

CAST IRONS

Advantages and disadvantages of cast irons
(in comparison with steels):

Advantages :

- good castability (low T_m , good fluidity)
- good machinability (graphite cast irons)
- antivibration properties
- low stress concentration
- sensibility

Disadvantages :

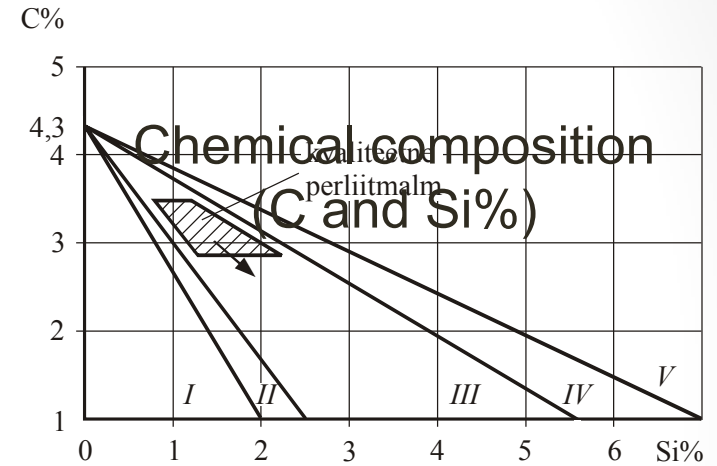
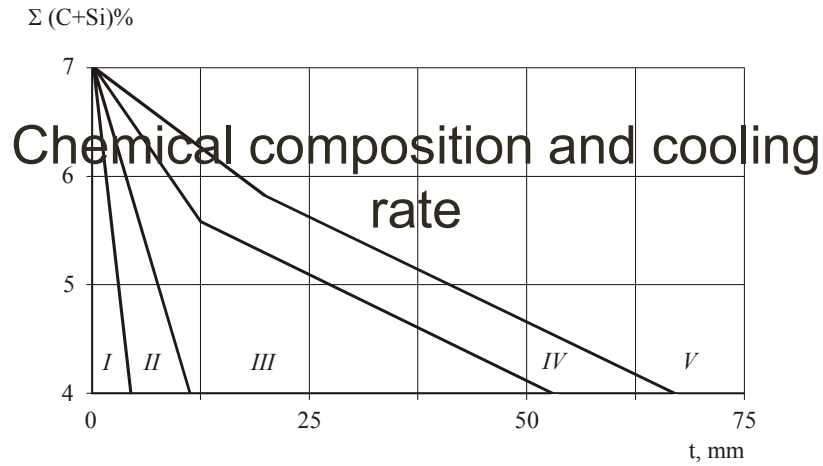
- high brittleness
- non machinable (white cast iron, chilled cast iron)
- cold brittleness (KV = 7 – 14 J, – 40°/+23°C)

Cast iron structure impactors

1. Chemical composition (C, Si, Mn) Si → graphite cast irons , Mn → white cast iron
2. Cooling rate
 $\uparrow v_{\text{jaht}}$ → white cast iron, chilled cast iron
 $\downarrow v_{\text{jaht}}$ → grey cast iron
3. Modification
Mg, Ts, Ca → spheroidal graphite cast iron
4. Alloying
Mn → wear resistance
Si → corrosion resistance
Cr → high-temperature strength
Ni → corrosion resistance, with Cr, Si wear resistance

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Structure diagrams of cast irons



Classification and properties of cast irons (1)

Mechanical properties of main graphite cast irons

| Types of cast irons | R_m , N/mm ² | HB | A, % |
|----------------------------------|---------------------------|-----------|----------|
| Lamellar graphite (grey) c.i. | 100...450 | 190...275 | ~ 0 |
| Spheroidal graphite c.i. | 350...1000 | 140...360 | 22...2 |
| Mallable (nest graphite) c.i. | 300...800 | 100...320 | 12...1,5 |

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Classification and properties of cast irons (2)

| Types of cast irons | Standard | Designation | R_m , N/mm ² |
|-------------------------------|-----------|--------------------|---------------------------|
| Grey cast iron | EN 1561 | EN-GJL | 100-450 |
| Spheroidal graphite cast iron | EN 1563 | EN-GJS | 350-900 |
| Bainitic cast iron | EN 1564 | EN-GJS | 800-1400 |
| Vermicular graphite cast iron | ISO 16112 | ISO 16112/JV | 300-500 |
| Malleable cast iron | EN 1562 | EN-GJMW EN-GJMB | 270-570 300-800 |
| Wear resistant cast iron | EN 12513 | EN-GJN | >1000 |
| Cast steels | | G-C35 G-XCrNi12 | |

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Heat treatment of cast irons (1)

Hardness of metallic ground mass

ferrite 100...160 HB

pearlite 180...220 HB

sorbite 220...300 HB

bainite 300...320 HB

martensite 380...600 HB

Grey cast iron heat treatment

| Heat treatment | Metallic groundmass | | Hardness |
|---------------------------|---------------------|--|--|
| | in. | fin. | |
| Hardening 850...950 °C | P+F, P | M, Tr, S | HB → 500 |
| Tempering | M, Tr | M _{nool} Tr _{nool} S _{nool} | Increase of plasticity and toughness Decrease of hardening stresses |

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Heat treatment of cast irons (2)

Heat treatment of spheroidal graphite/ malleable cast iron

| Heat treatment | Tkar, °C | Heat treatment, HRC |
|----------------------|-----------|--------------------------------------|
| Hardening | 900 | In dependent of structure 20...60 |
| Isothermal hardening | 850...880 | 300 °C – 45 |
| | | 350 °C – 35 |
| | | 400 °C – 30 |
| Tempering | 150...170 | 52...59 |
| | 380...400 | 38...45 |
| | 530...550 | 26...30 |
| | 600...650 | 22...27 |

Designation system of cast irons (EN)

Designation and materials No. (1)

- Grey cast iron EN-GJL L – *lamellar G*
- Spheroidal graphite c.i. EN-GJS S – *spheroidal G*
- Malleable cast iron EN-GJM M – *malleable (temper G)*
 - white EN-GJMW
 - black EN-GJMB

Grey cast iron (EN1561)

R_m based

HB based

| Designation | Material N° | Designation | Material N° |
|-------------|-------------|--------------|-------------|
| EN-GJL-100 | EN-JL1010 | EN-GJL-HB155 | EN-JL2010 |
| | | | |
| -350 | -JL1060 | -HB255 | -JL2060 |