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Indian Standard

SPECIFICATION FOR GREY IRON CASTINGS FOR ELEVATED TEMPERATURES FOR NON-PRESSURE CONTAINING PARTS

(First Revision)

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Indian Standard

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Indian Standard

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(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 6 February 1974, after the draft finalized by the Cast Iron and Malleable Cast Iron Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first published in 1965. As a result of experience gained during these years it has been decided to incorporate one more grade and modify the existing two grades of iron castings.

0.3 Grey iron castings covered in this specification are suitable for high temperature service such as grate bars, stoker links, stoker parts, oil still, furnace parts, firebox parts, glass moulds, caustic pots, metal melting pots and similar heat-resisting castings. The service temperature up to which these castings could be used may be as high as 760°C. It is, however, not intended to imply that the three grades of castings covered in this standard are suitable throughout the entire temperature range without any regard to actual service (thermal and fatigue) stresses. Some are suitable for long service at low temperatures only, but in case low stresses are involved, they could also be used at high temperatures.

0.3.1 For the benefit of the purchaser information regarding the typical hot tensile data has been specified in Appendix A for information only. However, the materials may be hot tensile tested to check for conformity if agreed to between the purchaser and the manufacturer.

0.4 In preparing this standard assistance has been derived from ASTM Designation: A319-71 'Grey iron castings for elevated temperatures for non-pressure containing parts', issued by the American Society for Testing and Materials.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated,

expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers the requirements for grey iron castings for elevated temperatures for non-pressure containing parts.

1.2 This standard does not include the requirements for grey cast iron ingot moulds, stools and slag ladles.

2. GRADES

2.1 There shall be three grades of grey iron castings, namely, Grades 1, 2 and 3. Grade 1 castings possess superior resistance to thermal shock, Grade 2 castings possess average resistance to thermal shock and a moderately good tensile strength (tensile strength above 20 kgf/mm^2 may be expected), and Grade 3 possess tensile strength higher than that of either Grade 1 or grade 2 (tensile strength as high as 30 kgf/mm^2 may be expected).

3. SUPPLY OF MATERIAL

3.1 General requirements for the supply of grey iron castings for elevated temperatures for non-pressure containing parts shall conform to IS : 1387-1967†.

4. MANUFACTURE

4.1 The melting practice shall be optional to the manufacturer.

5. CHEMICAL COMPOSITION

5.1 The material when analysed in accordance with IS : 228-1959‡ shall have the chemical composition as specified in Tables 1 and 2.

5.2 The grey iron castings of grades 1 to 3 may be alloyed with chromium to increase the strength and to improve and stabilize the structure for

*Rules for rounding off numerical values (*revised*).

†General requirements for the supply of metallurgical materials (*first revision*).

‡Methods of chemical analysis of pig iron, cast iron and plain carbon and low alloy steels (*revised*).

elevated temperature service. When chromium is present as an alloying element, each grade shall be subdivided into types designated as follows:

Type	*Chromium, Percent*
A	0·20 to 0·40
B	0·41 to 0·65
C	0·66 to 0·95
D	0·96 to 1·20
E	1·21 to 1·40

TABLE 1 CHEMICAL REQUIREMENTS

(*Clause* 5.1)

GRADE	CARBON CONTENT EQUIVALENT $(C + 0{\cdot}3\ \overline{Si + P})$	CARBON, *Min*, PERCENT	SULPHUR PERCENT, *Max*	PHOSPHORUS PERCENT, *Max*
(1)	(2)	(3)	(4)	(5)
1	3·81 to 4·40	3·50	0·15	0·4
2	3·51 to 4·10	3·20	0·15	0·4
3	3·20 to 3·80	2·80	0·15	0·4

TABLE 2 VARIATION IN CARBON AND SILICON CONTENTS

(*Clause* 5.1)

	CARBON, PERCENT	SILICON, PERCENT
(1)	(2)	(3)
1	3·50	0·90 to 2·70
	3·70	0·90 to 2·10
	3·90	0·90 to 1·50
2	3·20	0·90 to 2·70
	3·40	0·90 to 2·10
	3·50	1·80 *Max*
3	2·80	1·20 to 2·70
	3·00	0·60 to 2·40
	3·20	0·60 to 1·80

5.2.1 The alloying elements which in addition to chromium are commonly added to improve the properties at elevated temperatures are copper, molybdenum, nickel and vanadium. Any combination of these

alloying elements which assists in resisting oxidation or surface deterioration or in stabilizing the structure or retaining strength at elevated temperature may be used.

5.2.2 The purchaser may select the grade of cast iron suitable for a particular service and can define the product, for example, 'Casting Grade 2, Type A plus..... alloys'. All surfaces should be marked 'f' (for finished) with 250 *HB Max.*

6. CHECK ANALYSIS

6.1 When alloying elements are agreed upon by the manufacturer and the purchaser, the purchaser may make check analysis from any casting, test bar, or lot of castings delivered under this specification. Results of such analysis shall be in accordance with the limits agreed upon.

7. MECHANICAL TESTS

7.1 If required by the purchaser for applications where strength requirement is essential, room temperature tensile strength may be specified up to those prescribed for Grade 30 of IS: 210-1970*.

7.1.1 Tensil test shall be carried out at the ambient temperature in accordance with IS : 2078-1962†.

8. MACHINABILITY

8.1 All machinable castings shall be limited in hardness at such locations on the castings as indicated by the purchaser. The maximum hardness at the locations on castings that are to be machined, shall be as agreed to between the purchaser and the manufacturer.

9. FREEDOM FROM DEFECTS

9.1 The castings shall be free from shrinkage defects, scruff marks, cold, shut, pitting, scabbing, rat-tail marks and similar other defects. They shall be well dressed and fettled.

10. WORKMANSHIP AND FINISH

10.1 The castings shall conform to the dimensions of drawings furnished by the purchaser or to the dimensions predicted by the pattern supplied by the purchaser, if no drawing has been provided. Surface of the castings shall be free from burnt-on sand and shall be reasonably smooth. Runners, risers, fins and other cast-on pieces shall be removed. In other respects castings shall conform to whatever points may be specifically agreed to between the purchaser and the manufacturer.

*Specification for grey iron castings (*second revision*).
†Method for tensile testing of grey cast iron.

11. SAMPLING

11.1 Sampling for Chemical Analysis — Two spoon samples shall be taken during the pouring of each cast or ladle when about one-third and two-thirds of the metal has been discharged. The spoon samples so obtained shall be cast separately in dry sand in the form of 30 mm diameter bars about 75 mm long. Alternatively, the mould may be filled directly from the metal stream. The test bars shall be suitably marked so that the castings they represent could be identified.

11.1.1 After cleaning the surface, two flats shall be ground near the bottom of each test bar and the test bar drilled with a 25-mm drill from one clean surface to the other. The speed of the drill should not be more than 9 to 10 rev/min. Drillings after being thoroughly mixed shall constitute the samples for chemical analysis.

11.1.2 For the determination of total carbon, the molten metal shall be poured into a special split mould (*see* Fig.1). This gives iron pins of 3 mm diameter which can be broken off and used directly for total carbon determination.

11.2 Sampling for Tensile Test — The number of test bars to be selected for testing for each melt or batch of castings shall be as laid down in Table 3, castings being divided into five representative groups according to weight.

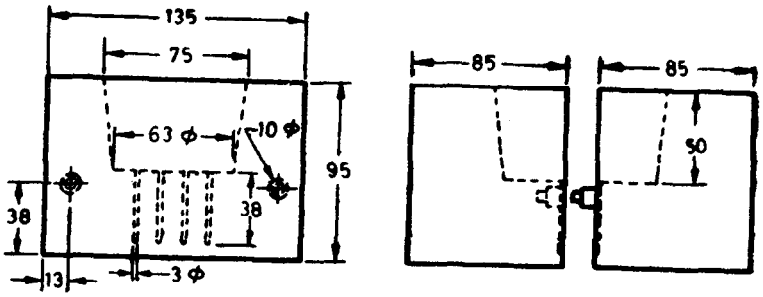
12. RETEST AND REJECTION

12.1 If a sample selected for testing fails to meet the requirements specified under **5** and if necessary under **6.1**, the purchaser shall select two further samples from the same cast, ladle or lot. If on testing, either of these samples fails to meet the specified requirements, the whole lot shall be deemed as not complying with this standard.

13. MARKING

13.1 Where practicable each casting shall be legibly marked with an identification mark by which it is possible to trace the cast or ladle from which it was poured.

13.2 By agreement between the purchaser and the manufacturer castings complying with the requirements of this standard shall, after inspection, be legibly marked with an acceptance mark.



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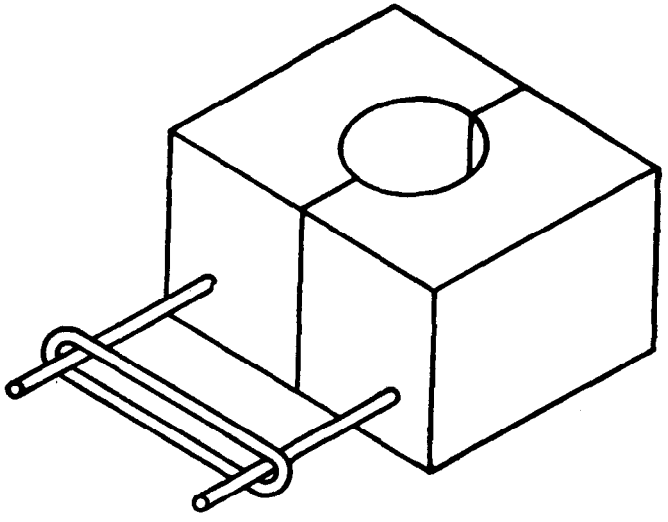

FIG. 1 PIN MOULD FOR CARBON SAMPLES

13.3 The castings may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

TABLE 3 NUMBER OF TEST BARS

(*Clause* 11.2)

GROUP	WEIGHT OF INDIVIDUAL CASTING	NUMBER OF TEST BARS
(1)	(2)	(3)
*1	Up to 12·5 kg	One cast bar for each 500 kg of castings or part thereof
*2	Over 12·5 kg and up to 50 kg	One test bar for every 1 tonne of castings or part thereof
*3	Over 50 kg and up to 500 kg	One test bar for every 2 tonnes of castings or part thereof
*4	Over 500 kg and up to 1 tonne	One test bar for every 5 tonnes of castings or part thereof
5	Over 1 tonne	One test bar for every 4 tonnes of castings or part thereof, or one test bar for every casting weighing 4 tonnes or more

*In the groups 1, 2, 3 and 4 all castings represented by one test bar shall be poured from the same ladle or same heat as the bar or bars provided for the test.

APPENDIX A

(*Clause* 0.3.1)

HOT TENSILE PROPERTIES

(For Information Only)

A-1. Up to temperatures of 300 to 400°C, cast irons are capable of carrying sustained loads without distortion. As the temperature rises, however, the sustained load which can be carried without distortion falls very rapidly.

A-1.1 Short term tensile data for pearlitic grey iron at temperatures up to 700°C are given below:

Composition, Percent					*Tensile Strength at in kgf/mm²*					
Total Carbon	Silicon	Manganese	Phosphorus	Sulphur	20°C	200°C	300°C	400°C	500°C	600°C
3·06	3·29	0·66	0·26	0·12	33·86	31·82	32·76	30·24	20·32	7·72
3·42	2·80	0·69	0·61	0·12	18·58	18·11	18·74	18·11	11·66	5·20

A-1.2 Another typical short term tensile test (1·6 kgf/mm², *Min*) shows the following results on an iron of composition : total carbon 3·05 percent; silicon 2·13 percent; manganese 0·66 percent, sulphur 0·065 percent, phosphorus 0·04 percent:

Temperature	150°C	200°C	400°C	500°C	600°C	700°C	After 100 hours at 700°C
Tensile strength kgf/mm²	29·92	31·18	32·13	25·20	17·32	10·40	4·72

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