

ORDNANCE FACTORY AMBAJHARI, NAGPUR

Bann
WM/SF²⁷⁻²⁻⁰⁶

SPECN. NO.

F-444D

SPECIFICATION OF STEEL BILLETS
FOR 155mm 107 SHELL

cm
JGM/CM²⁷⁻²⁻⁰⁶

SHEET NO. 1

NO.OF.SHT. 5

1 MATERIAL SPECIFICATION:TYPE B14

2. TABLE 1 : CHEMICAL COMPOSITION

ELEMENTS	PERCENTAGE
C	0.68 - 0.73
Si	0.20 - 0.35
Mn	0.30 - 0.50
P	0.050 Max.
S	0.050 Max.
Cr	0.30 Max.
Ni	0.30 Max.
Mo	0.08 Max.
Cu	0.30 Max.
Al	0.030 Max.
*] Cp%	1.05 - 1.20

$$*] C_p = C [1 + 0.5 (C-0.20)] + 0.15 Si + Mn [0.125 + 0.25 (C-0.20)] + 1.25 P + 0.2 Cr + 0.1 Ni.$$

Note: Atleast 3 sample should be taken in each heat & recorded.

3. MANUFACTURING PROCESS :

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

Teeming temperature should be maintained in such that there is a uniform grain structure through out the cross section of ingot and dendritic structure is to be avoided.

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

3.3. 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 any other method mutually acceptable to the manufacturer, & purchaser.

Sample is to be drawn from Top of the first bar of first ingot cast & second sample is to be drawn from bottom of the last bar of last ingot cast.

3.4. Segregation tests are to be carried out according to ASTM A711-S7. The maximum allowable variation between the sampled points being

ORDNANCE FACTORY AMBAJHARI, NAGPUR

B. Basu
WM/SF
27-2-06

SPECN. NO.
F-444D

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mm
JGM/CM
27-2-06

SHEET NO. 2
NO.OF.SHT. 5

10%. 3 Samples from frist, middle & end of the bar from any Ingot of each heat 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 heat is then to be subjected to this segregation test.

- 3.5. The reduction ratio of ingot to end product should be atleast 6:1
- 3.6. 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 Normalising.) of 7-8 ASTM. (Test as per ASTM E 112 or approved equivalent)

Atleast two sample to be checked for micro examination in each heat.

- 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 :
Billets shall be tested as under with following sampling plan.
Bottom poured 1st. set : 1 Top.
Bottom pouring 2nd set : 1 Bottom.
Bottom pouring 3rd set : 1 Top.
Acceptance standard is C1,S2,R2. in case of any Macro failur 100% Billets of the cast to be Macro eached from top & bottom.

5. INTERNAL DEFECTS :

Ultrasonic test as per IS: 8791-1978 class 'A'
100% bars to be checked.

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

ORDNANCE FACTORY AMBAJHARI, NAGPUR

Bannu
WM/SF^{27.2.06}

SPECN. NO.

F-444D

SPECIFICATION OF STEEL BILLETS
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Bannu
JGM/CM^{27.2.06}

SHEET NO. 3

NO.OF.SHT. 5

6. MECHANICAL PROPERTIES :

- 6.1. From two air cooled or normalised billet per melt, one tensile test piece is to be machined. The centre of the test piece must be 30mm below rolled surface.

Billet should achieve the following mechanical properties after forging.

$$\begin{aligned} R_p 0.2 &= \text{min. } 400 \text{ N/mm}^2 \\ R_m &= \text{min. } 790 \text{ N/mm}^2 \\ A10 \% &= 7-16 \% \end{aligned}$$

7. QUALITY ASSURANCE REQUIREMENTS :

Firm must submit the quality plan giving all details of manufacturing 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 3mm/m.

- 7.4. Bendness.
permissible bendness 3mm/meter max.

- 7.5. Hardness.
Hardness ~~190 BHN Min.~~ and 240 BHN Max.

Please note that grinding can cause surface hardening of the billet and make sawing impossible. Ground surfaces with high hardness are not allowed, the hardness specification does not apply for the Cut unit.

- 7.6. Surface.
As rolled.

8. DELIVERY REQUIREMENTS :

- 8.1. Supply.

Supply is to be made in length of 3m to 6m length in multiple of 365 mm plus 0 to 50 mm extra and maximum 5% short down to length 2245 mm is acceptable.

ORDNANCE FACTORY AMBAJHARI, NAGPUR

R. B. B. B.

SPECN. NO.

WM/SF ^{27.2.06}

F-444D

SPECIFICATION OF STEEL BILLETS
FOR 155mm 107 SHELL

mm
27.2.06
JGM/CM

SHEET NO. 4

NO.OF.SHT. 5

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

- 8.2. Suitable Post rolling treatment should be given to rolled bars such that it satisfies the cold sawing properties when cut in Cold saw Circular/Band sawing machine.

Incidental elements, inclusion and grain size to be controlled more than 1 ASTM so that the material can be parted off in cold sawing machine/Band sawing machine without any difficulties. *R. B. B. B.*

- 8.3. Dimension.

Bars shall have the dimensions as per drawing No. F434 A of latest issue.

- 8.4. Shape.

Hot or cold saw on One end & other end gas cut allowed with cut square. Ends to be deburred. How ever bundling is to be done with saw cut end at one direction.

- 8.5. Marking.

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

- 8.6. Colour code.

75mm to 80mm width "BRIGHT YELLOW" colour band is to be painted through out the length of each billet on one side. On both ends "107" is to painted with the same colour.

- 8.7. Bundling.

The shell bar are to be bundled Heat wise with 5 to 6 mm dia M.S. wire or steel strap with a steel tag mentioning steel grade, heat no, qty. and firm name, Weight of each bundle not to exceed 4 tons.

- 8.8. 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 : as per para 2.

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

- ~~9.3. Grain size certificate : as per para 4.~~

ORDNANCE FACTORY AMBAJHARI, NAGPUR	WM/SF ²⁷⁻²⁻⁰⁶ <i>R Baerw</i>	SPECN. NO. F-444D
	JGM/CM ²⁷⁻²⁻⁰⁶ <i>mm</i>	SHEET NO. 5 NO.OF.SHT. 5

SPECIFICATION OF STEEL BILLETS FOR 155mm 107 SHELL

- 9.3. Cleaniness certificate : as per para 4.1.
- 9.4. Macro Etch Certificate : as per para 4.2.
- 9.5. Ultrasonic inspection certificate : as per para 5.
- 9.6. Hardness certificate : as per para 7.5.
- 9.7. NO of bars and total quantity.

Note : Certificates are to be signed by Inspecting authority.

310/2014 D	31/12/2014	IN PARA NO. 8.1 LENGTH 365 mm & 2245mm WERE 345mm & 2120mm	<i>L. G. C.</i> WM/SF
388/05 C	01-09-06	PARA NO 8.4. AMENDED. PARA NO 8.2. SECOND PART DELETED. PARA NO 3.4. SEGREGATION TEST AMENDED, PARA NO 4 GRAIN SIZE DELETED PARA NO 7.5. HARDNESS 240 BHN MAX WAS 190-230 BHN. PARA NO 8.1. SUPPLY LENGTH 345 mm & 2120mm WAS 340 mm & 2050 mm	<i>R Baerw</i> WM/SF
81/08 B	27/02/06	SPECIFICATION MADE IN NEW FORMAT WITH ALL DETAILS WHICH COVERING THE MONITARING INSTRUCTION ALSO AUTHORITY: WM/SF L.NO. 2952/DRG/SPECN./SF DT 27/02/06	<i>R Baerw</i> WM/SF
156/05 A	06/06/05	NOTE NO 3 AMENDED, NOTE NO 18 ADDED. AS PER WM/SF L. NO. 2952/DRG/SPECN/SF DT. 19/05/05	-sd- WM/SF
REV.	DATE	DESCRIPTION	SIGN

A M E N D M E N T S

ORDNANCE FACTORY AMBAJHARI

RECOMPILED BY : <i>JL</i>	SPECIFICATION OF STEEL BILLET FOR 155MM 107 SHELL	SPECN. NO.: F-444D
CHECKED BY : JWM/CDO <i>R Baerw</i>		SHEET NO.- 5
APPROVED <i>R Baerw</i> WM/SF ²⁷⁻⁰²⁻⁰⁶		NO.OF SHEETS - 5
<i>mm</i> JGM/CM ²⁷⁻⁰²⁻⁰⁶	STORE : SHELL 107	COMPT. FORGED BODY F-358