

## 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, [C23F 17/00](#); unidirectional solidification of eutectic materials or unidirectional demixing of eutectoid materials [C30B](#))**

### Definition statement

*This place covers:*

Changing the physical structure of ferrous metals; General devices for heat treatments of ferrous or non-ferrous metals or alloys; making metal malleable by decarburisation, tempering or other treatments

The term "ferrous alloys" refers to alloys based essentially on iron.

### Relationships with other classification places

- [C22F](#) provides for decarburization of non-ferrous metal and non-ferrous alloys to modify the physical structure thereof.
- Subclass [C22B](#) covers the decarburization of metalliferous material for purposes of refining.
- [C23F 17/00](#) provides for surface treatment of metallic material involving at least one process provided for in class [C23](#) and at least one process covered in [C22F](#).
- When the method is intended for providing a particular use/product then the use/ product is classified as well (see informative references for some of them).
- When the composition of the alloy is disclosed, either in claims or description, this one is classified as well [C22C](#).

### References

#### Limiting references

*This place does not cover:*

Surface treatment of metallic material	<a href="#">C23</a> , <a href="#">C23F 17/00</a>
Cementation by diffusion processes	<a href="#">C23C</a>
Single crystals or homogeneous polycrystalline material with defined structure; production thereof	<a href="#">C30B</a>

#### Informative references

*Attention is drawn to the following places, which may be of interest for search:*

Mechanical metal-working	<a href="#">B21B</a> , <a href="#">B21C</a> , <a href="#">B21J</a>
Working metallic powder, powder metallurgical apparatus or processes	<a href="#">B22F</a> , <a href="#">C22C 1/04</a>
Layered products	<a href="#">B32B</a>
Changing the physical structure of non-ferrous metals or alloys	<a href="#">C22F</a>
Electrolytic production or refining of metals	<a href="#">C25C</a>
Furnaces	<a href="#">F27</a>

Investigating or analysing material by determining their chemical or physical properties	<a href="#">G01N</a>
Electric heating	<a href="#">H05B</a>

### Special rules of classification

- In [C21D](#) the last place rule is followed (classification in the last appropriate place) combined with multiple classifications, for a classification of a 100% disclosed alloy composition.
- When classifying in group [C21D 6/00](#), any aspect of the method for the heat treatment of ferrous alloys which is considered to represent information of interest for search may also be classified in groups [C21D 1/02](#) - [C21D 1/84](#). This can, for example, be the case when it is considered of interest to enable searching of heat treatment methods of ferrous alloys using a combination of classification symbols. Such non-obligatory classification should be given as "additional information".
- When classifying in [C21D](#) all essential features disclosed should be classified in EC classification.

### Glossary of terms

*In this place, the following terms or expressions are used with the meaning indicated:*

Alloy	A composition of plural elements at least one of which is a free metal. It also includes material containing any combination of fibres, filaments, whiskers and particles, e.g. carbides, diamond, oxides, borides, nitrides, silicides, or other metal compounds, e.g. oxynitrides or sulfides embedded in a metallic matrix
Cast iron	Ferrous alloy which solidifies with an eutectic, with C 2.1-4%.
Steel	Ferrous alloy with a carbon content C 0.2-2.1%.
Air hardening steel	Steel which does not require quenching from a high temperature to harden but which is hardened by cooling in air from above its critical temperature range.
Sub-critical annealing/Stress relief annealing	Heat treatment for relieving or dissipating stresses in weldments, heavily machined parts, castings, forgings by heating them, uniformly heated through, and air cooled/slow cooled with subsequent finishing or heat treatment.
Oil-hardening	Process of hardening a ferrous alloy by heating within or above the transformation range and quenching in oil
Decarburization	Subjecting the steel to high temperatures and heat treating in a media containing air, oxygen or hydrogen to remove carbon at the surface.
Recrystallization	After all metal crystals have been dissolved by heating enough to lose its structural strength, the metal temperature then falls, allowing the crystals to re-form
Spheroidizing	Heating the carbon steel to approximately 700 °C for over 30 hours to form spheroidite, to soften higher carbon steels and allow more formability.

Aging (or ageing)	A process in which the hardness or strength of a metal alloy having a constituent in supersaturated solid solution is increased over time as the constituent precipitates out as a secondary phase containing the constituent. When occurring at room temperature the process is termed "natural aging", while a process that occurs when subjecting the metal alloy to elevated temperature is termed "artificial aging". Aging for a longer time than that corresponding to maximum strength or hardness at the particular temperature is termed "over-ageing".
Hardening	The increase in resistance to deformation
Precipitation hardening	As the quenched alloy ages, a new material precipitates out of the metallic crystal lattice, filling in abutting spaces, and increasing hardness
Normalizing	A process of heating metallic material above its critical temperature and cooling in air thereby establishing a fine uniform grain size and improving the microstructural uniformity
Quenching	The rapid cooling of metallic material either from elevated temperature to room temperature or cooling of metal to sub-ambient temperature, at a specific rate, with a given medium.
Tempering	Heating of a previously quenched or normalized metallic material to an elevated temperature, and then cooling under suitable conditions to obtain the desired mechanical properties.
Martempering	Heat treatment of steel involving austenitisation of steel followed by quenching in heat extracting medium (e.g. salt), at a rate fast enough to avoid the formation of ferrite, pearlite or bainite to a temperature slightly above the martensite start (Ms) point
Austempering	Isothermal heat treatment applied to steel and cast iron, involves holding the metallic material at the quenching temperature for an extended period of time in order to produce a lower bainite microstructure for steels and a structure of acicular ferrite and high carbon, stabilized austenite known as ausferrite for cast-irons.
Case Hardening	Heat treatment or combination of heat treatments of surface hardening involving a change in the composition of the outer layer of an iron-base alloy in which the surface is made harder by inward diffusion of a gas or liquid followed by appropriate thermal treatment.

## C21D 1/00

### General methods or devices for heat treatment, e.g. annealing, hardening, quenching or tempering

#### Definition statement

*This place covers:*

Methods and devices for heat treatments: annealing, hardening, quenching of ferrous alloys.

#### Relationships with other classification places

Ferrous alloys are classified in [C22C 38/00](#).

When the heat-treated alloy is intended for a particular use/product then the use/ product is classified as well in the appropriate field/classes.

## References

### Informative references

Attention is drawn to the following places, which may be of interest for search:

Rolling of metal	<a href="#">B21B</a>
Cooling-beds for metal rolling	<a href="#">B21B 43/00</a>
Manufacture of metal sheets/bars/wires/tubes otherwise than by rolling	<a href="#">B21C</a>
Forging	<a href="#">B21J</a>
Machine tools; metal-working not otherwise provided for	<a href="#">B23</a>
Production of gases	<a href="#">C01</a> , <a href="#">C10</a>
Ferrous alloys	<a href="#">C22C 37/00</a> , <a href="#">C22C 38/00</a>
Coating material with metallic material, cementation (carburizing, nitriding, etc)/Chemical descaling	<a href="#">C23C</a>
Processes for the electrolytic removal of materials from objects	<a href="#">C25F</a>
Furnaces	<a href="#">F27</a>
Heat exchange apparatus in which the heat-exchange media do not come into direct contact	<a href="#">F28D</a>
Investigating or analysing material by determining their chemical or physical properties	<a href="#">G01N</a>
Electric heating	<a href="#">H05B</a>

### Special rules of classification

In these groups, the last place rule is followed combined with multiple classifications.

If the alloy composition is given it needs to be classified in [C22C 38/00](#) in the corresponding sub-group(s).

All the disclosed heat treatments (claims, description, examples, figures/diagrams) are classified.

For example, a case hardened gear steel consisting of, by weight percent, 16.3Co, 7.5Ni, 3.5Cr, 1.75Mo, 0.2W, 0.11C, 0.03Ti, and 0.02V and the balance Fe, will be classified in this group in [C21D 1/22](#) as well as in [C22C 38/44](#), [C22C 38/52](#).

## C21D 3/00

**Diffusion processes for extraction of non-metals; Furnaces therefor (local protective coatings [C21D 1/72](#))**

### Definition statement

*This place covers:*

Diffusion processes for extraction of non-metals, furnaces thereof.

### Relationships with other classification places

- Ferrous alloys are classified in [C22C 38/00](#).
- When the heat-treated alloy is intended for a particular use/product then the use/ product is classified as well in the appropriate field/classes, having also in mind group [C21D 9/00](#).

## References

### Limiting references

*This place does not cover:*

Local protective coatings	<a href="#">C21D 1/72</a>
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### Informative references

*Attention is drawn to the following places, which may be of interest for search:*

Rolling of metal	<a href="#">B21B</a>
Manufacture of metal sheets/bars/wires/tubes otherwise than by rolling	<a href="#">B21C</a>
Forging	<a href="#">B21J</a>
Production of gases	<a href="#">C01</a> , <a href="#">C10</a>
Alloys	<a href="#">C22C 38/00</a>
Coating material with metallic material, cementation (carburizing, nitriding, etc)/Chemical descaling	<a href="#">C23C</a>
Processes for the electrolytic removal of materials from objects	<a href="#">C25F</a>
Furnaces	<a href="#">F27</a>

## Special rules of classification

- In these groups, the last place rule is followed combined with multiple classifications.
- If the alloy composition is given it needs to be classified in [C22C 38/00](#) in the corresponding sub-group(s).
- All the disclosed heat treatments (claims, description, examples, figures/diagrams) are classified.
- For example, a method for production of a surface-decarburized hot-rolled strip with the following composition C: 0.4-1.0%, Si: 0.1-0.5%, Mn: 0.3-1.2%,
- P: <0.02%, S: <0.008%, Al: 0.01-0.05%, Cr: 0.1-0.5%, Ni: 0.1-0.4%, Mo: <50.1%, balance Fe will be classified in [C21D 3/04](#), as well as in [C21D 1/74](#), in [C22C 38/02](#), [C22C 38/04](#), [C22C 38/06](#), [C22C 38/40](#).
- In case of a method for manufacturing oriented silicon steel: (in wt %): C 0.020-0.050%, Si 2.6-3.6%, S 0.015-0.025%, Al 0.008-0.028%, N 0.005-0.020%, Mn 0.15-0.5%, Cu 0.3-1.2%, balance Fe and inevitable impurities, involves smelting steel, refining molten steel, continuously casting steel to obtain slab, hot rolling, cold rolling, annealing and applying annealing separator and insulation coating on slab, the classification in this group is: [C21D 3/04](#), [C21D 1/26](#), as well as [C22C 38/001](#), [C22C 38/02](#), [C22C 38/04](#), [C22C 38/06](#), [C22C 38/16](#).

## C21D 5/00

### Heat treatments of cast-iron

#### Definition statement

*This place covers:*

Heat treatments of cast iron alloys - ferrous alloy which solidifies with an eutectic, with C 2.1% -4%.

#### Relationships with other classification places

- Cast iron is classified in [C22C 37/00](#).

- When the heat-treated cast iron alloy is intended for a particular use/product then the use/ product is classified as well in the relevant class in the appropriate field/classes, having also in mind group [C21D 9/00](#).
- Making cast iron alloys are classified in [C22C 33/08](#) – [C22C 33/12](#).

## References

### Limiting references

*This place does not cover:*

Heat treating of non-ferrous alloys	<a href="#">C22F</a>
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### Informative references

*Attention is drawn to the following places, which may be of interest for search:*

Refining of metals	<a href="#">C22B</a>
Making cast iron alloys	<a href="#">C22C 33/08</a> - <a href="#">C22C 33/12</a>
Steels	<a href="#">C22C 38/00</a>

## Special rules of classification

In these groups, the last place rule is followed combined with multiple classifications.

If the alloy composition is given it needs to be classified in [C22C 37/00](#) in the corresponding sub-group.

All the disclosed heat treatments (claims, description, examples, figures/diagrams) are classified.

For example, a surface hardening cast iron parts by degraphitizing a surface layer part of cast iron member and thereafter irradiating a laser beam or an electron beam on said surface will be classified in [C21D 5/00](#), as well as [C21D 3/04](#) and [C21D 1/09](#).

## C21D 6/00

### Heat treatment of ferrous alloys

#### Definition statement

*This place covers:*

Heat treatment of ferrous alloys: iron based alloys and all types of steels (low alloy steels, dual-phase steels, tool steels, spring steels, maraging steels, stainless steels, ferritic, austenitic, martensitic, bainitic, pearlitic etc).

#### Relationships with other classification places

When the alloy is produced by a specifically described method (examples, claims) then the method is classified as well ([B22F](#), [C23C](#), [B23K](#), [C25D](#), [C25B](#), [B22D](#), [B21J](#), [B21B](#), [B21C](#) etc).

Ferrous alloys are classified in [C22C 38/00](#).

When the alloy is intended for a particular use/product then the use/ product is classified as well.

## References

### Limiting references

*This place does not cover:*

Heat treating of cast irons	<a href="#">C21D</a>
Heat treating of non-ferrous alloys	<a href="#">C22F</a>

### Informative references

*Attention is drawn to the following places, which may be of interest for search:*

Soldering/welding materials	<a href="#">B23K 35/3053</a> - <a href="#">B23K 35/3093</a> , <a href="#">C21D 9/50</a>
Layered products	<a href="#">B32B 1/00</a>

## Special rules of classification

- In these groups, the last place rule is followed combined with multiple classifications.
- Since the alloy composition is given it needs to be classified in [C22C 38/00](#) in the corresponding sub-group(s).
- Heat treatment of ferrous alloys/steels containing Ni (and no Cr) are classified in [C21D 6/001](#) and [C22C 38/08](#).
- Heat treatment of ferrous alloys/steels containing Cr (and no Ni) are classified in [C21D 6/002](#) and [C22C 38/18-C22C 38/38](#).
- Heat treatment of ferrous alloys/steels containing Cr and no Ni are classified in [C21D 6/004](#) and [C22C 38/40](#) - [C22C 38/58](#).
- All the disclosed heat treatments (claims, description, examples, figures/diagrams) are classified.

For example a case hardened gear steel having enhanced core fracture toughness includes by weight percent about 16.3Co, 7.5Ni, 3.5Cr, 1.75Mo, 0.2W, 0.11C, 0.03Ti, and 0.02V and the balance Fe, characterized as a predominantly lath martensitic microstructure essentially free of topologically close-packed (TCP) phases and carburized to include fine M<sub>2</sub>C carbides to provide a case hardness of at least about 62 HRC and a core toughness of at least about 50 ksi√in will be classified in [C21D 6/004](#); [C21D 6/007](#); [C21D 6/02](#); [C21D 6/04](#), and also in [C21D 1/22](#), [C21D 1/25](#) and [C22C 38/44](#), [C22C 38/52](#).

## Glossary of terms

*In this place, the following terms or expressions are used with the meaning indicated:*

Hardening by cooling below 0 degrees Celsius	Controlled cooling below 0° C in order to alter the material microstructure, and enhance its strength and wear properties
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## C21D 7/00

**Modifying the physical properties of iron or steel by deformation (apparatus for mechanical working of metal [B21](#), [B23](#), [B24](#))**

### Definition statement

*This place covers:*

Cold working and hot working deformation process of iron and steel.

## Relationships with other classification places

When the iron/steel alloy is produced by a specifically described method (examples, claims) then the method is classified as well ([B22F](#), [C23C](#), [B23K](#), [C25D](#), [C25B](#), [B22D](#), [B21J](#), [B21B](#), [B21C](#) etc).

Ferrous alloys are classified in [C22C 37/00](#), [C22C 38/00](#).

When the iron/steel alloy is intended for a particular use/product then the use/ product is classified as well.

## References

### Limiting references

*This place does not cover:*

Rolling of metal	<a href="#">B21B</a>
Manufacture of metal sheets/bars/wires/tubes otherwise than by rolling	<a href="#">B21C</a>
Forging	<a href="#">B21J</a>

### Informative references

*Attention is drawn to the following places, which may be of interest for search:*

Working or processing of sheet metal or metal tubes, rods, or profiles without essentially removing material; punching	<a href="#">B21D</a>
Apparatus for mechanical working of metal	<a href="#">B23</a> , <a href="#">B24</a>
Ferrous alloys	<a href="#">C22C 37/00</a> , <a href="#">C22C 38/00</a>

## Special rules of classification

- In these groups, the last place rule is followed combined with multiple classifications.
- If the alloy composition is given it needs to be classified in [C22C 38/00](#) in the corresponding sub-group.
- All the disclosed heat treatments (claims, description, examples, figures/diagrams) are classified.

For example a high cleanliness spring steel useful in manufacturing a spring with SiO<sub>2</sub>-based inclusions being extremely controlled and excellent in fatigue properties is obtained by scalping -> patenting -> cold wire drawing working (wire drawing) -> oil tempering -> process equivalent to strain relieving annealing -> shot peening -> strain relieving annealing will be classified in [C21D 7/04](#), [C21D 7/06](#), as well as in [C22C](#).

## C21D 8/00

**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 [C21D 1/02](#))**

### Definition statement

*This place covers:*

Modifying the physical properties by deformation combined with, or followed by, heat treatment during manufacturing processes of plates or strips, plates or strips for deep drawing, rods or wires, tubular bodies, articles with special electromagnetic properties



### Relationships with other classification places

When the alloy is intended for a particular use/product then the use/ product is classified as well.

Ferrous alloys are classified in [C22C 37/00](#), [C22C 38/00](#).

### References

#### Limiting references

*This place does not cover:*

Hardening articles or materials formed by forging or rolling with no further heating beyond that required for the formation	<a href="#">C21D 1/02</a>
Rolling of metal	<a href="#">B21B</a>
Manufacture of metal sheets/bars/wires/tubes otherwise than by rolling	<a href="#">B21C</a>
Forging	<a href="#">B21J</a>

#### Informative references

*Attention is drawn to the following places, which may be of interest for search:*

Working or processing of sheet metal or metal tubes, rods, or Profiles without essentially removing material; punching	<a href="#">B21D</a>
Ferrous alloys	<a href="#">C22C 37/00</a> , <a href="#">C22C 38/00</a>

### Special rules of classification

- In this maingroup, the last place rule is followed combined with multiple classifications.
- If the alloy composition is given it needs to be classified in [C22C 38/00](#) in the corresponding subgroup.
- All the disclosed heat treatments (claims, description, examples, figures/diagrams) are classified.

## C21D 8/005

{of ferrous alloys ([C21D 8/02](#) - [C21D 8/12](#) take precedence)}

### Definition statement

*This place covers:*

Modifying the physical properties by deformation combined with, or followed by, heat treatment of ferrous alloys, during manufacturing of plates or strips.

### Relationships with other classification places

When the alloy is intended for a particular use/product then the use/ product is classified as well.

Ferrous alloys are classified in [C22C 37/00](#), [C22C 38/00](#).

### References

#### Limiting references

*This place does not cover:*

Hardening articles or materials formed by forging or rolling with no further heating beyond that required for the formation	<a href="#">C21D 1/02</a>
Rolling of metal	<a href="#">B21B</a>

Manufacture of metal sheets/bars/wires/tubes otherwise than by rolling	<a href="#">B21C</a>
Forging	<a href="#">B21J</a>

### Informative references

Attention is drawn to the following places, which may be of interest for search:

Working or processing of sheet metal or metal tubes, rods, or Profiles without essentially removing material; punching	<a href="#">B21D</a>
Ferrous alloys	<a href="#">C22C 37/00</a> , <a href="#">C22C 38/00</a>

### Special rules of classification

- [C21D 8/02](#) - [C21D 8/12](#) take precedence.
- In these groups, the last place rule is followed combined with multiple classifications.
- Since the alloy composition is given it needs to be classified in [C22C 38/00](#) in the corresponding sub-group.
- All the disclosed heat treatments (claims, description, examples, figures/diagrams) are classified.

For example a method of producing a surface-decarburised hot-rolled strip consisting of heating the strip from heat-treated steel: C: 0.4-1.0%, Si: 0.1-0.5%, Mn: 0.3-1.2%, P: <0.02%, S: <0.008%, Al: 0.01-0.05%, Cr: 0.1-0.5%,

Ni: 0.1-0.4%, Mo: <50.1%, the remainder being iron and unavoidable impurities, heating it while wound as an open coil within austenitizing temperature limits, keeping it incandescent in a carbon-free atmosphere for at least 90 minutes, in which the atmosphere absorbs carbon from the steel, and cooling at an accelerated rate is classified in: [C21D 8/0257](#), [C21D 1/74](#), [C21D 3/04](#), [C22C 38/02](#); [C22C 38/04](#); [C22C 38/06](#); [C22C 38/40](#).

## C21D 8/04

### to produce plates or strips for deep-drawing

#### Definition statement

*This place covers:*

Modifying the physical properties by deformation combined with, or followed by, heat treatment of ferrous alloys, during manufacturing of plates or strips for deep-drawing.

#### Relationships with other classification places

When the alloy is intended for a particular use/product then the use/ product is classified as well.

Ferrous alloys are classified in [C22C 37/00](#), [C22C 38/00](#).

### References

#### Limiting references

*This place does not cover:*

Hardening articles or materials formed by forging or rolling with no further heating beyond that required for the formation	<a href="#">C21D 1/02</a>
Rolling of metal	<a href="#">B21B</a>
Manufacture of metal sheets/bars/wires/tubes otherwise than by rolling	<a href="#">B21C</a>
Forging	<a href="#">B21J</a>

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

Working or processing of sheet metal or metal tubes, rods, or Profiles without essentially removing material; punching	<a href="#">B21D</a>
Ferrous alloys	<a href="#">C22C 37/00</a> , <a href="#">C22C 38/00</a>

**Special rules of classification**

- In these groups, the last place rule is followed combined with multiple classifications.
- Since the alloy composition is given it needs to be classified in [C22C 38/00](#) in the corresponding sub-group.
- All the disclosed heat treatments (claims, description, examples, figures/diagrams) are classified.

For example a microalloyed low carbon steel strip C:0.04-0.08, Mn:0.15-2.0, Si:0.06-0.60, P:0.010 max, S:0.010 max, Cr:0.35 max, Ni:0.20 max, Mo: 0.25 max, Cu:0.20 max, Nb:0.012-0.070, V:0.02-0.03, Ti≤0.11, Al:0.025-0.050, N:0.0115 max, rest Fe, , for the production of finished pieces by cold pressing and shearing, obtained by hot rolling at temperature of the pre-strip temperature never lower than 900 DEG C in the steps preceding the final rolling, will be classified in [C21D 8/0405](#); [C21D 8/0415](#), [C21D 8/0415](#), [C21D 1/42](#), [C22C 38/02](#), [C22C 38/04](#); [C22C 38/06](#); [C22C 38/12](#).

**C21D 8/06****during manufacturing of rods or wires****Definition statement**

*This place covers:*

Modifying the physical properties by deformation combined with, or followed by, heat treatment of ferrous alloys, during manufacturing of rods or wires.

**Relationships with other classification places**

When the alloy is intended for a particular use/product then the use/ product is classified as well.

Ferrous alloys are classified in [C22C 37/00](#), [C22C 38/00](#).

**References****Limiting references**

*This place does not cover:*

Hardening articles or materials formed by forging or rolling with no further heating beyond that required for the formation	<a href="#">C21D 1/02</a>
Rolling of metal	<a href="#">B21B</a>
Manufacture of metal sheets/bars/wires/tubes otherwise than by rolling	<a href="#">B21C</a>
Forging	<a href="#">B21J</a>

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

Working or processing of sheet metal or metal tubes, rods, or Profiles without essentially removing material; punching	<a href="#">B21D</a>
Ferrous alloys	<a href="#">C22C 37/00</a> , <a href="#">C22C 38/00</a>

### Special rules of classification

- In these groups, the last place rule is followed combined with multiple classifications.
- Since the alloy composition is given it needs to be classified in [C22C 38/00](#) in the corresponding sub-group.
- All the disclosed heat treatments (claims, description, examples, figures/diagrams) are classified.

For example a method of producing a steel wire suitable for reinforcement bar consists of choosing a steel of composition in wt. percent: less than 0.22% C; less than 0.5% Si; less than 1.5% Mn; and 0.01-0.15% V or 0.01-0.15% Nb or 0.01-0.15% V+Nb in which the carbon equivalent is less than 0.45 %, where the steel wire is hot rolled from billet, quenched at the end of the hot rolling stand and finally wound on a bobbin will be classified in [C21D 8/08](#), [C21D 1/19](#), [C22C 38/12](#) .

## C21D 8/10

### during manufacturing of tubular bodies

#### Definition statement

*This place covers:*

Modifying the physical properties by deformation combined with, or followed by, heat treatment of ferrous alloys, during manufacturing of tubular bodies.

#### Relationships with other classification places

When the alloy is intended for a particular use/product then the use/ product is classified as well.

Ferrous alloys are classified in [C22C 37/00](#), [C22C 38/00](#).

#### References

##### Limiting references

*This place does not cover:*

Hardening articles or materials formed by forging or rolling with no further heating beyond that required for the formation	<a href="#">C21D 1/02</a>
Rolling of metal	<a href="#">B21B</a>
Manufacture of metal sheets/bars/wires/tubes otherwise than by rolling	<a href="#">B21C</a>
Forging	<a href="#">B21J</a>

##### Informative references

*Attention is drawn to the following places, which may be of interest for search:*

Working or processing of sheet metal or metal tubes, rods, or Profiles without essentially removing material; punching	<a href="#">B21D</a>
Ferrous alloys	<a href="#">C22C 37/00</a> , <a href="#">C22C 38/00</a>

### Special rules of classification

- In these groups, the last place rule is followed combined with multiple classifications.
- Since the alloy composition is given it needs to be classified in [C22C 38/00](#) in the corresponding sub-group.
- All the disclosed heat treatments (claims, description, examples, figures/diagrams) are classified.

For example the manufacture of case-hardened steel pipe for machine structural components, involves making pipe from steel composition in mass percent, C: 0.1 - 0.25%, Si: 0.2 - 0.4%, Mn: 0.3 - 0.9%, P: at most 0.02%, S: 0.001 - 0.15%, Cr: 0.5 - 0.9%, Mo: 0.15 - 1%, Al: 0.01 - 0.1%, B: 0.0005 - 0.009%, N: less than 0.006%, and a remainder essentially of Fe, followed by subjecting the resulting steel tube to normalizing by soaking at a temperature of 880 - 980 DEG C followed by cooling at a cooling rate of at most 70 DEG C per minute, carrying out cold working of the normalized steel tube, and then annealing the cold worked steel tube at a temperature of 700 - 820 DEG C will be classified in: [C21D 8/105](#); [C21D 8/10](#); [C21D 1/28](#); [C21D 1/32](#); [C21D 6/02](#); [C21D 7/04](#); [C22C 38/00](#).

## C21D 8/12

### during manufacturing of articles with special electromagnetic properties

#### Definition statement

*This place covers:*

Modifying the physical properties by deformation combined with, or followed by, heat treatment of ferrous alloys, during manufacturing of articles with special electromagnetic properties

#### Relationships with other classification places

When the alloy is intended for a particular use/product then the use/ product is classified as well, see [H01F 1/00](#).

Ferrous alloys are classified in [C22C 37/00](#), [C22C 38/00](#).

#### References

##### Limiting references

*This place does not cover:*

Hardening articles or materials formed by forging or rolling with no further heating beyond that required for the formation	<a href="#">C21D 1/02</a>
Rolling of metal	<a href="#">B21B</a>
Manufacture of metal sheets/bars/wires/tubes otherwise than by rolling	<a href="#">B21C</a>
Forging	<a href="#">B21J</a>

##### Informative references

*Attention is drawn to the following places, which may be of interest for search:*

Working or processing of sheet metal or metal tubes, rods, or Profiles without essentially removing material; punching	<a href="#">B21D</a>
Ferrous alloys	<a href="#">C22C 37/00</a> , <a href="#">C22C 38/00</a>

#### Special rules of classification

- In these groups, the last place rule is followed combined with multiple classifications.
- Since the alloy composition is given it needs to be classified in [C22C 38/00](#) in the corresponding sub-group.
- All the disclosed heat treatments (claims, description, examples, figures/diagrams) are classified.

For example the production of grain oriented magnetic sheet used for core of electrical transformer, involving heating slab made of steel : Si 3 - 3.3 %,

Al 0.012 - 0.028 %, C 0.005 - 0.065 %, Cu 0.01 - 0.1 %, Mn 0.045 - 0.05 %, N 0.0035 - 0.0055%, S 0.015 - 0.023 %, Se 0 - 0.018 %, Sn 0.082 %, Fe balance at a temperature (T1), hot-rolling using rolling mill at a temperature (T2), heating at a temperature (T3)>(T2), cold-rolling, optionally annealing and performing primary recrystallization and secondary recrystallization will be classified in [C21D 8/1211](#), [C21D 8/1222](#), [C21D 8/1255](#), [C21D 8/1272](#), [C21D 6/008](#), [C22C 38/001](#), [C22C 38/008](#), [C22C 38/02](#), [C22C 38/04](#), [C22C 38/16](#).

## C21D 9/00

**Heat treatment, e.g. annealing, hardening, quenching or tempering, adapted for particular articles; Furnaces therefor**

### Definition statement

*This place covers:*

Heat treatment, e.g. annealing, hardening, quenching, tempering, adapted for particular articles; Furnaces therefore.

### Relationships with other classification places

[F27B](#) provides for furnaces, kilns, ovens or retorts in general; open sintering or like apparatus.

[F27D](#) provides for details or accessories of furnaces, ovens or retorts, in so far as they are of kinds occurring in more than one kind of furnace.

### References

#### Informative references

*Attention is drawn to the following places, which may be of interest for search:*

Manufacture of metal sheets/bars/wires/tubes otherwise than by rolling	<a href="#">B21C</a>
Vehicle parts	<a href="#">B62</a>
Ferrous alloys	<a href="#">C22C 37/00</a> , <a href="#">C22C 38/00</a>
Surface treatment of metallic material	<a href="#">C23</a> , <a href="#">C23F</a>
Cementation by diffusion processes	<a href="#">C23C</a>
Electrolytic production or refining of metals	<a href="#">C25C</a>
Single crystals or homogeneous polycrystalline material with defined structure; production thereof	<a href="#">C30B</a>
Reconditioning or repairing worn or damaged parts on the spot; Heating or cooling of parts on the spot	<a href="#">E01B 31/18</a>
Steam turbines, turbine rotors Blades, turbine blades	<a href="#">F01D</a> , <a href="#">F01D 5/00</a>
Valve guides/valve seat inserts	<a href="#">F01L</a>
Gas turbine plants	<a href="#">F02C</a>
Bearings, shafts/crankshafts	<a href="#">F16C</a> , e.g. <a href="#">F16C 13/00</a> , <a href="#">F16C 23/00</a> , <a href="#">F16C 29/00</a> , <a href="#">F16C 33/00</a>
Springs	<a href="#">F16F</a>
Sliding member	<a href="#">F16J</a> , <a href="#">F16K</a>
Furnaces	<a href="#">F27B</a> , <a href="#">F27D</a>

## Special rules of classification

- In these groups, the last place rule is followed combined with multiple classifications.
- If the alloy composition is given it needs to be classified in [C22C 38/00](#) in the corresponding sub-group.
- For example a heat treatment method of manufacturing high carbon bearing steel having excellent abrasion resistance and fatigue resistance, a steel wire rod for high carbon bearing steel subjected to the heat treatment, a manufacturing method of the steel wire rod, high carbon bearing steel manufactured by the heat treatment and a soaking method of a steel bloom used for manufacturing the steel wire rod. The heat treatment method of bearings includes the steps of: quenching a bearing-shaped steel part containing, by weight, 0.5% to 1.20% carbon and 1.0% to 2.0% silicon; and partitioning the quenched steel part at a temperature ranging from Ms - 100 degrees C to Ms for at least 10 minutes, where Ms represents a temperature at which formation of martensite will start, will be classified in [C21D 9/0075](#) (rod of limited length), [C21D 9/38](#), [C21D 9/40](#), [C21D 1/19](#), [C21D 1/32](#), [C22C 38/02](#), [C22C 38/04](#), [C22C 38/34](#).
- Similarly, a rod of unlimited length, respectively a large gauge high strength steel rod having a diameter of not less than 9 mm, is produced from high carbon steel containing, by weight percent, from 0.65 to 0.90% carbon and from 0.15 to 1.5% chromium capable of being drawn without subsequent heat treatment will be classified in [C21D 9/525](#), [C21D 8/06](#), [C22C 38/18](#).
- The case hardened gear steel (example group [C21D 1/00- C21D 1/84](#)) consisting of, by weight percent, 16.3Co, 7.5Ni, 3.5Cr, 1.75Mo, 0.2W, 0.11C, 0.03Ti, and 0.02V and the balance Fe, classified in [C21D 1/22](#) as well as in [C22C 38/44](#), [C22C 38/52](#), **M21** as [C21D 1/25](#), will also be classified in [C21D 9/32](#).
- The method for production of a surface-decarburized hot-rolled strip with specific disclosed composition ( example group [C21D 3/00- C21D 3/10](#)) will be classified in [C21D 3/04](#), [C21D 1/74](#), the corresponding [C22C 38/00](#) classes and in [C21D 9/46](#) and [C21D 9/48](#).

## C21D 10/00

### Modifying the physical properties by methods other than heat treatment or deformation

#### Definition statement

*This place covers:*

Modifying the physical properties by laser shock processing, ultrasonic treatment and other methods other than heat treatment or deformation.

#### Relationships with other classification places

When the alloy is intended for a particular use/product then the use/ product is classified as well, see [H01F 1/00](#).

Ferrous alloys are classified in [C22C 37/00](#), [C22C 38/00](#).

#### References

##### Limiting references

*This place does not cover:*

Modifying the physical properties by heat treatment or deformation	<a href="#">C21D 1/00- C21D 7/04</a> , <a href="#">C21D 7/08- C21D 9/70</a>
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**Informative references**

Attention is drawn to the following places, which may be of interest for search:

Modifying the physical properties of iron and steel by deformation	<a href="#">C21D 7/06</a>
Abrasive or related blasting with particulate material	<a href="#">B24C</a>
Alloys	<a href="#">C22C</a>

**Special rules of classification**

- In these groups, the last place rule is followed combined with multiple classifications.
- If the alloy composition is given it needs to be classified in [C22C 38/00](#) in the corresponding sub-group.
- All the disclosed heat treatments (claims, description, examples, figures/diagrams) are classified.

For example a steel tube with excellent steam oxidation resistance and a method for producing the steel tube by shot peening the inner surface of the steel tube will be classified in [C21D 10/005](#) as well as in [C21D 7/06](#), the corresponding [C22C 38/00](#) classes and circulated to [B24C 1/00](#) group.

**C21D 11/00****Process control or regulation for heat treatments****Definition statement**

*This place covers:*

Control and regulation of heat treatments.

**Relationships with other classification places**

When classifying in this group, the disclosed heat treatments and/or furnaces should also be classified in [C21D](#) in the corresponding group and, for furnaces, in [F27](#) too.

**References****Informative references**

Attention is drawn to the following places, which may be of interest for search:

Controlling or regulating in general	<a href="#">G05</a>
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**Special rules of classification**

- In these groups, the last place rule is followed combined with multiple classifications.
- All the disclosed heat treatments (claims, description, examples, figures/diagrams) are classified.

Example: a metal processing system for forming and heat treating of metal casing comprises process control temperature station upstream from heat treatment station and having temperature sensing device, with a controlled cooling, classified in [C21D 1/84](#), [C21D 9/0068](#) will be also classified in [C21D 11/005](#).