# 18 Ferrous metallurgy

<table>
<thead>
<tr>
<th>18a</th>
<th>Ore preparation, production of pig iron, making of pig iron for special purposes, blast furnaces, hot-blast stoves, direct production of iron from iron ores</th>
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<tr>
<td><strong>(IPC: C21B) Manufacture of iron and steel</strong></td>
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<td>18b</td>
<td>Production of cast iron, steel and pure iron by processing of intermediate alloys or ferroalloys, sponge iron, scrap, etc.</td>
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<td><strong>(IPC: C21C) Processing of pig-iron</strong></td>
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<td>18c</td>
<td>Treatment of iron, steel, and cast iron in order to obtain special properties</td>
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<tr>
<td><strong>(IPC: C21D) Hardening and annealing of steel, iron, or articles made therefrom; Making malleable by decarburisation, tempering, or other treatments</strong></td>
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<tr>
<td>18d</td>
<td>Cast iron alloys, steel alloys, and ferrous alloys</td>
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</table>

## Preparation of iron ores for iron production

| 18a-1/01 | Process for roasting iron ores (roasting for iron extraction from ores 1a-33; for magnetic dressing 1b-2; for froth flotation 1c-9; roasting of nonferrous ores 40a, 2-6) |
| 18a-1/02 | Installations for iron ore roasting (for nonferrous ores 40a-2 – 40a-6) |
| 18a-1/03 | Desulphurisation, dephosphorisation, etc. of iron ores |
| 18a-1/10 | Sintering and agglomerating of iron ores |
| 18a-1/11 | in rotating furnaces (kilns) |
| 18a-1/12 | in channel-type furnaces and on belts |
| 18a-1/13 | in shaft furnaces |
| 18a-1/20 | Discharging equipment for shaft furnaces, only for iron ores and for obtaining a solid end product for roasting furnaces 80c-16) |
| 18a-1/30 | production of metallurgical coke |

## Binding and briquetting of iron ores and furnace dust

| 18a-2/01 | without binders |
| 18a-2/02 | with inorganic binders |
| 18a-2/03 | with organic binders |
| 18a-2/04 | with inorganic and organic binders |
| 18a-2/05 | Binding and briquetting of iron scrap, alloys, etc. |
| 18a-2/06 | Sintering of iron briquettes (coking 10a-18, 10b-9; briquetting presses 80a-25) |

## Pig iron production in blast furnaces

| 18a-3 | Processes for production of pig iron in blast furnaces |
| 18a-4/01 | Blast furnaces design: shape, brickwork, cooling (foundry shaft furnaces 31a-1; shaft furnaces for nonferrous metals 40a-7; calcining furnaces 80c-13) |
18a-4/02 Refractories for blast furnaces
18a-4/03 Taphole tapping and plugging (for foundry shaft furnaces 31a-6)
18a-5 Blast furnaces tuyeres (tuyeres for foundry shaft furnaces 31a-6)
18a-6/01 Charging equipment for blast furnaces and foundry shaft furnaces (for firings 24h)
18a-6/02 Inclined elevators
18a-6/03 Vertical and other types of elevators
18a-6/04 Skip-charging
18a-6/05 Component parts for skip charging; charging skips and covers, skin safety devices
18a-6/06 Bell and hopper
18a-6/07 Dust catchers
18a-6/08 Charging apparatus: bins, ore pockets and charging cars
18a-6/09 Measuring rods [probes] for blast furnaces and other shaft furnaces
18a-7 Removal of accretions [bears] in blast or shaft furnaces

By-products of pig iron production
18a-8/01 Top gases (in coke ovens 10a-19)
18a-8/02 Slags (slag bricks 80b-5)
18a-9/01 Conveying cars for blast-furnace slag disposal
18a-9/02 Slag cooling
18a-10 Production of special pig iron in blast furnaces (Si-iron, Mn-iron, P-iron, etc.)

**Hot blast stoves for blast furnaces** (in general 24c-5; 24k-4)
18a-11 Cowper brickwork stoves and modifications
18a-12 Withwell brickwork stove and modifications
18a-13 Lurmann brickwork stove and modifications
18a-14 Lining for brickwork hot-blast stoves; special brick shapes, bottom bricks
18a-15/01 Cutoff valves for blast-furnace gas and hot-blast pipes, particularly hot-blast valves for hot-blast stoves (general 47g)
18a-15/10 Firings (stokers) for hot-blast stoves (gas heaters, general 24c-1)
18a-16/01 Iron hot-blast stoves for blast furnaces
18a-16/10 preheating of combustion air for hot-blast stoves
18a-17/01 Cooling and drying of hot blast
18a-17/02 Chemical drying of hot blast

**Direct production of solid sponge iron and molten iron and steel from ores**
18a-18/01 not requiring processing in furnaces of special design
18a-18/02 in shaft furnaces
18a-18/03 in muffle furnaces
18a-18/04 in multi-deck furnaces
18a-18/05 in rotary furnaces
18a-18/06 in hearth furnaces
18a-18/07 in electric furnaces
18a-18/08 in furnaces of special design
18a-19 Electrometallurgical processing of iron ores, electric blast furnaces (electrometallurgical steelmaking 18b-21; electrolytic production of steel [iron] 40c-12, 40c-13)
18a  (IPC: C21B) Manufacture of iron and steel

Note:
This sub-class covers the pretreatment of iron ores, production of pig-iron, blast furnaces, and air heaters.

18a-1/00 Pretreatment of iron ores of ferrous material for the production of iron (pretreatment of ores in general 40a; washing and separating of ores 1a, 1c; furnaces)
18a-1/02 . Methods of roasting (18a-1/10 takes precedence)
18a-1/04 . Removing sulphur, phosphorus, arsenic, other than by roasting
18a-1/06 . Partial reduction, i.e. to a lower state of oxidation
18a-1/08 . Agglomerating, binding, or briquetting iron ores, or intermediate products, e.g. flue dust
18a-1/10 . . Sintering
18a-1/12 . . . in tunnel furnaces
18a-1/14 . . . in shaft furnaces
18a-1/16 . . . in rotary furnaces
18a-1/18 . . . in other apparatus, e.g. pots, sintering machines
18a-1/20 . . Binding or briquetting
18a-1/22 . . . with binders
18a-1/24 . . . . inorganic
18a-1/26 . . . . organic
18a-1/28 . . . . . with carbonaceous material for the production of coked agglomerates
18a-1/30 . . . . of ferrous waste or alloys

18a-3/00 General features in the manufacture of pig-iron (mixers for pig-iron 18b-1/06)
18a-3/02 . by applying additives, e.g. fluxing agents
18a-3/04 . Recovery of by-products, e.g. slag
18a-3/06 . . Treatment of liquid slag (slag wool 80b-5/07; slag stones 80b-22)
18a-3/08 . . . Cooling slag
18a-3/10 . . . . Slag pots; Slag cars
18a-3/12 . . . . Removing deposits from ovens

18a-5/00 Making pig-iron in the blast furnace
18a-5/02 . Making special pig-iron, e.g. by applying additives, e.g. oxides of other metals
18a-5/04 . Making slag of special composition
18a-5/06 . Using top gas in the blast furnace process (in coke ovens 10a, 26a)

18a-7/00 Blast furnaces
18a-7/02 . Internal forms
18a-7/04 . with special refractories (refractory materials 80b)
18a-7/06 . . Linings for furnaces
18a-7/08 . . Top armourings
18a-7/10 . Cooling; Devices therefor
18a-7/12 . Opening or sealing the tap holes
18a-7/14 . Discharging devices, e.g. for slag
18a-7/16 . Tuyères
18a-7/18 . Bell-and-hopper arrangements
18a-7/20 . . with appliances for distributing the burden
18a-7/22 . Dust arresters
18a-7/24 . . Test rods or other checking devices

18a-9/00 Stoves for heating the blast in blast furnaces
18a-9/02 . Brick hot-blast stoves
18a-9/04 . . with combustion shaft
18a-9/06 . . Linings
18a-9/08 . Iron hot-blast stoves
18a-9/10 . Other details, e.g. blast mains
18a-9/12 . . Hot-blast valves or slides for blast furnaces (valves in general 47g)
18a-9/14 . . Preheating the combustion air
<table>
<thead>
<tr>
<th>Class 18a-9/16</th>
<th>Cooling or drying the hot-blast</th>
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<tbody>
<tr>
<td><strong>Class 18a-11/00</strong> Making pig-iron other than in blast furnaces</td>
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<tr>
<td>18a-11/02</td>
<td>in low shaft furnaces</td>
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<td>18a-11/06</td>
<td>in rotary kilns</td>
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<tr>
<td>18a-11/08</td>
<td>in hearth-type furnaces</td>
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<td>18a-11/10</td>
<td>in electric furnaces</td>
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<tr>
<td><strong>Class 18a-13/00</strong> Making spongy iron or liquid steel, by direct processes</td>
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<tr>
<td>18a-13/02</td>
<td>in shaft furnaces</td>
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<td>18a-13/04</td>
<td>in retorts</td>
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<tr>
<td>18a-13/06</td>
<td>in multi-storied furnaces</td>
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<tr>
<td>18a-13/08</td>
<td>in rotary furnaces</td>
</tr>
<tr>
<td>18a-13/10</td>
<td>in hearth-type furnaces</td>
</tr>
<tr>
<td>18a-13/12</td>
<td>in electric furnaces</td>
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<tr>
<td>18a-13/14</td>
<td>Multi-stage processes</td>
</tr>
<tr>
<td><strong>Class 18a-15/00</strong> Other processes for the manufacture of iron from iron compounds (by electrolysis 40e)</td>
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<tr>
<td>18a-15/02</td>
<td>Metallothermic processes, e.g. thermit reduction</td>
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<tr>
<td><strong>Class 18a-56/01</strong> Charging equipment</td>
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<tr>
<td>18a-56/02</td>
<td>Inclined elevators</td>
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<tr>
<td>18a-56/03</td>
<td>Vertical elevators</td>
</tr>
<tr>
<td>18a-56/04</td>
<td>Skip charging</td>
</tr>
<tr>
<td>18a-56/05</td>
<td>Charging skips</td>
</tr>
</tbody>
</table>

**Class 18b** Production of cast iron, steel and pure iron by processing of intermediate [master] alloys or ferroalloys, sponge iron, scrap, etc. (direct production of iron or steel from ores 18a-18)

**Processing of pig iron; production of cast iron and foundry or ferroalloys**

| 18b-1/01 | Production of foundry or ferroalloys in foundry shaft furnaces (production of ferroalloys, general 18b-20; in blast furnaces 18a-10) |
| 18b-1/02 | Production of cast iron |
| 18b-1/03 | Refining of pig iron |
| 18b-2 | Separation of phosphorus and sulphur from pig iron (from steel 18b-9) |
| 18b-3 | Pig iron mixers |

**Production of wrought iron and wrought steel**

| 18b-4 | Processes for the production of wrought iron and wrought steel |
| 18b-5 | Simple puddling furnaces, including mechanical agitators |
| 18b-6 | Double puddling furnaces |
| 18b-7 | Oscillating and rotating puddling furnaces |

**Production of low and medium carbon steel, cast steel and special alloys**

| 18b-8 | General processes for refining pig iron |
| 18b-9 | Separation of phosphorus and sulfur from molten steel baths (from pig iron 18b-2) |
| 18b-10 | Recarburisation and deoxidation of molten steel baths |
| 18b-11 | Modification [treatment] of molten steel with additives with a view to obtaining compact ingots (castings 31c-11 – 31c-15) |
| 18b-12 | Production of crucible steel |
| 18b-13 | Steelmaking in Siemens-Martin open-hearth furnaces |
| 18b-14/01 | Stationary and tilting open-hearth furnaces |
| 18b-14/02 | Refractory linings for open-hearth furnaces |
| 18b-14/03 | Open-hearth furnaces with pulverised coal firing |
| 18b-14/04 | Special equipment for open-hearth furnaces |
| 18b-14/05 | Port ends for open-hearth furnaces |
| 18b-14/06 | Slag pockets for open-hearth furnaces |
18b-14/07 Tap holes of open-hearth furnaces (for cupola furnaces 31a-6/20)
18b-14/50 Slag removal from steel ladles
18b-15 Charging equipment for open-hearth furnaces (for electric furnaces 18b-21/10, for reheating furnaces 18c-11/20; for stokers 24h-1 – 24h-7)
18b-16/01 Steelmaking in Thomas and Bessemer converters
18b-16/02 Production of phosphate or Thomas slag during steelmaking operations
18b-16/03 Refractory linings for Thomas and Bessemer converters
18b-17 Special equipment for Thomas and Bessemer converters
18b-18 Miscellaneous types of converters
18b-19 Nozzles and bottoms for Thomas and Bessemer converters
18b-20 Special procedures for making high-grade steels and special steels or ferroalloys by the molten method, e.g. chromium steels, chromium-nickel steels, molybdenum steels; transformer dynamo steel, or mild steel
18b-21/01 Electrometallurgical steelmaking processes (electrolytic production processes 40c-12, 40c-13, 48a-6/03)
18b-21/02 Electric furnaces for steelmaking, inasmuch as electrical features are not included (electric furnaces, general 21h-14 – 21h-25)
18b-21/03 Special equipment for electric furnaces
18b-21/10 Charging equipment for electric furnaces
18b-22/01 Production of steel in special-structure melting installations (wrought iron 18b-4; crucible steel 18b-12; open-hearth steel 18b-13; converter steel 18b-16; electric-furnace steel 18b-21)
18b-22/10 Duplex and triplex processes
18b-23 Production of iron alloys by processes other than smelting, e.g. by pressing, ramming, or sintering (nonferrous alloys 40b-2)

18b (IPC: C21C) Processing of pig-iron, e.g. refining, manufacture of wrought-iron and steel

18b-1/00 Refining of pig-iron; Cast iron
18b-1/02 . Dephosphorising or desulphurising
18b-1/04 . Removing impurities other than carbon, phosphorus, and sulphur
18b-1/06 . Constructional features of mixers for pig-iron
18b-1/08 . Manufacture of cast-iron
18b-1/10 . Making spheroidal graphite cast-iron

18b-3/00 Manufacture of wrought-iron or wrought-steel
18b-3/02 . Puddling furnaces

18b-5/00 Manufacture of carbon steel, e.g. plain mild steel, medium carbon steel, or cast-steel
18b-5/02 . Crucible furnace process
18b-5/04 . Manufacture of hearth-furnace steel, e.g. Siemens-Marten steel
18b-5/06 . . Processes yielding slags of special composition
18b-5/08 . . Constructional features of hearth furnaces
18b-5/10 . . . Refractory linings
18b-5/12 . . . Details or accessories
18b-5/14 . . . . Venturi heads
18b-5/16 . . . . Burners
18b-5/18 . . . . Slag chambers
18b-5/20 . . . . Regenerative chambers
18b-5/22 . . . . Change-over devices for gas or air supply
18b-5/24 . . . . Charging apparatus
18b-5/26 . . . . Tapping methods or apparatus
18b-5/28 . . . Manufacture of steel in the converter
18b-5/30 . . . Regulating or controlling the blowing
18b-5/32 . . . Blowing from above
18b-5/34 . . . Blowing through the bath
18b-5/36 . . Processes yielding slags of special composition
### 18b-5/38
Removal of waste gases or dust

### 18b-5/40
Offtakes or separating apparatus for converter waste gases or dust

### 18b-5/42
Constructional features of converters

### 18b-5/44
Refractory linings

### 18b-5/46
Details or accessories

### 18b-5/48
Bottoms or tuyères of converters

### 18b-5/50
Tilting mechanisms for converters

### 18b-5/52
Manufacture of steel in electric furnaces

### 18b-5/54
Processes yielding slags of special composition

### 18b-5/56
Manufacture of steel by other methods

### 18b-7/00
Treatment in the molten state of steel, steel alloys, or ferrous alloys

#### 18b-7/02
Dephosphorising (18b-5/28 takes precedence); Desulphurising

#### 18b-7/04
Removing other impurities

#### 18b-7/06
Deoxidising

#### 18b-7/08
Killing

#### 18b-7/10
Handling in vacuum

### 18c
Treatment of iron, steel, and cast iron in order to obtain special properties (if the invention relates only to special fields of electrotechnics 21h-14 – 21h-19; pulverised coal combustion in general, 241-4 – 241-10; gas heaters in general 24c; furnaces for heat treatment of nonferrous metals only 40d; furnaces for treatment of ceramics 80c)

**Note:**
Subclass 18c includes electric furnaces if the invention is intended to modify the material

#### 18c-1/10
Hardening by quenching

#### 18c-1/11
Hardening by quenching the whole preheated workpiece

#### 18c-1/12
Hardening processes in which only a portion of the workpiece is heated to the hardening temperature

#### 18c-1/30
Hardening by tempering below the transformation point, precipitation hardening, age hardening

#### 18c-1/40
Hardening of steels of special composition

#### 18c-1/50
Determination of hardening temperature

#### 18c-1/60
Heating baths, e.g. salt baths, metallic baths

#### 18c-1/70
Quenching agents, e.g. liquids, gases, quenching tanks

#### 18c-1/80
Cold hardening

**Processes and devices for hardening of steel articles** (hardening in casting moulds 31c-16)

#### 18c-2/10
Hardening of articles, in general

#### 18c-2/15
Auxiliary tools for article hardening, e.g. tongs, holders

#### 18c-2/20
Hardening of special articles

#### 18c-2/21
of springs

#### 18c-2/22
of scrapers

#### 18c-2/23
of railway rails

#### 18c-2/24
of hollow bodies, tubes

#### 18c-2/25
of rifflle barrels

#### 18c-2/26
of projectiles

#### 18c-2/27
of skate blades

#### 18c-2/28
of blades, knives, scythes and similar tools

#### 18c-2/29
of turning chisels, milling cutters, drill bits and similar tools

#### 18c-2/30
of saw blades

#### 18c-2/31
of magnets, permanent magnets
The German Patent Classification, Class 18

18c-2/32 of needles
18c-2/33 of shafts, crankshafts
18c-2/34 of gears and the like articles
18c-2/35 of wheel tyres
18c-2/36 of balls and rollers
18c-2/37 of rings and annular-shaped elements

Processes, methods and furnaces for surface treatment of steel by decarburisation, carburisation, and nitriding

18c-3/10 Reduction of carbon content, decarburisation
18c-3/15 Enrichment of carbon content, carburisation, cementation
18c-3/25 Enrichment of nitrogen, nitriding
18c-3/50 Furnaces for the above processes, cementing furnaces, nitriding furnaces
18c-4 Cementation and hardening of armour plates

Hardening and tempering furnaces

18c-5/10 General structural features
18c-5/20 Furnaces with rotating heating chamber
18c-5/30 Automatic hardening furnaces, hardening machines
18c-5/40 Crucible furnaces for heating baths (heating baths 18c-1)

Heat treatment of iron and steel wires and strips (of nonferrous metals 40d)

18c-6/10 Annealing, hardening, and surface heat-treatment processes, e.g. patenting
18c-6/50 Furnaces with general structural features
18c-6/60 Continuous furnaces
18c-6/70 Furnace coilers

Heat treatment of iron and steel sheets (40d)

18c-7/10 Treatment of sheet metal, in general, heavy and medium plates, thin sheets
18c-7/20 Treatment of sheets for deep drawing and deep stamping, e.g. car body sheets
18c-7/30 Heat treatment of dynamo and transformer sheet
18c-7/50 Furnaces for special heat-treatment processes for finished sheets (sheet-annealing furnaces of conventional construction 18c-9)

Annealing and surface heat treatment of steel (for wire 18c-6; for sheet metal 18c-7; for cast iron 18c-12)

18c-8/10 Annealing, general, e.g. softening, normalising
18c-8/20 Heat treatment, hardening with subsequent tempering
18c-8/30 Annealing and heat treatment of special articles, e.g. tools, structural components
18c-8/40 Annealing and surface heat-treatment of steels of special composition
18c-8/50 Annealing and heat treatment of steel and steel articles with a view to obtaining special properties, e.g. fatigue strength, good workability and machinability
18c-8/55 Annealing and heat treatment of steel and steel articles with a view to obtaining special electric and magnetic properties
18c-8/80 Processes for annealing in solid protective media, in protective gases or in a vacuum (for nonferrous metals, 40d-2/31)
18c-8/90 Furnaces and apparatus for annealing in protective media and the like, e.g. in annealing pots, annealing boxes) for nonferrous metals 40d-2/30; annealing furnaces in general 18c-9)

Annealing, reheating, and tempering furnaces (for wire 18c-6; sheets 18c-7; for annealing in protective media, etc. 18c-8)

18c-9/01 Chamber furnaces
18c-9/02 Channel and tunnel-type furnaces
18c-9/03 Stack annealing furnaces
18c-9/50 processes and built-in devices for conveying the heated material, e.g. rollers, chains, travelling or vertically movable hearth bottoms (charging devices 18c-11)
18c-10/01 Pusher-type furnaces
18c-10/02 Roller-hearth furnaces
18c-10/03 Pit furnaces
18c-10/04 Soaking pits
18c-10/05 Sheet bar reheating furnaces
18c-10/06 Reheating furnaces for small iron articles, e.g. rivets, bolts

Accessories for heating, annealing, hardening, and tempering furnaces
18c-11/01 Roofs, covers, doors (general 24k-1)
18c-11/02 Automatic slide valves, flap valves (general 24k-1; 47g)
18c-11/10 Control of furnaces (24i-1 – 24i-8)
18c-11/20 Processes and apparatus for charging and discharging the annealed material, charging devices (for smelting furnaces 18b-15; fuel feeding 24h-1 – 24h-8)
18c-11/30 Labour protection safety devices (24k-8)
18c-11/40 Lining, brickwork

Processes and methods for the heat treatment of cast iron and malleable cast iron (furnaces 18e-5, 18e-9, 18e-10)
18c-12/01 Annealing, hardening, and heat treatment
18c-12/10 Annealing of malleable pig iron; making malleable, graphitising (furnaces 18c-9)
18c-12/11 Packing means

Miscellaneous
18c-13 Heat treatment during shaping by rolling, forging, drawing, etc.
18c-14 Working processes, including rolling and deep drawing, with a view to obtaining special properties (rolling and drawing, general 7)
18c-15 Testing methods as auxiliaries in material inspection, and direct testing during heat treatment (metallographic testing 42k-48; testing methods, general 42k)

18c (IPC: C21D) Hardening and annealing of steel, iron, or articles made therefrom; Making malleable by decarburisation, tempering, or other treatments (cementation by diffusion processes 48b)
18c-1/00 General methods or devices for heat treatments, e.g. annealing, hardening, quenching, tempering
18c-1/02 . Hardening articles or materials formed by forging or rolling, with no further heating beyond that required for the formation
18c-1/04 . with simultaneous application of supersonic waves, magnetic or electric fields
18c-1/06 . Surface hardening by heating
18c-1/08 . with flames
18c-1/10 . by electric induction
18c-1/12 . Apparatus therefor
18c-1/14 . Hardening by precipitation
18c-1/16 . Hardening by cooling below 0° C
18c-1/18 . Tempering
18c-1/20 . Bainitic hardening
18c-1/22 . Martempering
18c-1/24 . Low tempering
18c-1/26 . Methods of annealing
18c-1/28 . Normalising
18c-1/30 . Stress-relieving
18c-1/32 . Soft annealing
18c-1/34 . Methods of heating (18c-1/06 takes precedence)
18c-1/36 . Shock-heating
18c-1/38 . Heating by cathodic discharges
18c-1/40 . Direct resistance heating
<table>
<thead>
<tr>
<th>Class</th>
<th>Keywords</th>
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<tr>
<td>18c-1/42</td>
<td>Induction heating</td>
</tr>
<tr>
<td>18c-1/44</td>
<td>in heat-treatment baths</td>
</tr>
<tr>
<td>18c-1/46</td>
<td>Salt baths</td>
</tr>
<tr>
<td>18c-1/48</td>
<td>Metal baths</td>
</tr>
<tr>
<td>18c-1/50</td>
<td>Oil baths</td>
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<tr>
<td>18c-1/52</td>
<td>with flames</td>
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<tr>
<td>18c-1/54</td>
<td>Determining when the hardening temperature has been reached by measurement of magnetic or electrical properties</td>
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<tr>
<td>18c-1/56</td>
<td>with special quenching agents</td>
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<tr>
<td>18c-1/58</td>
<td>oils</td>
</tr>
<tr>
<td>18c-1/60</td>
<td>aqueous agents</td>
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<tr>
<td>18c-1/62</td>
<td>Quenching devices</td>
</tr>
<tr>
<td>18c-1/64</td>
<td>with circulating liquids (in general 17f)</td>
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<tr>
<td>18c-1/66</td>
<td>combined with induction heating</td>
</tr>
<tr>
<td>18c-1/68</td>
<td>Protective coatings for locally preventing heat-treatment</td>
</tr>
<tr>
<td>18c-1/70</td>
<td>whilst heating and quenching</td>
</tr>
<tr>
<td>18c-1/72</td>
<td>during chemical change of surfaces</td>
</tr>
<tr>
<td>18c-1/74</td>
<td>Methods of treatment in inert gas, controlled atmosphere, vacuum, or pulverulent material (production of gases 12i; 12k; 10a; 26a)</td>
</tr>
<tr>
<td>18c-1/76</td>
<td>Adjusting the composition of the atmosphere</td>
</tr>
<tr>
<td>18c-1/78</td>
<td>Combined heat-treatments not previously covered, to produce special technological properties</td>
</tr>
<tr>
<td>18c-1/80</td>
<td>Hardening, combined with annealing between 300° and 600°C, i.e. heat refining (Vergüten)</td>
</tr>
<tr>
<td>18c-1/82</td>
<td>Descaling by thermal stresses (mechanically 7a; chemically 48a)</td>
</tr>
</tbody>
</table>

**18c-3/00** **Diffusion processes for extraction of non-metals; Furnaces therefor**
(local protective coatings 18c-1/72)

- 18c-3/02 Extraction of non-metals
- 18c-3/04 Decarburising
- 18c-3/06 Extraction of hydrogen
- 18c-3/08 Extraction of nitrogen
- 18c-3/10 Furnaces therefor

**18c-5/00** **Heat treatments of cast-iron**

- 18c-5/02 improving the malleability of grey cast-iron
- 18c-5/04 of white cast-iron
- 18c-5/06 Malleabilising
- 18c-5/08 with oxidation of carbon
- 18c-5/10 in gaseous agents
- 18c-5/12 in solid agents
- 18c-5/14 Graphitising
- 18c-5/16 Packing agents

**18c-7/00** **Modifying the physical properties of iron or steel by deformation**

- 18c-7/02 by cold working
- 18c-7/04 of the surface
- 18c-7/06 by shot-peening or the like
- 18c-7/08 by burnishing or the like
- 18c-7/10 of the whole cross-section, e.g. of concrete reinforcing bars
- 18c-7/12 by expanding tubular bodies
- 18c-7/13 by hot working
- 18c-7/14 by hot working combined with a heat treatment (treating with no heat other than that of shaping 18c-1/02; hot working methods in general 7a – 7c)

**18c-9/00** **Heat treatment, e.g. annealing, hardening, quenching, tempering, adapted for particular articles; Furnaces therefor**

- 18c-9/02 for springs
- 18c-9/04 for rails (apparatus for heat treatment of railway rails on the spot 19a-31/18)
- 18c-9/06 with diminished tendency to become wavy
- 18c-9/08 for tubular bodies or pipes
- 18c-9/10 shotgun barrels
### 18c-9/12
- Barrels for ordnance

### 18c-9/14
- Wear- or pressure-resistant pipes

### 18c-9/16
- For explosive shells

### 18c-9/18
- For knives, scythes, scissors, or like hand cutting tools

### 18c-9/20
- For blades for skates

### 18c-9/22
- For drills; for milling cutters; for machine cutting tools

### 18c-9/24
- For saw blades

### 18c-9/26
- For needles; for teeth for card-clothing

### 18c-9/28
- For plain shafts

### 18c-9/30
- For crankshafts; for camshafts

### 18c-9/32
- For gear wheels, worm wheels, or the like

### 18c-9/34
- For tyres; for rims

### 18c-9/36
- For balls; for rollers

### 18c-9/38
- For roll bodies

### 18c-9/40
- For rings; for bearing races

### 18c-9/42
- For armour plate

### 18c-9/44
- For equipment for lining mine shafts, e.g. segments, rings, props

### 18c-9/46
- For sheet metals

### 18c-9/48
- Deep-drawing sheets

### 18c-9/50
- For welded joints

### 18c-9/52
- For wires; for strips

### 18c-9/54
- Furnaces for treating strips or wire

### 18c-9/56
- Continuous furnaces for strip or wire

### 18c-9/58
- With heating by baths

### 18c-9/60
- With induction heating

### 18c-9/62
- With direct resistance heating

### 18c-9/64
- Patenting furnaces

### 18c-9/66
- Tower-type furnaces

### 18c-9/68
- Furnace coilers; Hot coilers (cold coilers 7b)

### 18c-9/70
- Furnaces for ingots, i.e. soaking pits

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### 18d
**Cast iron alloys, steel alloys, and ferrous alloys**

**Alloying technology**

18d-1/10 Intermediate [master] alloys of definite composition, for the production of cast iron alloys, steel alloys and iron alloys

18d-1/20 Cast iron alloys

18d-1/30 Steel alloys

18d-1/70 Iron alloys, carbon-free or practically carbon-free alloys

**Utilisation of alloys on the basis of their general, technological, mechanical, physical or chemical properties** (utilisation of alloys for special technological purposes on the basis of special technological properties only in the respective classes), **i.e. according to:**

18d-2/10 Magnetic or electric properties

18d-2/20 Mechanical strength

18d-2/30 Wear resistance

18d-2/40 Corrosion resistance

18d-2/50 Resistance to scaling

18d-2/60 Edge durability

18d-2/70 Workability and machinability

18d-2/80 Thermal properties, e.g. thermal expansion, thermal conductivity