



**PREQUALIFICATION CRITERIA (PQC)**  
**FOR SOFT CROWBAR RESISTOR**  
**GROUP: TRACTION ENGINEERING**

Ref: 445/PQ\_SR/21

Rev. No.: 00

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**1.0 PRE QUALIFICATION CRITERIA (PQC)**

1. The Bidder should be Supplier of Power Resistor used in Traction applications.
2. BHEL shall approach and submit credentials/details furnished by vendor with their offers to customer and await customer's decision for a maximum of one month from the date of tender opening. If approval is not received within the above period, BHEL shall treat the offer as "Not meeting" Pre-qualification criteria and offer shall be rejected.
3. It is preferred that the bidder is the manufacturer of this item. If the bidder is importing some portion of the components, then minimum value addition shall be 20%. Bidder to confirm this in the offer. Value addition less than 20% is not acceptable

**2.0 DOCUMENTS SUBMISSION**

1. Bidder to submit clause by clause compliance to complete technical specification (Technical specification no. PS4452542 Rev. No.01, dated 06-01-2016) along with copy of type test report.
2. Should possess a valid type test report, not older than five years, conducted at a NABL accredited laboratory as per relevant standards mentioned in the specification with respect to time during the bid submission.
3. Proof of supply of Power Resistor used in traction applications directly or through any agency to Indian Railways during the last 5 years to be submitted.

**3.0 REFERENCE DOCUMENTS**

- a) Purchase Specification No PS4452542, Rev. No. 01 for Soft Crowbar Resistor

REVISION 00

APPROVED

AGOSH CHANDRAN R S

PREPARED

SUNITHA L

ISSUED

TRACTION ENGG

DATE

05.01.2020

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**REVISION HISTORY SHEET**

| REV.<br>NO. | DATE       | NATURE OF CHANGE               | REASONS | PREPARED BY  | APPROVED BY |
|-------------|------------|--------------------------------|---------|--------------|-------------|
| 00          | 27.11.2015 | FIRST ISSUE                    | --      | Purushottama | R.SHEKAR    |
| 01          | 06.01.2016 | Typographical errors corrected | --      | Purushottama | R.SHEKAR    |

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**Note:**

Reference document :  
Material Code :

REVISIONS 01 DT: 06.01.2016

APPROVED BY: R.SHEKAR

PREPARED BY:

ISSUED BY

DATE

Purushottama Rao

TRACTION ENGG

06.01.2016

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**SPECIFICATION FOR SOFT CROWBAR RESISTOR**

**Brief description**

The soft crow-bar is used to limit the DC-link voltage during dynamic conditions. The soft-crow bar resistor is controlled by a step-down chopper operating at an average switching frequency of 150 Hz.

**WIRING  
DIAGRAM**

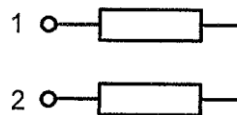


Fig1: Wiring Diagram



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**Detailed Specification**

**1. Technical Parameters**

|    |                                                                         |   |                                                     |
|----|-------------------------------------------------------------------------|---|-----------------------------------------------------|
| a) | Nominal Resistance Value at 20°C (1-2)                                  | : | <b>2.71 <math>\Omega</math> <math>\pm</math> 5%</b> |
| b) | Minimum Resistance                                                      | : | <b>2.5 <math>\Omega</math></b>                      |
| c) | Maximum Resistance at operating temperature and manufacturing tolerance | : | <b>3.65 <math>\Omega</math></b>                     |
| d) | Nominal Voltage                                                         | : | <b>DC 2800V</b>                                     |
| e) | Maximum Voltage                                                         | : | <b>DC 3300V</b>                                     |
| f) | Maximum Peak Voltage                                                    | : | <b>DC 3800V</b>                                     |
| g) | Insulation Test Voltage                                                 | : | <b>AC 6900V/50Hz/1min</b>                           |
| h) | Maximum Current                                                         | : | <b>DC 1360A</b>                                     |
| i) | Continuous Power Rating                                                 | : | <b>20KW</b>                                         |
| j) | Maximum Temperature of the Resistive Material:                          | : | <b>520°C</b>                                        |
| k) | Minimum Creeping Distance                                               | : | <b>85 mm</b>                                        |
| l) | Minimum Air Clearance                                                   | : | <b>32 mm</b>                                        |
| m) | Cooling                                                                 | : | <b>Natural Convection</b>                           |
| n) | Inductance                                                              | : | <b><math>\leq</math> 10<math>\mu</math>H</b>        |
| o) | Energy Rating                                                           | : | <b>3*0.475 MWs</b>                                  |
| p) | Duty Cycle                                                              | : | <b>As per Appendix I</b>                            |

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|    |                              |   |                          |
|----|------------------------------|---|--------------------------|
| q) | Degree of Protection         | : | <b>IP 20</b>             |
| r) | Total Weight of the Resistor | : | <b>30 Kg ± 10%</b>       |
| s) | Thermal Capacity             | : | <b>2.73 KJ/K</b>         |
| t) | Thermal Resistance           | : | <b>0.018 K/W</b>         |
| v) | Cooling Time Constant        | : | <b>44 s</b>              |
| u) | Material of Resistor Element | : | <b>AISI 310S</b>         |
| w) | Material of Enclosure        | : | <b>AISI 304 (1.4301)</b> |

**2. Standards**

| Standard  | Description                                                       | Notes |
|-----------|-------------------------------------------------------------------|-------|
| EN50125-1 | Environmental conditions                                          |       |
| EN50124-1 | Railway applications Isolation co-ordination, Basic requirements. |       |
| IEC60077  | Electric equipment for rolling stock                              |       |
| IEC61287  | Power converters                                                  |       |
| IEC61376  | Creepage and clearance                                            |       |
| IEC61373  | Shock and vibration test                                          |       |
| IEC60322  | Rules for ohmic resistors                                         |       |

**3. Functional requirements**

| Description                        | Value | Unit       | Notes            |
|------------------------------------|-------|------------|------------------|
| operating hours traction converter | 8640  | hours/year |                  |
| operating hours resistor           | <7300 | hours/year | normal operation |



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**4. Ambient conditions / operating conditions**

| Description                            | Value    | Unit     | Notes                                                                           |
|----------------------------------------|----------|----------|---------------------------------------------------------------------------------|
| operation                              | -25..+75 | °C       |                                                                                 |
| temperature distribution over the year | +75      | °C       | 10 days/year                                                                    |
|                                        | +65      | °C       | 20 days/year                                                                    |
|                                        | +55      | °C       | 90 days/year                                                                    |
|                                        | +40      | °C       | 100 days/year                                                                   |
|                                        | < +40    | °C       | 130 days/year                                                                   |
| storage                                | -25..+70 | °C       |                                                                                 |
| average year temperature               | + 40     | °C       |                                                                                 |
| relative humidity                      | < 95     | %        | during app 3 - 4 months (rainy season) per year frequent condensation can occur |
| altitude                               | <1200    | m        |                                                                                 |
| pollution levels                       |          |          |                                                                                 |
| operation in coastal areas             |          |          |                                                                                 |
| maximum PH                             | 8.5      |          | of water damp                                                                   |
| max. concentration of sulphate         | 7        | mg/liter | of water damp                                                                   |
| max. concentration of chlorine         | 6        | mg/liter | of water damp                                                                   |
| maximum conductivity                   | 130      | µS/cm    | of water damp                                                                   |
| operation in desert terrain            |          |          |                                                                                 |
| dust content in air                    | 1.6      | mg/m3    |                                                                                 |

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**5. Dimensional details**

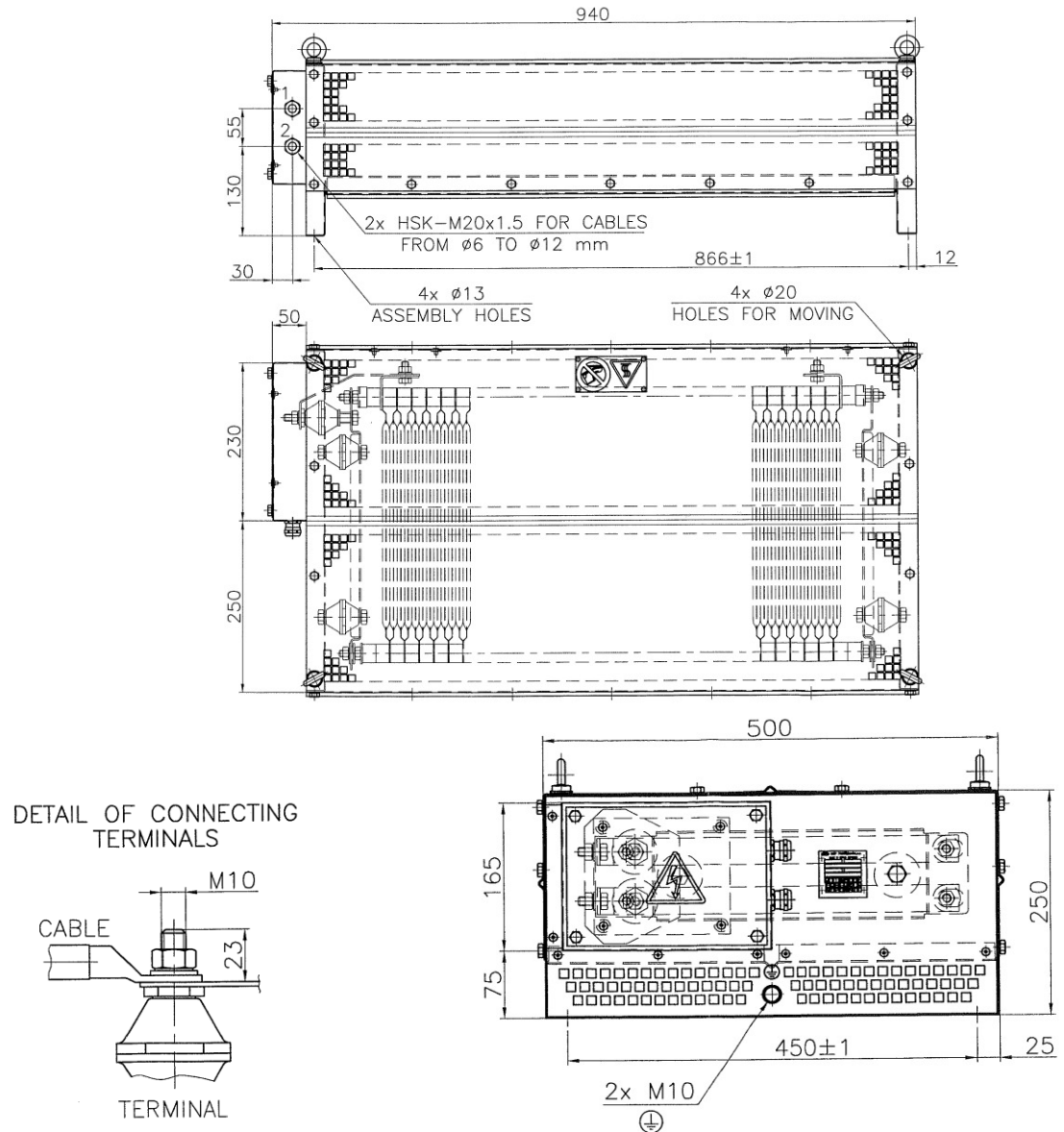


Fig 3: Dimensional Drawing

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**6. Testing**

List of tests to be performed on prototype as follows

| Sl No | Test                                                                  | Acceptance criteria                                                                                                                                                                                                    |
|-------|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Dimensional check                                                     | Dimensions to comply with the drawing                                                                                                                                                                                  |
| 2     | Check on creepage and clearance distances                             | Min. creepage 85mm and clearance 36mm                                                                                                                                                                                  |
| 3     | Check on rating label                                                 | Rating plate to have Make, Type no, Rated voltage, Rated Resistance, Sl no, year of manufacture and weight                                                                                                             |
| 4     | Check on Ingress protection                                           | The enclosure is IP 20 that means the cover protects against the incursion of foreign objects and is also used as a protection against accidental touch                                                                |
| 5     | Check on weight                                                       | 30 Kg $\pm$ 10%. i.e. within range of 27 Kg to 33 Kg                                                                                                                                                                   |
| 6     | Measurement of Resistance                                             |                                                                                                                                                                                                                        |
| 6.1   | Measurement of cold Resistance before temperature rise test           | 2.71 $\Omega$ $\pm$ 5% i.e. within range of 2.5745 $\Omega$ - 2.8455 $\Omega$ at an ambient temperature of 20 Deg.                                                                                                     |
| 6.2   | Measurement of cold Resistance after temperature rise test            | Readings should not differ from the first values Indicated in clause 6.1 by more than 3%.                                                                                                                              |
| 6.3   | Measurement of Hot Resistance IMMEDIATELY AFTER temperature rise test | $\leq$ 3.65 $\Omega$                                                                                                                                                                                                   |
| 7     | Check on Inductance                                                   | $\leq$ 10 $\mu$ H                                                                                                                                                                                                      |
| 8     | Dielectric test (Ref: 60077)                                          | Carried out between the connection and earth terminals of the resistor with a voltage of AC 6900 V/ with a frequency of 50 Hz, for a period of 1 minute. No disruptive discharge or breakdown occurred during the test |
| 9     | Insulation resistance test                                            | The measurement to carried out with 1000 V megger tester connected across terminals and frame of the resistor.<br>Required minimum value: 5 M $\Omega$                                                                 |
| 10    | Temperature rise test <sup>A)B)</sup>                                 |                                                                                                                                                                                                                        |
| 10.1  | Continuous power of 20 KW (Ambient Temp of 25 Deg)                    | Max temp of Active Material $\leq$ 520 Deg                                                                                                                                                                             |
|       |                                                                       | Max temp of the connection terminals $\leq$ 115 Deg                                                                                                                                                                    |
|       |                                                                       | Max Air temp 200mm above the resistor $\leq$ 210 Deg                                                                                                                                                                   |
| 10.2  | Repeated duty cycles (ref: APPENDIX I) (Ambient Temp of 25 Deg)       | Max temp of Active Material $\leq$ 490 Deg                                                                                                                                                                             |
|       |                                                                       | Max temp of the connection terminals $\leq$ 80 Deg                                                                                                                                                                     |
|       |                                                                       | Max Air temp 200mm above the resistor $\leq$ 200 Deg                                                                                                                                                                   |



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|    |                                                  |                                                                                                                                                           |
|----|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11 | Vibration and shock withstand test <sup>A)</sup> | To be done as per the standard IEC 61373. No visual damage and no change in resistance value should occur. Also the specimen has to pass insulation test. |
|----|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|

- A) Visual inspection, Di electric test needs, measurement of cold resistance to be performed before and after the test.  
B) Critical hot spot points needs to be identified before the test to monitor and record the temperature during the test.

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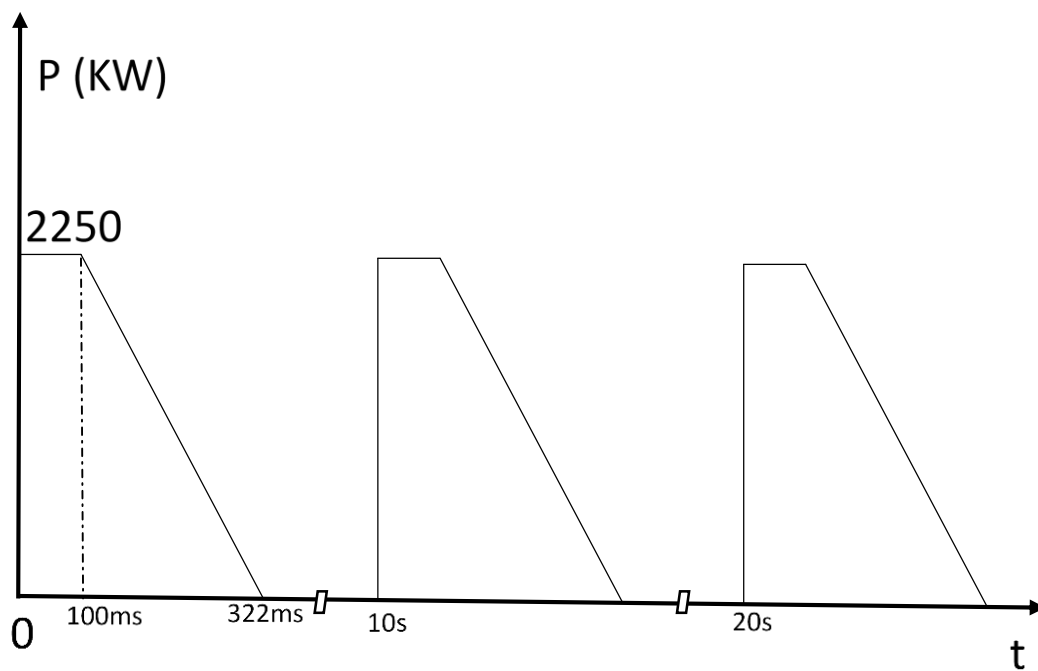
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## APPENDIX-I

Duty cycle Requirement for Temp rise test:



After 3 pulses there's a cooling down time of 10 minutes

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