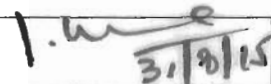
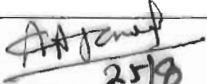

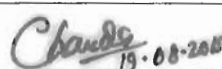


**GOVERNMENT OF INDIA  
(Ministry of Railways)**

**SPECIFICATION FOR  
FLAKE/GRANULAR TYPE  
PHENOL FORMALDEHYDE RESIN  
(PL No.8198 0206)**

Issued by

**MECHANICAL DRAWING OFFICE  
RAIL WHEEL FACTORY  
YELAHANKA, BANGALORE-560 064  
INDIA**

 3.1.8/15	 25/8		 19.08.2005
CME	CWE/W	Dy.CME/Mfg.	SSE/D
APPROVED	REVIEWED	VERIFIED	PREPARED

**SPECIFICATION FOR PHENOL FORMALDEHYDE RESIN  
(PL No. 8198 0218)**

**1.0 SCOPE**

- 1.1 The specification covers supply of Phenol Formaldehyde Resin suitable for hot coating of sand, which will be supplied at Rail Wheel Factory, Yelahanka, Bangalore, Karnataka State, India, as per instructions and conditions of contract and tender papers.

**2.0 DESCRIPTION**

Phenol Formaldehyde Resin Flake/Granular type (Novolac Resin), suitable for hot coating of sand.

**3.0 JOB REQUIREMENT**

- 3.1 The Phenol Formaldehyde Resin is required to prepare Resin Coated Sand of suitable quality by hot coating method to be used for shell baking in graphite moulds during the manufacture of cast steel wheels. Sand shell is formed with graphite mould at the temperature of 234 - 285°C and shell baking pad at the temperature of 300 - 380°C and curing time of 40 seconds; this should give sand shell of uniform thickness of 10 - 12 mm & pad 12 - 16 mm. The brief specification of sand used is given in A1 of Annexure A and the hot coating process is explained in A2 of Annexure A in brief.

**4.0 MANUFACTURE**

**4.1 CHARACTERISTICS OF RAW MATERIALS USED**

Supplier has to disclose the minimum details of the grade, source, specification and acceptance criteria of all raw materials used for manufacturing of Phenol Formaldehyde Resin, particularly the quality of Phenol, Formaldehyde and catalyst used

**4.2 MANUFACTURING FACILITIES REQUIRED**

The manufacturer shall have adequate manufacturing facilities such as reactors, shape & size controlling machineries, air tight packing and storage.

<i>P. U</i> <i>3/1/15</i>	<i>A. A. A. A.</i> <i>25/8</i>	<i>S. K.</i>	<i>Chad</i> <i>19.08.15</i>
CME	CWE/W	Dy.CME/Mfg.	SSE/D
APPROVED	REVIEWED	VERIFIED	PREPARED

**4.3 TESTING FACILITIES**

The manufacturer shall have all the facilities to test the properties of Phenol Formaldehyde Resin specified in this specification at clause 5.1,

For test mentioned in clause 6.1 firm can use out side test facility when required.

**5.0 TECHNICAL CHARACTERISTICS**

5.1	Sl. No.	Characteristics	Requirements
	i.	Melting point	70 - 80°C
	ii.	Flow length	100 - 160 mm

**6.0 COATED SILICA SAND CHARACTERISTICS**

6.1 Coated Sand properties:

(To be achieved by addition of resin not exceeding 3% by weight).

(a) Cold Tensile Strength (CTS) in PSI: 260 (min.)

(b) Hot Tensile Strength (HTS) in PSI : 140-260

(c) Stick point in degree C. : 98-110

6.2 Lubricant: The resin should contain necessary lubricant in just adequate quantity.

6.3 Particle size:

**I. Flake Type**

- (a) Length in mm : 10 - 15
- (b) Width in mm : 5 - 10
- (c) Thickness in mm : 1 - 2

<i>P.A. 5/10/15</i>	<i>AA 25/8</i>	<i>Sho - 1</i>	<i>Chad 19.08.15</i>
CME	CWE/W	Dy.CME/Mfg.	SSE/D
APPROVED	REVIEWED	VERIFIED	PREPARED

II. **Granular Type**

1-5mm and should be free from resin dust.

**7.0 TEST METHODS**

- 7.1 Melting point of resin shall be determined by the capillary method as given in IS 11266 to its latest revision or any other international standards.
- 7.2 Flow length shall be determined by the test procedure detailed in Annexure-D or any other international standards.
- 7.3 Coated sand properties shall be determined as per the procedures given in Annexure A.
  - i) Cold tensile strength shall be determined as per test procedure in Annexure C (C1).
  - ii) Hot Tensile Strength shall be determined as per test procedure in Annexure C (C-2)
  - iii) Stick point shall be determined as per test procedure in Annexure B.
- 7.4 The supplier shall supply test procedures and international standards followed for claiming referred characteristics of P.F. resin.

**8.0 SHELF LIFE**

8.1 The resin should possess a shelf life period of one year.

**9.0 LOT SIZE**

9.1 Each lot supplied should consist of resin from one manufacturing batch generally and not more than two batches under any circumstances.

**10.0 PACKING**

10.1 The resin shall be supplied in Paper sacks packed in cardboard drums.

<i>P. h</i> 3/19/15	<i>A. A. S. S. S. S.</i> 20/10	<i>S. P. A.</i>	<i>Chait</i> 19-08-15
CME	CWEM	Dy. CME/Mfg.	SSE/D
APPROVED	REVIEWED	VERIFIED	PREPARED

**11.0 MARKING**

11.1 Each drum/carton shall carry the manufacturer's name, brand name, date of manufacture and production batch number, etc.

**12.0 BATCH SIZE**

12.1 The supplier/vendor shall supply the resin in batches. The minimum batch size shall be 1 metric ton.

**13.0 TEST CERTIFICATE**

13.1 The vendor shall furnish the complete test certificates giving all the values for each batch of resin manufactured.

**14.0 SAMPLING NORMS**

14.1 One sealed drum will be selected at random from each manufacturing batch supplied for collection of sample for testing of technical characteristics as per clauses 5 and 6. A 500gm sample will be picked up from the drum from a depth of 100mm approx.

14.2 For checking properties as per para 6.1, three samples of coated sand shall be prepared as per para 7.3 and an average of 3 values shall be taken as final.

14.3 In case some parameter(s) do not meet the required values given in para 6.1, two further samples shall be drawn from two different drums and tested only for the failed parameter(s). **The complete batch will stand rejected** if any one of the two samples fails to meet the specification.

<i>P. h</i> <i>31/05/15</i>	<i>A. A. Patel</i> <i>25/5</i>	<i>A. R.</i> —	<i>Chase</i> <i>19.05.15</i>
CME	CWE/W	Dy.CME/Mfg.	SSE/D
APPROVED	REVIEWED	VERIFIED	PREPARED

**ANNEXURE - A**

**A-1 SPECIFICATION FOR SILICA SAND - 45 AFS**

The specification for dry silica sand used for 'Hot coating' of resin is as follows:

- |    |                         |   |                       |
|----|-------------------------|---|-----------------------|
| 1. | Grain shape             | : | Round to sub-angular. |
| 2. | Grain size              | : | 40 to 45 AFS.         |
| 3. | Clay content            | : | 0.3% Max.             |
| 4. | Fines                   | : | Trace                 |
| 5. | Sintering temp.         | : | 1600°C                |
| 6. | Silica content          | : | 98.5% Min.            |
| 7. | 3 sieve retrn. 40,50&70 | : | 90% Min.              |

**A-2 SPECIFICATION OF HEXAMETHYLENETETRAMINE (HEXAMINE)**

The specification for Hexamine used for "Hot coating" of resin is as follows:

- |     |  |   |               |
|-----|--|---|---------------|
| 1.  | Assay, % by mass (on dry basis), min                   | : | 99.0          |
| 2.  | pH of aqueous extract                                  | : | 8.0 to 9.0    |
| 3.  | Water insolubles, % by mass, min                       | : | 0.05          |
| 4.  | Loss on drying, % by mass, max                         | : | 0.5           |
| 5.  | Sulphated ash, % by mass, max                          | : | 0.1           |
| 6.  | Ammonia (as NH <sub>3</sub> ), % by mass, max          | : | 0.01          |
| 7.  | Arsenic (as As <sub>2</sub> O <sub>3</sub> ), ppm, max | : | 2             |
| 8.  | Chloride (as Cl), % by mass, max                       | : | 0.02          |
| 9.  | Sulphate (as SO <sub>4</sub> ), % by mass, max         | : | 0.005         |
| 10. | Iron (as Fe), % by mass, max                           | : | 0.005         |
| 11. | Heavy metals (as Pb), ppm, max                         | : | 10            |
| 12. | Organic impurities                                     | : | to pass test. |

**A-3 PROCEDURE FOR 'HOT COATING' OF SAND WITH RESIN**

Sand to coat with resin by 'Hot coating' process is as follows:


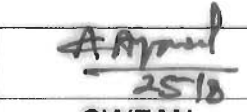
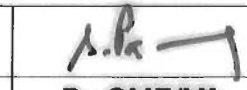

Weighed quantity of sand is heated to 135 to 150°C and discharged into a muller. To this hot sand, required quantity of resin is added and mulled as per the following details.

- |    |       |   |                            |
|----|-------|---|----------------------------|
| 1. | Resin | : | 3.0% max, (to sand by wt.) |
|----|-------|---|----------------------------|

<i>P-h</i> 31/8/15	<i>A. Anand</i> 25/8	<i>A.P.</i>	<i>Chauhan</i> 19.08.15
CME	CWE/W	Dy.CME/Mfg.	SSE/D
APPROVED	REVIEWED	VERIFIED	PREPARED

- 2. Wet mulling : 45 to 180 sec. (160 sec.)
- 3. Dry mulling : 15 to 75 sec. ( 65 sec.)
- 4. Hexa : 8% of resin preferably in the form of 25% solution.
- 5. Coated sand drop temp. : 75 to 82°C.

Both the mulling times are directly proportional to the batch quantity and the figures given in the bracket are followed by RWF for 180 Kgs. batch. Coated sand is required to pass through the sieve and allowed to cool before use.

			
CME	CWEM	Dy.CME/Mfg.	SSE/D
APPROVED	REVIEWED	VERIFIED	PREPARED

**ANNEXURE - B**

**MELT POINT OR STICK POINT OF COATED SAND**

**TESTING PROCEDURE:**

The melting point of coated sand is the temperature at which the coated sand melts and adheres to a heated bar under standard conditions.

The melt point equipment used at RWF for finding out the melt point of coated sand is manufactured by M/s. George Fischer DISA Inc. Detroit, Michigan, USA.

The equipment consists of a gradient heating copper bar, silver coated for easy cleaning and to prevent oxidation of the copper. The bar is heated from one end by a cartridge type heating element. It has a matching pyrometer of range upto 500°F/260°C and a variable transformer.

The copper bar acts as a part of the thermocouple. A weighted constantan pointer is attached to a slide and when the pointer is brought into contact with the bar, it forms a copper constantan thermocouple with the junction temperature of the thermocouple the same as the surface temperature of the bar at the point of contact. To prevent the slight temperature variation, when the thermo regulator turns the heater OFF and ON, a variable transformer is provided.

The sample to be tested is taken in a distribution plate and placed on the longitudinal centre line of the bar and the sand is emptied on to the bar so that it forms the thin ribbon of sand mix approximately 3 to 3.5" long. Wait for 60 seconds (1 minute) and then using the camel hairbrush, brush the material from left to right down the long axis of the copper bar. Place the constantan pointer at the extreme left of the fused portion where the sand first adheres to the bar. Read the temperature indicated by the pyrometer.

This temperature indicated by the pyrometer is the stick point of the coated sand. The above test may be carried out 3 times and the mean value shall be taken as stick point of coated sand.

<i>P. h</i> <i>5/18/15</i>	<i>A. Arund</i> <i>25/2</i>	<i>A. h</i>	<i>Chad</i> <i>19.08.15</i>
CME	CWE/W	Dy. CME/Mfg.	SSE/D
APPROVED	REVIEWED	VERIFIED	PREPARED



**ANNEXURE-C**

**C1 - COLD TENSILE STRENGTH OF COATED SAND**

**TESTING PROCEDURE:**

The equipment used for carrying out the test is manufactured by M/s. George Fischer DISA Inc. Detroit, Michigan, USA.

The test specimen shall be of a STANDARD AFS TENSILE BRIQUET (Dog Bone) shaped having  $0.250 \pm 0.010$ " thickness. The specimen is made in a Core Box.

The unit consists of 2 Steel blocks upper and lower each equipped with internal heating units and a thermostat for temperature control.

**PREPARATION OF THE SPECIMEN:**

The coated sand sample is filled in the bottom plate of the core box where 3 specimens are made. The excess sand is removed by a strike-off knife and the top plate is kept over the bottom plate. The temperature of the core box is maintained at  $232^{\circ}\text{C} \pm 5^{\circ}\text{C}$ , which is always confirmed by using a SURFACE THERMOMETER. The specimen is cured for 4 minutes. After 4 minutes the baked sand specimen is removed from the core box and cooled to room temperature.

The so prepared sand specimen is fit into the jaws of the Tensile Testing Machine in such a way that they are gripped uniformly along with lateral surface and so the load is applied along a line through their axis. When the specimen breaks the reading on the scale of the Tensile Testing Machine is noted. Three specimens are broken and the average value is taken as Cold Tensile Strength in terms of P.S.I. (Pounds per square inch).

CME	CWE/W	Dy. CME/Mfg.	SSE/D
APPROVED	REVIEWED	VERIFIED	PREPARED

**ANNEXURE-C**

**C-2 HOT TENSILE STRENGTH**

The specimen is prepared exactly in the same way like that of cold tensile strength with curing temperature of the specimen at 232°C ± 5°C for 4 minutes baking time.

The HTS test differs from CTS as follows:

The HTS test is carried out on a Direct Hot Tensile Unit dead weight type supplied by M/s. George Fischer DISA Inc. Detroit, Michigan, USA which has a Single Cavity Box unlike CTS equipment where multiple cavity box (i.e. 3 specimen preparation) exists. The single cavity split pattern rests on a Thermostatistically control heated block. This block is filled with the coated sand. The excess sand is wiped off by a strike-off knife. The upper heated block is placed on to the lower block for sand curing purpose. At the end of set time (4 minutes) without the removal of the sample the Hot Tensile Strength reading in terms of P.S.I. is read on a scale directly by just pressing a button provided in the unit.

<i>1.0</i> <i>3/10/15</i>	<i>Adrian</i> <i>25/8</i>	<i>A.R.</i>	<i>Chandra</i> <i>19-08-15</i>
CME	CWE/W	Dy.CME/Mfg.	SSE/D
APPROVED	REVIEWED	VERIFIED	PREPARED

**ANNEXURE-D****FLOW LENGTH TEST OF PHENOL FORMAL DEHYDE RESIN**

The equipment used for carrying out the Flow Length Test of P.F. Resin is an OVEN fitted with a plate inclined at an angle of 65° with thermostat control, thermometer and a built-in fan for keeping the temperature uniform. The desired temperature is 125°C ±2°C. The thermometer shall have graduation of 1 division.

The sample resin received (in flake form) is finely powdered by using a Mortar & Pestle. The powdered resin sample is made to pellet form by using a pellet press. The weight of the pellet to be exactly 1 gm. ± 0.002 gm.

The equipment is switched ON and allowed to attain the temperature of 125°C. This temperature is maintained constantly by a thermostat control provided in the equipment. As soon as the required temperature is attained (125°C) a smooth glass plate of 3 mm thickness (length 200 mm, width 150 mm) is placed over the inclined plate (inclination 65°) and the door is closed. The glass plate is allowed to gain temperature of 125°C for 60 minutes. Immediately after 60 minutes the resin pellets are placed on the glass plate and the door of the oven closed. The flow of the resin is observed for 3 minutes. (The flow can be seen through a glass window provided in the door of the equipment without opening the door during testing). At the end of 3 minutes the door is opened, the flow of the resin on the glass plate is marked by a marking pencil. The glass plate removed and allowed to cool. Subsequently the exact flow of the resin on the glass plate is measured and recorded as flow length of the sample under test.

Test should be conducted 3 times and the mean value should be taken as flow length of resin.

Repeatability : 100 - 160 mm (3%).

<i>P. V. 21/1/10</i>	<i>A. Agnew 25/1/10</i>	<i>A. K.</i>	<i>Chand 19.08.15</i>
CME	CWE/W	Dy. CME/Mfg.	SSE/D
APPROVED	REVIEWED	VERIFIED	PREPARED