



PRODUCT CATALOGUE



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# About us

**Dear Sirs,**

Stalma is the company with established market position in production of bright bars—cold drawn, peeled and ground. We work with leading European steel manufacturers.

Stalma offers products of the highest quality parameters, highest precision performance of cross section tolerance and with superior degree of surface finish.

On account of quick order realization, attractive prices, own transport fleet along with integrity and reliability of our employees we have earned the trust of our customers in Poland and abroad.

**We invite you to cooperation.**









Production technology:

# Drawing

Drawing is a process of cold metal forming, in which the processed material moves through a suitably shaped hole that is a special tool called a drawing die.

The aim of drawing is obtaining products in the form of bars or wire with very precise cross-sectional dimensions, smooth, bright surface and specific mechanical properties. As a result of the drawing process material is strengthened which means increase in strength properties and decrease in plastic properties.







Production technology:

# Peeling

The process is performed on a special machine – peeling line. Rotating head equipped with knives of carbide blades ensures the removal of surface layer with common metallurgical defects. As a result of peeling one obtains a product with flawless surface and with high accuracy of diameter - class IT9. Mechanical properties do not change during peeling.



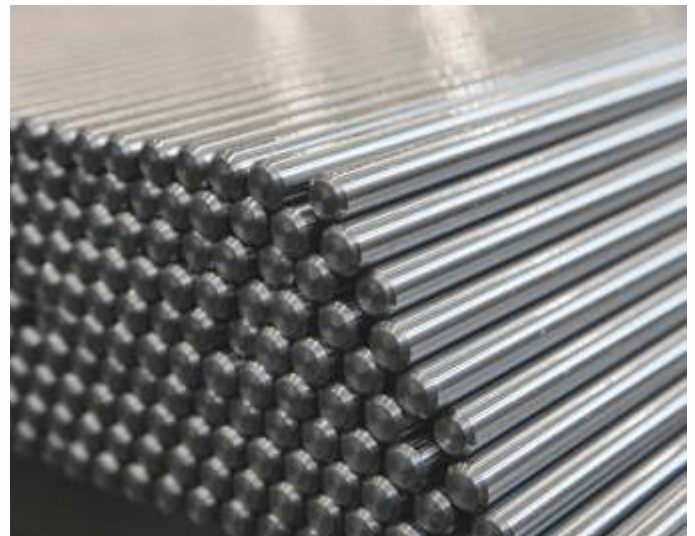




Production technology:

# Grinding

Grinding is a precise reduction machining done with the use of grinding wheels on special machines that are centreless grinders. Ground bars are characterized by the highest quality among bright steel products and find the application in the production of the most responsible parts of the machinery. Ground bars can be processed from both half-products, drawn or peeled bars. Mechanical properties do not change during grinding.











# Laboratory and logistics

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## LABORATORY

During all the processes there is constant supervision of the process parameters and properties of the products. We are equipped with modern crack detection machines based on eddy current method.

Our specialized research and development laboratory allows complex examination of the products. Thanks to having IATF 16949:2016 certificate we can cooperate with automotive companies which expect special quality requirements.



## LOGISTICS

Bars are packed in bundles, tied with steel bands. Additionally they can be packed in a special crepe paper, anticorrosive foil or packed in wooden boxes. Ground bars can be separately protected by the cardboard tubes with appropriate diameter. Transport to the customers takes place on covered trucks in leak-proof conditions.







Offer



DRAWN BARS



| ROUND                  | 4 to 8 mm  | > 8 to 40 mm | > 40 to 100 mm |
|------------------------|------------|--------------|----------------|
| Tolerance              | h9 h10 h11 | h9 h10 h11   | h9 h10 h11     |
| Length (mm)            | 3000       | 3000 to 6000 | 3000 or 6000   |
| Length tolerances (mm) | +100       | +100, +200   | +200, +500     |



| HEXAGONAL              | 4 to 8 mm | > 8 to 27 mm | > 30 to 70 mm |
|------------------------|-----------|--------------|---------------|
| Tolerance              | h11       | h11          | h11           |
| Length (mm)            | 3000      | 3000 to 6000 | 3000 or 6000  |
| Length tolerances (mm) | +100      | +100         | +200          |



| SQUARE                 | 4 to 8 mm | > 8 to 28 mm | > 30 to 80mm |
|------------------------|-----------|--------------|--------------|
| Tolerance              | h11       | h11          | h11          |
| Length (mm)            | 3000      | 3000 or 6000 | 3000 or 6000 |
| Length tolerances (mm) | +100      | +100         | +200         |

PEELED BARS



| ROUND                  | 18 or 100 mm |
|------------------------|--------------|
| Tolerance              | h9 h10 h11   |
| Length (mm)            | 3000 or 6000 |
| Length tolerances (mm) | +100, +200   |

GROUND BARS



| ROUND                  | 10 or 100 mm |
|------------------------|--------------|
| Tolerance              | h6 h7 h8     |
| Length (mm)            | 3000 or 6000 |
| Length tolerances (mm) | +100, +200   |

DRAWN WIRE



| ROUND     | 4 or 12 mm |
|-----------|------------|
| Tolerance | h9 h10 h11 |



| SQUARE    | 4 or 10 mm |
|-----------|------------|
| Tolerance | h11        |



# Standard technical conditions

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## Surface

Bar surfaces: <sup>a) b)</sup>

- drawn - class 1
- peeled - class 3
- ground - class 4

The surface can be inspected by the eddy current testing – scope and conditions of the inspection are to be agreed during ordering.

- a)** Acc. to EN 10277, rolling-mill scale removal before drawing by shot blasting,  
**b)** Manufacturing to a higher class requires prior agreement

## Bar ends

Bar ends:

- cut on a cutting machine
- one or two-sided cut on a saw
- chamfered and faced ends

Bars of cross-section dimensions from 8 mm to 90 mm can have chamfered ends and be faced on the ends. Size of chamfering  $\sim 2/45^\circ \varnothing$ . Bars made of free-cutting steel of diameters over 10 mm have chamfered ends as a standard. Colour marking of the ends requires agreement.

- c)** Other chamfers to be agreed

## Packing – bundle weight

Bars are packed in bundles, weighing 1000 to 2000kg, tied with steel bands at several points of the bundle length. Ground bars can be packed in a special way – in crepe paper – wrapped individually or in bundles, protected by cardboard tubes or packed in wooden boxes.

Special methods of packing require agreement.

## Delivery state

Standard bars are supplied as:

- drawn, hardened by drawing +C
- peeled, raw after rolling +SH
- ground after drawing +C+SL or after peeling +SH+SL

Delivery of bars in other manufacturing conditions can be agreed, e.g.:

- drawn: +A+C; +N+C
- peeled: +N+SH; +QT+SH
- ground: +N+SL; +QT+SL

## Anti-corrosion protection

Bar surface is covered with anticorrosive oil, protecting it during transport in closed vehicles and during storage in covered warehouses throughout the normal storage period.

Any special anticorrosive protections require agreement.

## Straightness

Bars are made as straightened, deviation value from straightness: max 1,0 mm/m. Higher straightness requires agreement.

## Quality documents

Inspection Certificate 3.1 or 2.2 acc. to EN 10204

## Cross section tolerances (acc. to EN 10278)

| Nominal size   | Accuracy class |        |        |        |        |        |
|----------------|----------------|--------|--------|--------|--------|--------|
|                | h6             | h7     | h8     | h9     | h10    | h11    |
| [mm]           |                |        |        |        |        |        |
| from 4 to 6    | -0,008         | -0,012 | -0,018 | -0,030 | -0,048 | -0,075 |
| over 6 to 10   | -0,009         | -0,015 | -0,022 | -0,036 | -0,058 | -0,090 |
| over 10 to 18  | -0,011         | -0,018 | -0,027 | -0,043 | -0,070 | -0,110 |
| over 18 to 30  | -0,013         | -0,021 | -0,033 | -0,052 | -0,084 | -0,130 |
| over 30 to 50  | -0,016         | -0,025 | -0,039 | -0,062 | -0,100 | -0,160 |
| over 50 to 80  | -0,019         | -0,030 | -0,046 | -0,074 | -0,120 | -0,190 |
| over 80 to 100 | -0,022         | -0,035 | -0,054 | -0,087 | -0,140 | -0,220 |

Production of the products with diferent dimensions and parameters requires agreement upon request.

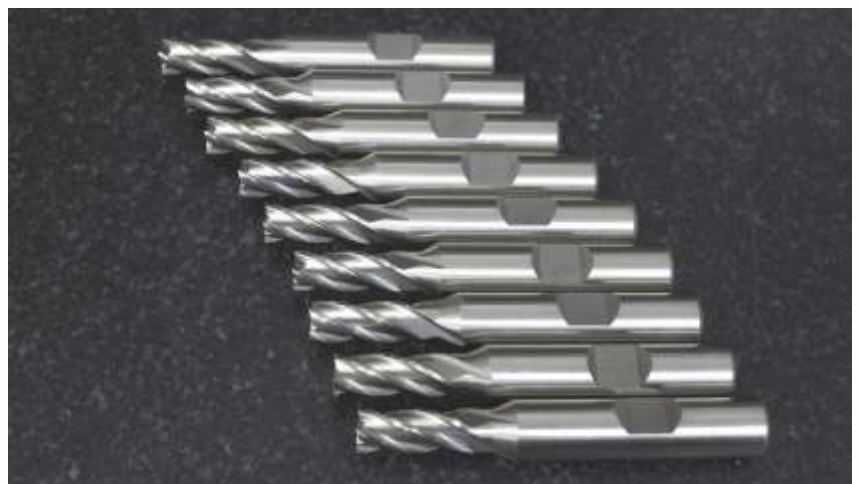


# Application

Products provided are widely applied in:

- automotive industry
- machine building industry
- tools production and precision devices
- fitting and furniture industry
- electro-technical industry
- production of pneumatic fittings and hydraulics
- fasteners production
- agriculture products
- rail industry
- mining industry
- production of home appliances







# Technical specifications of chosen steel grades

**Description applies to all the tables with the references:**

- ① acc. to smelt analysis
- ② “as rolled + peeled” for non-alloy steels, “annealed + peeled” for alloy steels
- ③ approximate value from calculation
- ④ values in the table are for information only
- ⑤ increased carbon content applies to products with diameter exceeding 40mm
- ⑥ does not apply to +C state





# Non-alloy engineering steels

- Chemical composition
- Mechanical properties–Impact test value KV
- Mechanical properties after peeling or drawing

## 01 Chemical composition<sup>①</sup>

| Standards  | Designation | Steel No. | C                    | Mn          | Si          | P         | S         | N            | Other       |
|------------|-------------|-----------|----------------------|-------------|-------------|-----------|-----------|--------------|-------------|
| EN 10025-2 | S235JR      | 1.0038    | $\leq 0,17 / 0,20$ ⑤ | $\leq 1,40$ | -           | max 0,040 | max 0,040 | $\leq 0,012$ | Cu max 0,55 |
|            | S235J0      | 1.0114    | $\leq 0,17$          | $\leq 1,40$ | -           | max 0,035 | max 0,035 | $\leq 0,012$ | Cu max 0,55 |
|            | S235J2      | 1.0117    | $\leq 0,17$          | $\leq 1,40$ | -           | max 0,030 | max 0,030 | -            | Cu max 0,55 |
|            | S355JR      | 1.0045    | $\leq 0,24$          | $\leq 1,60$ | $\leq 0,55$ | max 0,040 | max 0,040 | $\leq 0,012$ | Cu max 0,55 |
|            | S355J0      | 1.0553    | $\leq 0,20 / 0,22$ ⑤ | $\leq 1,60$ | $\leq 0,55$ | max 0,035 | max 0,035 | $\leq 0,012$ | Cu max 0,55 |
|            | S355J2      | 1.0577    | $\leq 0,20 / 0,22$ ⑤ | $\leq 1,60$ | $\leq 0,55$ | max 0,030 | max 0,030 | -            | Cu max 0,55 |
|            | E295        | 1.0050    | -                    | -           | -           | max 0,045 | max 0,045 | $\leq 0,012$ | -           |
|            | E335        | 1.0060    | -                    | -           | -           | max 0,045 | max 0,045 | $\leq 0,012$ | -           |
|            | E360        | 1.0070    | -                    | -           | -           | max 0,045 | max 0,045 | $\leq 0,012$ | -           |

## 02 Mechanical properties–Impact test value KV<sup>⑥</sup>

| Standard   | Designation | Steel No. | Test temperature [°C] | Minimal impact test [J] |
|------------|-------------|-----------|-----------------------|-------------------------|
| EN 10025-2 | S235JR      | 1.0038    | 20                    | 27                      |
|            | S235J0      | 1.0114    | 0                     | 27                      |
|            | S235J2      | 1.0117    | - 20                  | 27                      |
|            | S355JR      | 1.0045    | 20                    | 27                      |
|            | S355J0      | 1.0553    | 0                     | 27                      |
|            | S355J2      | 1.0577    | - 20                  | 27                      |

03 Mechanical properties after peeling or drawing

| Steel grade      |           | As rolled (+AR) and peeled (+SH) ② |                       |                      |                    |            | Drawn (+C)   |                       |                      |                    |
|------------------|-----------|------------------------------------|-----------------------|----------------------|--------------------|------------|--------------|-----------------------|----------------------|--------------------|
| Designation      | Steel No. | Size                               | R <sub>p0.2</sub> min | R <sub>m</sub>       | A <sub>5</sub> min | Hardness ④ | Size         | R <sub>p0.2</sub> min | R <sub>m</sub>       | A <sub>5</sub> min |
|                  |           | [mm]                               | [N/mm <sup>2</sup> ]  | [N/mm <sup>2</sup> ] | [%]                | [HB]       | [mm]         | [N/mm <sup>2</sup> ]  | [N/mm <sup>2</sup> ] | [%]                |
| S235JRC<br>S235B |           | ≤ 16                               | 235                   | 360-510              | 26                 | -          | > 5<br>≤ 10  | 355                   | 470-840              | 8                  |
|                  |           |                                    |                       |                      |                    |            | >10<br>≤ 16  | 300                   | 420-770              | 9                  |
|                  |           | > 16<br>≤ 40                       | 225                   | 360-510              | 26                 | 102-140    | >16<br>≤ 40  | 260                   | 390-730              | 10                 |
|                  |           | > 40<br>≤ 63                       | 215                   | 360-510              | 25                 | 102-140    | > 40<br>≤ 63 | 235                   | 380-670              | 11                 |
|                  |           | > 63<br>≤ 80                       | 215                   | 360-510              | 24                 | 102-140    | > 63<br>≤ 80 | 215                   | 340-640              | 11                 |
| S355J2C<br>S355D |           | ≤ 16                               | 355                   | 470-630              | 22                 | -          | > 5<br>≤ 10  | 520                   | 630-950              | 6                  |
|                  |           |                                    |                       |                      |                    |            | >10<br>≤ 16  | 450                   | 580-880              | 7                  |
|                  |           | > 16<br>≤ 40                       | 345                   | 470-630              | 22                 | 146-187    | >16<br>≤ 40  | 350                   | 530-850              | 8                  |
|                  |           | > 40<br>≤ 63                       | 335                   | 470-630              | 21                 | 146-187    | > 40<br>≤ 63 | 335                   | 500-770              | 9                  |
|                  |           | > 63<br>≤ 80                       | 325                   | 470-630              | 20                 | 146-187    | > 63<br>≤ 80 | 315                   | 470-740              | 9                  |
| E295             | 1.0050    | ≤ 16                               | 295                   | 470-610              | 20                 | -          | > 5<br>≤ 10  | 510                   | 650-950              | 6                  |
|                  |           |                                    |                       |                      |                    |            | >10<br>≤ 16  | 420                   | 600-900              | 7                  |
|                  |           | > 16<br>≤ 40                       | 285                   | 470-610              | 20                 | 140-181    | >16<br>≤ 40  | 320                   | 550-850              | 8                  |
|                  |           | > 40<br>≤ 63                       | 275                   | 470-610              | 19                 | 140-181    | > 40<br>≤ 63 | 300                   | 520-770              | 9                  |
|                  |           | > 63<br>≤ 80                       | 265                   | 470-610              | 18                 | 140-181    | > 63<br>≤ 80 | 255                   | 470-740              | 9                  |
| E335             | 1.0060    | ≤ 16                               | 335                   | 570-710              | 16                 | -          | > 5<br>≤ 10  | 540                   | 700-1050             | 5                  |
|                  |           |                                    |                       |                      |                    |            | >10<br>≤ 16  | 480                   | 680-970              | 6                  |
|                  |           | > 16<br>≤ 40                       | 325                   | 570-710              | 16                 | 169-211    | >16<br>≤ 40  | 390                   | 640-930              | 7                  |
|                  |           | > 40<br>≤ 63                       | 315                   | 570-710              | 15                 | 169-211    | > 40<br>≤ 63 | 340                   | 620-870              | 8                  |
|                  |           | > 63<br>≤ 80                       | 305                   | 570-710              | 14                 | 169-211    | > 63<br>≤ 80 | 295                   | 570-810              | 8                  |



# Free-cutting steels

- Chemical composition
- Mechanical properties after peeling or drawing
- Mechanical properties after heat-treatment

## 01 Chemical composition<sup>①</sup>

| Standards                                                            | Designation | Steel No. | C            | Mn           | Si     | P           | S            | Other           |
|----------------------------------------------------------------------|-------------|-----------|--------------|--------------|--------|-------------|--------------|-----------------|
| FREE-CUTTING STEELS<br>EN ISO 683-4                                  | 11SMn30     | 1.0715    | ≤ 0,14       | 0,90<br>1,30 | ≤ 0,05 | max<br>0,11 | 0,27<br>0,33 | -               |
|                                                                      | 11SMnPb30   | 1.0718    | ≤ 0,14       | 0,90<br>1,30 | ≤ 0,05 | max<br>0,11 | 0,27<br>0,33 | Pb<br>0,20-0,35 |
|                                                                      | 11SMn37     | 1.0736    | ≤ 0,14       | 1,00<br>1,50 | ≤ 0,05 | max<br>0,11 | 0,34<br>0,40 | -               |
|                                                                      | 11SMnPb37   | 1.0737    | ≤ 0,14       | 1,00<br>1,50 | ≤ 0,05 | max<br>0,11 | 0,34<br>0,40 | Pb<br>0,20-0,35 |
| FREE-CUTTING STEELS<br>(intended for heat-treatment)<br>EN ISO 683-4 | 35S20       | 1.0726    | 0,32<br>0,39 | 0,70<br>1,10 | ≤ 0,40 | max<br>0,06 | 0,15<br>0,25 | -               |
|                                                                      | 35SPb20     | 1.0756    | 0,32<br>0,39 | 0,70<br>1,10 | ≤ 0,40 | max<br>0,06 | 0,15<br>0,25 | Pb<br>0,15-0,35 |
|                                                                      | 46S20       | 1.0727    | 0,42<br>0,50 | 0,70<br>1,10 | ≤ 0,40 | max<br>0,06 | 0,15<br>0,25 | -               |
|                                                                      | 46SPb20     | 1.0757    | 0,42<br>0,50 | 0,70<br>1,10 | ≤ 0,40 | max<br>0,06 | 0,15<br>0,25 | Pb<br>0,15-0,35 |

## 02 Mechanical properties after peeling or drawing

| Steel grade                                  |                                      | Size         | As rolled (+AR) and peeled (+SH) ② |            | Drawn (+C)            |                |                    |
|----------------------------------------------|--------------------------------------|--------------|------------------------------------|------------|-----------------------|----------------|--------------------|
| Designation                                  | Steel No.                            |              | R <sub>m</sub>                     | Hardness ④ | R <sub>p0,2</sub> min | R <sub>m</sub> | A <sub>5</sub> min |
|                                              |                                      | [mm]         | [N/mm²]                            | [HB]       | [N/mm²]               | [N/mm²]        | [%]                |
| 11SMn30<br>11SMnPb30<br>11SMn37<br>11SMnPb37 | 1.0715<br>1.0718<br>1.0736<br>1.0737 | > 5<br>≤ 10  | 380-570                            | -          | 440                   | 510-810        | 6                  |
|                                              |                                      | > 10<br>≤ 16 | 380-570                            | -          | 410                   | 490-760        | 7                  |
|                                              |                                      | > 16<br>≤ 40 | 380-570                            | 112-169    | 375                   | 460-710        | 8                  |
|                                              |                                      | > 40<br>≤ 63 | 370-570                            | 112-169    | 305                   | 400-650        | 9                  |
|                                              |                                      | > 63<br>≤ 80 | 360-520                            | 107-154    | 245                   | 360-630        | 9                  |
| 35S20<br>35SPb20                             | 1.0726<br>1.0756                     | > 5<br>≤ 10  | 550-720                            | -          | 480                   | 640-880        | 6                  |
|                                              |                                      | > 10<br>≤ 16 | 550-700                            | -          | 400                   | 590-830        | 7                  |
|                                              |                                      | > 16<br>≤ 40 | 520-680                            | 154-201    | 360                   | 560-800        | 8                  |
|                                              |                                      | > 40<br>≤ 63 | 520-670                            | 154-198    | 340                   | 530-760        | 9                  |
|                                              |                                      | > 63<br>≤ 80 | 500-650                            | 149-193    | 300                   | 510-680        | 9                  |
| 46S20<br>46SPb20                             | 1.0727<br>1.0757                     | > 5<br>≤ 10  | 590-800                            | -          | 570                   | 740-980        | 5                  |
|                                              |                                      | > 10<br>≤ 16 | 590-780                            | -          | 470                   | 690-930        | 6                  |
|                                              |                                      | > 16<br>≤ 40 | 590-760                            | 175-225    | 400                   | 640-880        | 7                  |
|                                              |                                      | > 40<br>≤ 63 | 580-730                            | 172-216    | 380                   | 610-850        | 8                  |
|                                              |                                      | > 63<br>≤ 80 | 560-710                            | 166-211    | 340                   | 580-820        | 8                  |

03 Mechanical properties after heat-treatment

| Steel grade      |                  | Size         | Quenched and tempered and peeled (+QT+SH) |                |                    |
|------------------|------------------|--------------|-------------------------------------------|----------------|--------------------|
| Designation      | Steel No.        |              | R <sub>p 0,2</sub> min                    | R <sub>m</sub> | A <sub>5</sub> min |
|                  |                  |              | [N/mm²]                                   | [N/mm²]        | [%]                |
| 35S20<br>35SPb20 | 1.0726<br>1.0756 | > 5<br>≤ 10  | 430                                       | 630-780        | 15                 |
|                  |                  | > 10<br>≤ 16 | 430                                       | 630-780        | 15                 |
|                  |                  | > 16<br>≤ 40 | 380                                       | 600-750        | 16                 |
|                  |                  | > 40<br>≤ 63 | 320                                       | 550-700        | 17                 |
|                  |                  | > 63<br>≤ 80 | 320                                       | 550-700        | 17                 |
| 46S20<br>46SPb20 | 1.0727<br>1.0757 | > 5<br>≤ 10  | 490                                       | 700-850        | 12                 |
|                  |                  | > 10<br>≤ 16 | 490                                       | 700-850        | 12                 |
|                  |                  | > 16<br>≤ 40 | 430                                       | 650-800        | 13                 |
|                  |                  | > 40<br>≤ 63 | 370                                       | 630-780        | 14                 |
|                  |                  | > 63<br>≤ 80 | 370                                       | 630-780        | 14                 |





# Non-alloy steels for quenching and tempering

- Chemical composition
- Mechanical properties after peeling or drawing
- Mechanical properties after heat-treatment

## 01 Chemical composition<sup>①</sup>

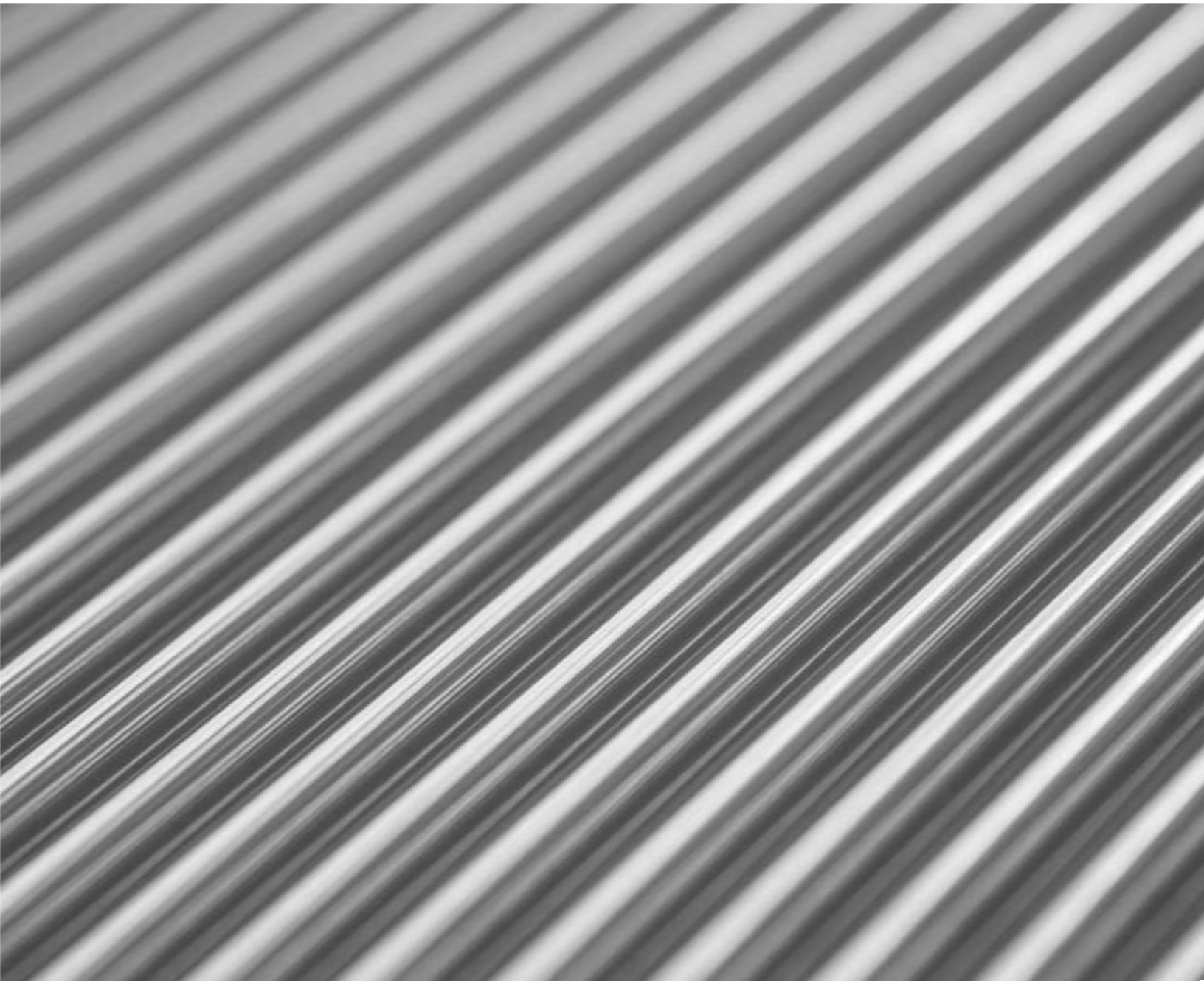
| Standards                                                             | Designation | Steel No. | C            | Mn           | Si     | P            | S              | Cr     | Ni     | Mo     | Other           |
|-----------------------------------------------------------------------|-------------|-----------|--------------|--------------|--------|--------------|----------------|--------|--------|--------|-----------------|
| NON-ALLOY<br>STEELS FOR<br>QUENCHING<br>AND TEMPERING<br>EN ISO 683-1 | C35         | 1.0501    | 0,32<br>0,39 | 0,50<br>0,80 | ≤ 0,40 | max<br>0,045 | max<br>0,045   | ≤ 0,40 | ≤ 0,40 | ≤ 0,10 | Cr+Mo+Ni ≤ 0,63 |
|                                                                       | C35E        | 1.1181    | 0,32<br>0,39 | 0,50<br>0,80 | ≤ 0,40 | max<br>0,030 | max<br>0,035   | ≤ 0,40 | ≤ 0,40 | ≤ 0,10 | Cr+Mo+Ni ≤ 0,63 |
|                                                                       | C35R        | 1.1180    | 0,32<br>0,39 | 0,50<br>0,80 | ≤ 0,40 | max<br>0,030 | 0,020<br>0,040 | ≤ 0,40 | ≤ 0,40 | ≤ 0,10 | Cr+Mo+Ni ≤ 0,63 |
|                                                                       | C45         | 1.0503    | 0,42<br>0,50 | 0,50<br>0,80 | ≤ 0,40 | max<br>0,045 | max<br>0,045   | ≤ 0,40 | ≤ 0,40 | ≤ 0,10 | Cr+Mo+Ni ≤ 0,63 |
|                                                                       | C45E        | 1.1191    | 0,42<br>0,50 | 0,50<br>0,80 | ≤ 0,40 | max<br>0,030 | max<br>0,035   | ≤ 0,40 | ≤ 0,40 | ≤ 0,10 | Cr+Mo+Ni ≤ 0,63 |
|                                                                       | C45R        | 1.1201    | 0,42<br>0,50 | 0,50<br>0,80 | ≤ 0,40 | max<br>0,030 | 0,020<br>0,040 | ≤ 0,40 | ≤ 0,40 | ≤ 0,10 | Cr+Mo+Ni ≤ 0,63 |
|                                                                       | C50E        | 1.1206    | 0,47<br>0,55 | 0,60<br>0,90 | ≤ 0,40 | max<br>0,030 | max<br>0,035   | ≤ 0,40 | ≤ 0,40 | ≤ 0,10 | Cr+Mo+Ni ≤ 0,63 |
|                                                                       | C50R        | 1.1241    | 0,47<br>0,55 | 0,60<br>0,90 | ≤ 0,40 | max<br>0,030 | 0,020<br>0,040 | ≤ 0,40 | ≤ 0,40 | ≤ 0,10 | Cr+Mo+Ni ≤ 0,63 |
|                                                                       | C55         | 1.0535    | 0,52<br>0,60 | 0,60<br>0,90 | ≤ 0,40 | max<br>0,045 | max<br>0,045   | ≤ 0,40 | ≤ 0,40 | ≤ 0,10 | Cr+Mo+Ni ≤ 0,63 |

## 02 Mechanical properties after peeling or drawing

| Steel grade         |                            | Size         | As rolled (+AR) and peeled (+SH) ② |          | Drawn after annealing (+A+C) |                |                    |
|---------------------|----------------------------|--------------|------------------------------------|----------|------------------------------|----------------|--------------------|
| Designation         | Steel No.                  |              | R <sub>m</sub>                     | Hardness | R <sub>p0,2</sub> min        | R <sub>m</sub> | A <sub>5</sub> min |
|                     |                            |              | [N/mm²]                            | [HB]     | [N/mm²]                      | [N/mm²]        | [%]                |
| C35<br>C35E<br>C35R | 1.0501<br>1.1181<br>1.1180 | > 5<br>≤ 10  | -                                  | -        | 510                          | 650-1000       | 6                  |
|                     |                            | > 10<br>≤ 16 | -                                  | -        | 420                          | 600-950        | 7                  |
|                     |                            | > 16<br>≤ 40 | 520-700                            | 154-207  | 320                          | 580-880        | 8                  |
|                     |                            | > 40<br>≤ 63 | 520-700                            | 154-207  | 300                          | 550-840        | 9                  |
|                     |                            | > 63<br>≤ 80 | 520-700                            | 154-207  | 270                          | 520-800        | 9                  |
| C45<br>C45E<br>C45R | 1.0503<br>1.1191<br>1.1201 | > 5<br>≤ 10  | -                                  | -        | 565                          | 750-1050       | 5                  |
|                     |                            | > 10<br>≤ 16 | -                                  | -        | 500                          | 710-1030       | 6                  |
|                     |                            | > 16<br>≤ 40 | 580-820                            | 172-242  | 410                          | 650-1000       | 7                  |
|                     |                            | > 40<br>≤ 63 | 580-820                            | 172-242  | 360                          | 630-900        | 8                  |
|                     |                            | > 63<br>≤ 80 | 580-820                            | 172-242  | 310                          | 580-850        | 8                  |

03 Mechanical properties after heat-treatment

| Steel grade         |                            | Size         | Quenched and tempered and peeled (+QT+SH) |                      |                    |
|---------------------|----------------------------|--------------|-------------------------------------------|----------------------|--------------------|
| Designation         | Steel No.                  |              | R <sub>p0,2</sub> min                     | R <sub>m</sub>       | A <sub>5</sub> min |
|                     |                            | [mm]         | [N/mm <sup>2</sup> ]                      | [N/mm <sup>2</sup> ] | [%]                |
| C35<br>C35E<br>C35R | 1.0501<br>1.1181<br>1.1180 | > 16<br>≤ 40 | 380                                       | 600-750              | 19                 |
|                     |                            | > 40<br>≤ 80 | 320                                       | 550-700              | 20                 |
| C45<br>C45E<br>C45R | 1.0503<br>1.1191<br>1.1201 | > 16<br>≤ 40 | 430                                       | 650-800              | 16                 |
|                     |                            | > 40<br>≤ 80 | 370                                       | 630-780              | 17                 |





# Alloy steels for quenching and tempering

- Chemical composition
- Mechanical properties after peeling or drawing
- Mechanical properties after heat-treatment

## 01 Chemical composition<sup>①</sup>

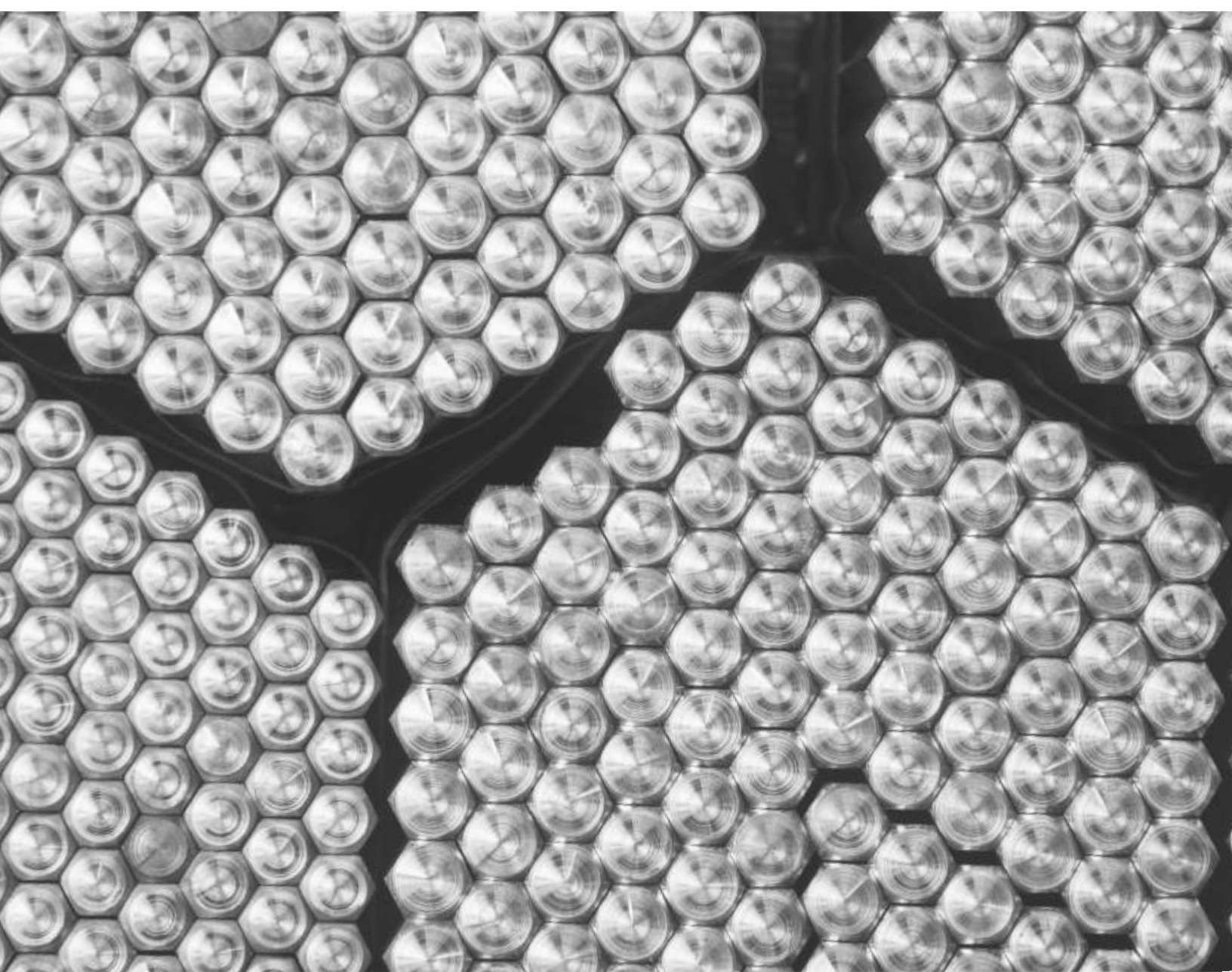
| Standards                                                | Designation | Steel No. | C            | Mn           | Si     | P            | S              | Cr           | Ni | Mo           | Other          |
|----------------------------------------------------------|-------------|-----------|--------------|--------------|--------|--------------|----------------|--------------|----|--------------|----------------|
| ALLOY STEELS FOR QUENCHING AND TEMPERING<br>EN ISO 683-2 | 41Cr4       | 1.7035    | 0,38<br>0,45 | 0,60<br>0,90 | ≤ 0,40 | max<br>0,025 | max<br>0,035   | 0,90<br>1,20 | -  | -            | -              |
|                                                          | 41CrS4      | 1.7039    | 0,38<br>0,45 | 0,60<br>0,90 | ≤ 0,40 | max<br>0,025 | 0,020<br>0,040 | 0,90<br>1,20 | -  | -            | -              |
|                                                          | 42CrMo4     | 1.7225    | 0,38<br>0,45 | 0,60<br>0,90 | ≤ 0,40 | max<br>0,025 | max<br>0,035   | 0,90<br>1,20 | -  | 0,15<br>0,30 | -              |
|                                                          | 42CrMoS4    | 1.7227    | 0,38<br>0,45 | 0,60<br>0,90 | ≤ 0,40 | max<br>0,025 | 0,020<br>0,040 | 0,90<br>1,20 | -  | 0,15<br>0,30 | -              |
|                                                          | 51CrV4      | 1.8159    | 0,47<br>0,55 | 0,70<br>1,10 | ≤ 0,40 | max<br>0,025 | max<br>0,025   | 0,90<br>1,20 | -  | -            | V<br>0,10-0,25 |

## 02 Mechanical properties after peeling or drawing

| Steel grade         |                  | Size         | As rolled (+AR) and peeled (+SH) <sup>②</sup> | Drawn after annealing (+A+C) |
|---------------------|------------------|--------------|-----------------------------------------------|------------------------------|
| Designation         | Steel No.        |              | Hardness max                                  | Hardness max                 |
|                     |                  | [mm]         | [HB]                                          | [HB]                         |
| 41Cr4<br>41CrS4     | 1.7035<br>1.7039 | > 5<br>≤ 10  | -                                             | 295                          |
|                     |                  | > 10<br>≤ 16 | -                                             | 285                          |
|                     |                  | > 16<br>≤ 40 | 241                                           | 280                          |
|                     |                  | > 40<br>≤ 63 | 241                                           | 270                          |
|                     |                  | > 63<br>≤ 80 | 241                                           | 270                          |
| 42CrMo4<br>42CrMoS4 | 1.7225<br>1.7227 | > 5<br>≤ 10  | -                                             | 300                          |
|                     |                  | > 10<br>≤ 16 | -                                             | 290                          |
|                     |                  | > 16<br>≤ 40 | 241                                           | 285                          |
|                     |                  | > 40<br>≤ 63 | 241                                           | 280                          |
|                     |                  | > 63<br>≤ 80 | 241                                           | 280                          |
| 51CrV4              | 1.8159           | ≤ 16         | 248                                           | 311                          |
|                     |                  | > 16<br>≤ 40 | 248                                           | 293                          |
|                     |                  | > 40<br>≤ 80 | 248                                           | 287                          |

03 Mechanical properties after heat-treatment

| Steel grade         |                  | Size         | Quenched and tempered and peeled (+QT+SH) |                      |                    |
|---------------------|------------------|--------------|-------------------------------------------|----------------------|--------------------|
| Designation         | Steel No.        |              | R <sub>p0.2</sub> min                     | R <sub>m</sub>       | A <sub>5</sub> min |
|                     |                  | [mm]         | [N/mm <sup>2</sup> ]                      | [N/mm <sup>2</sup> ] | [%]                |
| 41Cr4<br>41CrS4     | 1.7035<br>1.7039 | > 16<br>≤ 40 | 660                                       | 900-1100             | 12                 |
|                     |                  | > 40<br>≤ 80 | 560                                       | 800-950              | 14                 |
| 42CrMo4<br>42CrMoS4 | 1.7225<br>1.7227 | > 16<br>≤ 40 | 750                                       | 1000-1200            | 11                 |
|                     |                  | > 40<br>≤ 80 | 650                                       | 900-1100             | 12                 |
| 51CrV4              | 1.8159           | > 16<br>≤ 40 | 800                                       | 1000-1200            | 10                 |
|                     |                  | > 40<br>≤ 80 | 700                                       | 900-1100             | 12                 |





# Case hardening steels

- Chemical composition
- Required hardness after heat-treatment
- Mechanical properties after heat-treatment and after peeling or drawing (carbon steels)
- Mechanical properties after heat-treatment and after peeling or drawing (alloy steels)

## 01 Chemical composition<sup>①</sup>

| Standards                                         | Designation | Steel No. | C            | Mn           | Si     | P            | S              | Cr           | Ni | Mo | Other |
|---------------------------------------------------|-------------|-----------|--------------|--------------|--------|--------------|----------------|--------------|----|----|-------|
| CASE HARDENING STEELS (non-alloy)<br>EN ISO 683-3 | C10E        | 1.1121    | 0,07<br>0,13 | 0,30<br>0,60 | ≤ 0,40 | max<br>0,035 | max<br>0,035   | -            | -  | -  | -     |
|                                                   | C10R        | 1.1207    | 0,07<br>0,13 | 0,30<br>0,60 | ≤ 0,40 | max<br>0,035 | 0,020<br>0,040 | -            | -  | -  | -     |
|                                                   | C15E        | 1.1141    | 0,12<br>0,18 | 0,30<br>0,60 | ≤ 0,40 | max<br>0,035 | max<br>0,035   | -            | -  | -  | -     |
|                                                   | C15R        | 1.1140    | 0,12<br>0,18 | 0,30<br>0,60 | ≤ 0,40 | max<br>0,035 | 0,020<br>0,040 | -            | -  | -  | -     |
| CASE HARDENING STEELS (alloy)<br>EN ISO 683-3     | 16MnCr5     | 1.7131    | 0,14<br>0,19 | 1,00<br>1,30 | ≤ 0,40 | max<br>0,025 | max<br>0,035   | 0,80<br>1,10 | -  | -  | -     |
|                                                   | 16MnCrS5    | 1.7139    | 0,14<br>0,19 | 1,00<br>1,30 | ≤ 0,40 | max<br>0,025 | 0,020<br>0,040 | 0,80<br>1,10 | -  | -  | -     |
|                                                   | 20MnCr5     | 1.7147    | 0,17<br>0,22 | 1,10<br>1,40 | ≤ 0,40 | max<br>0,025 | max<br>0,035   | 1,00<br>1,30 | -  | -  | -     |
|                                                   | 20MnCrS5    | 1.7149    | 0,17<br>0,22 | 1,10<br>1,40 | ≤ 0,40 | max<br>0,025 | 0,020<br>0,040 | 1,00<br>1,30 | -  | -  | -     |

## 02 Required hardness after heat-treatment

| Steel grade |           | State              |                                 |                                                                |                 |
|-------------|-----------|--------------------|---------------------------------|----------------------------------------------------------------|-----------------|
| Designation | Steel No. | Soft annealed (+A) | Treated to hardness range (+TH) | Treated to ferrite-pearlite structure and hardness range (+FP) | Normalized (+N) |
|             |           | Hardness [HB]      |                                 |                                                                |                 |
| C10E        | 1.1121    | max 131            | -                               | -                                                              | 85-140          |
| C10R        | 1.1207    | max 131            | -                               | -                                                              | 85-140          |
| C15E        | 1.1141    | max 143            | -                               | -                                                              | 95-150          |
| C15R        | 1.1140    | max 143            | -                               | -                                                              | 95-150          |
| 16MnCr5     | 1.7131    | max 207            | 156-207                         | 140-187                                                        | 138-187         |
| 16MnCrS5    | 1.7139    | max 207            | 156-207                         | 140-187                                                        | 138-187         |
| 20MnCr5     | 1.7147    | max 217            | 170-217                         | 152-201                                                        | 140-201         |
| 20MnCrS5    | 1.7149    | max 217            | 170-217                         | 152-201                                                        | 140-201         |

03 Mechanical properties after heat-treatment and after peeling or drawing (carbon steels)

| Steel grade  |                  | Size         | As rolled (+AR)<br>and peeled (+SH) ② |                | Drawn (+C)            |                |                    | Peeled after<br>annealing<br>{+A+SH} | Drawn after<br>annealing {+A+C} |
|--------------|------------------|--------------|---------------------------------------|----------------|-----------------------|----------------|--------------------|--------------------------------------|---------------------------------|
|              |                  |              | Hardness                              | R <sub>m</sub> | R <sub>p0.2</sub> min | R <sub>m</sub> | A <sub>5</sub> min | Hardness                             | Hardness                        |
| Designation  | Steel No.        | [mm]         | [HB]                                  | [N/mm²]        | [N/mm²]               | [N/mm²]        | [%]                | [HB]                                 | [HB]                            |
| C10E<br>C10R | 1.1121<br>1.1207 | > 5<br>≤ 10  | -                                     | -              | 350                   | 460-760        | 8                  | -                                    | 225                             |
|              |                  | > 10<br>≤ 16 | -                                     | -              | 300                   | 430-730        | 9                  | -                                    | 216                             |
|              |                  | > 16<br>≤ 40 | 92-163                                | 310-550        | 250                   | 400-700        | 10                 | 131                                  | 207                             |
|              |                  | > 40<br>≤ 63 | 92-163                                | 310-550        | 200                   | 350-640        | 12                 | 131                                  | 190                             |
|              |                  | > 63<br>≤ 80 | 92-163                                | 310-550        | 180                   | 320-580        | 12                 | 131                                  | 172                             |
| C15E<br>C15R | 1.1141<br>1.1140 | > 5<br>≤ 10  | -                                     | -              | 380                   | 500-800        | 7                  | -                                    | 238                             |
|              |                  | > 10<br>≤ 16 | -                                     | -              | 340                   | 480-780        | 8                  | -                                    | 231                             |
|              |                  | > 16<br>≤ 40 | 98-178                                | 330-600        | 280                   | 430-730        | 9                  | 143                                  | 216                             |
|              |                  | > 40<br>≤ 63 | 98-178                                | 330-600        | 240                   | 380-670        | 11                 | 143                                  | 198                             |
|              |                  | > 63<br>≤ 80 | 98-178                                | 330-600        | 215                   | 340-600        | 12                 | 143                                  | 178                             |

04 Mechanical properties after heat-treatment and after peeling or drawing (alloy steels)

| Steel grade         |                  | Size         | Mechanical properties               |                                 |                                                                    |                                                                  |
|---------------------|------------------|--------------|-------------------------------------|---------------------------------|--------------------------------------------------------------------|------------------------------------------------------------------|
|                     |                  |              | Soft annealed<br>and peeled (+A+SH) | Drawn after<br>annealing (+A+C) | Treated to<br>ferrite-pearlite<br>structure and peeled<br>(+FP+SH) | Drawn after treating<br>to ferrite-pearlite<br>structure (+FP+C) |
|                     |                  |              | Hardness max                        |                                 |                                                                    |                                                                  |
| Designation         | Steel No.        | [mm]         | [HB]                                |                                 |                                                                    |                                                                  |
| 16MnCr5<br>16MnCrS5 | 1.7131<br>1.7139 | > 5<br>≤ 10  | -                                   | 260                             | -                                                                  | -                                                                |
|                     |                  | > 10<br>≤ 16 | -                                   | 250                             | -                                                                  | -                                                                |
|                     |                  | > 16<br>≤ 40 | 207                                 | 245                             | 140-187                                                            | 140-240                                                          |
|                     |                  | > 40<br>≤ 63 | 207                                 | 240                             | 140-187                                                            | 140-235                                                          |
|                     |                  | > 63<br>≤ 80 | 207                                 | 240                             | 140-187                                                            | 140-235                                                          |
| 20MnCr5<br>20MnCrS5 | 1.7147<br>1.7149 | > 5<br>≤ 10  | -                                   | 270                             | -                                                                  | -                                                                |
|                     |                  | > 10<br>≤ 16 | -                                   | 260                             | -                                                                  | -                                                                |
|                     |                  | > 16<br>≤ 40 | 217                                 | 255                             | 152-201                                                            | 152-250                                                          |
|                     |                  | > 40<br>≤ 63 | 217                                 | 250                             | 152-201                                                            | 152-245                                                          |
|                     |                  | > 63<br>≤ 80 | 217                                 | 250                             | 152-201                                                            | 152-245                                                          |



# Product accuracy

## 01 Classes of cross section tolerance and surface quality of bright steel products

| Type of product |                                                                                   | Cross - section tolerances |      |     |     |     |     | Surface quality class |   |   |   |
|-----------------|-----------------------------------------------------------------------------------|----------------------------|------|-----|-----|-----|-----|-----------------------|---|---|---|
|                 |                                                                                   | IT11                       | IT10 | IT9 | IT8 | IT7 | IT6 | 1                     | 2 | 3 | 4 |
| Drawn bars      |  | ●                          | ●    | ●   |     |     |     | ●                     | ● | ○ |   |
|                 |  | ●                          |      |     |     |     |     | ●                     | ○ |   |   |
|                 |  | ●                          |      |     |     |     |     | ●                     | ○ |   |   |
| Peeled bars     |  | ●                          | ●    | ●   |     |     |     | ●                     | ● | ● | ○ |
| Ground bars     |  |                            |      | ●   | ●   | ●   | ●   | ●                     | ● | ● | ● |

## 02 Straightness deviations acc. to EN 10278 <sup>\*)</sup>

| Product                   | Steel group                                              | Nominal size [mm] | Max dimensional deviation [mm] |
|---------------------------|----------------------------------------------------------|-------------------|--------------------------------|
| Round bars                | < 0,25% C                                                | -                 | 1,0                            |
|                           | ≥ 0,25% C,<br>Alloy steels, quenched and tempered steels | -                 | 1,5                            |
|                           | Stainless, tool and bearing steels                       | -                 | 1,0                            |
| Square and hexagonal bars | <0,25% C                                                 | ≤ 75 mm           | 1,0                            |
|                           | ≥ 0,25% C,<br>Alloy steels, quenched and tempered steels | ≤ 75 mm           | 2,0                            |
|                           | Stainless, tool and bearing steels                       | ≤ 75 mm           | 1,0                            |

## 03 Surface quality classes

|                                                                       | Accuracy class <sup>①</sup>                                  |                                                                                       |                                                                                        |                                                      |
|-----------------------------------------------------------------------|--------------------------------------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|------------------------------------------------------|
|                                                                       | 1                                                            | 2                                                                                     | 3                                                                                      | 4                                                    |
| Permissible defect depth                                              | max 0,3mm for d ≤ 15mm<br>max 0,02 x d<br>for 15 < d ≤ 100mm | max 0,3mm for d ≤ 15mm<br>max 0,02 x d<br>for 15 < d ≤ 75mm<br>max 1,5mm for d > 75mm | max 0,2mm for d ≤ 20mm<br>max 0,01 x d<br>for 20 < d ≤ 75mm<br>max 0,75mm for d > 75mm | without cracks<br>formed in manufacturing<br>process |
| Max. percentage of<br>delivery with defect rate<br>higher than agreed | 4%                                                           | 1%                                                                                    | 1%                                                                                     | 0,2%                                                 |
| Product <sup>②</sup>                                                  |                                                              |                                                                                       |                                                                                        |                                                      |
| Round bars                                                            | +                                                            | +                                                                                     | +                                                                                      | +                                                    |
| Square bars                                                           | +                                                            | (for d ≤ 20 mm) <sup>③</sup>                                                          | -                                                                                      | -                                                    |
| Hexagonal bars                                                        | +                                                            | (for d ≤ 50 mm) <sup>③</sup>                                                          | -                                                                                      | -                                                    |

● - means possibility to manufacture a product

○ - means possibility to agree on the implementation of selected assortments of products

\*) higher straightness of bars requires agreement

d nominal bar diameter or distance between parallel sides of square and hexagonal bars

① if no agreements have been made in tender and on ordering, production in class 1 is to be assumed

② „+“ indicates available in these classes, „-“ indicates not available in these classes

③ crack detection with eddy current device not possible for cross section range d<20mm or d<50mm

# Steel bars weight

Weight per metre (kg)

| Size | Cross-section                                                                     |                                                                                   |                                                                                   |
|------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| [mm] |  |  |  |
| 4    | 0,10                                                                              | 0,11                                                                              | 0,13                                                                              |
| 5    | 0,15                                                                              | 0,17                                                                              | 0,20                                                                              |
| 6    | 0,22                                                                              | 0,24                                                                              | 0,28                                                                              |
| 7    | 0,30                                                                              | 0,33                                                                              | 0,38                                                                              |
| 8    | 0,39                                                                              | 0,44                                                                              | 0,50                                                                              |
| 9    | 0,50                                                                              | 0,55                                                                              | 0,64                                                                              |
| 10   | 0,62                                                                              | 0,68                                                                              | 0,79                                                                              |
| 11   | 0,75                                                                              | 0,82                                                                              | 0,95                                                                              |
| 12   | 0,89                                                                              | 0,98                                                                              | 1,13                                                                              |
| 13   | 1,04                                                                              | 1,15                                                                              | 1,33                                                                              |
| 14   | 1,21                                                                              | 1,33                                                                              | 1,54                                                                              |
| 15   | 1,39                                                                              | 1,53                                                                              | 1,77                                                                              |
| 16   | 1,58                                                                              | 1,74                                                                              | 2,01                                                                              |
| 17   | 1,78                                                                              | 1,97                                                                              | 2,27                                                                              |
| 18   | 2,00                                                                              | 2,20                                                                              | 2,54                                                                              |
| 19   | 2,22                                                                              | 2,45                                                                              | 2,83                                                                              |
| 20   | 2,46                                                                              | 2,72                                                                              | 3,15                                                                              |
| 21   | 2,72                                                                              | 3,00                                                                              | 3,46                                                                              |
| 22   | 2,98                                                                              | 3,29                                                                              | 3,80                                                                              |
| 23   | 3,26                                                                              | 3,60                                                                              | 4,15                                                                              |
| 24   | 3,55                                                                              | 3,92                                                                              | 4,52                                                                              |
| 25   | 3,85                                                                              | 4,25                                                                              | 4,91                                                                              |
| 26   | 4,16                                                                              | 4,60                                                                              | 5,31                                                                              |
| 27   | 4,49                                                                              | 4,96                                                                              | 5,72                                                                              |
| 28   | 4,83                                                                              | 5,33                                                                              | 6,15                                                                              |
| 29   | 5,18                                                                              | 5,72                                                                              | 6,60                                                                              |
| 30   | 5,54                                                                              | 6,12                                                                              | 7,07                                                                              |
| 31   | 5,92                                                                              | 6,53                                                                              | 7,54                                                                              |
| 32   | 6,31                                                                              | 6,96                                                                              | 8,04                                                                              |
| 33   | 6,71                                                                              | 7,41                                                                              | 8,55                                                                              |
| 34   | 7,12                                                                              | 7,86                                                                              | 9,07                                                                              |
| 35   | 7,55                                                                              | 8,33                                                                              | 9,62                                                                              |
| 36   | 7,98                                                                              | 8,81                                                                              | 10,17                                                                             |
| 37   | 8,43                                                                              | 9,31                                                                              | 10,75                                                                             |
| 38   | 8,90                                                                              | 9,82                                                                              | 11,34                                                                             |
| 39   | 9,37                                                                              | 10,34                                                                             | 11,94                                                                             |

| Size | Cross-section                                                                      |                                                                                     |                                                                                     |
|------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| [mm] |  |  |  |
| 40   | 9,86                                                                               | 10,88                                                                               | 12,56                                                                               |
| 41   | 10,35                                                                              | 11,43                                                                               | 13,20                                                                               |
| 42   | 10,87                                                                              | 12,00                                                                               | 13,85                                                                               |
| 43   | 11,39                                                                              | 12,57                                                                               | 14,51                                                                               |
| 44   | 11,93                                                                              | 13,16                                                                               | 15,20                                                                               |
| 45   | 12,47                                                                              | 13,77                                                                               | 15,90                                                                               |
| 46   | 13,03                                                                              | 14,39                                                                               | 16,61                                                                               |
| 47   | 13,61                                                                              | 15,02                                                                               | 17,34                                                                               |
| 48   | 14,19                                                                              | 15,67                                                                               | 18,09                                                                               |
| 49   | 14,79                                                                              | 16,33                                                                               | 18,85                                                                               |
| 50   | 15,40                                                                              | 17,00                                                                               | 19,63                                                                               |
| 51   | 16,02                                                                              | 17,69                                                                               | 20,42                                                                               |
| 52   | 16,66                                                                              | 18,39                                                                               | 21,23                                                                               |
| 53   | 17,30                                                                              | 19,10                                                                               | 22,05                                                                               |
| 54   | 17,96                                                                              | 19,83                                                                               | 22,89                                                                               |
| 55   | 18,63                                                                              | 20,57                                                                               | 23,75                                                                               |
| 56   | 19,32                                                                              | 21,32                                                                               | 24,62                                                                               |
| 57   | 20,01                                                                              | 22,09                                                                               | 25,50                                                                               |
| 58   | 20,72                                                                              | 22,88                                                                               | 26,41                                                                               |
| 60   | 22,18                                                                              | 24,48                                                                               | 28,26                                                                               |
| 61   | 22,92                                                                              | 25,30                                                                               | 29,21                                                                               |
| 62   | 23,68                                                                              | 26,14                                                                               | 30,18                                                                               |
| 63   | 24,45                                                                              | 26,99                                                                               | 31,16                                                                               |
| 64   | 25,23                                                                              | 27,85                                                                               | 32,15                                                                               |
| 65   | 26,03                                                                              | 28,73                                                                               | 33,17                                                                               |
| 66   | 26,83                                                                              | 29,62                                                                               | 34,19                                                                               |
| 67   | 27,65                                                                              | 30,53                                                                               | 35,24                                                                               |
| 68   | 28,48                                                                              | 31,44                                                                               | 36,30                                                                               |
| 69   | 29,33                                                                              | 32,37                                                                               | 37,37                                                                               |
| 70   | 30,18                                                                              | 33,32                                                                               | 38,47                                                                               |
| 71   | 31,05                                                                              | 34,28                                                                               | 39,57                                                                               |
| 72   | 31,93                                                                              | 35,25                                                                               | 40,69                                                                               |
| 73   | 32,83                                                                              | 36,24                                                                               | 41,83                                                                               |
| 74   | 33,73                                                                              | 37,24                                                                               | 42,99                                                                               |
| 75   | 34,65                                                                              | 38,25                                                                               | 44,16                                                                               |
| 80   | 39,46                                                                              | 43,51                                                                               | 50,24                                                                               |





IATF 16949:2016



ISO 9001:2015



ISO 14001:2015



ISO 45001:2018

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