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DRAFT TANZANIA STANDARD

Carbon steel cast billet ingots, billets, blooms and slabs for re-rolling into steel for general structural purposes — Specification

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*National Development Corporation (NDC)
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0 Foreword

This draft Tanzania Standard has been prepared under Metals and Structures Technical Committee (MEDC 02), under supervision of Mechanical Engineering Standards Divisional Committee (MEDC).

During the preparation of this Tanzania Standard, assistance was derived from the following publications:

IS 2830:2012, published by the Bureau of Indian Standards *Carbon Steel Cast Billet Ingots, Billets, Blooms and Slabs For Re-rolling into Steel for General Structural Purposes — Specification*.

1 Scope

1.1 This standard covers the requirements of carbon steel cast billet ingots, billets, blooms, slabs and for re-rolling into medium and high tensile structural steel including steel for concrete reinforcement. The requirements of this standard shall also be applicable to billets, blooms and slabs produced by continuously cast process.

1.2 Carbon steel cast billet ingots, billets, bloom and slabs (including continuously cast) may also be supplied in copper-bearing quality. In which case steel shall be designated with a suffix Cu.

2 Normative References

ISO 404, Steel and steel products - General technical delivery requirements.

ASTM E381, Standard Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings

ISO 4968, Steel — Macrographic examination by sulfur print (Baumann method)

ASTM A751, Standard Test Methods and Practices for Chemical Analysis of Steel Products

3 Terms and Definitions

For the purpose of this standard the following definitions shall apply.

3.1 Cast Billet Ingots

For the purpose of this standard, cast billet ingot shall be defined as ingot, generally of cross-section not more than 200 mm^2 which can be rolled directly into merchant products. Cast billet ingot is also sometimes known as ‘pencil ingot’.

3.2 Billet

A semi-finished product obtained by forging, rolling or continuously casting, usually square (not exceeding 125 mm × 125 mm in cross-section) with rounded corners or round (not exceeding 125 mm in diameter) and are intended for further processing into suitable finished product by forging or re-rolling.

3.3 Bloom

A semi-finished forged, rolled or continuously cast product. The cross-section is square or nearly rectangular (excluding slab) and the cross-section is generally more than 125 mm × 125 mm (or equivalent cross-sectional area).

3.4 Slab

A semi-finished rolled, forged or continuously cast product intended for re-rolling or forging. The cross-section is rectangular. The thickness does not exceed one-third of the width.

4 Supply of Material

General requirements relating to the supply of Carbon steel cast billet ingots, billets, blooms and slabs shall conform to ISO 404.

5 Manufacture

5.1 Steel shall be manufactured by any process of steel making except the Bessemer process. It may be followed by secondary refining.

5.2 Steel shall be supplied semi-killed or killed. Rimming steel may also be supplied subject to a special agreement between the purchaser and the supplier.

6 Chemical Compositions

6.1 The ladle analysis of the steel, when carried out by the method specified in the ASTM A751 or any other established instrumental/chemical method, shall be as given in Table 1. In case of dispute the procedure given in ASTM A751 shall be the reference method.

Table 1: Chemical Composition

S/No.	Designation	Carbon, %	Manganese, %
i)	C15	0.12 - 0.18	0.30 - 0.60
ii)	C18	0.15 - 0.21	0.30 - 0.60
iii)	C20	0.17 - 0.23	0.30 - 0.60
iv)	C15 MMn	0.12 - 0.18	0.60 - 1.00
v)	C18 MMn	0.15 - 0.21	0.60 - 1.00
vi)	C20 MMn	0.17 - 0.23	0.60 - 1.00
vii)	C15 HMn	0.12 - 0.18	1.00 - 1.80
viii)	C18 HMn	0.15 - 0.21	1.00 - 1.80
ix)	C20 HMn	0.17 - 0.23	1.00 - 1.80
x)	C25 HMn	0.30, *Max*	1.80, *Max*

NOTES:

1 The carbon equivalent (CE) shall be subject to the mutual agreement between the purchaser and the manufacturer. The formula for determination of CE is given below:

$$\text{CE based on ladle analysis} = C + \frac{Mn}{6} + \frac{(Cr + Mo + V)}{5} + \frac{(Ni + Cu)}{15}$$

2 When the steel is killed by aluminium alone, the total aluminium content shall not be less than 0.02 percent. When the steel is killed by silicon alone, the silicon content shall not be less than 0.10 percent. When the steel is silicon aluminium killed, the silicon content shall not be less than 0.03 percent and total aluminium content shall not be less than 0.01 percent.

3 When micro-alloying elements like Nb, V and Ti are used individually or in combination the total content shall not exceed 0.2 percent.

4 While placing order the steel should be designated by 'Designation (*see* Table 1), followed by grade (*see* **6.1.1**). For example C15 A (steel designation C15 and grade A) or C20 HMn B (steel designation C20 HMn and Grade B). When steel is required in copper beating quality, it shall be designated with a suffix Cu, for example C15 ACu or C20 HMn BCu.

5 Some of the grades may be treated with rare earths for better formability.

6 Nitrogen content of the steel should not exceed 0.012 percent and shall be ensured by the manufacturer by occasional check analysis.

7 Details of elements other than those specified may be supplied, if agreed at the time of enquiry.

8 Steel may be ordered with restricted sulphur and phosphorous subject to mutual agreement.

9 For grade C25 HMn, sulphur and phosphorus shall be 0.060, *Max* each. However, combined sulphur and phosphorus shall not exceed 0.11 percent. Other requirements shall be as per the relevant finished product standard.

10 In order to get the desired properties, the chemical composition may be mutually agreed to between the manufacturer and the purchaser within the stipulation of this standard.

6.1.1 All types of steel in Table 1 (except C25 HMn) may be supplied in three grades, namely A, B and C having following sulphur, phosphorus content (on ladle analysis):

Grade	Sulphur % Max	Phosphorous % Max
A	0.050	0.050
B	0.045	0.045
C	0.040	0.040

6.2 When steel is required in copper bearing quality, copper content shall be between 0.20 and 0.35 percent.

6.3 Check Analysis

Check analysis shall be carried out on the finished product from the standard position. Permissible variations in the case of check analysis from the limits of ladle analysis specified in Table 1 and **6.1.1** shall be as given in Table 2.

Table 2: Permissible Variation Over the Ladle Analysis for Check Analysis

S/No.	Constituent	Variation Over the Specified Maximum or Under the Minimum Limits, Percent
i)	Carbon	0.02
ii)	Manganese	0.03
iii)	Sulphur	0.005
iv)	Phosphorous	0.005
v)	Copper	0.03

NOTES

1. Variation shall not be applicable both over and under the specified limit in several determinations in a heat.
2. Check analysis shall not apply to rimming quality.

7 Sampling

At least one ladle analysis shall be taken per cast.

8 Selection of Test Sample for Check Analysis

8.1 In the case of cast billet ingots, if required, the samples for product analysis shall be prepared by forging/rolling down to 30 mm round section.

8.1.1 Drilling shall be taken from the sample (*see* **8.1**) representing two-thirds, one-half and one-third of height from bottom of the ingot separately.

8.2 In case of billets, blooms and slabs (including continuously cast) the sample for check analysis shall be taken from the location as shown in Figure 1.

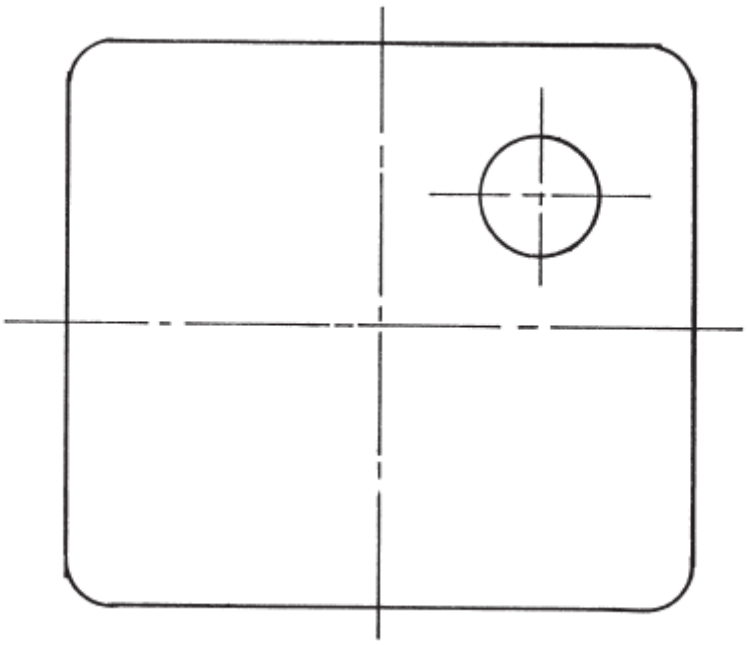

Figure 1: Location for taking drilling for check analysis

9 Freedom from Defects

9.1 The billets, blooms and slabs (including continuously cast) shall be well and cleanly rolled to the dimensions specified. The finished billets bloom and slabs shall be free from all harmful defects, such as cracks, surface flaws; laminations and rough, jagged and imperfect edges.

9.2 Cast billet ingots shall either be supplied free from harmful defects, such as, segregation, piping, cracks, inclusions and blow-holes by appropriate top and bottom discard and dressing or supplied with suitable surface dressing only, without top and bottom discard, if mutually agreed to between the purchaser and the manufacturer.

10 Tests

10.1 If mutually agreed to between the purchaser and the manufacturer, the following tests may be carried out from the samples prepared under 8.1:

a) Macro-examination (*see* ASTM E381-20); and

b) Sulphur print tests (*see* ISO 4968).

10.2 Bend

In the case of slabs and continuously cast slabs the bend shall not exceed 8 mm/m of slab length subject to a maximum of 40 mm. In the case of billets, blooms and continuously cast billets and blooms the bend shall not exceed 5 mm/m.

10.3 Camber

In the case of slabs and continuously cast slabs the camber shall not exceed 8 mm/m of slab length subject to a maximum of 40 mm. In the case of billets, blooms and continuously cast billets and blooms the camber shall not exceed 3 mm/m.

11 Dimensions

11.1 The sizes of cast billet ingots shall be subject to mutual agreement between the purchaser and the manufacturer.

11.1.1 The sizes of cast billet ingots other than those specified may be supplied by agreement between the purchaser and the manufacturer.

11.2 The billets, blooms and slabs (including continuously cast) shall be reasonably square.

11.2.1 The preferred size for with across flat of billets, blooms and slabs (including continuously cast) shall be 50, 63, 75, 80, 85, 90, 100, 110, 125, 150, 165, 200, 250 and 320 mm.

11.2.2 Width other than those specified in Table 3, may be supplied as per agreement between the purchaser and the manufacturer.

11.3 Length of billets, blooms and slabs (including continuously cast) shall be supplied in lengths between 3 m and 13 m as specified by the purchaser.

Table 3: Tolerances on Width

S/No.	Product	Width Across Flat, mm	Thickness, mm	Thickness on Width/Thickness, mm
i)	Billets	a) Up to and including 75	—	± 1.5
		b) Over 75	—	± 3.0
ii)	Blooms	a) Up to and including 150	—	+ 4.0 – 3.0
		b) Over 150	—	+ 6.0 – 3.0
iii)	Slabs	—	a) Up to and including 150	+ 3.0 – 4.0
		—	b) Over 150	+ 3.0 – 6.0
		a) Up to and including 300	— —	+ 3.0 – 6.0
		b) Over 300	— —	+ 5.0 – 10.0

12 Tolerances

12.1 In case of cast billet ingots, a tolerance of + 5 mm shall be permitted on the specified width across flat.

12.2 In case of billets, blooms and slabs (including continuously cast), the following tolerances shall apply.

12.3 A tolerance of +150 mm shall be permitted on the specified length of cast billet ingots, billets, blooms and slabs (including continuously cast).

13 Marking

13.1 Unless agreed otherwise, the material shall be marked as given in 13.2 and 13.3.

13.2 Each cast billet ingot, billets, blooms and slabs (including continuously cast) shall be legibly stamped or painted with the cast number; and the name or trademark of the manufacturer.

13.3 The ends of cast billet ingots, billets, blooms and slabs (including continuously cast) shall be suitably painted as per agreement between the purchaser and the manufacturer. For designations C 15, C 18 and C 20 the colour coding shall be as given in Table 4.

14 Ordering Information

While placing an order for the cast billet ingots and billets, blooms and slabs (including continuously cast) covered by this standard, the purchaser should specify clearly the following:

a) Steel grade;

b) Size of cast billet ingot, billet, bloom and slab (including continuously cast);

c) Size and dimensions of end product;

d) End use;

e) Tests and test report required; and

f) Special requirements, if any.

Table 4: Colour Coding

(*Clause* 13.3)

S/No.	Designation	Colour	Grade		
			A	B	C
i)	C 15	Grey	A	B	C
ii)	C 18	Green	A	B	C
iii)	C 20	Orange	A	B	C
iv)	C 15 MMn	Grey	A with one dot	B with one dot	C with one dot
v)	C 18 MMn	Green	A with one dot	B with one dot	C with one dot
vi)	C 20 MMn	Orange	A with one dot	B with one dot	C with one dot
vii)	C 15 HMn	Grey	A with two dots	B with two dots	C with two dots
viii)	C 18 HMn	Green	A with two dots	B with two dots	C with two dots
ix)	C 20 HMn	Orange	A with two dots	B with two dots	C with two dots

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