BUREAU OF INDIAN STNADARD

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Draft Indian Standard

HIGH CHROME GRINDING MEDIA BALL FOR CEMENT MILLS – SPECIFICATION

ICS 77.140.80

Foundry and Steel Castings Sectional Committee, MTD 14	**Last date for receipt of comment is 16 March 2024**

FOREWORD

High chrome grinding media balls are a crucial component in cement mills, responsible for effectively crushing and grinding the raw materials and clinker during the cement production process. These balls are made from high-quality alloy steel, which contains chromium as the main element, along with other alloying elements like carbon, manganese, and silicon.

The high chrome content in these grinding media balls provides excellent wear resistance, making them ideal for harsh and abrasive environments inside cement mills. They can withstand the impact and abrasion caused by the continuous grinding of raw materials and clinker, ensuring consistent and efficient comminution.

In formulation of this standard, assistance has been derived from the following:

a) ISO 21988: 2006 Abrasion resistant cast irons – Classifications, and

b) IS 6907: 1992 low allow cast steel grinding media specification.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (second revision)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft Indian Standard

HIGH CHROME GRINDING MEDIA BALL FOR CEMENT MILLS − SPECIFICATION

1 SCOPE

This standard covers the requirements for high chrome grinding media ball for cement mills.

2 REFERENCES

The following standards contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
IS 228 (relevant parts)	Methods of chemical analysis of steels
IS 1387 : 1993	General requirements for the supply of metallurgical materials
IS 1586 : 2012	Metallic materials - Rockwell Hardness Test
IS 3343 : 1965	Specification for natural moulding sand for use in foundries
IS 6079 : 1989	Low alloy cast steel grinding media - specification

3 TERMINOLOGY

3.0 For the purpose of this standard, the following definitions shall apply.

3.1 Lot

Ten tonnes or part thereof of high chrome grinding media balls for cement mills of one size, having similar composition and subjected to similar heat treatment.

4 SUPPLY OF MATERIALS

4.1 General requirements relating to supply of high chrome grinding media balls for cement mill shall be as laid down in IS 1387 .

5 PARTICULARS TO BE SPECIFIED WHILE ORDERING

5.1 For the benefit of the purchaser, particulars, to be specified while ordering for high chrome grinding media for cement mill are as given:

a) Material specification;

b) Tests required;

c) Weather the castings are to be inspected and tested in presence of purchaser’s representative;

d) Condition of delivery;

e) Any special requirement; and

f) Test reports, if required.

6 RAW MATERIALS

6.1 The scraps with various compositions of chromium may be used as raw material depending on the chemical composition required.

7 MANUFACTURING

7.1 The raw materials such as scraps, if used, shall be melted and mixed by induction melting or as such other process as may be agreed to between the purchaser and the manufacturer.

7.2 Sand casting shall be used for casting the grinding media and the specification for natural sand used shall be as laid down in IS 3343.

8 WORKMANSHIP AND FINISH

8.1 Grinding media shall be accurately moulded in accordance with the sizes and tolerances specified in the standard, or as agreed between the manufacturer and purchaser.

9 CHEMICAL COMPOSITION

9.1 The ladle analysis of the melt when carried out either by the method specified in IS 228 and its relevant parts or any other established instrumental/chemical methods shall be as given in Table 1 or as may be agreed between the manufacturer and purchaser. In case of dispute the procedure given in IS 228 shall be the referee method. However, where the method is not given in IS 228, the referee method shall be as agreed between the purchaser and manufacturer.

Table 1 Chemical Composition, Percent
(*Clause* 9.1, 9.2)

Constituent	Composition in Percentage
Carbon	1.8-3.6
Silicon	1.0 max
Manganese	0.5-1.5
Nickel	0.5 max
Chromium	10-28
Molybdenum	3.0 max
Sulphur	0.08 max

Phosphorus	0.06 max

9.2 The manufacturer shall carry out analysis from a sample of each melt and, if so specified by the purchaser at the time of enquiry and order, shall supply a test certificate of chemical analysis of the sample for each melt.

9.3 Chemicals not specified in Table 1 shall not be ordinarily added in melt and all reasonable precautions shall be taken to prevent contamination from the scrap, etc, to keep as low as practicable.

9.3.1 Analysis and reporting of analysis in the rest certificates for residual elements shall be done only when so specified by the purchaser in the enquiry and order. However, the manufacturer shall ensure that the residual elements are within the limits specified.

10 FREEDOM FROM DEFECTS

10.1 All grinding media shall be free from any surface or subsurface defects that affect the utility of castings. No surface conditioning, except grinding shall be permissible.

10.2 The ball sample should be checked for any surface or subsurface defects after rotating the sample in an empty test mill for 18 hours.

11 WEAR RESISTANCE

11.1 The consumption rate of balls when calculated in grams per ton of cement should be between 2.2 to 50 grams per ton of cement or as agreed to between the purchaser and the manufacturer. Recommended procedure to determine consumption rate of balls is given at Annex B.

12.1 Grinding media shall be cast in the following sizes:

SI No.	Balls, Dia (*mm*)
i)	25
ii)	17
iii)	20
iv)	22
v)	25
vi)	30
vii)	35
viii)	40
ix)	50
x)	60
xi)	65

xii)	70
xiii)	75
xiv)	80
xv)	90

12.2 Grinding media may also be cast in other sizes as agreed to between the purchaser and the manufacturer.

13 TOLERANCE ON SIZE

13.1 Variation in sizes shall not exceed the following limits:

Sl no.	Shape and Size	Tolerance on Diameter, mm
i)	Balls for sizes less than 25 mm	± 1. 5
ii)	Balls for sizes 25 to 30 mm	± 2.5
iii)	Balls for sizes 40 to 80 mm	± 3.0
iv)	Balls for sizes 90 mm	±3.5

14 HEAT TREATMENT

14.1 All grinding media shall be suitably heat treated to obtain the required hardness and microstructure.

14.2 Grinding media larger than or equal to 60 mm shall be suitably heat tempered to increase the required toughness.

15 HARDNESS

15.1 When tested in accordance with IS 1586, the hardness at any point across the cross section of the ball shall not be less than 53 HRC.

15.2 The purchaser may, at his discretion, agree to test the hardness of the balls on the surface instead of across the section, provided the supplier is able to demonstrate to the satisfaction of the purchaser the existence of a definite correlation between the hardness at the surface and across the section.

16 MICROSTRUCTURE

16.1 Microstructure shall be free from any carbide network.

17 SAMPLING

17.1 Methods of sampling of grinding media and the criteria for conformity shall be as given in Annex A.

18 PACKING

18.1 The material can be supplied in drums, preferably of size 1 tonne, bags of various sizes or any such other method as may be agreed between the manufacturer and purchaser.

19 MARKING

19.1 In case the material is not supplied in loose condition the container or bag shall be legibly marked with the following:

a) Name of the manufacturer or trade mark,

b) Name of the purchaser, and

c) Size of the grinding media ball.

19.2 In case the material is supplied loose, the method of identification shall be mutually agreed upon at the time of enquiry and order.

19.3 BIS Certification marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the Bureau of Indian Standards Act, 2016 and the Rules and Regulations framed there under, and the products may be marked with the standard mark.

20 WASTE DISPOSAL

20.1 The sand dust produced during the moulding process shall be recycled and rest shall be collected by dust collectors and used in landfills or making bricks along with the waste bags produced, if being used for packing.

20.2 The slag produced during the manufacturing process shall be supplied to cement plants as and when demand arises.

ANNEX A

(*Clause* 17.1)

B-1 VISUAL AND DIMENSIONAL CHARACTERISTICS

B-1.1 Sampling and criteria for conforming to the visual and dimensional characteristics for the balls shall be as laid down in IS 6079 (B-1).

B-2 HARDNESS AND MICROSTRUCTURE

B-2.1 Sampling and criteria for conforming to the hardness and microstructure characteristics for the balls shall be as laid down in IS 6079 (B-2.1, B-2.2).

B-2.2 Notwithstanding anything stated above, if any of the individual balls in the selected sample shows a hardness less than 53 HRC or has a continuous network of carbides in an area exceeding ⅙ of the area of field of view when view through a microscope at X 100 shall deemed to be not conforming to the standard and not acceptable.

B-3 RE-INSPECTION

B-3.1 The manufacturer has the right, if he so desires, to sort the balls in the rejected lot by 100 percent inspection and to put up a revised lot for re-inspection.

ANNEX B
(Clause 11.1)

Recommended procedure to determine consumption rate of balls

1. Keep a pre-determined charging quantity of grinding media by weight, size wise near the mill.
2. Completely empty out the mill and there should be nothing inside.
3. Before starting to load the mill with grinding media, make sure that there is sufficient quantity of coal in the mill (Near the drop point of grinding media) to absorb the impact of falling grinding media to prevent any damage to both liners & grinding media.
4. Load the smallest sized balls first & then bigger size. Follow other standard grinding media loading procedure as laid down by mill OEM.
5. Once the required quantity of grinding media is loaded, run the mill with low coal loading for few minutes and note down the current of mill motor.
6. The coal loading should be increased gradually so that optimum quantity of coal circulates in the milling circuit. Change / increase coal loading only after some time interval. (Mill motor Current will increase & then will gradually stabilize). Increase the coal load only after several minutes of mill run with stabilized current. This way, mill will stabilize within few hours with optimum output.
7. Based on reduction of mill motor current, indicating wear of grinding media, charge more grinding media in the mill to bring back the current level to original level. Repeat this exercise weekly / bi-monthly / monthly as per requirement. Always record the quantity of grinding media added.
8. Always run the mill with full load to avoid any un-necessary wear caused due to empty running of the mill.
9. During a period of 6-8 month time, note the quantity of make-up charge added and coal ground by themill besides the total original charge that was added at startup of the mill.

The wear rate of grinding media can now be established as under:

A = New charge in the beginning (Kg)
B = Total Make up balls added during experiment (Kg)
C = Balls left in the mill (Kg)
D = Total coal grinding during experiment (M.Ts.)

$$\text{WEAR RATE (Gms/Ts)} = \frac{(A + B) - C \times 1000}{D}$$

Note: In case of drainage of balls not possible/feasible at the end of trial period, then the current level in the mill should be maintained at the initial level so that grinding media will be same as the charged media in beginning of the trial.

In this case, wear rate can be calculated as under:

$$\text{WEAR RATE (Gms/Ts)} = \frac{B \times 1000}{D} \quad (B \text{ \& } D \text{ are same as above})$$

During the experiment/trial, following care should be taken to establish the most accurate wear rate figure:

1. Coal fineness must be maintained at the same level throughout the experiment as per

boilerrequirement.

2. Empty running of mill without coal feed must be avoided. The mill motor should trip within 5 minutes ofstopping of coal feeders.
3. Foreign material such as iron/metal pieces, rods, big boulders should not enter the mill.
4. During the experiment, there should not be variation in raw coal quality such as coal HGI & calorificvalue, moisture, coal size, ash contents etc.
5. Experiment should be done preferably in the mill having new set of liners.