ORDNANCE FACTORY AMBAJHARI, NAGPUR	WM/SF	SPECN. NO. F-537 A
SPECIFICATION OF STEEL BILLETS FOR 76/62 SRGM	JGM/CM	SHEET NO. 1
		NO.OF.SHT. 6

1 MATERIAL SPECIFICATION: AISI 9260

2. TABLE 1 : CHEMICAL COMPOSITION

ELEMENTS	PERCENTAGE
C	0.56 – 0.64
Si	1.80 – 2.20
Mn	0.75 – 1.00
S	0.040 MAX.
P	0.035 MAX.
Al	0.02 – 0.04
Ni	0.25 MAX.
Cr	0.20 MAX.
Mo	0.06 MAX.
Cu	0.035 MAX.

INDEX OF PURITY	:	P + S	0.065% MAX.
RESIDUAL INDEX	:	Ni + Cr + Mo	0.40% MAX.

2.1. Results of all chemical analysis must conform with the figures laid down in Table 1

3. MANUFACTURING PROCESS :

3.1. Steel is to be manufactured through EAF/BOF–LRF–VAD/VD–bottom poured ingot route.

3.2. The material must be vacuum degassed and subjected to a hydrogen diffusion cycle to ensure freedom from hydrogen embrittlement and flaking. This must be stated on the release certificate. Hydrogen diffusion cycle is not required if Hydrogen level <2PPM is achieved

3.3. The steel shall be killed and free from harmful defects such as seams, flaws, piping, cracks porosity,impurities and surface defects.

3.4. Actual rolling temperature & final furnace temperature is at the descretion of the steel manufacturer. It must be recorded & supplied on demand.

3.5. Adequate top and bottom discards are to be given to all ingots to ensure soundness and freedom from piping, porosity, & harmful segregation. This is to be proved by sulphur print, macro–etch, or other method mutually acceptable to the manufacturer, purchaser and the company. Macro sample shall be selected from billets representing top & bottom for 2 ingots per plate (i.e. 4 samples–2 Top & 2 Bottom per plate)

3.6. Segregation tests are to be carried out according to ASTM A711–S7. The maximum allowable variation between the sampled points being 10%. The first, middle and end bars of each ingots are to be sampled by cutting a slice off the bar. Sample for Chemical Analysis is to be selected by taking 15% material from centre & balance along the same diagonal. Each of these chemical analysis are to confirm to Table 1. The chemical composition between each of the three points may not vary by more than that specified in table no 1.

Should any one of the three bars be out of this specification, that bar is to be recorded and scrapped and every bar from that ingot is then to be subjected to this segragation test.

3.7. The reduction ratio of ingot to end product should be atleast 6:1

3.8. The billet from the bottom and the top end of each ingot must be marked (B & T resp.)

4. MICROGRAPHICAL ANALYSIS :

The test sample material must inherently be fine grain with a grain size (after hardened and tempd.) of 5–8 ASTM. (Test as per ASTM E 112 or approved equivalent)

4.1. Permissible Inclusion rating :
permissible inclusion rating will be as under ;
2/1 (Thin/Thick) as per IS: 4163–1982 (Reaffitmed 1996) for each type of inclusion A, B, C and D.

4.2. Macro Etch Test :
Macro Etch test should confirm to grade C1, R2 & S2 of ASTM E 381–98. Carbon based deposits/carbon dots undesirable and are to be avoided.

5. INTERNAL DEFECTS :

The Ultrasonic testing shall be carried out in 100% Bars as per following process.

5.1. Prodedure

a) The surface of the material under test shall be such that uniformly good ultrasonic coupling is achieved over the scanning area.

b) Calibration block as per IS: 4904–90 shall be used for calibration of the equipment.

c) Two sides of the billets with 90° angle between each other to be scanned over their complete surfaces with suitable overlapping.

d) For sensetive setting of the equipment and defect assesment a DAC curve will be drawn with suitable 2mm FBH referances std. (min. 3 point reference)

e) Alternatively, DGS scale may be used.

f) DAC gain level + 4 dB may be used for gain as working sensitivity.

g) 2MHz to 5MHz normal beam probe will be used for scanning.

h) While assessing the defect, transfer loss should be taken into account and necessary correction to be made.

5.2. Acceptance level

a) Single defects giving indications that exceeds 2mm dia FBH are not acceptable (single defect means with a length that not exceeding the probe–dia. 24mm.

b) Single defect upto 3 nos/m separated by less than 100mm each having indication exceeding 50% of 2mm FBH are not acceptable.

c) Reduction of bottom each caused by internal defects over 20% are not acceptable.

d) Multiple defects with max. indication less than that from a 2mm dia equivalent artificial flow but not seperable at test. Sencitivity are not acceptable if the back echo is reduced to less than 70% of full screen height.

6. MECHANICAL PROPERTIES :

6.1. The test condition of the samples selected from billets for Mechanical test is required to be in Hardened and Tempered condition to satisfy the following mechanical properties or The sample is to be forged down to 40mm dia. and suitably hardened & tempered to satisfy the following mechanical properties.

Hardness = 35–39 Rockwell
Yield strength = 0.2% 1080–1200 Mpa
Tensile strength = 1225 Mpa min.
Elongation = 7% min.
Charpy impact = 10 J min.

7. QUALITY ASSURANCE REQUIREMENTS :

Firm must submit the quility plan giving all details of manu–facturing process and other requirements.

7.1. Visual inspection.

100% visual inspection of the bars shall be carried out to make sure that they are free from harmful seams, cracks, embedded scale and folds.

7.2. Straightness.

Maximum bow 3mm/m.

7.3. Twist.

Maximum 5mm/m.

7.4. Hardness.

Hardness 240 BHN max. and 190 BHN (Min.).

7.5. Surface.

As rolled.

Depth of cracks 1mm max.
Depth of local grinding 3mm max.

8. DELIVERY REQUIREMENTS :

8.1. Supply.

Supply is to be made in length of 3m to 6m length in multiple of 278mm plus 50 to 100mm extra and maximum 5% short down to length 2300mm is acceptable.

Any material which will not fall in the above length range, the corrosponding end pieces will be rejected by O.F.Aj. supplier will. replace the same quantity immediately.

8.2. Material must be supplied in annealed condition. The grain size after annealing shall be greater than ASTM 1.

8.3. Dimension.

Bars shall have the dimensions as per drawing No. F- 536 of latest issue.

8.4. Shape.

Hot or cold saw on both ends with cut square.
Ends to be deburred.

8.5. Marking.

Each bar to be stamped with melt No. or melt code No. on one end. The melts are to be delivered seperated in bundles. Two tags stating melt No. and steel brand to be attached to each bundle.

8.6. Colour code.

35mm to 40mm width "BLACK" colour band is to be painted throughout the length of each bar on one side.

8.7. A cast must be delivered in its full quantity before the delivery of any other cast may commence.

9. CERTIFICATES :

Certificate covering following analysis, steel melting practice and mechanical properties to be sent in triplicate to user.

9.1. Chemical Analysis Certificate :
Certificate of chemical analysis and check analysis as per para 2.

9.2. Mechanical Properties Certificate :
Mechanical Properties Certificate as per para 6.

9.3. Grain size certificate :

A Certificate certifying grain size as specified in para 4.. must be supplied.

9.4 Cleaniness certificate :

A certificate to certify cleanliness as specified in para 4.1..

9.5. Macro Each Certificate :

A certificate to certify Macro etch results as per para 4.2.

9.6. Annealing :

The certificate shall contain a statement to verify that this has been done.

9.7. Ultrasonic inspection certificate :

A certifcate to certify ultrasonic testing as per para 5.

REV.	DATE	DESCRIPTION	SIGN
65/15 A	03/04/2015	IN POINT 8.1, 278 & 2300 WERE 260 & 2150 RESPY	WM/SF

AMENDMENTS

ORDNANCE FACTORY AMBAJHARI

COMPILED BY : BAGDE	SPECIFICATION OF STEEL BILLET	SPECN. NO.: F-537 A
CHECKED BY : 28.10.05		SHEET NO.- 6
JWM/CDO 29.10.05		NO.OF SHEETS - 6
APPROVED WM/SF 29.10.05 JGM/CM	STORE : 76/62 SRGM	COMPT. FORGED BODY F-534