



PRODUCT STANDARD

PULVERISERS

HYDERABAD

Product
STD no.

BA35053

Rev No. 00

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GRINDING ELEMENTS FOR BHEL HP BOWL MILLS

1.0 GENERAL:

This specification governs the procurement of grinding elements consisting of Grinding Rolls and matching Bull Ring Segments for OEM Supplies of HP-1103 Bowl Mill. The guaranteed wear life is 8000 running hours (without repair or rebuild of the wear area) for project coal as per Annexure-II, having ash content of about 30% - 44% & meeting the technical requirements / performance requirements for the Bowl Mills.

2.0 QUALIFYING REQUIREMENTS:

The bidder shall satisfy the following minimum qualifying requirements by submitting documentary evidences along with the technical offer, failing which the offers shall be summarily rejected.

2.1 Proven Experience: Documentary evidence to be submitted for the following.

Bidder should have manufactured and supplied Grinding rolls and matching bull ring segment for 500 MW or higher size pulverized coal fired power generating units to at least two different sites. Supplied grinding rolls and bull ring segments should have achieved a wear life of minimum 8000 hrs. (without repair or rebuild of the wear area) with typical high ash Indian coal as given in Annexure I prior to date of techno-commercial bid opening. End user certificate for satisfactory performance shall be furnish for the above supplies.

The evidences shall be submitted in the following format.

Name of Site	Power unit rating	Mill type	Size of grinding roll	Date of supply	Life achieved in hrs.
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Amir
2.2.19

Chaitra
2-2-19



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2.1 Manufacturing facilities and proven process:

2.1.1 Vendors to note that at present BHEL is using the Grinding elements as per the following details:

Rolls and Bull ring segments are manufactured using proven casting process.

The Inserts of the rolls are made up of hard metal matrix composite comprising of high chrome and ceramic, the high chrome iron having following Chemical composition:

C = 2.5-3.4 %, Cr = 18.0-27.0 %, Mo= 0.5-1.3 %, Ni-0.3-1.3%,

Mn = 0.5 - 1.5 %, Si = 1.0 % max., S-0.1% Max, P-0.1% Max

This High-Chrome alloy is reinforced with ceramic particles, evenly distributed. The hardness of inserts is in the range of 58 – 66 RC.

These inserts are embedded into a base metal, which is either ductile iron (SG iron) / Hi-Chrome / any other equivalent material, forming a roll by Static / centrifugal process with overall dimensions as per BHEL drawing.

The Chemical composition of SG iron: C- 3.2-3.5%, Si-2.5-3.0%, Mn-0.3% max. Mg-0.04-0.07%.

Any bidder following the above manufacturing process will be qualified subject to meeting the clause 2.1.

However, the above Chemical Composition/Process/ technology do not absolve the supplier from guarantee responsibility. The Heat treatment procedure shall be established by the vendor and shall be indicated in Quality Plan.

2.1.2 ANY OTHER PROCESS FOLLOWED & MEETING 2.1

In case the bidder is having a manufacturing process different from 2.2.1, the bidder shall have all the necessary facilities for the manufacture of Grinding rolls and bull ring segments. The process used for manufacture shall be a proven one. Details of their manufacturing facilities shall be submitted.

In case any of the sub-process is out sourced / subcontracted, the tie-up letter with the agency along with details of their facilities and capabilities shall also be submitted for acceptance by BHEL.

The information given by the bidder is liable for evaluation by BHEL

2.1.3 Traders / stockiest / mediators are not allowed to quote. Only manufacturers who are having relevant facilities, proven process and experience will be considered for the supply.

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2.2 Infrastructure for providing Technical Services for:

Bidder shall have the sufficient infrastructure for the following after sales services

- Supervision of erection and commissioning.
- Performance monitoring with respect to wear life, output, fineness, coal characteristic etc.

Documentary evidences/confirmation for the above shall be submitted.

3.0 MATERIAL CODE: See Table

4.0 QUANTITY REQUIRED PER MILL

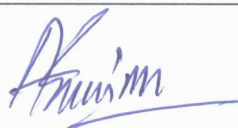
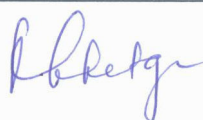
- 1) 3 Nos. Grinding Rolls.
- 2) 1 set of matching Bull Ring Segments.

5.0 MANUFACTURING PROCESS AND QUALITY PLAN:

- 5.1 Dimensions: The overall dimensions of the Grinding Roll and Bull Ring Segments shall be as per BHEL Drawings.
- 5.2 A detailed manufacturing process (along with the process control parameters) and manufacturing and test facilities data shall be submitted for review by BHEL.
- 5.3 Material used for the manufacture of the Grinding rolls and Bull ring segments shall be specified along with the technical details. The specifications shall be submitted for acceptance by BHEL. The details of the patented portion of the technology need not be provided, however the generic name of the proven patented technology along with the broad details shall be provided.
- 5.4 A Quality plan with stage wise inspection and acceptance criteria shall be submitted for approval by BHEL and/or customer.

6.0 INSPECTION:

- 6.1 The inspection of items will be as per the approved Quality plan.
- 6.2 Inspection of the material will be based on the applicable process of manufacture acceptable to BHEL. The tests like chemical composition, microstructure, hardness and NDT etc as applicable will be part of the approved Quality plan.
- 6.3 The overall dimension of the grinding roll and bull ring segments shall be as per BHEL drawing.
- 6.4 The bullring segments shall be assembled in Check Bowl. After assembling of the segments, final gap should not be more than 20 mm. The drawing for the check Bowl and the arrangement for segment assembly on Check Bowl shall be furnished by BHEL.
- 6.5 The number of segments i.e. Plain, Half, Quarter, Keyed & Shim for each size of the mill shall be shown on Check Bowl drg. However, additional shims/ segment to fill the gap upto 20 mm shall be supplied by the vendor which may be required at site during assembly.



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7.0 GUARANTEES:

Wear Life: The minimum guaranteed wear life shall be 8000 hours (without repair or rebuild of the wear area) for the range of coal mentioned in Annexure-II.

Supplier shall depute his representative while conducting the mill capacity and performance test with originally installed worn out grinding elements after the guaranteed wear life during the Performance Guarantee (PG) test of mills along with BHEL team as per the customer approved PG test procedure and guarantees given there off. Guaranteed wear life is considered to have been met with only when the mill PG test results are achieved. Typical Mill PG Test requirement is as per Annexure III.

- 7.1** The supplier shall give back to back guarantee for wear life of grinding elements as per terms and conditions of applicable contract clauses given in Annexure IV- which gives calculation for replacement of grinding elements as part of Mill Warranty Shortfall Part Settlement.
- 7.2** Consistency in mill output to minimum 90% of the rated capacity and pulverized fuel fineness of minimum 70% through 200 mesh and 99% through 50 mesh at the end of guaranteed wear life.
- 7.3** Failure due to manufacturing defects (generally leading to breakage/ catastrophic failure of grinding elements) shall be replaced and installed immediately.

8.0 INSPECTION AT SUPPLIERS WORK

Tests and inspection are to be conducted in the presence of BHEL/ customer representatives as per approved Quality plan. The representatives shall have free access at all times while the work on the contract is being performed. The supplier shall offer all the tools and tackles required for inspection to the inspection agency.

9.0 TEST CERTIFICATE:

All the rolls shall be identified with a serial number punched. The Bull ring segments set shall be numbered by paint for each set. Supplier shall supply 3 copies of Test certificates with following information for rolls and bull ring segments.

1. BHEL order number
2. Supplier's reference and name.
3. Heat No. / Roll no.
4. Results of chemical analysis, Hardness Test and all other tests or any other tests as per approved QAP
5. Drawing no., Material Code
6. Consignment/ Identification no.



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10.0 ACCESSORIES

Wear measurement gauge for project site, and any other items/consumables required shall be supplied by the supplier at no extra charge to BHEL.

11.0 DOCUMENTS

11.1 Three Copies of test certificates are to be provided.

12.0 PACKING:

Bull ring segments shall be suitably packed in seaworthy metallic boxes set wise to prevent Corrosion and damage during transit. Machined/ Ground surfaces shall be properly protected with suitable anti-corrosive compound. Bull ring segments and shims shall also be coated with anti-corrosive compound. Grinding rolls which are being directly dispatched to site shall be packed in seaworthy metallic boxes. Each package shall be legibly marked with following information.

1. BHEL Order No.
2. Consignment/ Identification No.
3. Roll No. / Set No.
4. Drawing no., Material Code
5. Weight in Kg
6. Suppliers Name

Separate identification mark shall be given for spare grinding rolls and bull ring segments .

13.0 SUPERVISION & SERVICES:

13.1 Personnel for supervision for Erection and commissioning shall be deputed within a period of one week from the notice given by BHEL.

13.2 Supplier shall depute his representative while conducting the mill capacity and performance test with originally installed worn out grinding elements after the guaranteed wear life during the Performance Guarantee (PG) test of mills along with BHEL team.

14.0 TABLE FOR MATERIAL CODE

Var No.	Mill Type	Item Description	Drawing No.	Malt. Code
01	HP-1103	Grinding roll HP 1103	26101003169	BA9735053012
03	HP-1103	Bull ring segment set HP 1103	16111001564	BA9735053039



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ANNEXURE – I

TYPICAL COAL ANALYSIS (INDIAN COAL):

Parameter	Unit	Coal Analysis Data (as available)					
Proximate Analysis (as recd)		Coal 1	Coal 2	Coal 3	Coal 4	Coal 5	Coal 6
Moisture	%	18	14	18	16	15	15
Ash	%	46	45	38	45	45	45
Volatile Matter	%	16	20	20	19	20	19.5
Fixed Carbon	%	20	21	24	20	20	20.5
Hard Grove Index		45	47	60	50	47	42
Abrasion Index (YGP)	mg steel/ kg coal	85	80	80	80	80	80
Ash Analysis (as recd)							
Silica (SiO ₂)	%	64.86	62.4	59.79	59.54	62.5	59.6
Alumina (Al ₂ O ₃)	%	23.8	27.31	25.36	29	27.3	30.75
Iron Oxide (Fe ₂ O ₃)	%	6.52	4.96	7.2	6.42	4.9	6.5
Balance	%						

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ANNEXURE – II

Fuel Analysis - Coal

Description (Source / Type)	Range of 95% coal supplies			Range of 5% coal supplies	
	Design	Worst	Best	Worst	Best
Proximate Analysis					
Fixed carbon %	27	22	31	19	32
Volatile matter %	23	19	24	19	28
Moisture %	14	17	11	18	10
Ash %	36	42	34	44	30
Total %	100	100	100	100	100
Ultimate Analysis					
Carbon %	33.31	27.23	39.07	25.72	44.43
Hydrogen %	3.49	3.05	3.53	2.93	3.72
Sulphur %	0.6	0.9	0.5	0.95	0.35
Nitrogen %	0.9	1.3	0.8	1.4	0.6
Oxygen % (by difference)	11.7	8.52	11.1	7	10.9
Total Moisture %	14	17	11	18	10
Ash %	36	42	34	44	30
Carbonates	0.3	0.38	0.27	0.2	0.43
Phosphorous	0.05	0.04	0.06	0.03	0.07
Chloride	0.08	0.15	0.05	0.18	0.04
Trace Elements (PPM)					
Arsenic	1	1.5	0.5	2.5	0.4
Lead	35	75	25	150	10
Mercury	0.1	0.5	0.08	0.6	0.06
Selenium	0.8	1	0.6	1.5	0.5
Hard Grove Index	55	50	60	45	65
YGP Index (mg/kg)	75	80	70	85	65
GCV Kcal/Kg	3400	2900	3900	2800	4400
Ash Characteristics (Under reduced atmosphere)					
IT - Initial deformation temp. °C	1100	1100	1100	1100	1100
ST - Softening temp. H = W °C	-	-	-	-	-
HT - Hemispherical temp. H = W/2 °C	1300	1250	1350	1250	1350
FT - Fusion temp. °C	1400	1400	1400	1400	1400
Ash Constituents					
A - Si O ₂ %	59.25	63.4	56.92	63.56	54.2
A - Al ₂ O ₃ %	27.62	27.29	28.47	27.2	29.89
B - Fe ₂ O ₃ %	6.75	5.48	7	5.46	7.5
B - MgO %	0.2	0.3	0.15	0.35	0.1
B - CaO %	0.9	0.7	1.5	0.6	1.8
B - Na ₂ O %	0.17	0.25	0.15	0.3	0.15
B - K ₂ O %	---	---	---	---	---
A - TiO ₂ %	1.05	0.88	2.6	0.08	2.82
P ₂ O ₅ %	0.24	0.3	0.11	0.35	0.1
Sulphuric Anhydride%	1.2	0.5	1.4	0.4	1.7
Alkalies (by difference)	1.72	0.9	1.8	0.8	1.94
Total	100	100	100	100	100



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ANNEXURE-III

TYPICAL MILLS PG TEST REQUIREMENT:

Coal Pulveriser Capacity at Rated Fineness

Performance testing shall be conducted on coal pulverisers towards establishing their guaranteed capacity meeting the specification requirement. Corrections may be applied for the variation in coal characteristics i.e.HGI & Total Moisture of test coal with respect to specified design coal.

Capacity demonstration test shall be carried out for the following conditions.

(a) The Contractor shall demonstrate capacity output on one coal pulverizer of each Steam Generator for establishing its capacity at 100% mill loading at rated pulverized coal fineness with specified design coal with new set of grinding elements.

(b) Further, Contractor shall also demonstrate capacity output on four coal pulverizers (of Employer's choice) of each Steam Generator, not less than the 90% of guaranteed value of (a) above, at 100% mill loading with the originally, installed grinding elements in after the guaranteed wear life of grinding elements.

Capacity test as mentioned at (a) & (b) above shall be demonstrated at the following condition occurring simultaneously during testing:

Rated Pulverised coal	i) Not less than 70% through 200 mesh and
fineness	ii) Not less than 99% through 50 mesh screen
Test coal	Any available coal from the specified range

In case the Contractor successfully demonstrates the guaranteed capacity of coal pulverisers as stated above remaining coal pulverisers of corresponding steam generator will also be considered to have successfully met the above capacity guarantee requirement. However, in the event of any of the coal pulverizers not meeting the guarantee test, all the coal pulverizers of corresponding steam generator will have to be tested by the contractor to demonstrate guaranteed capacity.

During the demonstration of the mill capacity output, manufacturer's operating instructions will be followed and mill will be operated with the specified range of coals without any such readjustment that requires a shutdown of the mill or reduction of the load and / or any replacement of any mill wear parts.

For the purpose of testing to demonstrate the capacity, if HGI (grindability) and total moisture vary from those given in coal characteristics, the above pulverizer measured capacity shall be corrected using the capacity correction curves furnished by the Contractor and approved by the Employer. HGI versus coal pulverizer capacity curve shall be furnished for HGI variation upto a value above which the capacity remain constant.

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ANNEXURE-IV

COAL PULVERISER WEAR PART WARRANTY

1. The Contractor(vendor) shall warrant the wear life of all wear parts of the coal pulveriser when grinding the specified range of coal(s). Pulveriser wear parts are defined as those parts of the pulveriser which are in contact with coal or coal dust and are likely to wear out during the operation of the pulveriser. The guarantee/warranty shall be demonstrated on each pulveriser during the Guarantee Trial Period (GTP) commencing after establishing successful operation of the pulveriser continuously for a period of not less than twenty four (24) hours, at or near its guaranteed rated capacity. The GTP for the respective wear part(s) shall be at least three years or the wear life of that wear part(s), whichever occurs later. The establishment of the warranty will be based on equivalent running hours of the pulveriser regardless of the specified coal. The average wear life (AWL) of the mill wear parts during GTP shall, however be corrected for the variation in YGP index for the coal fired during GTP.
2. Minimum Guaranteed Life for grinding elements shall be as indicated in the Cl. 7.0 Page 4 of 12 of BHEL Standard BA35053.
3. The wear parts shall be considered to have passed their warranted operating life when they have successfully demonstrated their capability to meet the full load rated capacity of the pulveriser during the guaranteed life of the wear part. No weld Buildup or reversing of grinding elements will be permitted for achieving the guaranteed wear life. In case any of the wear part has worn out to such an extent that either the normal or safe operation of the pulveriser is jeopardized if this part is not replaced/repared, or continuous use with this part may lead to exposure or wear of other parts which are not meant for the purpose of checking the shortfall in wear life, even if there is no reduction in pulveriser rated capacity, then the part shall be deemed to have outlived its wear life. If any of the wear parts fail to meet the warranted life, additional quantities of these wear parts shall be supplied on pro-rata basis as defined in Clause 6. Below. For the duration of this warranty period, the replacement wear parts shall be available to the Employer at the spare part price indicated in the Contract, adjusted as per terms and conditions of the Contract.
4. **Computation of liquidated damages for plant life of 25 years**

On the expiry of GTP (minimum 3 years), deficiency in the life of each wear part that has not fulfilled the warranty will be worked out on an item wise basis and shortfall so established due to reduced wear life and its implications for the plant life shall be worked out. The contractor at no extra cost to the Employer shall provide one and half times the wear parts needed to make good the shortfall in the wear life for 25 years of plant life.

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5. The shortfall part settlement (SPS) will be calculated based on the actual wear life of the parts that have worn-out in the GTP on a pulveriser-by-pulveriser basis. In this connection the procedure given below in clause 6. shall be followed.

6. Pulveriser Warranty Shortfall Part Settlement (SPS) Procedure(With example)

For all wear parts of each vertical coal pulveriser:

S.N	Description	Procedure	Example
(i)	Guaranteed wear life of wear part	(say X hours)	X=16000 Hrs.
(ii)	Total life achieved by a particular wear part during GTP (say X1 hours by originally installed part(s) & X2 hours by subsequently replaced part(s))	X1= 13000 Hrs X2= 14000 Hrs	Life of wear parts replaced during guarantee trial period(GTP)
(iii)	Average wear life (AWL) of failed	$AWL = \frac{X1+X2}{2}$	$AWL = \frac{13000+14000}{2} = 13500$

	wear parts		2
(iv)	Short fall in Hrs Total shortfall for wear part during GTP.	$S = (X-X1) + (X-X2)$	$(16000-13000) + (16000-14000) = 5000$
(v)	GTP in years	$GTP = \frac{(X1+X2)}{8760}$	$(13000+14000)/8760 = 3.08$
(vi)	Shortfall part settlement (SPS)	$= \frac{S \times (25)}{AWL \times GTP}$	$= \frac{5000 \times (25)}{13500 \times 3.08} = 3.006$ (To be rounded off to nearest whole number. In case of 0.5 or higher decimal place, it shall be next higher number.) $= 3.0$

The Contractor(Vendor) shall provide to Employer either the wear parts of original or better quality material in number equivalent to one and half times the quantity worked out based on the method explained in the above example so as to compensate for the shortfall in wear life for a plant life of 25 years as has been established above, or the cost of such number (i.e. one and half times the quantity worked out as per the above example) of wear parts based on the

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prices agreed for mandatory spares. The final mode of compensation for such shortfall viz. by means of additional quantities of spares worked out or by cost thereof shall be as per employer's discretion.

The credit of one and half times of shortfall in wear parts life shall also apply for already supplied mandatory spare parts under this contract based on average wear life achieved during GTP period.

Average Wear Life (AWL) during GTP, to be considered for pulveriser wear part warranty shall be as arrived at from the station record for each pulveriser, and as corrected for variation in YGP index of the coal being fired during GTP. For this purpose the coal YGP shall be the average tested value during GTP. The Contractor shall collect the coal samples and get them tested for YGP index at recognized, Employer's approved test lab, periodically. (The frequency of sampling and testing shall be mutually agreed between Contractor & Employer). The YGP index testing shall be done as per the BS Standard specified. A jointly signed record shall be maintained during GTP.

Note:

Employer : Customer of BHEL

Contractor : BHEL

Vendor : Agency who is supplying Grinding Elements to BHEL as per BA35053



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2. 99% Pure	99
3. 98% Pure	98
4. 97% Pure	97
5. 96% Pure	96
6. 95% Pure	95
7. 94% Pure	94
8. 93% Pure	93
9. 92% Pure	92
10. 91% Pure	91
11. 90% Pure	90
12. 89% Pure	89
13. 88% Pure	88
14. 87% Pure	87
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16. 85% Pure	85
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94. 7% Pure	7
95. 6% Pure	6
96. 5% Pure	5
97. 4% Pure	4
98. 3% Pure	3
99. 2% Pure	2
100. 1% Pure	1

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RECORD OF REVISION

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Ed. R. R. R. R. R.