

ECLA EUROPEAN CLASSIFICATION

- C21D** **MODIFYING THE PHYSICAL STRUCTURE OF FERROUS METALS; GENERAL DEVICES FOR HEAT TREATMENT OF FERROUS OR NON-FERROUS METALS OR ALLOYS; MAKING METAL MALLEABLE BY DECARBURISATION, TEMPERING OR OTHER TREATMENTS**
 (cementation by diffusion processes [C23C](#); surface treatment of metallic material involving at least one process provided for in class C23 and at least one process covered by this subclass, [C23F17/00](#); unidirectional solidification of eutectic materials or unidirectional demixing of eutectoid materials [C30B](#))
- C21D1/00** **General methods or devices for heat treatments, e.g. annealing, hardening, quenching, tempering** (furnaces in general [F27](#); electric heating per se [H05B](#))
- [C21D1/02](#) . Hardening articles or materials formed by forging or rolling, with no further heating beyond that required for the formation
- [C21D1/04](#) . with simultaneous application of supersonic waves, magnetic or electric fields
- [C21D1/06](#) . Surface hardening
- [C21D1/08](#) . . with flames
- [C21D1/09](#) . . by direct application of electrical or wave energy; by particle radiation
- [C21D1/10](#) . . . by electric induction
- [C21D1/18](#) . Hardening ([C21D1/02](#) takes precedence); Quenching with or without subsequent tempering ([quenching devices C21D1/62](#))
- [C21D1/18B](#) . . **[N: from an intercritical temperature]**
- [C21D1/19](#) . . by interrupted quenching
- [C21D1/20](#) . . . Isothermal quenching, e.g. bainitic hardening
- [C21D1/22](#) . . . Martempering
- [C21D1/25](#) . . Hardening, combined with annealing between 300 degrees Celsius and 600 degrees Celsius, i.e. heat refining ("Vergüten")
- [C21D1/26](#) . Methods of annealing
- [C21D1/28](#) . . Normalising
- [C21D1/30](#) . . Stress-relieving
- [C21D1/32](#) . . Soft annealing, e.g. spheroidising
- [C21D1/34](#) . Methods of heating ([C21D1/06](#) takes precedence)
- [C21D1/38](#) . . Heating by cathodic discharges
- [C21D1/40](#) . . Direct resistance heating
- [C21D1/42](#) . . Induction heating
- [C21D1/44](#) . . in heat-treatment baths
- [C21D1/46](#) . . . Salt baths
- [C21D1/48](#) . . . Metal baths

- C21D1/50 . . . Oil baths
- C21D1/52 . . with flames
- C21D1/53 . . Heating in fluidised beds
- C21D1/54 . Determining when the hardening temperature has been reached by measurement of magnetic or electrical properties
- C21D1/55 . Hardenability tests, e.g. end-quench tests ([investigating chemical or physical properties of materials in general G01N](#))
- C21D1/56 . characterised by the quenching agents
- C21D1/58 . . Oils
- C21D1/60 . . Aqueous agents
- C21D1/607 . . Molten salts
- C21D1/613 . . Gases; Liquefied or solidified normally gaseous material
- C21D1/62 . Quenching devices
- C21D1/63 . . for bath quenching
- C21D1/64 . . . with circulating liquids ([in general F28D](#))
- C21D1/667 . . for spray quenching
- C21D1/673 . . for die quenching
- C21D1/68 . Temporary coatings or embedding materials applied before or during heat treatment
- C21D1/70 . . while heating or quenching
- C21D1/72 . . during chemical change of surfaces
- C21D1/74 . Methods of treatment in inert gas, controlled atmosphere, vacuum, or pulverulent material ([production of gases C01, C10](#))
- C21D1/76 . . Adjusting the composition of the atmosphere
- C21D1/76C . . . [\[N: using a catalyst\] \[N9702\]](#)
- C21D1/767 . . with forced gas circulation; Reheating thereof
- C21D1/773 . . under reduced pressure or vacuum
- C21D1/78 . Combined heat-treatments not provided for above
- C21D1/78C . . [\[N: Thermocycling\] \[N9502\]](#)
- C21D1/82 . Descaling by thermal stresses ([mechanically B21, B23; chemically C23; electrolytically C25F](#))
- C21D1/84 . Controlled slow cooling ([cooling-beds for metal rolling B21B43/00](#))
- C21D3/00** **Diffusion processes for extraction of non-metals; Furnaces therefor** ([local protective coatings C21D1/72; furnaces in general F27](#))
- C21D3/02 . Extraction of non-metals
- C21D3/04 . . Decarburising
- C21D3/06 . . Extraction of hydrogen

- C21D3/08 . . . Extraction of nitrogen
- C21D3/10 . . . Furnaces therefor
- C21D5/00 Heat treatments of cast-iron**
- C21D5/02 . . . improving the malleability of grey cast-iron
- C21D5/04 . . . of white cast-iron
- C21D5/06 . . . Malleabilising
- C21D5/08 with oxidation of carbon
- C21D5/10 in gaseous agents
- C21D5/12 in solid agents
- C21D5/14 Graphitising
- C21D5/16 Packing agents
- C21D6/00 Heat treatment of ferrous alloys**
- C21D6/00B . . [N: containing Ni ([C21D6/00F](#) takes precedence)]
- C21D6/00D . . [N: containing Cr ([C21D6/00F](#) takes precedence)]
- C21D6/00F . . [N: containing Cr and Ni]
- C21D6/00H . . [N: containing Mn]
- C21D6/00J . . [N: containing Co]
- C21D6/00K . . [N: containing Si]
- C21D6/02 . . . Hardening by precipitation
- C21D6/04 . . . Hardening by cooling below 0 degrees Celsius
- C21D7/00 Modifying the physical properties of iron or steel by deformation ([apparatus for mechanical working of metal B21, B23, B24](#)) [[C9506](#)]**
- C21D7/02 . . . by cold working
- C21D7/04 of the surface
- C21D7/06 by shot-peening or the like
- C21D7/08 by burnishing or the like
- C21D7/10 of the whole cross-section, e.g. of concrete reinforcing bars
- C21D7/10B [N: of concrete reinforcing bars]
- C21D7/12 by expanding tubular bodies
- C21D7/13 . . . by hot working
- C21D8/00 Modifying the physical properties by deformation combined with, or followed by,**

heat treatment (hardening articles or materials formed by forging or rolling with no further heating beyond that required for the formation [C21D1/02](#))

- C21D8/00A . [N: of ferrous alloys ([C21D8/02](#) to [C21D8/12](#) take precedence)]
- C21D8/02 . during manufacturing of plates or strips ([C21D8/12](#) takes precedence)
- [N: **Note**
[N9605]In this group classification is made according to the most important feature in one subgroup only; for other features indexing codes of [M21D](#) are added
]
- C21D8/02A . . [N: of ferrous alloys]
- C21D8/02B . . [N: involving a particular fabrication or treatment of ingot or slab] [N9605]
- C21D8/02B2 . . . [N: Rapid solidification; Thin strip casting] [N9605]
- C21D8/02D . . [N: characterised by the working steps] [N9605]
- C21D8/02D2 . . . [N: Hot rolling] [N9605]
- C21D8/02D4 . . . [N: Warm rolling] [N9605]
- C21D8/02D6 . . . [N: Cold rolling] [N9605]
- C21D8/02D8 . . . [N: Flattening; Dressing; Flexing] [N9605]
- C21D8/02F . . [N: characterised by the heat treatment] [N9605]
- C21D8/02F2 . . . [N: with application of tension] [N9605]
- C21D8/02F4 . . . [N: with diffusion of elements, e.g. decarburising, nitriding] [N9605]
- C21D8/02F6 . . . [N: following hot rolling] [N9605]
- C21D8/02F7 . . . [N: between cold rolling steps] [N9605]
- C21D8/02F8 . . . [N: Final recrystallisation annealing] [N9605]
- C21D8/02H . . [N: involving a particular surface treatment ([C21D8/02L](#) takes precedence)] [N9605]
- C21D8/02H2 . . . [N: Application of a separating or insulating coating] [N9605]
- C21D8/02H4 . . . [N: Application of a tension-inducing coating] [N9605]
- C21D8/02L . . [N: involving a localised treatment] [N9605]
- C21D8/04 . . to produce plates or strips for deep-drawing
- [N: **Note**
[N9605]In this group classification is made according to the most important feature in one subgroup only; for other features indexing codes of [M21D](#) are added
]
- C21D8/04A . . . [N: of ferrous alloys]
- C21D8/04B . . . [N: involving a particular fabrication or treatment of ingot or slab] [N9605]
- C21D8/04B2 [N: Rapid solidification; Thin strip casting] [N9605]
- C21D8/04D . . . [N: characterised by the working steps] [N9605]
- C21D8/04D2 [N: Hot rolling] [N9605]
- C21D8/04D4 [N: Warm rolling] [N9605]
- C21D8/04D6 [N: Cold rolling] [N9605]
- C21D8/04D8 [N: Flattening; Dressing; Flexing] [N9605]
- C21D8/04F . . . [N: characterised by the heat treatment] [N9605]

- C21D8/04F2 [N: with application of tension] [N9605]
- C21D8/04F4 [N: with diffusion of elements, e.g. decarburising, nitriding] [N9605]
- C21D8/04F6 [N: following hot rolling] [N9605]
- C21D8/04F7 [N: between cold rolling steps] [N9605]
- C21D8/04F8 [N: Final recrystallisation annealing] [N9605]
- C21D8/04H . . . [N: involving a particular surface treatment ([C21D8/04L](#) takes precedence)] [N9605]
- C21D8/04H2 [N: Application of a separating or insulating coating] [N9605]
- C21D8/04H4 [N: Application of a tension-inducing coating] [N9605]
- C21D8/04L . . . [N: involving a localised treatment] [N9605]

- C21D8/06 . . . during manufacturing of rods or wires
- C21D8/06A . . . [N: of ferrous alloys]
- C21D8/08 . . . for concrete reinforcement

- C21D8/10 . . . during manufacturing of tubular bodies
- C21D8/10A . . . [N: of ferrous alloys] [N9611]

- C21D8/12 . . . during manufacturing of articles with special electromagnetic properties

- [N: **Note**
In this group classification is made according to the most important feature in one subgroup only; for other features indexing codes of [M21D](#) are added]

- C21D8/12B . . . [N: involving a particular fabrication or treatment of ingot or slab]
- C21D8/12B2 [N: Rapid solidification; Thin strip casting]
- C21D8/12D . . . [N: the working step(s) being of interest]
- C21D8/12D2 [N: Hot rolling]
- C21D8/12D4 [N: Warm rolling]
- C21D8/12D6 [N: Cold rolling]
- C21D8/12D8 [N: Flattening; Dressing; Flexing]
- C21D8/12F . . . [N: the heat treatment(s) being of interest]
- C21D8/12F2 [N: with application of tension]
- C21D8/12F4 [N: with diffusion of elements, e.g. decarburising, nitriding]
- C21D8/12F6 [N: following hot rolling]
- C21D8/12F7 [N: between cold rolling steps]
- C21D8/12F8 [N: Final recrystallisation annealing]
- C21D8/12H . . . [N: involving a particular surface treatment ([C21D8/12L](#) takes precedence)]
- C21D8/12H2 [N: Application of a separating or insulating coating]
- C21D8/12H4 [N: Application of a tension-inducing coating]
- C21D8/12L . . . [N: involving a localized treatment]

- C21D9/00** . . . **Heat treatment, e.g. annealing, hardening, quenching, tempering, adapted for particular articles; Furnaces therefor** (furnaces in general [E27](#))

- C21D9/00D . [N: Details, accessories not peculiar to any of the following furnaces (**control devices** [C21D11/00](#))]
- C21D9/00D2 . . [N: Rolls; Roll arrangements]
- C21D9/00D3 . . [N: for charging, discharging or manipulation of charge]
- C21D9/00D5 . . [N: Supports; Baskets; Containers; Covers]
- C21D9/00E . [N: Rotary furnaces with horizontal or slightly inclined axis]
- C21D9/00F . [N: Rotary furnaces with vertical axis; Furnaces with rotating floor]
- C21D9/00G . [N: Muffle furnaces; Retort furnaces]
- C21D9/00H . [N: Furnaces in which the charge is moving up or down (**for wire, strip** [C21D9/54](#))]
- C21D9/00J . [N: Furnaces through which the charge is moved in a horizontal straight path ([C21D9/00G](#) **takes precedence**)]
- C21D9/00K . [N: Heat-treating apparatus with a cooling or quenching zone]
- C21D9/00P . [N: for particular articles not mentioned below]
- C21D9/00R . [N: for rods of limited length (**of unlimited length** [C21D9/52](#))]
- C21D9/00S . [N: for slabs; for billets]
- C21D9/00T . [N: for chains, for chain links]
- C21D9/00U . [N: for screws; for bolts]
- C21D9/02 . for springs
- C21D9/04 . for rails (**apparatus for heat treatment of railway rails on the spot** [E01B31/18](#))
- C21D9/06 . . with diminished tendency to become wavy
- C21D9/08 . for tubular bodies or pipes
- C21D9/08K . . [N: **Cooling or quenching**] [[N9601](#)]
- C21D9/10 . . shotgun barrels
- C21D9/12 . . barrels for ordnance
- C21D9/14 . . wear- or pressure-resistant pipes
- C21D9/16 . for explosive shells
- C21D9/18 . for knives, scythes, scissors, or like hand cutting tools
- C21D9/20 . for blades for skates
- C21D9/22 . for drills; for milling cutters; for machine cutting tools
- C21D9/24 . for saw blades

- C21D9/26 . for needles; for teeth for card-clothing
- C21D9/28 . for plain shafts
- C21D9/30 . for crankshafts; for camshafts
- C21D9/32 . for gear wheels, worm wheels, or the like
- C21D9/34 . for tyres; for rims
- C21D9/36 . for balls; for rollers
- C21D9/38 . for roll bodies
- C21D9/40 . for rings; for bearing races
- C21D9/42 . for armour plate
- C21D9/44 . for equipment for lining mine shafts, e.g. segments, rings, props
- C21D9/46 . for sheet metals
- C21D9/48 . . deep-drawing sheets
- C21D9/50 . for welded joints
- C21D9/50K . . [N: Cooling thereof] [N9412]
- C21D9/52 . for wires; for strips; [N: for rods of unlimited length]
- C21D9/52B . . [N: for wire, for rods (C21D9/54 takes precedence)]
- C21D9/54 . . Furnaces for treating strips or wire
- C21D9/56 . . . Continuous furnaces for strip or wire
- C21D9/56C [N: with a controlled atmosphere or vacuum]
- C21D9/56D [N: Details]
- C21D9/56D2 [N: Rolls; Drums; Roll arrangements]
- C21D9/56D4 [N: Tension control] [N9601]
- C21D9/56D6 [N: Sealing arrangements] [N9903]
- C21D9/567 with heating in fluidised beds
- C21D9/573 with cooling
- C21D9/573B [N: of wires; of rods]
- C21D9/573D [N: Details]
- C21D9/573D2 [N: Rolls; Drums; Roll arrangements]
- C21D9/58 with heating by baths
- C21D9/60 with induction heating
- C21D9/62 with direct resistance heating
- C21D9/63 the strip being supported by a cushion of gas
- C21D9/64 . . . Patenting furnaces
- C21D9/66 . . . Tower-type furnaces

- C21D9/663 . . . Bell-type furnaces
- C21D9/665 inverted or side-facing
- C21D9/667 Multi-station furnaces
- C21D9/67 adapted for treating the charge in vacuum or special atmosphere
- C21D9/673 Details, accessories, or equipment peculiar to bell-type furnaces
- C21D9/675 Arrangements of charging or discharging devices
- C21D9/677 Arrangements of heating devices
- C21D9/68 . . . Furnace coilers; hot coilers ([cold coilers B21C](#))

- C21D9/70 . Furnaces for ingots, i.e. soaking pits

- C21D10/00** **Modifying the physical properties by methods other than heat treatment or deformation**

- C21D10/00L . [\[N: by laser shock processing\] \[N9812\]](#)

- C21D11/00** **Process control or regulation for heat treatments** ([controlling or regulating in general G05](#))

- C21D11/00K . [\[N: for cooling\] \[N0108\]](#)