
International Standard



5922

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Malleable cast iron

Fonte malléable

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Descriptors : iron, malleable cast iron, classification, mechanical properties, tests, mechanical tests, test specimen conditioning, sampling.

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 5922 was developed by Technical Committee ISO/TC 25, *Cast iron*, and was circulated to the member bodies in November 1979.

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It has been approved by the member bodies of the following countries :

Australia	Germany, F. R.	Romania
Belgium	India	South Africa, Rep. of
Bulgaria	Italy	Spain
Canada	Korea, Dem. P. Rep. of	Switzerland
China	Korea, Rep. of	United Kingdom
Czechoslovakia	Netherlands	USSR
Finland	Norway	
France	Poland	

The member body of the following country expressed disapproval of the document on technical grounds :

Sweden

This International Standard cancels and replaces ISO Recommendations R 942-1969, R 943-1969 and R 944-1969, of which it constitutes a technical revision.

Malleable cast iron

1 Scope and field of application

This International Standard specifies requirements for malleable cast iron. It also gives a classification on the basis of mechanical properties.

It is applicable only to malleable cast iron cast into sand moulds or moulds of comparable thermal diffusivity.

2 References

ISO/R 79, *Brinell hardness test for steel and cast iron*.¹⁾

ISO 82, *Steel — Tensile testing*.

3 Terms, definitions and characteristics of malleable cast iron

3.1 Malleable cast iron

Malleable cast iron is a heat-treated iron-carbon alloy, which solidifies in the as-cast condition with a graphite-free structure, i.e. the total carbon content is present in the combined form as cementite (Fe_3C).

3.2 Types

Two groups of malleable cast iron are specified, differentiated by chemical composition, temperature and time cycles of the annealing process, the annealing atmosphere and the properties and microstructure resulting therefrom.

3.2.1 Whiteheart malleable cast iron

The microstructure of whiteheart malleable cast iron is dependent on section size, as follows :

- a) small section size = ferrite (+ pearlite + temper carbon);
- b) large section size :
 - surface zone = ferrite,

- intermediate zone = pearlite + ferrite + temper carbon,
- core zone = pearlite (+ ferrite) + temper carbon.

The microstructure shall not contain flake graphite.

3.2.2 Blackheart and pearlitic malleable cast iron

The microstructure of blackheart malleable cast iron has a matrix essentially of ferrite. The microstructure of pearlitic malleable cast iron has a matrix, according to the grade specified, of pearlite or other transformation products of austenite. Graphite is present in the form of temper carbon nodules.

The microstructure shall not contain flake graphite.

3.3 Designation

The types of malleable cast iron covered by this International Standard shall be designated as follows :

- a) by a letter designating the type of malleable cast iron as follows :

W for whiteheart malleable cast iron,

B for blackheart malleable cast iron²⁾,

P for pearlitic malleable cast iron.

This letter shall be followed by a space;

- b) by two figures designating the minimum tensile strength, in newtons per square millimetre, of a 12 mm diameter test piece, divided by ten, for example if the minimum tensile strength were 350 N/mm², the designation would be 35.

These figures shall be followed by a hyphen (-);

1) A revised version of ISO/R 79 will be incorporated in ISO 6506.

2) It should be noted that in national standards in the French language, the symbol B has been used to designate whiteheart malleable cast iron ("fonte malléable à cœur blanc").

c) by two figures designating the minimum elongation ($L_0 = 3d$), as a percentage of a 12 mm diameter test piece. A nought (0) shall be the first figure when the value is less than 10 %, for example if the minimum elongation is 4 %, the designation is 04, and if the minimum elongation is 12 %, the designation is 12.

Example of full designation :

The designation of a whiteheart malleable cast iron having a minimum tensile strength of 400 N/mm² and minimum elongation of 5 % when measured on a 12 mm diameter test piece, would be

W 40-05

4 Production

The method of producing malleable cast iron, its composition and heat treatment, are left to the discretion of the manufacturer, who shall ensure compliance with the property re-

quirements given in this International Standard for the grade required in the order.

However, for malleable cast iron to be used in special applications, the chemical composition and heat treatment may be the subject of agreement between the manufacturer and the purchaser.

5 Mechanical properties

The mechanical properties of test pieces of malleable cast iron shall be in accordance with the values listed in tables 1 and 2.

The 0,2 % proof stress values shall be determined only if requested by the purchaser in the order.

The Brinell hardness values are for information only. If they are to be considered mandatory, this shall be agreed between the manufacturer and the purchaser, based on the values listed in tables 1 and 2.

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Table 1 — Mechanical properties of whiteheart malleable cast iron

Designation	Diameter * of test piece mm	Tensile strength N/mm ² ** min.	0,2 % proof stress N/mm ² ** min.	Elongation ($L_0 = 3d$) % min.	Hardness HB max.
W 35-04	9	340	—	5	230
	12	350	—	4	
	15	360	—	3	
W 38-12 †	9	320	170	15	200
	12	380	200	12	
	15	400	210	8	
W 40-05	9	360	200	8	220
	12	400	220	5	
	15	420	230	4	
W 45-07	9	400	230	10	220
	12	450	260	7	
	15	480	280	4	

* For whiteheart malleable cast iron, the test piece diameter should have the closest possible relationship to the section thickness of the casting. The test piece diameter should be agreed between purchaser and manufacturer.

** 1 N/mm² = 1 MPa.

† All grades of whiteheart malleable cast iron can be welded provided correct procedures are employed. Grade W 38-12 should be selected for components where strength and avoidance of postweld heat treatment is particularly required.

Table 2 — Mechanical properties of blackheart and pearlitic malleable cast iron

Designation		Diameter of test piece ** mm	Tensile strength N/mm ² † min.	0,2 % proof stress N/mm ² † min.	Elongation ($L_0 = 3d$) % min.	Hardness HB
A *	B *					
B 30-06 ‡		12 or 15	300	—	6	150 max.
	B 32-12	12 or 15	320	190	12	150 max
B 35-10		12 or 15	350	200	10	150 max.
P 45-06		12 or 15	450	270	6	150 to 200
	P 50-05	12 or 15	500	300	5	160 to 220
P 55-04		12 or 15	550	340	4	180 to 230
	P 60-03	12 or 15	600	390	3	200 to 250
P 65-02		12 or 15	650	430	2	210 to 260
P 70-02 § II		12 or 15	700	530	2	240 to 290
	P 80-01 §	12 or 15	800	600	1	270 to 310

* For classification principles, see the annex.

** Of the two diameters given for the test pieces, the manufacturer shall have the option of choosing either size if this is not specified by the purchaser.

† 1 N/mm² = 1 MPa.

‡ Grade B 30-06 is intended particularly for applications in which pressure tightness is more important than a high degree of strength or ductility.

§ Oil quenched and subsequently tempered.

II If this quality is air quenched and subsequently tempered, the 0,2 % proof stress shall be 430 N/mm² min.

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6 Mechanical tests

6.1 Tensile test

Tensile testing shall be carried out in accordance with ISO 82.

NOTE — In case of grades with an apparent (natural) yield point, it is advisable to determine the yield strength¹⁾ instead of the 0,2 % proof stress subject to the following conditions :

The test piece shall not be prestressed. In the case of the continuous loading procedure, the loading velocity shall not exceed 2 N/mm² · s, in the range from 0,5 times the yield point to 1,2 times the yield point.

In the case of the procedure with repeated unloading, a rest time of 0,5 min per load level shall apply.

Test pieces shall be test bars prepared as described in clause 7.

6.2 Brinell hardness test

The Brinell hardness test, when specified by the purchaser, shall be carried out in accordance with ISO/R 79. The test shall be carried out on test pieces or at point(s) on the casting as agreed between the manufacturer and the purchaser.

7 Tensile test pieces

Tensile test pieces (see the figure and table 3) shall be separately cast and shall be unmachined, unless otherwise agreed between the manufacturer and the purchaser.

1) For further information on the determination of yield strength of malleable cast iron, see CIATF-Report No. 2, obtainable from the CIATF-Secretariat, Verein Deutscher Gießereifachleute, Sohnstraße 70, D-4000 Düsseldorf, Germany, F. R.

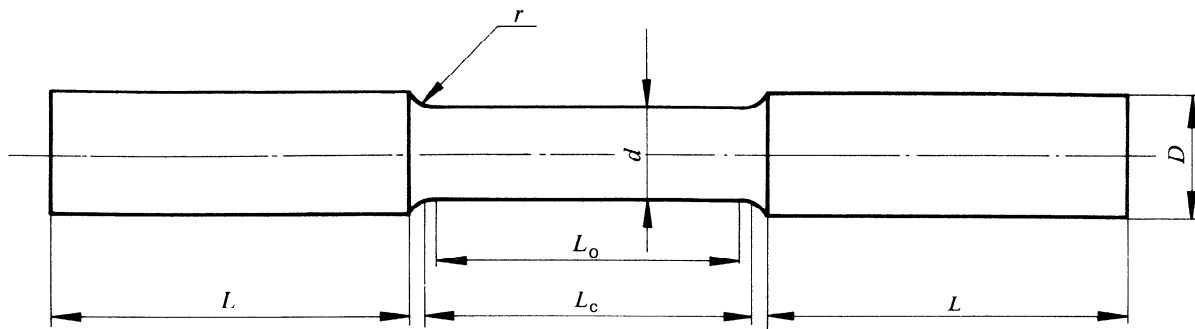


Figure – Tensile test piece

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Table 3 – Dimensions of tensile test pieces

Diameter *	Tolerance on diameter	Nominal sectional area S_0	Shank dimensions **		Gauge length $L_0 = 3d$	Minimum parallel length L_c	Radius at shoulder r
			Diameter D	Length L^\dagger			
mm	mm	mm ²	mm	mm	mm	mm	mm
9	± 0,7	63,6	13	40	27	30	6
12	± 0,7	113,1	16	50	36	40	8
15	± 0,7	176,7	19	60	45	50	8

* Where the test pieces are tested in the unmachined state, the tensile strength shall be calculated from the measured diameters of each test piece. For this purpose the average diameter shall be obtained by taking the average of two measurements made at right angles to each other.

** If necessary, the shanks may be modified to suit the grips of the testing machine available.

† The minimum length L shall fit the full length of the grips of the testing machine available.

8 Sampling

8.1 Test pieces shall be cast from the same melt (or ladle) of metal as that used to produce the castings, in accordance with the sampling procedure agreed.

Two additional test pieces should be prepared for the purpose of retest.

8.2 The test pieces shall, in all cases, be heat-treated under the same conditions as the castings which they represent.

9 Formation of batches

In the case of acceptance tests by random sampling, batches should be formed from castings poured from the same melt (or ladle) of metal and submitted to the same heat treatment.

For continuous production, the size of the batch shall be determined by the tonnage being produced and the types of castings being made.

10 Validity of tests

The results of a test may be disregarded if they are poor and are not due to the quality of the malleable cast iron itself, but to any

of the following reasons :

- a) faulty mounting of the test piece or defective operation of the test machine;
- b) defective casting or machining of the test piece;
- c) fracture of the test piece beyond the gauge marks;
- d) casting defects in the test piece, evident after fracture.

11 Retests

11.1 Should any of the test pieces fail to meet the specified property requirements, other than for the reasons given in clause 10, two retests for each failed test piece shall be carried out.

11.2 The batch shall be considered to comply with the requirements if the results of the two retests comply with the values specified in clause 5. The batch shall be rejected if one of the test pieces fails in a retest.

11.3 The manufacturer shall have the right to reheat-treat the batch, together with representative test pieces, and re-submit the castings for acceptance.

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Annex

Classification principles

(This annex does not form part of the standard.)

To meet the requirements of individual groups of users of blackheart and pearlitic malleable iron castings, a large number of grades of these materials have been included in the national standards of most ISO member bodies. The small differences between the specified properties of many of these grades suggest, however, that for many casting applications, an alternative grade of material could be specified safely and, thus, specification of a fewer number of grades should be possible with consequent simplification also to foundry production procedures.

At present a reduction in the number of grades in this International Standard would conflict with many national standards and could also cause difficulty to users of malleable iron castings who would find that grades of material specified for many years are no longer included in the International Standard. For these reasons 10 grades of blackheart and pearlitic malleable cast iron have been specified in table 2.

In preparing this International Standard, it has been recognized, however, that there are good reasons for reducing the number of specified grades and, to give guidance on how this might be achieved realistically in a future revision, the designation of grades in table 2 has been presented in two columns. Column A (i.e. Grade B30-06 to Grade P70-02) gives the grades which might be retained in a revised edition and column B (i.e. Grade B32-12 to Grade P80-01) grades which might be deleted.

It is hoped that, in the period before revision of this International Standard, users of malleable iron castings and ISO member bodies revising national standards will recognize the advisability of reducing the number of specified grades of blackheart and pearlitic malleable cast irons and will concentrate on the use and specification of grades given in column A of table 2.

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