INTER PLANT STANDARD IN STEEL INDUSTRY		
IPSS	**METHOD OF RECONDITIONING OF BLAST FURNACE BELLS**	**IPSS:3-02-005-18**
	Corresponding IS does not exist	Formerly: IPSS:3-02-005-06

0. **FOREWORD**

0.1 Interplant standardization in steel industry was initiated under the aegis of the Indian Standards Institution (ISI) and the Steel Authority of India Limited (SAIL). This IPSS was prepared by the standard committee on Operation and Maintenance, IPSS 3:2 and firstly published in 1995. Lastly, this has been revised by the standard committee in July 2018 with the active participation of the representatives from major Indian steel plants and leading consultants.

0.2 This standard is intended to visualize the general defects / deteriorations in Blast Furnace Bells arising out of exposure to pressure, temperature and sliding abrasive materials over a period of time. The common defects are Cracks, Erosion, Scoring, Ovality and Wear.

1. **SCOPE**

1.1. This Inter Plant Standard covers the range of normal defects in used / removed Blast Furnace bells and specifies the methodology for their reconditioning.

2. **MATERIAL OF BELL**

The material of Bell shall be cast steel conforming to grade 230-450 W of IS 1030:1989 **"Carbon steel castings for general engineering purposes (fourth revision) (Amendment 1)".**

3. **METHODOLOGY OF RECONDITIONING**

3.1. Preparation of Defect List

3.1.1 Thorough cleaning of the removed / taken out BF Bell shall be done.

3.1.2 Visual inspection shall be done to find out the cracks, erosion / scoring.

3.1.3 The ovality at the bottom diameter shall be checked on machine.

3.1.4 For wear pattern, the wall thickness of the bell shall be checked by ultrasonic method.

3.1.5 After above inspections / checking, the defect list shall be prepared.

3.1.6 Reconditioning of the Bell shall depend upon the defects found.

3.2. In case the ovality is more than 20 mm, the Bell shall be rejected.

3.2.1 In case the wall thickness is less than 75% of the drawing thickness, the bell shall be rejected.

3.2.2 The bell shall not be reconditioned more than two times and that too when the above conditions are fulfilled.

3.3. **Removal of old Hard Weld Deposit**

3.3.1 The Bell shall be loaded on a vertical boring machine and its ovality shall be checked. A clean cut shall be given at a convenient location for future use.

3.3.2 In the same setting, the existing (hard) weld metal shall be removed leaving the M.S. deposits.

3.4 **Building Up of Burden Zone (if required)**

3.4.1 Worn out burden zone portion / thickness shall be built up by suitable electrodes giving 50 (plus) RC hardness and have excellent resistance to abrasion and erosion and impact in hot condition.

3.4.2 Before starting burden zone welding, pre-heating of the area shall be done upto 150^{o}C to 200^{o}C. Pre-heating is essential whenever welding is carried out.

3.4.3 In order to achieve the desired pre-heat temperature, re-heating may be done either from inside or outside depending upon the site conditions, giving prime importance to safety as normally mixed gas will be used for the purpose of heating.

3.4.4 Thickness shall be restored to drawing dimensions.

3.4.5 Hot welds shall be covered with asbestos cloth to allow slow cooling.

3.5 **Cushioning M.S. Deposit on Contact Zone**

3.5.1 Belt shall be kept on 800 mm high stands so as to keep it raised for fixing pre-heating arrangement inside or outside.

3.5.2 Pre-heating burners along with exhauster (while heating from inside) shall be fixed / placed.

3.5.3 Pre-heating shall be done at 150^{o}C to 200^{o}C.

3.5.4 Ovality in the contact zone area shall be built / made up by MS deposit by low hydrogen electrodes (E-7018).

3.5.5 Cushioning MS deposit (thickness = 6 to 8 mm) shall be carried out by low hydrogen electrodes (E-7018).

3.5.6 Thorough cleaning of the surface shall be done before starting another layer.

3.6 **Machining of Contact Zone for Preparing the Seat for Hard Weld Deposit**

3.6.1 Bell shall be set on vertical Boring Machine.

3.6.2 Machining of the contact zone shall be carried out to the specified taper and dimensions for getting the seat of 5 mm thick for the hard weld layer.

3.7 **Hard Weld Deposit**

3.7.1 The bell shall be placed on the 800 mm stands already made for it.

3.7.2 Pre-heating of the bell shall be done as described earlier.

3.7.3 Contact zone area shall be divided into 32 equal sectors and marked serially by paint. 4 welders at a time shall be employed at 90^{o} apart in sequence directional welding. Weld deposit shall be kept inclined at 30^{o} to vertical.

3.7.4 Three layers of hard weld deposit by electrodes (5 mm) which give a maximum hardness of 46 RC at 500^{o}C and have excellent resistance to abrasion and hot erosion shall be carried out. Any undesirable crack on the Bell surface, if found, shall be gouged out and welded.

3.7.5 Every time after completion of welding, the area shall be covered with asbestos cloth to allow slow cooling only.

3.7.6 Cleaning, chipping and finishing of the layers shall be carried out in the same fashion as done in MS deposit.

3.7.7 **Stress Relieving** – The bell hopper shall be charged into the cold furnace. Slowly the temperature shall be raised to 650^{o}C at the rate not exceeding 50^{o}C per hour and soaked at that temperature for six and half hours. The cooling inside the furnace shall be effected slowly. When the temperature comes down to 300^{o}C, items shall be taken out of the furnace and allowed to cool in still air.

3.8 **Machining and Grinding of Contact Zone**

3.8.1 The Bell shall be loaded on the vertical boring machine and set with reference to the earlier reference. The hard surface material shall be machined using suitable cutting tools, setting the tool-post as stated in the drawing leaving sufficient material for grinding.

3.8.2 In case of any shortage of weld metal, the Bell shall be unload from the machine and welded after taking necessary precaution as described earlier.

3.8.3 The Bell shall be loaded again, set with reference to the old reference and machined the excess material leaving material for grinding.

3.8.4 The grinding attachment shall be fixed, the angle shall be set giving a clean cut and the desired angle shall be checked. If found correct as per drawing grinding operation can be considered as finished.

4. TRANSFER OF ANGLE FOR HOPPER GRINDING

The actual angle achieved on the bell shall be copied by the tool post and accordingly the matching hopper contact surface shall be ground to the same angle so that the matching on the contact surface is perfect.

5. FINAL INSPECTION

5.1.1 The final inspection of the contact surface shall be checked after keeping the hopper on the bell with the contact surfaces matching. In this position the clearance shall be checked between the contact surfaces from inside as well as outside. Maximum permissible clearance shall be 0.03 mm over a length of

maximum 10% of the circumference cumulative or light should not pass through.

5.2 The clearance of 0.03 mm shall not be more than 100 mm in one stretch.

5.3 The best position shall be arrived by placing the bell on the ground at 4 position separated by 90^{o} and checked by turning the hopper over the bell.

5.4 Checkup corrugation of the contact surface along the generatrix. Through an accurate straight edge kept on contact surface along a generator, 0.03 feeler gage should not pass.

5.5 Individual blocks and pores having are 20 mm SQ should be less than 10 in No over the entire ground surface.

5.6 Width of hairline cracks on the contact surface is to be within 0.05 mm in vertical direction and 0.5 mm in horizontal direction.

5.7 Final approved position shall be marked indicating matching marks on bell and Hopper.

6. WEDGE MATCHING BALANCING

6.1 The slot in bore of the Bell shall be colour-matched with wedge.

6.2 Finished bell together with the rigidity cone shall be adjusted so as to keep its centre line strictly vertical. Deviation in eccentricity permitted is not more than 0.6 mm.

6.3 The Bell for balancing purposes shall be hung vertical with the help of false rod assembled in its top bore by means of wedge.

6.4 Minimum unbalance of Bell with the rigidity device mounted on it shall be found by rotation of rigidity device.

6.5 As soon as balance has been reached, the rigidity device shall be bolted to the Bell permanently.

6.6 Balancing planks shall be bolted to a horizontal ring at the down part of the bell. Bolts and planks shall be welded around. Welding of balancing planks without fastening with bolts is prohibited.

6.7 Accuracy of balancing shall be reached within 3 mm of tolerance i.e. maximum clearance between the Bell-hem of the skirt (machined face) and the marking-block pointer in two diametrically opposite points shall not be over 3 mm at the maximum diameter.

6.8 Weight of final balanced Big Bell should be within +15% to -10% of the calculated weight.

6.9 Contact surface is to be asphalt varnish coated after inspection.

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