
Reclamation Of Main Drive Spindle of Blooming & Billet Mill of Bhilai Steel Plant

(Winner of **Eutectic Award** for reclamation in **NWS 2008**)

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ABSTRACT

Blooming and Billet Mill is the mother mill of Bhilai Steel Plant. Yearly about 2.5 MT ingots are rolled in to blooms in the Blooming Mill & these blooms are further rolled in to billets in continuous Billet Mill. Billets are fed to Wire Rod Mill & Merchant Mill as raw material

The main drive spindle gives drive to main stand roll. Due to continuous working, the slide block seating and the bearing seating on the journal portion of spindle gets worn out. The average working life of spindle is around 6 months.

The estimated cost of a new spindle assembly is approx. Rs. 5 Crores. Weight of spindle is 32.63 T. The present Russian units & also other units around the world are reluctant to supply such massive spare. Hence it was decided to reclaim slide blocks seating & as well as bearing seating of main drive spindle.

This paper deals with the reclamation technology adopted to revive this vital spare. This paper includes selection of welding consumables, preheat & post heat treatment, welding parameters, preparation & precautions for reclamation procedure.

INTRODUCTION

Blooming and Billet Mill is the back bone mill of Bhilai Steel Plant.

The function of Main Drive Spindle is to give drive to main stand roll of Blooming Mill.

These spindles are used to connect main drive to the rolls of 1150 mm stand. The spindle is about 12 meters in length and

weighs more than 32 T.

At both ends of spindle, roll coupling brass sleeper pads are fitted together with link block to join fork of main drive at one end and that of roll at another end.

In between two journal seating, babbitt bearings are provided. The journal size of babbitt bearing is Φ 550 mm.

PROBLEM

Due to continuous working, the slide block seating and the bearing seating on the journal portion of spindle gets worn out.

The average working life of slide block seating of spindle is 6 months.

The average working life of journal portion of spindle is 18 months.

WHY RECLAMATION?

The present Russian Units and also other units around the world are reluctant to supply massive spare. (Weight of spindle is 32.63 T)

The estimated cost of a new spindle assembly is approx. Rs. 5 Crores.



TECHNICAL DATA OF MAIN DRIVE SPINDLE	
1. Spindle body Φ	550 mm
2. Spindle head Φ at roll side	1050 mm
3. Spindle head Φ at motor side	1200 mm
4. Length of spindle (Measured between center line of joints)	11700 mm
5. Maximum torque transmitted by coupling	140 TM
6. RPM of spindle	0-70-120
7. Wt. of each spindle in assembly with babbit bearing of slide blocks	41055 Kg
8. Material of spindle	ST-50

MECHANICAL PROPERTIES OF PARENT METAL	
UTS	64 Kg/mm ²
YS	38 Kg/mm ²
% Elongation	Not less than 15%
Hardness	217 - 245 BHN

CHEMICAL COMPOSITION OF PARENT METAL	
C	0.20
Si	0.10 Minimum
S	0.04 Maximum
P	0.04 Maximum

RECLAMATION OF MAIN DRIVE SPINDLE CAN BE DIVIDED AS

1. Reclamation of key way.
2. Reclamation of paw area.
3. Reclamation of journal portion.

JOB PREPARATION

Main Drive Spindle is to be placed on specially designed one set of rollers stand. This facilitates easy rotation of drive spindle with the help of E.O.T. (Electric Overhead Travel) crane for right welding position.

Thoroughly grinding of area to be welded is must to remove fatigue material.



Burners are in-house made for preheating the job & post heating the HAZ. Coke Oven gas is used for heating the job.

Welding parameters selected are current, voltage & welding speed. Heat input is kept minimum.

Type of Consumable	Dia	Current	Voltage
Flux Core Wire	2.4 mm	200-250 amp.	28-30
Electrode	3.15 mm	70-90 amp.	24
Electrode	4 mm	90-120 amp.	26

Prior to take up welding, area to be reclaimed is tested to detect the crack if any. Dye Penetration Test (D.P. Test) should be done to ensure cracks or any other surface defects that may occur due to prolonged use.

RECLAMATION OF KEY WAY

MMAW (Manual Metal Arc Welding) is most suitable for welding of key way because of positional welding.

Electrode type E Ni Cr Fe-2 should be selected for reclamation of key ways.

Properties of electrode selected for reclamation of keyway are given below

- Withstands stresses produced by thermal shock.
- Extraordinary weld-ability.
- Withstands strains caused by weld shrinkage in massive sections.
- Useful for crack free joining.
- The weld metal has excellent high temperature properties like creep strength and oxidation resistance.

Mechanical Properties of Electrode (For keyway welding)

Elongation	32% to 36%
Tensile Strength	58 - 65 Kg/mm ²

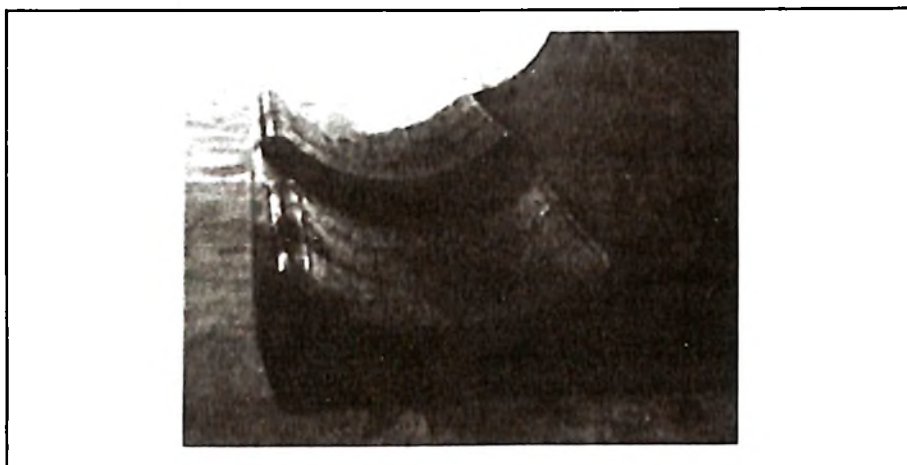
Chemical Composition of Electrode (For keyway welding)

C	0.04 - 0.06
Ni	58 - 62
Cr	14 - 16
Mn	2.5 - 3

RECLAMATION OF PAW AREA

Because of positional welding MMAW is most suitable for welding of paw portion.

Electrode low heat input E-312 type with special features should be selected for reclamation of paw area.



Properties of electrode selected for reclamation of paw area are given below

- Superior crack resistance.
- Superb weld-ability.
- Outstanding strength.
- The weld metal has controlled ferrite content as well as grain structure.
- Electrode has spray type transfer & weld bead is smooth with uniform ripples.

Mechanical properties of electrode (for welding of paw area)

Tensile Strength	80 - 85 Kg/mm ²
Elongation	22% to 24%
Hardness	220 BHN - 245 BHN

Chemical composition of electrode (for welding of paw area)

C	0.10 approx.
Cr	28 - 30
Ni	9.7 - 10

Welding procedure for reclamation of key way & paw area

- Cleaning and grinding of area to be welded.
- Preheating of job between 1500C to 2500C.
- Preheating of electrode.
- First of all key way welding should be taken up.

While welding

- Set lowest possible current
- Weld with short arc.
- Deposit stringer bead.
- Chip slag between passes.
- Peen each deposit
- Cool slowly.

After completion of keyway welding, now take up welding of paw area

- Divide each side of paw area in to 9 sectors as shown in Fig. no. 1.
- Follow welding sequence 1,2,3,4,5,6,7,8 & 9
- Take measurement after completion of each layer of welding.
- Sufficient machining allowance i. e. 5 mm to 6 mm is provided for paw portion & as well for keyway.

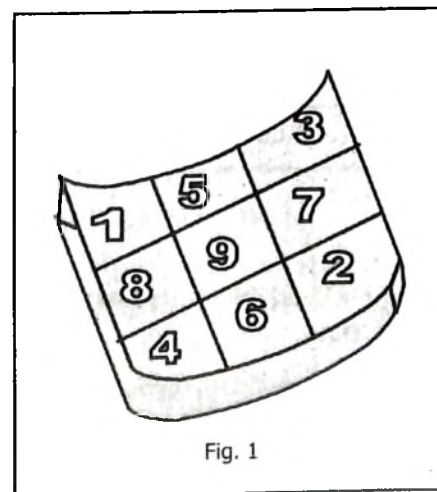


Fig. 1

Post Heat Treatment

After completion of welding, post heat treatment should be done to relieve internal stresses. For that, HAZ should be heated up to 400°C to 450°C for 8 hours and then allow slow cooling.

RECLAMATION OF JOURNAL PORTION



RECLAMATION OF JOURNAL PORTION

Selection of welding process & consumable

MIG process or open arc process is selected for reclamation of journal portion as about 200 Kg weld deposit is required. This process is capable of welding metals of unlimited thickness. This process gives smooth and deep penetration weld bead. This welding process is the least expensive that can be used for depositing X-ray quality weld bead.

Divide the journal portion in to 8 sectors as shown in Fig. No 3.

Follow welding sequence 1,2,3,4-----8.

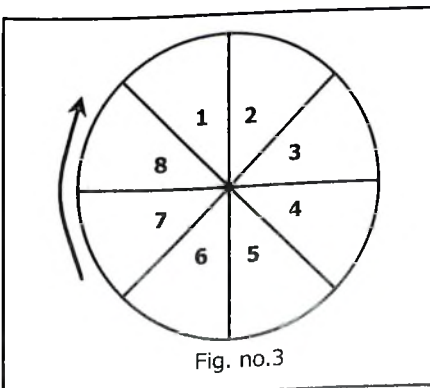


Fig. no.3

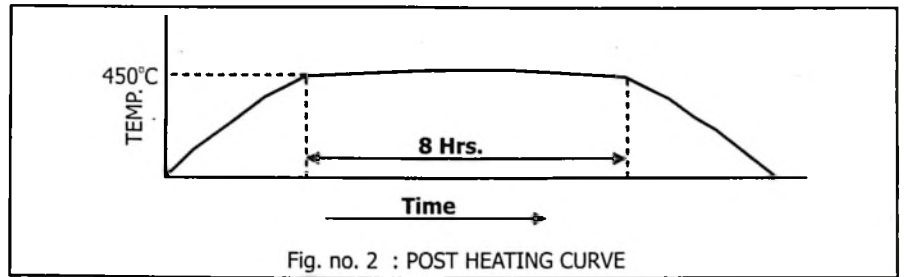


Fig. no. 2 : POST HEATING CURVE

For buffer layer of 3 to 4 mm thickness, low heat input type 312 welding wire is selected.

For subsequent built up runs, low heat input type 18-8 (ISO-3581) welding wire is selected. Hardness of the weld deposit of the built up run is

As welded	180 BHN to 230 BHN
After work hardening	325 BHN to 340 BHN

After each run the surface must be ground finished to eliminate slag inclusions, blow holes etc.

Dimensions after final welding should have a machining allowance of 6 mm to 8 mm on all drawing dimensions.

Post Heat Treatment

After completion of welding of journal portion post heating should be done to relieve internal stresses. HAZ should be heated up to 400°C to 450°C for 8 Hrs. and then allow slow cooling.

Precautions

1. Ensure that the electrodes are dry. Re-dry the electrodes at 200°C to 300°C for one hour.
2. While welding on paw area, put two welders simultaneously.
3. Maintain inter pass temperature between 150°C to 200°C.
4. Cover the job to allow slow cooling.
5. Weld in flat position wherever possible.
6. After each run, surface should be cleaned thoroughly to eliminate slag

inclusion, blow holes etc.

Techno-economics

Reclamation cost of one side key way and paw portion (which depends upon wear pattern) is around Rs. 3 to 4 Lakhs.

Reclamation cost of one side journal portion (which depends upon wear pattern) is around Rs. 5 to 6 Lakhs.

So the reclamation cost of both sides paw portion, key way & journal portion will be around Rs. 20 Lakhs max, which comes around 4% of the cost of new assembly.

CONCLUSION

The spindles of BBM were supplied by erstwhile USSR. Presently efforts are made to purchase new spindles from Soviet Block Nations / Europe. But it could not materialize as either vendors did not have the capacity to make such huge item or they were not interested.

At present the reclaimed drive spindles are running satisfactorily. The pioneering effort of the team is successful & spindles are being reclaimed regularly @ 2 nos./ year.

The success achieved here has also opened new avenues for reclamation of spindles of new mill like Plate Mill and old mills like Rail & Structural Mill etc.

REFERENCE

Welding & welding technology by Richard L. Little.