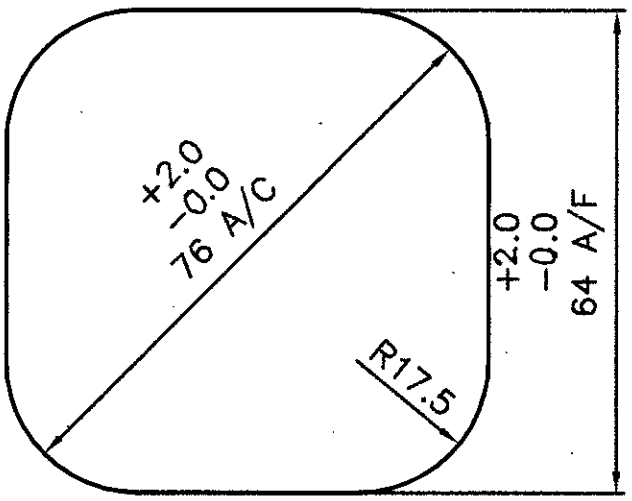
DRG. NO. F-329 M

AMENDMENTS			
REV	DATE	DESCRIPTION	SIGN



DIMENSIONS ARE IN mm			MATERIAL STEEL TO SPECN. JSS 9510-1,GRADE SS/F44
THIRD ANGLE PROJECTION			
SCALE – 1 :1			NOMENCLATURE
2005	NAME	DATE	STEEL BILLET
DRAWN	BAGDE	12-07-86	
RE TRACED		27.02.06	
CHECKED	B.K.CHAKRABORTY	12-07-86	
JWM/CDD			
APPVD WM/SF		27-2-06	M/C :
			STORE : 81mm SHELL

ORDNANCE FACTORY
AMBAJHARI

DRAWING NO.
F-329 M

SHEET NO.– 1
NO.OF SHEETS – 6

OPERATION –

COMPT. FORGED BODY
F-9,10

ORDNANCE FACTORY AMBAJHARI, NAGPUR	WM/SF 27.2.06	SPECN. NO. F-329 M
SPECIFICATION OF STEEL BILLETS FOR 81mm SHELL	JGM/CM 27.2.06	SHEET NO. 2
		NO.OF.SHT. 6

1 MATERIAL SPECIFICATION: JSS 9501-I,GRADE SS/F44

2. TABLE 1 : CHEMICAL COMPOSITION

ELEMENTS	PERCENTAGE
C	0.45 – 0.55
Mn	0.70 – 1.00
Si	0.12 – 0.35
S	0.05 MAX.
P	0.05 MAX.
Ni	0.25 MAX.
Cr	0.20 MAX.
Mo	0.10 MAX.
Al	0.035 MAX.
V	0.02 MAX.

3. MANUFACTURING PROCESS :

3.1. Steel is to be manufactured through EAF/BOF-LRF-VAD/VD-bottom poured ingot route /Concast route with EMS facilities. Teeming temperature should be maintained in such that there is a uniform grain structure thruogh out the cross section of ingot and dendrite 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 Macro sample shall be selected from billets representing top & bottom for atleast one ingot per plate or six no per heat which ever is max.

Sample is to be drawn from top of the first bar of first ingot cast and 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 10%. 3 Samples from first, 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 segragation 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.~~

14/7/06

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 : Sample will be six no's per heat/one no per plate.
Macro Etch test should confirm to grade C1, R2 & S2 of ASTM E 381–68. Carbon based deposits/carbon dots are undesirable and are to be avoided.
~~Atleast two sample to be checked in each heat for macro examination.~~

~~5.~~ INTERNAL DEFECTS :

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

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

14/7/06

5. MECHANICAL PROPERTIES :

5.1. The test condition of the samples selected from billets for Mechanical test in normalised condition, to satisfy the following mechanucal properties.

0.2% Proof stress = 310 Mpa Min.
Tensile strength = 590 Min. & 885 Mpa Max.
Elongation = 8% Min.

Atleast two sample to be checked for above test in each heat.

The heat treatment schedule should be recorded and mentioned in Test certificate.

6. QUALITY ASSURANCE REQUIREMENTS :

Firm must submit the quality plan giving all details of manufacturing process and other requirements.

6.1. 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.

6.2. Straightness.
Maximum bow 3mm/m.

6.3. Twist.
Maximum 3mm/m.

6.4. Bendness:
Permissible bendness 3mm/meter max.

6.5. Hardness.
Hardness 210 BHN max. and 190 BHN min. However ruling factor for ~~Hardness should be uniform from surface to core~~
~~5% of total shell bars to be checked against each heat no. if not found OK. further 20% to be checked, if not found OK. then 100% to be checked.~~
Acceptance will be defect free Cold Shearing. Hardness indicated above is for Guidence only to achieve better Cold shearing properties.

6.6. Surface.
As rolled.

ORDNANCE FACTORY AMBAJHARI, NAGPUR	WM/SF 27-2-06	SPECN. NO. F-329 M
SPECIFICATION OF STEEL BILLETS FOR 81mm SHELL	JGM/CM 27-2-06	SHEET NO. 5
		NO.OF.SHT. 6

~~7. DELIVERY REQUIREMENTS :~~

~~7.1.~~ ~~Supply.~~

Supply is to be made in length of 3m to 6m maximum 5% short down to 1350 mm

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.

~~7.2.~~ Post rolling treatment should be given to rolled bars such that it satisfies the cropping properties when cut in 1000T /1600T cold shearing machine.
Incidental elements, inclusion and grain size to be controlled ~~with in 7-8 ASTM sc~~ such that the material can be parted off in cold shearing machine without any defect on sheared surfaces.

~~7.3.~~ Dimension.
Bars shall have the dimensions as per drawing No. F-329 of latest issue.

~~7.4.~~ Shape.
Hot or cold saw at One end and other end gas cut allowed with cut square. Ends to be deburred. However bundling is to be done with saw cut end at one direction.

~~7.5.~~ 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.

~~7.6.~~ Colour code.
25mm to 30mm width "YELLOW" colour band is to be painted throughout length of each bar on one side. Heat no to be stamped on each bar.

~~7.7.~~ ~~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.

~~7.8.~~ A cast must be delivered in its full quantity before the delivery of any other cast may commence.

7. CERTIFICATES :

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

7.1. Chemical Analysis Certificate : as per para 2.

ORDNANCE FACTORY AMBAJHARI, NAGPUR	WM/SF 27.2.06	SPECN. NO. F-329 M
SPECIFICATION OF STEEL BILLETS FOR 81mm SHELL	JGM/CM 27.2.06	SHEET NO. 6
		NO.OF.SHT. 6

7.2. Mechanical Properties Certificate : as per para 5.

~~8.3. Grain size certificate : as per para 4.~~

7.3. Cleaniness certificate : asper para 4.1.

.4. Macro Etch Certificate : as per para 4.2.

~~9.6. Ultrasonic inspection certificate as per para 5.~~

7.5. Hardness certificate : as per para 6.5.

7.6. No of bars and total quantity.

Note : Certificates are to be signed by inspecting authority.

REV.	DATE	DESCRIPTION	SIGN
137/2014 M	12.05.2014	DELIVERY REQUIREMENTS NO 7 TO 7.8 DELETED BALANCE NO ADJUSTED ACCORDINGLY	WM/SF
389/06 L	01.09.06	PARA NO 4.2. SAMPLE NOS ADDED & LAST LINE DELETED PARA NO 3.4 SEGREGATION TEST AMENDED. PARA NO 3.3. AMENDED. TOL. ON BILLET CROSS SECTION $\pm 2.0_{-0.0}$ WAS $-0.0_{+2.0}$ ON BOTH DIMNS.	WM/SF
308/2006 K	11/07/06	PARA NO 4.5 DETAIL DELETED, IN PARA NO 6.5. DETAIL AMENDED, IN PARA NO 7.2. WITH IN 7-8 ASTM DELETED, IN PARA NO 7.4. DETAIL AMENDED, IN PARA NO 8 NO ADJUSTED ACCORDINGLY. AUTH. WM/SF L.NO 2952/DRG./SPECN/SF. DT. 11/07/06	WM/SF
83/2006 J	27/02/06	SPECIFICATION MADE IN NAW FORMAT WITH ALL DETAILS WHICH COVERING THE MONITERING INSTRUCTION ALSO R 17.5 INTRODUCED IN BILLET. AUTHORITY: WM/SF L.NO. 2952/DRG/SPECN/SF DT 27/02/06	WM/SF
311/2005 H	10/11/94	NOTE NO 10 AMENDEDIN. CHEMICAL COMPOSITION S% AMENDED 0.05 MAX WAS 0.03-0.06 REF. SR GM. APPROVAL L.NO. 7801/1/MTL (STD CELL) DT 21/10/2005	-sd- WM/SF
100/2004 G	10/03/04	IN NOTE NO 4 HARDNESS ADDED, NOTE NO 10,11,12 ADDED AUTHORITY AWM/SF L.NO. 2953/TOOL/SF. DT. 08/03/04	-sd- AWM/SF
23/2003 F	14/01/03	IN NOTE NO 1, 5% WAS 10%	-sd- JGM/SF
430/94 E	29/11/94	NOTE NO 9 ADDED AUTH. CQA(MET) L NO. INST/MQA-2, DT 15-9-94	-sd- DGM/QA
62/88 D	06/02/88	IN NOTE 8 BILLET ON ONE SIDE WAS BAR ON TWO OPPOSITE SIDES.	-sd- DGM/SF
508/87 C	21/12/87	NOTE NO 8 FOR COLOUR CODE ADDED.	-sd- DGM/SF
152/87 B	18/4/87	IN NOTE NO.7 'GASSY' WAS 'GRASSY'.	-sd- F/DO
82/87 A	19/02/87	NOTE NO 7 ADDED.	-sd- DGM/PL

A M E N D M E N T S

ORDNANCE FACTORY AMBAJHARI

COMPILED BY :	SPECIFICATION OF STEEL BILLET	SPECN. NO.: F-329 M
CHECKED BY :		SHEET NO.- 6
JWM/CDO		NO.OF SHEETS - 6
APPROVED WM/SF 27.2.06 JGM/CM 27-2-06	STORE : 81mm SHELL	COMPT. FORGED BODY F-9,10 Latest issue