW (Diss.)             |
| (vi) Max. temp. rise at actual test conditions in continuous rated current 515 Amperes under a equivalent wind speed of 40 kmph towards the DBR. (The type of DBR shall be similar as that in actual DBR operating condition on locomotive). | : | 400°C                      |
| (vii) Average current to maintain speed from 110/100 kmph to 67 kmph   | : | 400 to 750 Amperes.        |
| (viii) Average current to maintain the speed from 67 kmph to 40 kmph.  | : | 750 to 650 Amperes.        |

SPECIFICATION FOR BRIDGE  
MOUNTED NATURALLY  
COOLED (NWC) WAP-4  
LOCOMOTIVES.



IN. CEE. (D)

CHITTARANJAN LOCOMOTIVE WORKS  
WEST BENGAL, INDIA.

NO. CLW/DR/WALY-C  
DATE: 24.08.2004

8A)	Peak overhead rating at 1.25 times the rated power at 110/100 kV/mph	900 kVA
8C)	The max. operating temperature at a speed of 110/100 kV/mph with 800 kVA/gnd contact	800 deg. C.
8D)	Total heat dissipation at 800 kVA/gnd contact	1000 KW
8E)	No. of frame per bay set	02 nos.
8F)	Each frame contains three Dynamic brake resistor for 7 traction motor	i.e. 3D-1,2,3 & 4D-4,5,6
8G)	Max. dimensions of each motor frame including mesh guard (excluding bracket & insulators, which houses brake resistance for these traction motor.	L - 800 mm W - 1400 mm H - 450 mm
8H)	Insulation	Classified - windings must have insulation withstanding 1500°C continuously and sufficient to prevent shock of 80 °C
8I)	Wire mesh guard	Should be provided on motor side for all traction motor not to more than 20%
8J)	Max. Wt. of each unit	450 Kg. i.e. 900 Kg. total for two traction motor
8K)	Mounting frame with mesh cover including hardware.	MSI 300 grade stainless steel
8L)	Insulation level	- as per electric test 20 Hz. 1 minute for partial with 4-5.

SPECIFICATIONS FOR BOM  
WINDING NATURALLY  
COOLED MOTOR FOR WAP-4  
LOCOMOTIVES.

BY: LEE JIN

CHITTARANJAN COGNITIVE WORKS  
WEST BENGAL, INDIA

NO. CLW/SR/DR/ALT.C.  
DATE: 24/08/2006

If the resistor utilizes a double insulation system, therefore:  
 Primary insulation - Classen 10.  
 Through 7 kv.  
 Secondary insulation - The same as  
 Class 3.21 kv.

## DESIGN FEATURES

- 4.1.  $\omega$  Creepage path to Mta clearance between iron and earth. - 20 mm  
 - 40 mm
- 4.2. Mounting Place - On the roof - Location shown in Dwg. No. CUWSSM-138-31.
- 4.3. Cooling - Heat dissipation by air circulation (no forced air cooling, but by air circulation due to heat movement).
- 4.4. The resistor units shall be of a very robust design for meeting the severe traction duty. All materials used for the assembly shall be suitable to withstand a temperature of the order of 80 deg. C continuously.
- 4.5. The resistor shall be designed to carry 95% overload in the loading current, above the maximum rating, on account of permissible tolerance in the current rating of the overhead cable.
- 4.6. The material for the resistor grids shall be alloy of 80% Ni, 15% chromium and iron base. The accelerated life test as per ASTM-B-7699 (1997) shall be carried out to determine the maximum life time. The resistor material approved by Electrical Department of RMDO by DMR of Electric Locomotive of VDM Germany Make. Material of any other make in place of VDM Germany shall not be used by any manufacturer without getting prior approval of DMR.
- 4.7. Each resistor element shall be designed such that there is uniform air flow over the entire surface of the resistor element. No separator shall be used between adjacent resistor elements/modules.
- 4.8. The values of resistance measured when cold and corrected if necessary to the reference temperature of 20 deg. C, shall not vary from the rated value by more than  $\pm 1\%$  tolerance.
- 4.9. All materials other than grid element and ceramic insulators used for the assembly of the DRB shall be suitable to withstand the temperature of at least 80° C continuously.

SPECIFICATION FOR ROOF  
 MOUNTED NATURALLY  
 COOLED DRB 138 W&L  
 LOCOMOTIVES.

  
 DR. CEE (D)

CHHABANDAS LOCOMOTIVE WORKS  
 WEST BENGAL, INDIA.

NO. CUWSSM-138-31-C  
 DATE: 26/08/2009.

- 4.10 Each resistor unit shall be designed such that as far as possible, uniform air flow over the entire surface of the resistor elements is achieved.
- 4.11 Resistor elements shall be fast to the framework by such a way that their thermal expansion at high temperature (of the order of 300 deg C) does not result in the deterioration supporting/sagging of the grids. The details of the arrangement for supporting the elements and allowing for thermal expansion at high temperature shall be furnished.
- 4.12 The resistor element for each reaction channel shall preferably be in one length without any joints. However, if joints are unavoidable, it shall be a spot welded joint and the electrical resistance of the joint shall not be more than the equal length of the parent element. Further, the mechanical strength of the joint shall not less than the parent element.
- 4.13 The ceramic material used for the resistors should be free from sulphur to prevent corrosion of Nickel-Chromium resistor alloy due to evolution of sulphur dioxide at high temperature.
- 4.14 Turned flat ribbon of copper or silver material of suitable length with high compressive withstanding capacity shall be held on the incoming/outgoing ends of the grid elements to connect each reaction channel.
- 4.15 Copper bus bars of size approximately 40mm x 10mm thick of suitable length as per the requirements shall be supplied to bring down the connections of all the six grids (incoming/outgoing) to the end of the buswork.
- 4.16 Adequate clearance and coverage dimensions shall be maintained in each resistor unit to avoid distortion. Whenever such clearance are not possible to maintain, suitable insulating material shall be provided to obtain the required dielectric strength.
- 4.17 Cooling of the grid element will be by air circulation due to low velocities. Any other scheme in addition to this natural cooling i.e. air collectors etc. to achieve uniform air distribution in all grid element to improve the performance and efficiency of the system will be given due consideration provided full technical details with justification are furnished by the tenderer. However, no deviation in the specified overall dimensions will be allowed.

- 4.18 Each resistor unit shall be provided with Plate displaying manufacturer's name, type No., rating, year of manufacture and weight etc.
- 4.19 All hardware used shall be with metric threads only. High speed steels are to be used only from the firms like Lubrizol, M/s. Hamilton, Parkers and M/s. IPS. The spring washers of TORRE' make only shall be used. Fasteners of make other than mentioned can be used only after taking prior approval from RDSI.

SPECIFICATION FOR NON  
SERVICED NATURALLY  
COOLED DBR FOR WAF-4  
LOCUMBITER

BY: CDR (D)

CHITTARANJAN LOCOMOTIVE WORKS  
WEST BENGAL, INDIA.

NO. CU/WBR/SCALY-C  
DATE: 24/08/2014

ACCEPTED

RECEIVED

DATE:

- 4.20 The following accessories for each unit shall be within the scope of supply - (1) 02 non-channels as per Drg. No. CI.W/EN/06.2/0-16 (i) 08 nos. MICA V-GR M10 or of equivalent material support insulators (ii) Insulating sheet of size approximately 1000 x 770 mm of suitable thickness for joining the same on the roof as between the two channels to prevent leakage of roof slab at heat penetration in the grid.
- 4.21 The material selected shall have melting point not below 1400 deg. C and it should not get corroded/deteriorated at a temp. of 800-900 deg. C. The DMR shall be roof mounted therefore, water pooling will occur even at high temp. of 800-900 deg. C. The material should not disintegrate.
- 4.22 Tenderer who wish to offer DMR of higher rating, within the given space only, need to submit full details in order that their offer is evaluated correctly.
- 4.23 In WAPM item, dating heating enclosure is provided through 10000KV ATPEX as field of 6 Y.M. 80% of ATPEX corresponds to 450V across DMR.
- 4.24 Colour of main framework shall be of colour No.03 Light Gray conforming to the requirement of IS-5:1994.
- 4.25 Name of the manufacturer, Serial No., month and year of manufacture shall be indicated on each component eg. On Ratchet Disc Assembly, Mounting Insulators and Connecting Copper Rods etc.
- 4.26 Each ratchet disc shall be provided with a plate displaying the following information:  
 Manufacturer's name  
 - Indication of type and size  
 - Important ratings  
 - Year of manufacture and  
 - Weight
- 4.27 (ii) The tenderer will also supply following accessories along with their roof mounted ratchet disc (1000).

Sl. No.	Description	Qty. required per Area
1	Insulated Bushing as per CI.W. dty No. CI.W/EN/06.2/0-16	7 Nos.
2	Copper Bus Bar (approx. Size of each Bar Bar is 100mm Thick x 8mm width x 7 mm length) as per detail	17 Nos.
3	Bus Bar support Insulator (Open) Black size 50mm, Thick x 8mm, Width x 150mm Long.	20 Nos.

MEDICALS, PHARMACEUTICALS,  
 SOLIDLY NATURAL  
 COOKED DMR FOR WAPM  
 ENCLOSURES.



DR. SUDH

CHITARANJAN LAKSHMINEE WORKS  
 WERTHONGAL, PANDRA.

NO. CI.W/EN/06.2/0-16  
 DATE: 24/06/2008

Date: \_\_\_\_\_  
 OFFICE  
 ATTENTION

DR. SUDH



- 4.27 (ii) All above accessories will be procured from a source/source approved to be approved by RDSO/CTW. All such items will be got type tested by RDSO.
- 4.28 The Design and commissioning of steel mounted ODR including the accessories for the locomotive is to be done by the ODR manufacturer/supplier.
- 4.30 **TYPE TEST FOR TYPE TEST INSPECTION CIRCUIT**  
The type and routine test shall be carried out conforming to the requirements of following standards:-
- (i) IS: 48- EC standard voltages.
  - (ii) IS: 322- Rules of ohmic resistors used in the power circuits of electrically power voltage.

#### 5.1 TYPE TEST :-

The same to be conforming as per IS:322.

- (i) Visual inspection/Dimensional check.
- (ii) Check on characteristics of various electric materials,  $m$ - and  $p$ -value determination; life determination-as per clause 2.4 and 4.6.
- (iii) Check on rated value of resistance as per clause 2.7 and 4.8.
- (iv) Temperature rise test (as per Annexure-1)
- (v) Dielectric test  
These tests shall be carried out at the normal temperature of the test site on each source bus, frame of block. Each source bus/frame shall be subjected to the test voltages mentioned below for one minute. The test voltage of the overhead (frequency of 50 Hz) shall be as per the following:-
  - (a) Resistors with single insulation -  $2.5 U + 2000$  Volts.
  - (b) Resistors with double insulation -
    - (i) Primary insulation - 4000 Volts.
    - (ii) Secondary insulation -  $2.5 U + 2000$  Volts.
 U is the rated voltage of the circuit.
- (vi) Test for performance criteria (As per Annexure 1, Cl. 3.1)
- (vii) Test for withstanding vibration and shock
  - (a) Resonant vibration test
    - (i) in each of three directions i.e. vertical, longitudinal and transverse, the motor bus frame, when cold, shall be subjected for a time not less than 15 minutes, as specified.
    - (ii) either at the critical frequency if such a frequency, well defined, has been detected during the run described in clause 3.2
    - (iii) or otherwise at (10 Hz).
 In both cases, the amplitude of vibration table is adjusted to the value corresponding to the frequency considered (see clause 2.2).

SPECIFICATIONS FOR ROOF  
MOUNTED NATURALLY  
COOLED ODR FOR WAG-9  
LOCOMOTIVES.

  
DY. CEE/DR

CHITTARANJAN LOCOMOTIVE WORKS  
WERT HENGAL, INDIA.

NA CL/WER/WAG-9  
DATE: 24/02/2004.

- 4) Test involving loading checks  
In the direction corresponding to the longitudinal movement of the vehicle on which it will be mounted the resistor box of linear shall be subjected to a series of three successive impacts each corresponding to a maximum acceleration of 3g.

900) Humidity test

The resistor box or frame shall be placed in a humid enclosure at a temperature of 20 deg C and showing a relative humidity of at least 95% for 24 hours.

As soon as possible, and in any case, less than five minutes after removal from the humid enclosure and after wiping off external surface moisture with a clean cloth, a dielectric test is carried out, using test voltages of value 1000V less than the value shown in clause 3.1V.

No failures shall occur.

3c) Short circuit test (As per IEC 322)

3) Condition of resistor after test

After the tests specified in clauses 3.1 (b) to 3.1 (c) a check shall be made that:

- No wires or not in place.
- The electric parts have correctly fulfilled their purpose.
- There is no distortion or corrosion or scaling of any components.
- The resistor elements are not cracked or broken.
- The resistances have suffered no damage.

4c) Weight

Weight of the complete resistor assembly shall be recorded after necessary modifications as a result of the above check.

3.2 DEFINITIONS

- Visual inspection/visual check.
- Check on rated value of resistance.
- Dimensional.

3.3 General inspection to be carried out with regard to the delivery, breakage etc. and provisions taken to give adequate protection against corrosion for all the components of resistor specially contact surfaces and processes of lock washers and their connections.

3.4 The moisture and the average value of temperature coefficient over the range between the ambient and maximum operating temperature will be determined from test pieces taken from the alloy forming the resistor element.

MR. B. K. ADITYA, JR. ENGINEER  
NON-NUCLEAR SAFETY  
COOLING SYSTEMS  
LOCOMOTIVE

DR. CH. DEVI

CHITTARANJAN LOCOMOTIVE WORKS  
WEST BENGAL, INDIA.

NO. CW/HR-26/ALL-C  
DATE: 24/08/2006

- 5.5 Tests for verifying the compression of the vertical and tie rods shall be conducted as per requirements of CI. 4.4.
- 5.6 In case the joints are used in the tension elements, suitable tests shall be carried out to verify the requirements of CI. 4.12.
- 5.7 Rated value of resistance for the slabs of each tension member shall be verified with Kishin Dynamic Bridge or by using Voltmeter and Strainmeter. The current through sensors being sufficient to activate the stress due to normal conditions. Measurements shall be taken at ambient temperature and corrected to the reference temperature of 20 deg. C. The allowable tolerance with reference to the rated value shall be + 7% and - 7%.
- 5.8 The resistance measurement shall be reported at the end of temperature rise not described in Sub-clause (A1) Annexure 1 (Page 17). Increase in the resistance should apply normally to the value considered on the basis of the temperature coefficient determined during the test described in CI. 5.4.
- 5.9 Resistance shall also be measured at the ambient temperature of the workshop after the temperature rise test. The value obtained and corrected to 20 deg. C shall not exceed by more than 2% the value measured before the temperature rise test.

#### 6. WARRANTY

24 Months from the date of dispatch and 36 months from the date of commissioning whichever is earlier as per ISN condition of contract.

#### 7. INSTRUCTIONS TO TENDERS

The tenderer shall correct the following statements without which the offer may be treated as incomplete and liable to be rejected.

- (i) Draw sheet for detail construction and design with shop and fabrication for the detail DMB.
- (ii) Clause wise compliance to the specifications and test programme.
- (iii) Source for raw materials that he intends to use for manufacture of the equipment.
- (iv) General outline drawing including components.
- (v) Sufficient information to prove that the manufacturer has adequate facilities and capacity to manufacture and test the equipment offered.
- (vi) Supplier to agree to incorporate necessary changes from the purchase stage that may become necessary during field tests.

DRAWN: \_\_\_\_\_  
 CHECKED: \_\_\_\_\_  
 APPROVED: \_\_\_\_\_

SPECIFICATION FOR ROAD  
 MOUNTED NATURALLY  
 VIBRO DMB FOR WAF-1  
 LOCOMOTIVES.

BY:  C.E./D.

CHITTARANJAN LOCOMOTIVE WORKS  
 WEST BENGAL, INDIA.

NO. CL/MSR/36/CT/C  
 DATE: 24/08/2004.

A. Temperature rise test should be done in three steps

- i) Static test without blower
- ii) Static test with blower
- iii) Dynamic test (As provided in the locomotive)

However, mode of testing shall be as mutually agreed terms and conditions between C.T.W., RINCO and supplier.

A.1) Static test without blower

To determine the Radiation properties of the Grid Material, all the elements of one complete fan shall be electrically heated up by passing current of 200 Amps initially and increasing the same gradually in steps giving sufficient time to establish the temperature rise of the elements. The current at which the element temperature attains a constant value of 80° C shall be recorded.

A current of 250A (gradually increased) shall be injected and maintain for 10 minutes and then add some at once temp. should be updated. The process is to be repeated for at least 3 times.

The spray shall be made at an angle 45° deg. with the direction of rotation in service and with an output of max. 3mm/min for 5 min.

After the test, the Di-electric test will be done at the specified voltage under CT No.5.1 (v) advised by IRO for one min. No flash over shall occur.

After the Di-electric test check the resistor element and ceramic material used. There should be no abnormal sag or distortion on resistor element and ceramic material should be suitable crack should be developed.

A.2) Static test with blower

The primary aim of the test is to determine/assess the efficacy of IRO under no pressure.

Temperature rise test to be done under a wind speed of 15m/sec. at least of the equipment different current level - at 400 Amps, 500 Amps, 600 Amps and 680 Amps. The direction of air flow shall be similar to that in actual IRO mounting condition on locomotive.

From the data loggers maximum temperature level should be recorded. Record also air velocity and direction of test for each loading. Max. Hot spot temp. should not exceed 800 deg. C.

After the test check insulation and elements physically and also by Di-electric test

SPECIFICATION FOR BARE  
MOUNTED NATURALLY  
COOLED IRO FOR WAP-4  
LOCOMOTIVES.

Dr. Ch. D.

CHITARANJAN LOCOMOTIVE WORKS  
WEST BENGAL, INDIA.

NO. CUW/ENR. S.W/LT. C.  
DATE: 24/08/2004.

Also  
 CHITARANJAN LOCOMOTIVE WORKS  
 WEST BENGAL, INDIA.

## A.40 Dynamic Test

After successful completion of above mentioned two tests, temperature rise test also be repeated on total DHR actually mounted on the loco and in Dynamic braking mode.

The following is procedure of testing:

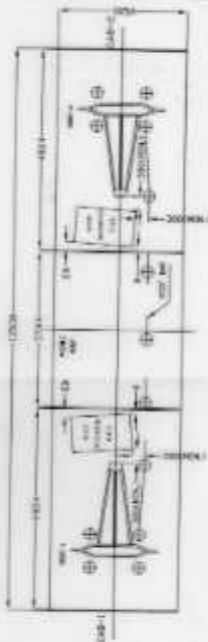
- One loco should work in traction mode and other loco in braking mode.
- Loco in traction mode should be leading during trial.
- Disable the auto coast and QP setting.
- The driver of leading loco should be responsible for caution and signal aspect.
- Testing should be done preferably at a stretch where there is long span without speed reduction.
- Driver of leading loco will notch up/down or apply the air brake to maintain the speed of loco at constant and desired level. The start speed should be maintained at 30 kmph and be allowed to the next attempt go at 50 kmph, 60 kmph, 70 kmph, 80 kmph as on.
- Driver of test loco should apply the Dynamic brake only. Notch up/down should be made to maintain the desired current level. During trial notch up the achieve the desired braking current should be done upto the level of test upto temperature limit 800 deg. C.
- From the data logger, maximum temperature level should be recorded. Record air velocity, loco speed, braking current, Min. Notch position, time consumed during test.

NOTE: - 1) Locomotive and crew will be arranged by Indian Railway while instrumentation will be arranged by suppliers for static and Dynamic tests.

- Maximum points on the grid elements for measurement of temperature rise with the provision of thermocouple should be at least one nos. per frame of DHRs.

**DETAILED DATA OF BRAKING RESISTORS (TO BE SUPPLIED BY TENDERERS AT THE TIME OF SUBMISSION OF BIDS)**

- 1.0 Resistors
  - 1.1 Resistor material
    - 1.1.1 Chemical Composition
    - 1.1.2 Specific Resistance at 20° C
    - 1.1.3 Temperature Co-efficient at 20° C, 100° C, 500° C
    - 1.1.4 Maximum permissible service temperature
    - 1.1.5 Specific heat
    - 1.1.6 Melting point
    - 1.1.7 Coefficient of Linear expansion
    - 1.1.8 Heat conduction
    - 1.1.9 Density
  - 1.2 Details of Resistor
    - 1.2.1 Ohmic value of resistor at 20° C for each resistor model
    - 1.2.2 Size of element strip
    - 1.2.3 Total length of element per TM
    - 1.2.4 No. of turns per element
    - 1.2.5 Connection of element per TM
      - a) Series
      - b) Parallel
      - c) Series/parallel
  - 1.2.6 Weight of active material for each T.M. unit
  - 1.2.7 Complete weight of each resistor unit
- 1.3 Temperature of the element
  - 1.3.1 Average working temperature of the element and hot spot
  - 1.3.2 Time constant
- 2.0 Insulator
  - 2.1 Details of insulator with its temperature withstanding capacity
- 3.0 Drawings
  - 3.1 Detail drawing showing the arrangement of resistor elements, design of system bus/branch electrical connections/terminals, including, over all dimensions and fixing arrangement to be enclosed.

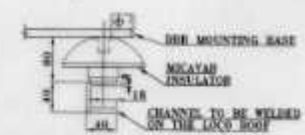
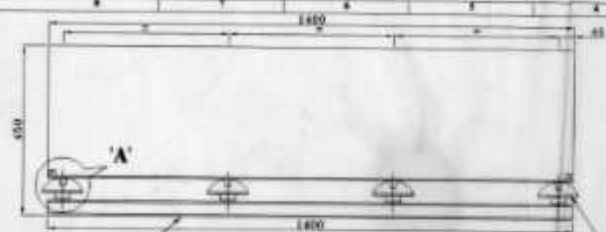


NOTE: ALL DIMENSIONS ARE IN MM.

SPECIFICATION FOR  
ROOF FOR DIESEL NATURALLY  
COOLED DIESEL FOR WAP-4  
LOCOMOTIVES

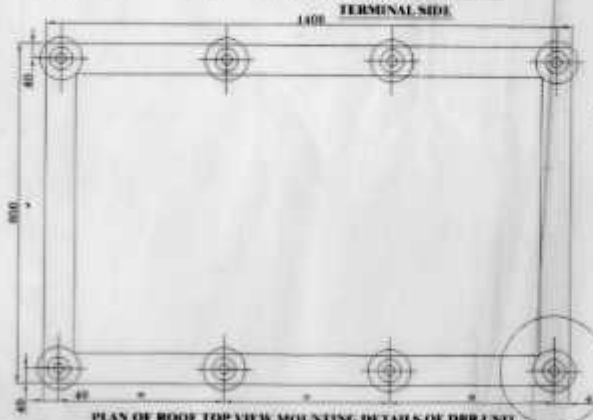
DR. (E.E.) (D)

CHETTARANAM LOCOMOTIVE WORKS  
WEST BENGAL, INDIA  
NO. CLW/ES/SK-1/9-36 & T.E  
DATE: 20/02/2004  
C



**FRONT VIEW AT 'A'**

3 NOS. MCAYAR MID  
SECTION INSULATOR  
FOR MOUNTING OF DBR  
UNIT ON LOCO ROOF



**PLAN OF ROOF TOP VIEW MOUNTING DETAILS OF DBR UNIT**

**NOTES :**

- DETAILS OF RESISTOR:**
1. RESISTANCE AT 20°C PER MOTOR = 0.4720
  2. MATERIAL OF RESISTANCE 60% Ni, 15% Cr, BALANCE Fe
  3. THE RESISTANCE MATERIAL MAY ALSO ATTAIN THE MAXIMUM OPERATING TEMPERATURE OF 1150 DEGREE CENTIGRADE
  4. MELTING POINT OF RESISTANCE MATERIAL-1400 DEGREE CENTIGRADE
  5. SIZE OF RESISTANCE STRIP USED PER MOTOR : AS DECIDED BY THE FIRM.
  6. TERMINATION : EACH TERMINAL SUITABLE TO ACCOMMODATE 2x150 sq. mm. CABLE. SUPPLIER SHALL PROVIDE HARDWARES FOR MAKING CONNECTIONS.
  7. THE MCAYAR MOUNTING INSULATORS TO BE USED IN DBR SHOULD BE FROM A SOURCE/SOURCES APPROVED/TO BE APPROVED BY SMO.

DRAWN: [Signature] CHECKED: [Signature] DATE: 31/05/04  
 DESIGNED: [Signature]

**GENERAL ASSY. OF ROOF MOUNTED DBR FOR WAP-4 LOCOMOTIVES**

By C.E.E.(D)

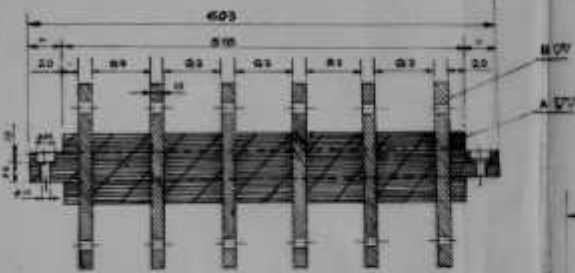
**CHITTARANJAN LOCOMOTIVE WORKS**  
 WEST BENGAL, INDIA  
 DRG.No: CLW.E5.AK-2.B-16  
 SGT-2/C  
 SMT. No. 16

Date : 31-05-2004

**CLW**

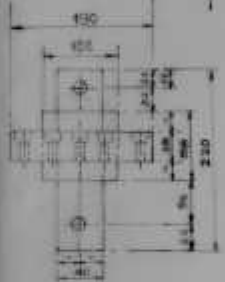


1/P



SECTION A A

SHADED PORTION ONLY TO BE  
ONLY BLASTED ON BOTH SIDES  $\phi$  8 BOLCS 240



**NOTES:**  
1. EPOXY RESIN EMBEDDED COPPER TERMINAL BAR SUITABLE FOR WITHSTANDING CURRENTS MORE THAN 100% AT AN OVERLOAD CONDITION.

2. TERMINAL BARS SHALL BE MADE OF ELECTROLYTIC HIGH CONDUCTIVITY PURE COPPER. COPPER STRIP SHALL BE 12.5% I. S. S. COPPER CORNERS SHALL BE ROUNDED OFF TO R 0.5 MM MIN.
3. DIELECTRIC STRENGTH SHALL WITHSTAND ANY AC 250V 1PH. UNGROUNDED METALLIC SURROUNDING TERMINALS.
4. THIS JOB IS BASED ON DRG NO. 17 AND 17S FOR BUSHING TERMINAL FOR THE MAIN TRANSFORMER OF 300 KVA.

TERMINAL BUSHING FOR  
ROOF MOUNTED DBR

DRG NO. 17  
REV. 1  
REV. 2

पिबाराज इन्स्ट्रुमेंट्स प्राइवेट लिमिटेड  
प्लॉट नं. 9/0  
CONTAINMENT INDUSTRIAL PARK  
ROD NO. 100A, 100B, 100C, 100D  
NEW DELHI/INDIA-110029

चिरिका CLW  
Type/Date - 1A 2. 2006