

Abdujabborov Obidjon*Doctoral student of Andijan machine building institute**Tel: +998 94 383 00 91 Email. abdujabborovobidjon@gmail.com***Solijonov Javohir***Assistant of Andijan Institute of Economics and Construction***Abdujabborov Avazbek***3rd stage student of Andijan Institute of Economics and Construction**Tel: +998 88 583 10 07 Email. abdujabborovobidjon@gmail.com***Tolibjonov Shoyatbek***3rd stage student of Andijan Institute of Economics and Construction***FORMALIZATION OF METHODS OF MECHANICAL TESTING OF IRON CASTINGS AT TEMPERATURE $(20^{+15}_{-10})^{\circ}\text{C}$** **Key words:**Material resistance, GOST 27208, hardness, temperature, compression, elongation**Abstract:**This article aims to explain the basic concepts of mechanical testing of iron castings at a specified temperature in accordance with the GOST 27208 standard and the preparation of test formalization protocols.

The GOST 27208 standard defines the methods of mechanical testing of cast iron ingots at a temperature of $(20^{+15}_{-10})^{\circ}\text{C}$:

- stress and elongation after stress cracking;
- temporary compressive strength;
- temporary resistance and maximum deflection during bending;
- Brinell hardness.
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- Standard steps:

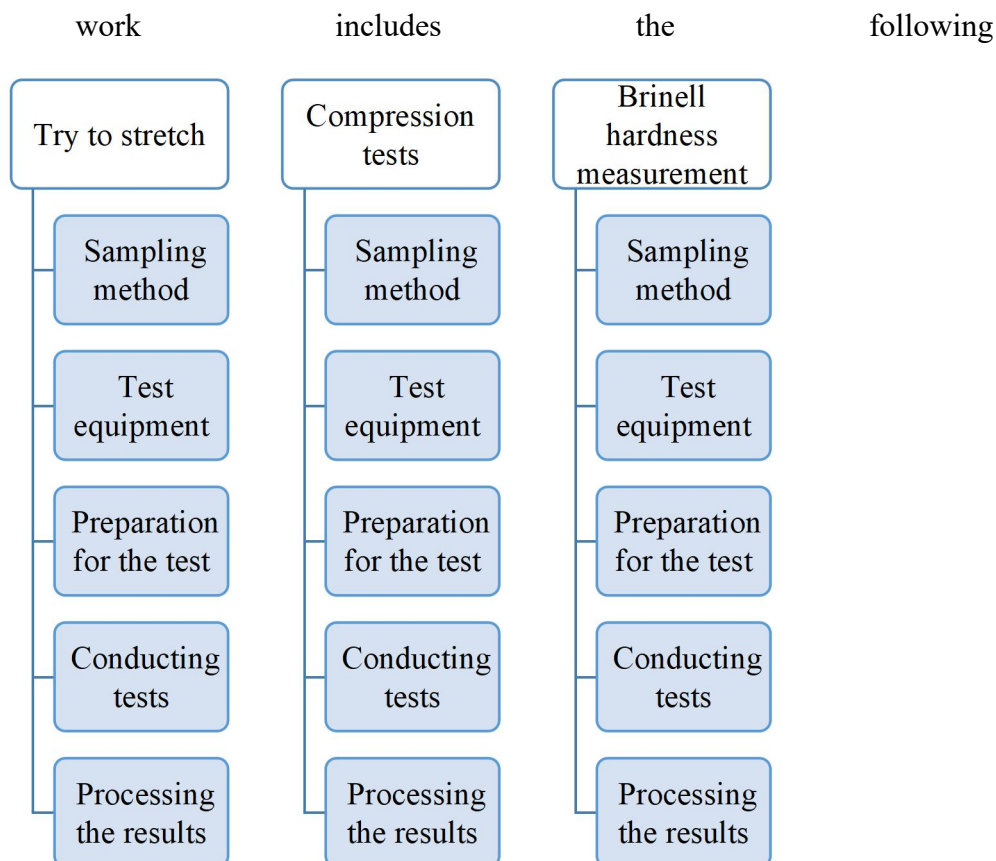


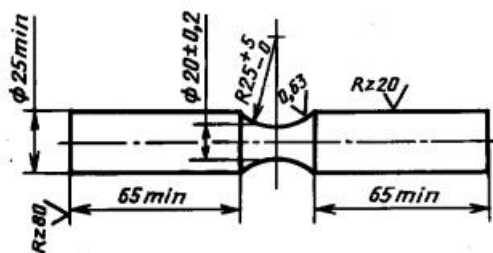
Figure 1. Sequence of work according to the standard.

Try to stretch.

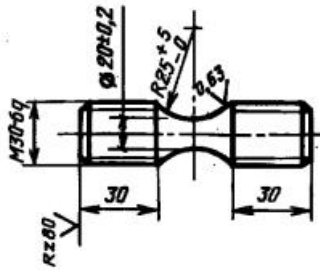
Sampling method.

The method of obtaining blanks for the preparation of samples from graphite cast iron is in accordance with GOST 24648 [1].

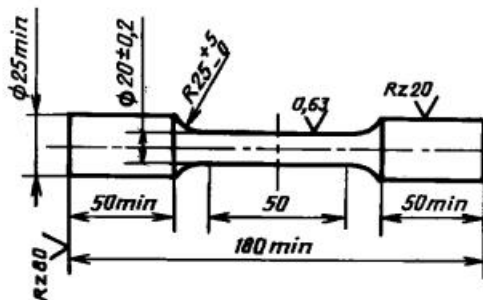
The shape and size of the samples should correspond to those shown in the picture.



2-fig.



3-fig.



4-fig.

The total length of the sample and the method of fixing it are determined by the design of the handles or the size of the working place of the testing machine [2].

The method of obtaining the workpiece, the shape and dimensions of the sample for testing a cast made of ductile cast iron are in accordance with GOST 1215.

The method of obtaining the workpiece, the shape and dimensions of the sample for testing castings made of nodular cast iron are in accordance with GOST 7293.

Tests shall be carried out on three samples, unless otherwise specified in the casting specifications.

Test equipment.

Tensile tests of cast iron castings are carried out in tensile testing machines under the condition that they meet the requirements of GOST 28840.

Preparation for the test.

After mechanical processing, the working surface of the sample should be free of voids, non-metallic inclusions, cracks, marks and mechanical damage.

According to GOST 2789, the elongation R_a of the processed surfaces of the working part of the sample should not exceed $0.63 \mu\text{m}$, and the elongation R_z of the sample heads should not exceed $20 \mu\text{m}$.

The diameter of the working part of the sample according to the figure. 1 and 2 are measured in the smallest section in two mutually perpendicular directions before the test and according to fig. 3 - in three places: in the middle part and at the limits of the working length. The difference between the smallest and largest diameter of the sample should not exceed 0.05 mm .

As a result, their average arithmetic value is obtained. The cross-sectional area of the sample is calculated to the nearest 1.0 mm².

Conducting tests.

The specimen is smoothly loaded with an axial tensile force until the mechanical properties are determined.

A capped graphite cast iron specimen is attached to the holder so that the threads along the entire length of the specimen head mate with the threads of the holder.

Testing of malleable cast iron samples is carried out in accordance with GOST 1497.

Tests of samples made of nodular graphite cast iron are carried out in accordance with GOST 1497.

The loading speed of the sample during tensioning should not exceed 10 MPa/s.

Processing the results.

Temporary resistance is the stress corresponding to the largest load (kilogram-force per square millimeter) before destruction of the sample (1) in megapascals, calculated according to the formula.

$$\sigma_B^p = \frac{P_{\max}}{F_0}, \quad (1);$$

where P_{max} is the maximum load before failure of the sample, N (kgf);

F₀ is the cross-sectional area of the working part of the sample before the test, mm².

The relative elongation after the crack is determined according to GOST 1497.

For gray cast iron, only temporary resistance is determined.

Results are rounded to 5.0 MPa.

If the inconsistency occurs outside the working part of the sample, or if voids, various inclusions or other defects are found in the fracture after destruction, the test results are not taken into account.

In this case, the tests are repeated on another sample from the same batch.

The form of the test report is given in Appendix 1.

Compression tests.

Sampling method.

The method of obtaining blanks for the preparation of samples must be specified in accordance with GOST 24648 or in the technical documentation for casting.

Cylindrical samples with a nominal diameter of 10, 15, 20, 25 mm are prepared for the test. Other diameter samples can be produced in the range from 10 to 25 mm. The diameter of the workpiece should be at least 5 mm larger than the diameter of the sample.

The sample height is set equal to the diameter.

Tests should be carried out on three samples, unless there are other requirements in the technical documentation for casting.

Test equipment.

Compression tests of samples are carried out on any type of machine, if they comply with the requirements of GOST 28840.

Preparation for the test.

After mechanical processing, the surface of the sample should not have traces, corrosion, voids and holes [3].

According to GOST 2789, the elongation of the working surface of the cylindrical and end parts of the Ra sample should not exceed 1.25 microns.

The diameter of the sample is measured in two mutually perpendicular directions before the test.

The result is obtained as the arithmetic mean value of two measurements. The difference between the smallest and largest diameter of the sample should not exceed 0.05 mm.

The sample cross-sectional area is rounded to 1.0 mm².

The ends of the sample should be plane-parallel and perpendicular to the axis. Deviation from perpendicularity should not exceed ± 10 .

The height of the sample is measured in two mutually perpendicular sections before the test.

The result is obtained as the arithmetic mean value of two measurements. The measurement difference should not exceed 0.1 mm.

Allowed deviations from the nominal diameter of the sample ± 0.1 mm, height ± 0.2 mm.

Conducting tests

The specimen is loaded with axial compressive force until failure.

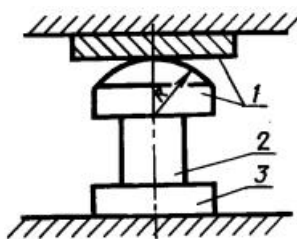


Figure 5. 1 and 3 - supports; 2 – sample.

During the test, reliable centering of the sample on the supports should be ensured (Fig. 5).

During the test, the ends of the specimen shall rest on supports with polished smooth surfaces made of hardened steel with a hardness of at least 60 HRC3 and an elongation Ra of not more than 1.25 microns. The parallelism of the supporting planes must be ensured by a sphere made on one of the supports. The center of the spherical surface must coincide with the center of the end surface of the sample.

The movement of the moving crossbar should not exceed the sample loading speed of 20 MPa/s.

Processing the results.

Temporary resistance is the stress corresponding to the largest load before the destruction of the sample, calculated according to the formula (2,3) in megapascals (kilogram-force per square millimeter) [4].

$$\sigma_{\text{изг}} = \frac{M}{W}, \quad (2) \text{ or}$$

$$\sigma_{\text{изг}} = \frac{8 P_{\text{max}} l}{\pi d^3}, \quad (3)$$

where M is the bending moment, N • mm (kgf • mm);

W—moment of resistance, mm³;

P_{max} — the maximum load at the moment of breaking the sample, N (kgf);

l - distance between supports, mm;

d - diameter of the sample after the test, mm.

Brinell hardness measurement

Sampling method.

Measurement of the hardness of castings is carried out in the places stipulated in the regulatory and technical documents for the casting.

After the bending test, the hardness can be determined on the sample or on the workpieces for tensile tests. The specimens shall have the same temperature as the casting being tested.

It is allowed to measure hardness in special samples in the form of cast waves. In this case, their location and dimensions, as well as test areas, should be specified in the technical conditions for casting.

Measuring instruments

Hardness is measured using the Brinell method according to GOST 9012 and GOST 23677.

Preparation for measurement

Unless there are other requirements in the technical characteristics of the tissue, the area to be measured must first be cleaned to a depth of at least 2.0 mm.

According to GOST 2789, the elongation of the Ra surface should not exceed 2.5 microns.

The mounting surface of the tissue should be cleaned of burnt traces, scale and other coatings [5].

Taking measurements

In large castings, if it is not possible to measure the hardness with a stationary device using the Brinell method, the hardness is measured with a portable static hardness tester according to GOST 22761 or

TU 25-06-325, TU 25-06-845 or Brinell it is allowed to measure with a dynamic device using a hardness standard or with a normalized impact force according to GOST 18661[6].

Brinell hardness is determined as the arithmetic mean of the results of three hardness measurements, unless otherwise specified in the casting specifications.

Appendix 1

Tensile test protocol

Type of cast iron _____

Number of Samples _____

Test machine type _____

Sample number or stamp	Heat number	Batch number	Initial design length, mm	Sample diameter, mm	The final approximate length after the break /k, mm	Maximum breaking force, N (kgf)	Tensile strength, MPa (kgf/mm ²)	Relative elongation after crack, %

Appendix 2

Compression test protocol

Type of cast iron _____

Number of samples _____

Test machine type _____

Sample number or stamp	Heat number	Batch number	Sample diameter d ₀ , mm	Cross-sectional area F ₀ , mm ²	Load P, N (kgf)	Tensile strength (kgf/mm ²)

Appendix 3

Bending test protocol

Type of cast iron _____

Number of samples _____

Test machine type _____

Sample number or stamp	Heat number	Batch number	Sample diameter, mm	The distance between the supports, mm	Breaking load p _{max} , N (kgf)	Bending tensile strength, MPa (kgf/mm ²)	Maximum deviation, mm	Ball diameter, mm Load P, N (kgf) Brinell hardness, (HB)			
								Average			Average
								1-	2-	3-	

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