

GOVERNMENT OF INDIA
(Ministry of Railways)

SPECIFICATION FOR
HIGH ALUMINA 70% BRICK SET
FOR LADLE LINING

Issued by

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

<i>gk</i> 14/3/22	<i>md</i> 14/3	<i>lsh</i>	<i>lsh</i> 10.03.22		<i>gk</i> 07.03.22
PCME	CWE/W	APD /M&C	Dy.CME/Mfg	SME/D	SSE/D
APPROVED	REVIEWED	VERIFIED		PREPARED	

AMENDMENT SHEET

Sl. No	alt 'q'		alt 'Y'		Job No	Signature
	Clause No.	Description	Clause No.	Revised Description		
1	7.0	INSPECTION NORM a. SAMPLING NORM: IS-1528 Pt. VII - 1974. b. ACCEPTANCE CRITERIA : IS-1528 Pt. VII - 1974	7.0	INSPECTION NORM a. Sampling norm: IS-1528 (Part 7) : 2010 b. Acceptance criteria: IS-1528 (Part 7) : 2010	7576	
2	Annexure 1	(Drg No. RWF/SK/MW-61 alt 'n')	Annexure 1	(Drg No. RWF/SK/MW-61 alt 'o')		
3	Annexure 3 & Annexure 4	(Reference of the specification was with old specification numbers and alteration)	Annexure 3 & Annexure 4	(Reference of the specification made to the current specification number and alteration)		

<i>144</i>	<i>R. K. S.</i>		<i>6/2/22</i>
AEQ/M&C	Dy.CME/Mfg	SME/D	SSE/D
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SPECIFICATION FOR H.A.70% BRICK SET FOR LADLE LINING

1.0 SCOPE

- 1.1 The specification covers the manufacture and supply of the HA 70% Arch brick set for ladle side wall lining, HA 70% Std. brick set for ladle bottom lining and High Alumina heat setting expansive mortar to Rail Wheel Factory, Yelahanka, Bengaluru 560064, Karnataka State.
- 1.2 Supplier/manufacturer shall be an ISO 9001 certified company. Supplier/ manufacturer shall have proven technical capability and experience of having supplied the ladle bricks for similar applications. Evidences shall be furnished by the supplier along with the offer to corroborate the performance.

2.0 GENERAL DESCRIPTION & JOB REQUIREMENT

Five sizes of High Alumina Brick sets are used for lining the ladle. The Ladle lining arrangement is as shown in Annexure 1. Molten metal is tapped from Electric Arc Furnace at temperature up to 1715°C. Steel is killed and alloyed in the ladle using ferro-silicon and silico-manganese. The same ladle is used for upward pressure pouring of wheels. Tapping into drain is practised and the metal remains at the bottom till the ladle campaign is terminated. During the pressure pouring, metal front moves over the facing refractory while casting each wheel. The refractory lining shall be capable of withstanding such operating condition. Lined ladles are preheated as per schedule at the rate not more than 100°C/hr to 1200°C and soaked at 1200°C not less than 3 hrs before using for the first time.

Prospective tenderers can visit RWF to see the actual usage at their own interest before making the offer.

3.0 QUALITY ASSURANCE PLAN (QAP)

The manufacturer shall submit their Quality Assurance Plan (QAP) along with their bid for approval by RWF, which will be followed in the manufacturing of High Alumina 70% bricks for Ladle lining to satisfy the technical requirement as required under this specification. Manufacturer shall ensure that the expected life of HA70 bricked ladle is not less than 24 heats under RWF's standard working condition. Manufacturer shall get their QAP approved from RWF in advance, unless a waiver is given to this effect.

4.0 MATERIAL

The following specification is common for all the five types of the bricks.

4.1 CHEMICAL COMPOSITION

(When tested as per IS 12107:1987 relevant parts)

- 1) Al₂O₃ (Alumina) : 70% Minimum.
- 2) Fe₂O₃ (Iron Oxide) : 2.5% Maximum.
- 3) Alkalis (Na₂O + K₂O) : 1.0% Maximum.

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4.2 PHYSICAL PROPERTIES

Sl. No.	Properties	For Brick Sizes (S.A)	For Brick Size
		230x115x76/65 mm 230x115x76/70 mm 255x115x76/65 mm 255x115x76/70 mm	230x115x76 mm STD.
i	Pyrometric Cone Equivalent (PCE)	+36 Orton (ORTON cone)	
ii	Cold Crushing Strength (CCS)	600 kg/cm ² (Min)	550 kg/cm ² (Min)
iii	Apparent porosity (AP)	20% (Max)	
iv	Permanent Linear Change (PLC) after heating at 1600°C for 2 hours	+1 to +2.5%	+1 to +2.25%
v	Size Tolerance	±1.5% or ±2 mm, whichever is greater	
vi	Refractoriness Under Load (RUL)	1500°C (Min)	1550°C (Min)
vii	Bulk Density (BD)	2.60 gm/cc (Min)	
viii	Warpage on 230/280 x115 mm face	0.50 mm (Max)	
ix	Spalling Resistance	30 cycles (Min) – (IS 1528:Part 3-2010, Cl.5.2 (Air quenching test))	
x	Physical Appearance	Bricks should be free from black coring, iron spots and corner damage. Crack in any form is not accepted. When bricks are cut either for sampling or for lining purpose, they should not show any signs of lamination or refractory particle loosening due to large grains or inadequate bonding, or coring due to improper firing.	

(Physical properties will be tested as per IS 1528 relevant parts)

4.3 SIZE

The general size for the five types of bricks in the Ladle brick set is as follows:

- High Alumina 70 : 230 X 115 X 76/65 S.A.
- High Alumina 70 : 230 X 115 X 76/70 S.A.
- High Alumina 70 : 255 X 115 X 76/65 S.A.
- High Alumina 70 : 255 X 115 X 76/70 S.A.
- High Alumina 70 : 230 X 115 X 76 STD.

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5.0 REFRACTORY PARTICLE SIZE AND GRANULOMETRY

Bricks should be compact having close grains. The raw material should not have more than 3 mm size refractory particles. The manufacturer shall select appropriate particle size distribution to achieve the specified properties.

6.0 TESTING FACILITIES

The firm should have complete testing facilities to check and control the raw material and the product as per the specification given above.

7.0 INSPECTION NORM

- a. Sampling norm : IS-1528 (Part 7) : 2010
- b. Acceptance criteria : IS-1528 (Part 7) : 2010

8.0 HIGH ALUMINA HEAT SETTING EXPANSILE MORTAR

Supply shall be accompanied with a quantity of 50 kg/set, of High Alumina heat setting expansile mortar having the following specification, for lining the ladle. The mortar is used in between gap of sidewall brick joints and shall have expansion properties under service temperature so that no gap is formed in the joints. The mortar shall have higher softening temperature than the brick and shall not show abnormal erosion resulting in 'coble storing' appearance in the joints of the used ladles or seepage of liquid metal to the safety lining through the joint.

- (1) Alumina Content (Al_2O_3) : 70% min.
- (2) Iron Oxides content (Fe_2O_3) : 2.0% max.
- (3) Pyrometric Cone Equivalent : +37 Orton (1820°C)
- (4) Expansion characteristic : $\geq +1.0\%$ (at 1500°C / 2hours)
- (5) Grading : 95% passing through 150-micron sieve
- (6) Maximum particle size : 0.5 mm

(Physical properties will be tested as per IS1528 relevant parts)

High Alumina heat setting expansile mortar shall be supplied in polythene lined double walled paper / gunny bags weighing 25 kg each. Manufacturer's name, material name, batch number and date of manufacture shall be marked on the bags. Use eco-friendly biodegradable packing material.

9.0 HANDLING

Special care should be taken by the supplier to ensure that the edges do not get chipped off during manufacturing and subsequent handling. The bricks that are chipped off are liable to be rejected and would have to be replaced by the firm at their expense.

10.0 STORAGE

The supplier should have arrangement to store the subject item under covered accommodation to protect them from water.

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11.0 PACKING AND MARKING

The bricks shall be packed as Ladle brick sets, in disposable pallets of wooden base and top, capable of being handled by 3 Ton Forklifts as shown in Annexure-2. The edges of the bricks should be protected with cardboard paper and strapped on to the base and top pallets. Additional corrugated cardboard of adequate thickness has to be used on all faces including inter layers to avoid damage to brick edges due to strapping force, handling and transportation. The manufacturer's name/brand shall be marked or sealed on the bricks.

Packing arrangement of different size bricks packed in a pallet is as follows.

Pallet No.	Top/Bottom	Size
1	Bottom	230x115x76/65 mm
	Top or in between layers	50 kg HA Mortar
2	Top	230x115x76/70 mm
	Bottom	255x115x76/65 mm
3	Bottom	255x115x76/70 mm
	Top	230x115x76 mm Standard

12.0 TRANSPORT

The bricks should be transported to RWF stores by road directly from the firm's premises to avoid any damages to the bricks. Utmost care should be taken during the transportation of these bricks by adequately covering them with tarpaulin, etc to avoid bricks getting exposed to rain water during transit.

13.0 TRIAL OF THE SUPPLY

The trial for the ladle brick under developmental/extended developmental PO shall be carried out in following manner:

1. The order has to be in multiples of lorry load which comes to about 05 sets. The first consignment will be restricted to this number. Subsequent consignments will be dependent on results of testing as well as shop floor performance
2. The inspection will involve visual inspection followed by lab testing of every lot received at RWF.
3. The firm's representative should be present for above testing for which intimation will be given to firm on the receipt of material. However, RWF reserves the right to go ahead with inspection if no representative is deputed within ten calendar days.
4. Only on clearance after lab test the brick set will be scheduled to be put in shop floor trials by Steel Melt Shop. The firm's representative should be present for the shop floor trial for which intimation will be given to firm. However, RWF reserves the right to go ahead with inspection if no representative is deputed within ten calendar days.
5. The format of trial for ladle brick is enclosed with the tender. (Annexure-3 & 4)

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6. The supply involves testing and shop floor evaluation of each lot. As such, only after clearance from the shop, next consignment should be dispatched.
7. The performance report will be shared with the firm.
8. Minimum quantity on each firm shall be 10 sets each to carry out developmental and extended trial

For development of new suppliers, RWF places developmental and extended developmental order and the material is subjected to rigorous tests and trial. This includes but is not limited to pre-dispatch inspection, inspection at RWF before putting in to trial of the material on shop floor, etc. 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-3 and the corresponding Trial report shall be prepared as per Annexure-4.

13.1 TRIAL ORDER QUANTITY & SCHEDULE

Development of new supplier is in two phases; developmental order followed by extended developmental order.

13.1.1 DEVELOPMENTAL ORDER

Order Quantity: 10 sets in two lots of 5 sets each.

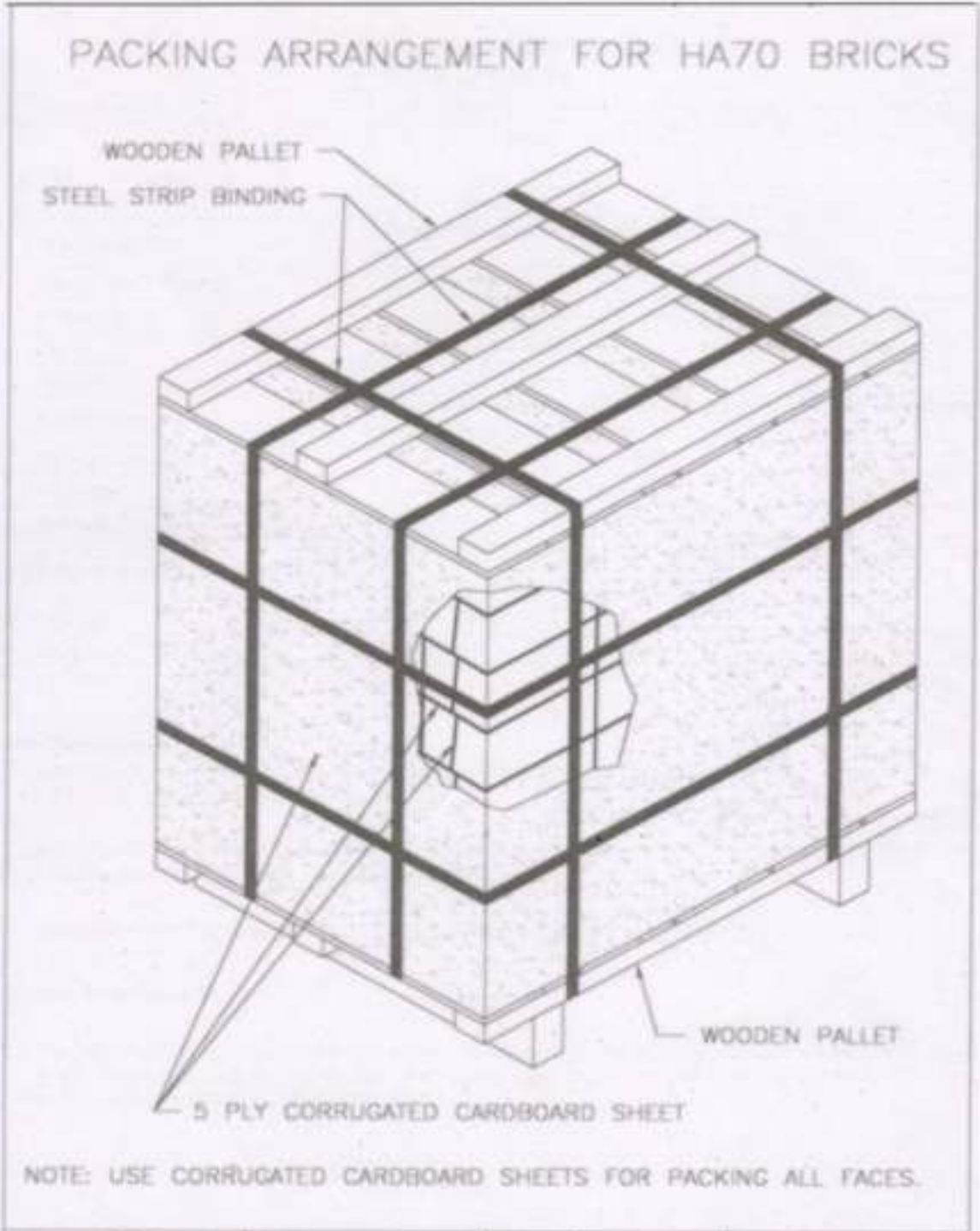
Schedule:

- i. First lot of 5 sets will be supplied. Material will be put to shop floor trial if it passes visual inspection and testing by Lab.
- ii. On successful trial, second lot of 5 sets will be cleared for supply. In case life of bricks during the trials, desired life of 24 heats or comparable to the regular supplier is not achieved or if induction of brick results in higher rejection of XC122 (imbedded metal reaction substance-small irregular combined brown, white or gray), XC123 (imbedded material, generally brown, but very porous under scope) and XC124 (ladle brick), firm will be given one chance to supply improved lot. This lot will again be tested before it is put to shop floor trial.
- iii. On successful performance of first lot of 5, second lot of 5 sets will be cleared for despatch.
- iv. Second set of lot will also be subjected to protocol as given in points (i) and (ii) above. However, no second chance will be given. The lot has to clear testing as well as shop floor trials in one go.

13.1.2 EXTENDED DEVELOPMENTAL ORDER

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Annexure-3

Trial Scheme of Ladle Bricks
(PL No.:84018756)

1	Trial scheme No.	Ladle bricks/PO.-----/Firm----- / Trial No.----- (01, 02 etc)			
2	Trial Details:	From		To	
		Date: -----	-----	Date: -----	-----
		Heat: -----	-----	Heat: -----	-----
3	Objective of Trial	To establish suitability of Ladle Bricks Supplied by: M/s. -----			
4	Description of Material	Ladle Bricks			
	PO Details	----- Dt.----- (PO type), PO Qty. -----Sets			
	Qty.	Supplied: -----Sets,		Accepted: -----Sets,	
	Supplier	M/s. -----			
5	Specification	Bricks High Alumina70% for Ladle lining as per RWF Specification No.RWF/M/SPECN-1/039/1991 Alt "r"			
	ISL Number & Date	-----			
6	Total Qty.	-----Sets			
	Authority for conducting Trial	Dy.CME / Mfg.			
7	Earlier trial details	First supply /Second time /Third time ----- /----- /-----			
8	Trial Qty	-----Sets			
9	Equipment / Station process	EAF-A,B & C			

(..... TO BE FILLED BY TEAM MEMBERS)

Trial Parameters:

- Total quantity of Ladle Bricks to be drawn and trial conducted on the entire quantity under the purchase order / 5 % of the tendered quantity whichever is less.
- Inspection & Testing by shop and whenever required by laboratory completely in line with the specification. Sampling for inspection as per specification.
- Examination of MTC (Manufacture's Test Certificate) and comments on its suitability.

Specific Requirement:

The overall performance w.r.t shrinkage, erosion, spalling, life should be at par with established brands already in use, when tried in matching number by ensuring same process parameter during use and in the same period (or just preceding/succeeding period).

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Trial report of Ladle Bricks
(PL No.:84018756)

1	Trial No.	Ladle bricks/PO.-----/Firm----- / Trial No.----- (01, 02 etc)	
2	Trial Details	From	To
		Date: -----	Date: -----
		Heat: -----	Heat: -----
3	Objective of Trial	To establish suitability of Ladle Bricks Supplied by: M/s. -----	
4	Description of Material	Ladle Bricks	
	PO details	----- Dt.----- (PO type), PO Qty. ----- Sets	
	Quantity	Supplied: ----- Sets,	Accepted: ----- Sets,
	Supplier	M/s. -----	
	Specification	Bricks High Alumina 70% for Ladle lining as per RWF Specification No.RWF/M/SPECN-1/039/1991 Alt "r"	
5	ISL Number & Date	-----	
	Total Qty.	----- Sets	
6	Authority for conducting Trial	Dy.CME / Mfg.	
7	Earlier trial details	First supply /Second time /Third time ----- /----- /-----	
8	Trial Qty	----- Sets	
9	Equipment	EAF-A,B & C	

Trial Parameters:

- Total quantity of Ladle Bricks to be drawn and trial conducted on the entire quantity under the purchase order / 5 % of the tendered quantity whichever is less.



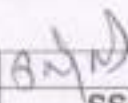
Comments:

- Examination of MTC (Manufacturer's Test Certificate) and comments on its suitability.

Enclosure Details:

- Inspection & Testing by shop and whenever required by laboratory completely in line with the specification. Sampling for inspection as per specification.

Comments with documents:

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RWF/M/SPECN-1/039/1991, Alt. 'r'

Type-A		Nos of lab samples		Nos of Physical samples		Remarks
230x115x76/65mm						
230x115x76/70mm						
Lab no & dt	Parameter	Unit	Reqd.		Results (Range)	
			Min	Max	Min	Max
	Al2O3	%	70.00	---		
	Fe2O3	%	---	2.50		
	Alkalis	%	---	1.00		
	CCS-1	Kg/C	600.00	---		
	AP	%	---	20.00		
	BD	gm/C	2.60	---		
	RUL	°C	1500.00	---		
	PLC	%	1.00	2.50		
	PCE	STD	36	---		
Type-B		Nos of lab samples		Nos of Physical samples		Remarks
255x115x76/65mm						
255x115x76/70mm						
Lab no & dt	Parameter	Unit	Reqd.		Results (Range)	
			Min	Max	Min	Max
	Al2O3	%	70.00	---		
	Fe2O3	%	---	2.50		
	Alkalis	%	---	1.00		
	CCS-1	Kg/C	600.00	---		
	AP	%	---	20.00		
	BD	gm/C	2.60	---		
	RUL	°C	1500.00	---		
	PLC	%	1.00	2.50		
	PCE	STD	36	---		
Type-C		Nos of lab samples		Nos of Physical samples		Remarks
230x115x76mm						
Lab no & dt	Parameter	Unit	Reqd.		Results (Range)	
			Min	Max	Min	Max
	Al2O3	%	70.00	---		
	Fe2O3	%	---	2.50		
	Alkalis	%	---	1.00		
	CCS-1	Kg/C	550.00	---		
	AP	%	---	20.00		
	BD	gm/C	2.60	---		
	RUL	°C	1500.00	---		
	PLC	%	1.00	2.25		
	PCE	STD	36	---		

Note: Comments regarding inspection.

<i>Hy</i> AED/M&C	<i>Abh</i> Dy.CME/Mfg	<i>02/12</i> SME/D	<i>07.05.22</i> SSE/D
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RWF/M/SPECN-1/039/1991, Alt. 'r'

The relevant production & XC data shall be compared with a similar quantity in use of other make, in addition to any specific performance requirement given in specification.

Comments with documents:

The overall performance w.r.t shrinkage, erosion, spalling, life should be at par with established brands already in use, when tried in matching number by ensuring same process parameter during use and in the same period (or just preceding/succeeding period).

Observations:

Usage details (F----)	Trial material (Ranchi Ref.)			Regular Material		
	No of ladles	Heats	Average (Hts/Ladle)	No of ladles	Heats	Average (Hts/Ladle)
Normal usage						
Refractory failure						
* Weekend/ Holiday break						
* Process constraint						
Total						
* - Discounted						
5) XC details of the heats tapped with trial and regular material are as follows (F-):-						
XC details	Trial material (Ranchi Ref)		Regular Material			
XC122 (Small irregular combined brown, white or Grey)						
XC123 (Small irregular combined brown, white or Grey splatter without slag)						
XC124 (Brick)						
Total XC						

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
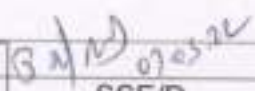
OMT / Wheel

SSE / SMS

Remarks of Dy CME/Mfg

Remarks of AED/M&C

Recommendation of CWE / W

		
AED/M&C	Dy. CME/Mfg	SME/D
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