# GOVERNMENT OF INDIA
# (Ministry of Railways)

# SPECIFICATION FOR GRAPHITE MOULD BLANKS

**TYPE A: 1097 Dia x 575 Height**
**TYPE B: 1224 Dia x 575 Height**
**TYPE C: 1325 Dia x 575 Height**
**TYPE D: 1021 Dia x 575 Height**

**Issued by**

**MECHANICAL DRAWING OFFICE**
**RAIL WHEEL FACTORY**
**YELAHANKA, BANGALORE-560 064**
**I N D I A**

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| CWE/M | AED/M&C | Dy. CME/Mfg | SSE/D |
| APPROVED BY | REVIEWED BY | VERIFIED BY | PREPARED BY |

# SPECIFICATION FOR GRAPHITE MOULD BLANKS

## 1.0 SCOPE

The Specification covers the design, manufacture and supply of Graphite Mould Blanks at Rail Wheel Factory, Bangalore - 560 064, Karnataka State, India as per instructions and conditions of contract.

## 2.0 GENERAL DESCRIPTION

Graphite Mould Blanks of dimensions and sizes specified in technical data of the specification.

## 3.0 JOB REQUIREMENTS

**3.1** The Graphite Blanks shall be used as permanent graphite moulds (Cope and Drag), after machining, for manufacture of Cast steel wheels by the pressure pouring method, i.e., forcing up molten metal into mould cavity through the in-gate made up of clay graphite The temperature of molten metal is in the range of 1600-1620°C. Moulds are pre heated to 350°C before using and the surface is protected using fused silica spray coating. Cast moulds are recycled after cleaning the surface by sand blasting using fine sand. The graphite Mould shall with stand the operating condition and shall have good wear/ erosion and oxidation resistance under the operating condition.

## 3.2 MANUFACTURE AND QUALITY ASSURANCE PLAN (QAP)

The manufacturer shall take extreme care to meet the product requirement and job requirement and have optimum erosion and oxidation resistance so that the consumption rate shall be the minimum. The blanks shall be adequately pitch impregnated to achieve the bulk density specified. The particle size and their size distribution in the raw material shall be selected in such a manner to obtain the optimum performance. The manufacturer shall submit their QAP along with their bid for approval by RWF, which will be followed in the manufacturing of Graphite Mould Blanks to satisfy the technical requirement as required under this specification. Manufacturer shall get their QAP approved from RWF in advance, i.e., before starting manufacturing of graphite mould blanks, unless a waiver is given to this effect.

## 3.3 MANUFACTURERS TEST CERTIFICATE (MTC)

The manufacturer shall submit the MTC containing the test results of the Graphite Mould Blanks for all parameters specified under Clauses 4.1, 4.3, 4.4 & 4.5 and ensure the compliance of the specified parameters under Clause 5.0

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## 3.4 TESTING FACILITY

The manufacturer shall have testing facility for characteristics specified in clause 4.3.1 to 4.3.7. In case any facility is not available in-house, the manufacturer shall carry out the test through a reputed laboratory on his own expense. Testing from any out-side agency shall be clearly brought out in the offer.

## 4.0 TECHNICAL DATA

4.1 Sizes of Graphite Mould Blanks shall be as follows:

Blank dia for

a) Type A {1097 dia} : $1097^{+3}/_{-0}$ mm dia x 575 $^{+3}/_{-0}$ mm height.

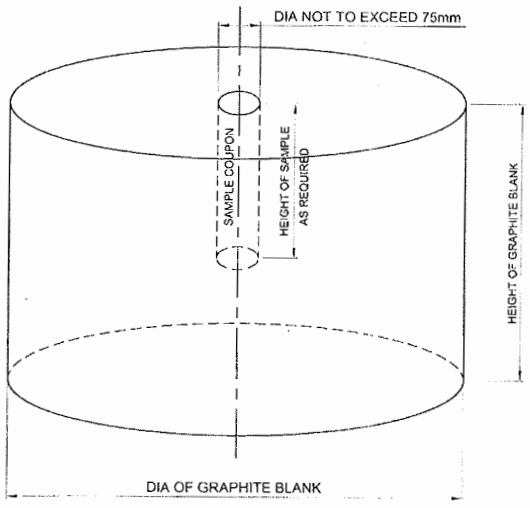
b) Type B {1224 dia} : $1224^{+3}/_{-0}$ mm dia x $575^{+3}/_{-0}$ mm height.

c) Type C {1325 dia} : $1325^{+3}/_{-0}$ mm dia x $575^{+3}/_{-0}$ mm height.

d) Type D {1021 dia} : $1021^{+3}/_{-0}$ mm dia x $575^{+3}/_{-0}$ mm height.

4.1.1 Surface finish of the Graphite Mould Blank: N8 all over.

4.2 A cylindrical coupon for sample preparation for testing shall be drawn from Graphite Mould Blank (GMB) as shown in the sketch below. The sample shall be drawn in such a manner that it shall not damage or make the blank unsuitable for the intended purpose.




SKETCH SHOWING THE SAMPLING LOCATION

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4.3 Other technical parameters shall be as follows:

| Clause No | Characteristic | Unit | Specified value | Test Method | Sample frequency | Sampling location |
|---|---|---|---|---|---|---|
| 4.3.1 | Bulk Density | $gm/cm^3$ | 1.60 -1.70 | ASTM C-559 | All Blanks | As per the sketch at clause 4.2 |
| 4.3.2 | Electric resistivity (measured parallel to axis) (max) | Ohm-cm | $15X10^{-4}$ | ASTM C-611 | All Blanks | As per the sketch at clause 4.2 |
| 4.3.3 | Permeability (parallel to axis) | AFS unit | 0.16-0.80 | Air Flow Method AFS | All Blanks | As per the sketch at clause 4.2 |
| 4.3.4 | Flexural strength (parallel to axis) (min) | $kg/cm^2$ | Not less than 100 - 4 point loading Or Equivalent in 3 point loading | ASTM C 651-Latest, 4-point loading Or ASTM D-7972-Latest for 3 point loading | All Blanks | As per the sketch at clause 4.2 |
| 4.3.5 | Structure and surface | Shall not show any extraneous material | | Visual inspection | All Blanks | Full mould surface |
| 4.3.6 | Ash content (max) | % by weight | 0.20 | Loss on Ignition ASTM C-561 | Batch wise | As per the sketch at clause 4.2 |
| 4.3.7 | Maximum grain size used | mm | 0.8 | Verification of manufacture records | Batch wise | Sample from processed raw material mix |

4.4 Apparent porosity preferred is less than 24% but shall not be more than 29% when tested as per ASTM C-1039 or by calculation as:

{(True density – App. density) / True density} X100

4.5 The permeability range in a lot shall be uniformly distributed. The manufacturer shall aim to achieve the permeability range distribution of the lot in such a way that the following shall be met.

| Permeability Range | Percentage of mould in a lot |
|---|---|
| 0.16 – 0.40 AFS | 80% |
| 0.41 – 0.80 AFS | 20% |

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## 5.0 OTHER FEATURES

i) The graphite mould blanks shall have sufficient thermal shock resistance to withstand high temperature of molten steel without cracking.

ii) The graphite mould blanks shall have low co-efficient of thermal expansion.

iii) The Graphite mould blanks shall be easily machinable; contour of the wheel shall be machined by form tools on cope and drag.

iv) The supplier shall legibly print the permeability values and ash content on the mould blank.

## 6.0 WARRANTY

For the under mentioned conditions, the shop operating parameters & practices are considered common for all manufacturer/suppliers:

i) If after removing the mould coating and oxidised surface, an area with unsatisfactory structure becomes visible and requires machining, the contractor shall offer incremental credit whenever void/flaws greater than 6 mm in depth are noticed.

ii) RWF will proceed with machining of all such moulds until the void/flaw disappears. The extra machining (in excess of 6 mm) necessitated by the said void/flaw in the structure will have to be compensated by the contractor (without insisting on joint inspection). The rate of such compensation should also be stated at the time of making the offer.

iii) However, if the void/flaw does not get eliminated even after machining to a depth of 36 mm, the mould will be kept aside and offered for joint inspection with the supplier and further disposal will be decided during such joint inspection.

iv) The contractor shall, if required, replace the Stores or such portion thereof as is rejected by the purchaser free of cost at the ultimate destination, or at the option of the purchaser and the contractor shall pay the purchaser value thereof at the contract price, and to such other expenditure and damages as may arise by reason of the breach of conditions herein specific.

v) If any defective Stores is not replaced within the above mentioned 3 months, the purchaser may proceed to do the replacement at contractor's risk and cost and also without prejudice to any other rights of the purchaser under this contract.

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vi) If the contractor so desires, the replaced parts can be taken by him or his representatives in India for disposal as he deems fit within a period of 3 months, from the date of replacement of the Stores. At the expiry of this period, no claim whatsoever shall lie on the purchaser.

vii) If a cope produces more than 5 wheel rejections attributable to mould quality, duly discounting for process variation, the mould will be rejected and warranty claim will be raised.

Note:

i. The Wheel defects (XC set) likely to be caused due to poor graphite mould quality is based on RWF's 35 years of experience with different make/type of moulds and process variation. List of defects in XC set: XC46-Pocker, XC56-Hollowface Hub, XC626-Graphite Inclusion, XC15-Pinhole, XC33-hole in bore.

ii. Process related defects to be discounted are defined as
   a. Defects arising just after machining i.e., at Cope Life 1, will be taken on process account.
   b. In case more than 2 of above defects are arising in a particular heat these defects also will be taken as on process account.

## 7.0 PERFORMANCE

The performance of the firm will be adjudged based on % Warranty replacements with respect to the supplied quantity against the particular purchase order.

## 8.0 INSPECTIONS, TEST CERTIFICATE AND ACCEPTANCE

8.1 The manufacturer will submit their Internal Test Certificate along with the supply as specified in clause 3.3. Acceptance will be based on manufacturer's internal test certificate indicating compliance to technical parameters and other features detailed under main clauses 4.0 and 5.0 respectively.

8.2 If laid down in the purchase order, RWF or its authorised representative may carry out inspection at the manufacturer's premises. The manufacturer shall offer the Graphite Mould Blank after the internal inspection and compliance of specified requirements along with Manufacturer's Test Certificate. The RWF's authorised representative shall have access to verify the manufacturing process, records, and witness the testing of the offered Graphite Mould Blanks either at their own laboratory or at the authorised outside laboratory. It is the responsibility of the manufacturer to offer him free access to carry out the inspection.

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## 9.0 PACKING & HANDLING

The graphite mould blanks shall be suitably packed in wooden cases to avoid transportation damage. Cases must amenable to handle by forklift trucks.

## 10.0 TRIAL OF THE SUPPLY

The material for trial shall necessarily meet all the requirements mentioned elsewhere in this specification prior to shop floor trial. Only after this, the material will be taken up for shop floor trial by RWF as per Trial Scheme at Annexure-1 and the corresponding Trial Report shall be prepared as per Annexure-2.

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**Annexure -1**

## TRIAL SCHEME OF GRAPHITE MOULD BLANK

| | | |
|---|---|---|
| 1 | Trial Scheme No. | RWF/M/SPECN-1/016/1987 alt .../ Trial Scheme PL NO..... |
| 2 | Objective of Trial | To establish the suitability of graphite mould blank as per Specn No. RWF/M/SPECN-1/016/1987 alt ... |
| 3 | Description of Material<br>PO Number & PO date<br>PO Qty.<br>Supplier | GRAPHITE MOULD BLANK<br>.....<br>.....<br>..... |
| 4 | IDN Number & Date<br>IDN Qty. | .....<br>..... |
| 5 | Authority for conducting Trial | Dy. CME/ Mfg |
| 6 | Earlier trial details | First Time Supply/ Second time/ Third time<br>...../...../..... |
| 7 | Trial Parameters | As mentioned in Trial Scheme |
| 8 | Specification | RWF/M/SPECN-1/016/1987 alt ..... |
| 9 | Pre-trial Testing details | Met. Lab Report & MTC |
| 10 | Trial qty | Full IDN Qty/ 5% of the tendered quantity |
| 11 | Equipment / Station process | Mould Room |

( ..... to be filled by Team Members)

Trial Parameters:

1. Total quantity graphite mould blank to be drawn and trial conducted on the entire quantity under the purchase order/5% of the tendered quantity, whichever is less.
2. Inspection & testing by shop and whenever required by laboratory completely in line (not in part) with the specification. Sampling for inspection as per RWF specification.
3. Examination of MTC (Manufacturer's Test Certificate) and comments on its suitability.

**Specific Requirements:**

**1.** Study the trend of XC set (XC46-Pocker, XC56-Hollowface Hub, XC626-Graphite Inclusion, XC15-Pinhole, XC33-hole in bore) wheel rejections in the trial moulds and find out number of GMBs producing more than 5 rejections duly discounting process variations and compare with that of other makes by ensuring same process parameter during use and in the same period (or just preceding/succeeding period).

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**Annexure -2**

## TRIAL REPORT OF GRAPHITE MOULD BLANK

| | | |
|---|---|---|
| 1 | Trial No. | RWF/M/SPECN-1/016/1987 alt .../ Trial Scheme PL NO..... |
| 2 | Objective of Trial | To establish the suitability of graphite mould blank as per Specn No. RWF/M/SPECN-1/016/1987 alt .../ |
| 3 | Description of Material<br>PO Number & PO date<br>PO Qty.<br>Supplier | GRAPHITE MOULD BLANK<br>.....<br>.....<br>..... |
| 4 | IDN Number & Date<br>IDN Qty. | .....<br>..... |
| 5 | Authority for conducting Trial | Dy. CME/ Mfg |
| 6 | Earlier trial details | Fist Time Supply/ Second time/ Third time<br>...../...../..... |
| 7 | Trial Parameters | As mentioned in Trial Scheme |
| 8 | Specification | RWF/M/SPECN-1/016/1987 alt ... |
| 9 | Pre-trial Testing details | Met. Lab Report & MTC |
| 10 | Trial qty | Full IDN Qty/ 5% of the tendered quantity |
| 11 | Equipment / Station process | Mould Room |
| 12 | Nominated Officers | ACMT/W & AWM/MR |

( ..... to be filled by Team Members)

**Application Test**: Shop Floor test conducted from date _____to date _____ & H. No. _____

Trial Parameters:

1 Total quantity of graphite mould blank to be drawn and trial conducted on the entire quantity under the purchase order/5% of the tendered quantity, whichever is less.

| Comments: |
|---|

2 Inspection & testing by shop and whenever required by laboratory completely in line (not in part) with the specification. Sampling for inspection as per RWF specification.

| Enclosure Details: |
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3 Examination of M Lab report & MTC (Manufacturer's Test Certificate) and comments on its suitability

| Comments with documents: |
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**Specific Requirements:**

1. Study the trend of XC set (XC46-Pocker, XC56-Hollowface Hub, XC626-Graphite Inclusion, XC15-Pinhole, XC33-hole in bore) wheel rejections in the trial moulds and find out number of GMBs producing more than 5 rejections duly discounting process variations and compare with that of other makes by ensuring same process parameter during use and in the same period (or just preceding/succeeding period).

## Observations:

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AWM/WM ACMT/W SSE/MR

WM/W

Remarks of Dy CME/Mfg.

Remarks of AED/M&C

CWE/W

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# AMENDMENT SHEET

<table>
<tr><th colspan="2">Alt 'n'</th><th colspan="2">Alt. 'o'</th><th rowspan="2">Job No.</th><th rowspan="2">Sign</th></tr>
<tr><th>Clause No.</th><th>Description</th><th>Clause No.</th><th>Description</th></tr>
<tr><td>4.3.4</td><td>
<table>
<tr><th>Clause No</th><th>Characteristic</th><th>Unit</th><th>Specified value</th><th>Test Method</th><th>Sample frequency</th><th>Sampling location</th></tr>
<tr><td>4.3.4</td><td>Flexural strength (parallel to axis) (min)</td><td>kg/cm²</td><td>100</td><td>ASTM C 651– latest.</td><td>All Blanks</td><td>As per the sketch at Clause 4.2</td></tr>
</table>
</td><td>4.3.4</td><td>
<table>
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</td><td rowspan="4">7030</td><td rowspan="4">Chanda</td></tr>
<tr><td>6.0<br>vii</td><td>WARRANTY<br>vii. The percentage of copes, which cause repeated rejections should not exceed more than 33.33% of the total population subject to a minimum of 50 copes used consecutively for a firm, given that repeated rejections would mean wheel rejections exceeding 6.5% in the life of a cope. In case this limit is exceeded, all the copes, which cause repeated rejections, shall be liable for replacement under warranty</td><td>6.0<br>vii</td><td>WARRANTY<br>vii. If a cope produces more than 5 wheel rejections attributable to mould quality, duly discounting for process variation, the mould will be rejected and warranty claim will be raised.<br>Note:<br>i. The Wheel defects (XC Set) likely to be caused due to poor graphite mould quality is based on RWF's 35 years of experience with different make/type of moulds and process variation. List of defects in XC set: XC46-Pocker, XC56-Hollowface Hub, XC626-Graphite Inclusion, XC15-Pinhole, XC33-hole in bore.<br>ii. Process related defects to be discounted are defined as<br>a) Defects arising just after machining i.e., at Cope Life 1, will be taken on process account.<br>b) In case more than 2 of above defects are arising in a particular heat these defects also will be taken as on process account</td></tr>
<tr><td>7.0</td><td>PERFORMANCE<br>For the under mentioned conditions, the shop operating parameters & practices are considered common for all manufacturer/suppliers:<br>i) The cope life..... weightage for future procurement.<br>ii) Similar data for off-load ..... for future procurement.</td><td>7.0</td><td>PERFORMANCE<br>The performance of the firm will be adjudged based on % Warranty replacements with respect to the supplied quantity against the particular purchase order.</td></tr>
<tr><td>Annex<br>1 & 2</td><td>Specific Requirements:<br>1. Compare the consumption per thousand wheels and with matching number of other makes by ensuring same process parameter during use and in the same period (or just preceding/succeeding period).</td><td>Annex<br>1 & 2</td><td>Specific Requirements:<br>1. Study the trend of XC set (XC46-Pocker, XC56-Hollowface Hub, XC626-Graphite Inclusion, XC15-Pinhole, XC33-hole in bore) wheel rejections in the trial moulds and find out number of GMBs producing more than 5 rejections duly discounting process variations and compare with that of other makes by ensuring same process parameter during use and in the same period (or just preceding/succeeding period).</td></tr>
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