## EXPERT PIPE SOLUTIONS FOR MECHANICAL ENGINEERING MECHANICAL PIPES



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## EXPERT PIPE SOLUTIONS FOR MECHANICAL ENGINEERING

Our product strategy in the mechanical pipes sector is defined by a thorough market analysis and investigation of our clients' needs in the automotive, shipbuilding and power generation industries.

The company produces machinery use products as basic elements for the manufacture of vehicles of different configurations, hydraulic cylinders, bearings, steam generators, mining equipment and high-precision parts of aeronautical engineering and cars.

Basic car components for vehicles are manufactured from our products


## INTERPIPE IS A GLOBAL STEEL PIPE PRODUCER AND SUPPLIER

Interpipe is a global steel pipe producer for all major application - oil \& gas exploration and transportation, power generation, machanical and structural use.

The company's products are supplied to 80 countries all over the world through a chain of commercial offices located in Ukraine, Europe, the USA and the Middle East.

Interpipe structure includes production facilities located in Dnipro region, one of the major industrial centers of Ukraine. The company continues to invest heavily in the development and modernization of its mills.

Interpipe includes 3 operating divisions - Steel, Pipe and Railway Products. The company controls product quality at every stage: from manufacturing of raw materials to delivery of final products to customers.


SELLING TO CUSTOMERS GLOBALLY - KEY MARKETS


## PIPE PRODUCTS FOR DIVERSE APPLICATIONS

Designing any of its products, Interpipe is always focused on exact customer requirements and the field of its application. Our products are used throughout the world in diverse applications - from mining, heavy machinery to automobile industries. We design and produce steel pipes for special customers' needs.

## Hydraulic cylinders

Tube is a key element of any hydraulic machinery device. Interpipe produces precision seamless cold drawn tubes suitable for the manufacturing of hydraulic cylinders.
The tubes are produced with close tolerances out of easily weldable steel. Such tubes undergo special treatment to guarantee good machinability. Upon the request from our customers tubes may be produced quite close to the finished product dimensions. Application: motocranes, tractors and trucks


## Mining equipment

Interpipe products are used in mining explorations. For these applications, Interpipe supplies seamless tubes for engineering purposes, where the critical factors are weight control and high stress resistance are the critical factors. These types of tubes have high-performance steel characteristics, ensured by the heat treatment. Our products are used for applications where the ratio between mass and space occupied is especially critical. Application: powered roof supports, hydraulic pit props


## Rollers

The tube material and tube diameter determine the load capacity and operation of conveyor rollers. Interpipe product range includes tubes for different application rollers. The Company ensures good machinability and excellent concentricity of the product.
Application: conveyor rollers, tubes for textile, paper, and printing industries, steel plant rollers


## Bearings

Interpipe tubes perfectly meet the requirements of the advanced automotive industry. The close tolerances of steel tubes in diameter and thickness, exceptional concentricity and a smooth finish, both inside and outside, facilitate engineers' obtainment of uniform flow under controlled temperature and pressure. Its excellent low temperature properties ensure smooth hardening in the process of cold working.
Application: car components


## Cranes and agricultural engineering

Interpipe product range covers engineering applications where such factors as weight control and high stress resistance are of top priority. Our seamless pipes are used in lifting and load handling systems and as components of lift arms in mobile cranes. High-strength seamless steel pipes are also used in agriculturalconstruction. This type of pipes has high-tensile properties and flexibility and may be designed and produced with any heights and strengths.
Application: Tour cranes, tractors and harvesters


## Downhole equipment

Being focused on satisfying the needs of oil and gas companies Interpipe offers a range of products for downhole equipment. Our products are applied in diverse hostile environments as basic elements for submerged pumps and engines. Pipes used for downholes are made of steel sustaining high gravity or pressures. These pipes have close tolerances and high straightness. Application: submerged pumps


## QUALITY-FOCUSED OPERATIONS

Interpipe considers quality control as the key part of its production activities, exceeding customer needs. The quality of our products is approved by international standards - EN, ASTM, ISO and GOST.

## Quality of structural steel grades: even texture, high weldability and good machinability

Interpipe has in-house steel billets production, ensuring steel quality control and continuous monitoring of its parameters. High quality characteristics of steel are provided by the subsequent processing at the out-of-furnace steel treatment complex. The ladles with metal are delivered in turn to the furnace ladle unit, where the metal finishing and refining take place. Steel blowing in the ladle by argon along with the refining process ensure low content of phosphorus and sulphur in the finished metal and uniform distribution of other elements. Degassing process is carried out by removing hydrogen, nitrogen and oxygen dissolved in metal at the vacuum degassing unit simultaneously with argon blowing.


As a result, these fine-grain structural steel grades are characterised by maximal yield strength rate, good weldability and high resistance to brittle cracking. These grades are used mainly for hydraulic engineering, heavy machinery, shipbuilding and crane constructions.

## Quality management system

Interpipe mills are certified in accordance with Quality management system ISO 9001 and also have certification for energy industry API Q1. Every mill has quality manual that determines quality policy.

Environmental management system is certified according to ISO 14001. Occupational health and safety of the personnel are certified according to the requirements of OHSAS 18001 standard.


## Ongoing investments program

Interpipe regularly invests in development of its production capacities, improvement of the output quality, and expansion of its product range. Interpipe is focused on providing the high quality product at short delivery time for each client. Interpipe has been conducting extensive improvement program, which included launch of in-house steel melting complex Interpipe Steel, installation of various new NDE systems, finishing lines and hydro testing equipment on the mills, improvement of heat treatment technologies.

## Interpipe Steel: In-house steel production

In 2012, Interpipe commissioned a new electric steel melting complex - Interpipe Steel. The capacity of the mill is 1.32 mln tons of steel billets. Total investment has reached $\$ 700$ million. Currently Interpipe Steel is the biggest electric steel melting mill in Eastern Europe.

Interpipe Steel represents new phase in the steel industry due to leading European technology, labor conditions and environmental protection standards. The turn-key construction of the mill has been carried out by Danieli Company - global leader in metallurgical equipment manufacturing.

Innovative DANIELI technologies on Interpipe Steel:

- Electric arc furnace
- Twin tank vacuum degasser
- Twin position ladle furnace
- Two continuous casting machines

In 2014 Interpipe Steel started to export steel billets as finished products. The main production uses are:

- forgings (rings, shafts, pulleys, flanges, fittings and for space industry)
- railway products
- pipes for mechanical, industrial and oil\&gas application

Interpipe Steel continuously develops range of steel grades according to international standards and customers' requirements.


## EN 10297-1 SEAMLESS PIPES FOR MECHANICAL APPLICATIONS

Chemical composition

| Steel grade | Elements content, \% |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | C | Si | Mn | P | S | Cr | Mo | Ni | Al | Cu | N | Nb | V |
| E235 | $\leq 0,17$ | $\leq 0,35$ | $\leq 1,20$ | $\leq 0,030$ | $\leq 0,035$ |  |  |  |  |  |  |  |  |
| E275 | $\leq 0,21$ | $\leq 0,35$ | $\leq 1,40$ | $\leq 0,030$ | $\leq 0,035$ |  |  |  |  |  |  |  |  |
| E315 | $\leq 0,21$ | $\leq 0,30$ | $\leq 1,50$ | $\leq 0,030$ | $\leq 0,035$ |  |  |  |  |  |  |  |  |
| E355 | $\leq 0,22$ | $\leq 0,55$ | $\leq 1,60$ | $\leq 0,30$ | $\leq 0,035$ |  |  |  |  |  |  |  |  |
| E470 | 0,16-0,22 | 0,10-0,50 | 1,30-1,70 | $\leq 0,030$ | $\leq 0,035$ |  |  |  | $\geq 0,010$ |  | $\leq 0,020$ | $\leq 0,07$ | 0,08-0,15 |
| E275K2 | $\leq 0,20$ | $\leq 0,40$ | 0,50-1,40 | $\leq 0,030$ | $\leq 0,035$ | $\leq 0,030$ | $\leq 0,010$ | $\leq 0,030$ | $\geq 0,020$ | $\leq 0,035$ | $\leq 0,015$ | $\leq 0,05$ | $\leq 0,05$ |
| E355K2 | $\leq 0,20$ | $\leq 0,50$ | 0,90-1,65 | $\leq 0,030$ | $\leq 0,035$ | $\leq 0,030$ | $\leq 0,010$ | $\leq 0,050$ | $\geq 0,020$ | $\leq 0,035$ | $\leq 0,015$ | $\leq 0,05$ | $\leq 0,12$ |
| E420,2 | 0,16-0,22 | 0,10-0,50 | 1,30-1,70 | $\leq 0,030$ | $\leq 0,035$ | $\leq 0,030$ | $\leq 0,080$ | $\leq 0,040$ | $\geq 0,010$ | $\leq 0,030$ | $\leq 0,020$ | $\leq 0,07$ | 0,08-0,15 |
| E460K2 | $\leq 0,20$ | $\leq 0,60$ | 1,00-1,70 | $\leq 0,030$ | $\leq 0,035$ | $\leq 0,030$ | <0,010 | <0,080 | $\geq 0,020$ | $\leq 0,070$ | $\leq 0,025$ | $\leq 0,05$ | $\leq 0,02$ |
| E590K2 | 0,16-0,22 | 0,10-0,50 | 1,30-1,70 | $\leq 0,030$ | $\leq 0,035$ | $\leq 0,030$ | $\leq 0,080$ | $\leq 0,040$ | $\geq 0,010$ | $\leq 0,030$ | $\leq 0,020$ | $\leq 0,07$ | 0,08-0,15 |
| E730K2 | $\leq 0,20$ | $\leq 0,50$ | 1,40-1,70 | <0,030 | $\leq 0,035$ | $\leq 0,030$ | 0,30-0,45 | 0,30-0,70 | $\geq 0,020$ | $\leq 0,020$ | $\leq 0,020$ | $\leq 0,05$ | $\leq 0,12$ |
| C22E | 0,17-0,24 | $\leq 0,40$ | 0,40-0,70 | $\leq 0,035$ | $\leq 0,035$ |  |  |  |  |  |  |  |  |
| 25CrMo4 | 0,22-0,29 | $\leq 0,40$ | 0,60-0,90 | $\leq 0,035$ | $\leq 0,035$ | 0,9-1,2 | 0,15-0,30 |  |  |  |  |  |  |
| 34CrMo4 | 0,30-0,37 | $\leq 0,40$ | 0,60-0,90 | $\leq 0,035$ | $\leq 0,035$ | 0,9-1,2 | 0,15-0,30 |  |  |  |  |  |  |
| 42CrM04 | 0,38-0,45 | $\leq 0,40$ | 0,60-0,90 | $\leq 0,035$ | $\leq 0,035$ | 0,9-1,2 | 0,15-0,30 |  |  |  |  |  |  |
| C15E | 0,12-0,18 | $\leq 0,40$ | 0,30-0,60 | $\leq 0,035$ | $\leq 0,035$ |  |  |  |  |  |  |  |  |



## Mechanical properties

| Steel grade | Delivery condition | Yield strength, $\mathrm{R}_{\mathrm{EH}} \mathrm{N} / \mathrm{mm}^{2}$ |  |  |  | Tensile strength Rm, $\mathrm{N} / \mathrm{mm}^{2}$ |  |  |  | Elongation A, \% |  | Impact test, KV, J |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Wall thickness Tn, mm |  |  |  | Wall thickness Tn, mm |  |  |  |  |  | Test tem | ature $-20^{\circ} \mathrm{C}$ |
|  |  | <16 | $16<T n \leq 40$ | $40<T n \leq 65$ | $65<T n \leq 80$ | <16 | $16<$ Tn $\leq 40$ | $40<T n \leq 65$ | $65<T n \leq 100$ | Longitudinal direction | Transverse direction | Longitudinal direction | Transverse direction |
|  |  | Not less |  |  |  |  |  |  |  |  |  |  |  |
| E235 | +AR or + N | 235 | 225 | 215 | 205 | 360 | 360 | 360 | 340 | 25 | 23 |  |  |
| E275 | +AR or + N | 275 | 265 | 255 | 245 | 410 | 410 | 410 | 380 | 22 | 20 |  |  |
| E315 | +AR or +N | 315 | 305 | 295 | 280 | 450 | 450 | 450 | 420 | 21 | 19 |  |  |
| E355 | +AR or + N | 355 | 345 | 335 | 315 | 490 | 490 | 490 | 470 | 20 | 18 |  |  |
| E470 | +AR | 470 | 430 | - | - | 650 | 600 | - | - | 17 | 15 |  |  |
| E275K2 | +N | 275 | 265 | 255 | 245 | 410 | 410 | 410 | 380 | 22 | 20 | 40 | 27 |
| E355K2 | +N | 355 | 345 | 335 | 315 | 490 | 490 | 470 | 470 | 20 | 18 | 40 | 27 |
| E420,2 | +N | 420 | 400 | 390 | 370 | 600 | 560 | 530 | 500 | 19 | 17 | 27 | 20 |
| E460K2 | +N | 460 | 440 | 430 | 410 | 550 | 550 | 550 | 520 | 19 | 17 | 40 | 27 |
| E590K2 | +QT* | 590 | 540 | 480 | 455 | 700 | 650 | 570 | 520 | 16 | 14 | 40 | 27 |
| E730K2 | +QT* | 730 | 670 | 620 | 580 | 790 | 750 | 700 | 680 | 15 | 13 | 40 | 27 |


| Steel grade | Delivery condition | Yield strength, $\mathrm{R}_{\text {EHH }} \mathrm{N} / \mathrm{mm}^{2}$ |  |  | Tensile strength Rm, $\mathrm{N} / \mathrm{mm}^{2}$ |  |  | Elongation A, \% |  |  |  | Impact test, KV, J Test temperature $-20^{\circ} \mathrm{C}$ |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Wall thikness Tn, mm |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | <16 | $16<T n \leq 40$ | $40<T n \leq 80$ | <16 | $16<T n \leq 40$ | $40<T n \leq 80$ | <16 |  | $16<\operatorname{Tn} \leq 40$ |  | <8 | $8<T n \leq 20$ |  | $20<T \mathrm{n} \leq 60$ |  |
|  |  |  |  |  |  |  |  | I | t | 1 | t |  | 1 | t | 1 | t |
|  |  | Not less |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| C22E | +N | 240 | 210 | 210 | 430 | 410 | 410 | 24 | 22 | 25 | 23 | 50 | 50 | 32 | 40 | 27 |


| Steel grade | Delivery condition | Yield strength, $\mathrm{R}_{\mathrm{EH}} \mathrm{N} / \mathrm{mm}^{2}$ |  |  |  | Tensile strength $\mathrm{Rm}, \mathrm{N} / \mathrm{mm}^{2}$ |  |  |  | Elongation A, \% |  |  |  |  |  |  |  | Impact test, KV, J <br> Test temperature $+20^{\circ} \mathrm{C}$ |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Wall thickness Tn , mm |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | $<8$ | $\begin{aligned} & 8<\mathrm{Tn} \\ & \leq 20 \end{aligned}$ | $\begin{aligned} & 20<T n \\ & \leq 50 \end{aligned}$ | $\begin{aligned} & 50<\text { Tn } \\ & \leq 80 \end{aligned}$ | <8 | $\begin{aligned} & 8<\pi n \\ & \leq 20 \end{aligned}$ | $\begin{aligned} & 20<T n \\ & \leq 50 \end{aligned}$ | $\begin{aligned} & 50<T n \\ & \leq 80 \end{aligned}$ | <8 |  | $8<T n \leq 20$ |  | 20<Tn $\leq 50$ |  | $50<T$ n $\leq 80$ |  | <8 | $8<T n \leq 20$ |  | 20<Tn $\leq 50$ |  |
|  |  |  |  |  |  |  |  |  |  | I | t | I | t | 1 | t | I | t |  | I | t | 1 | t |
|  |  | Not less |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 25CrMo4 | +QT* | 700 | 600 | 450 | 400 | 900 | 800 | 700 | 700 | 12 | 10 | 14 | 12 | 15 | 13 | 16 | 14 | 45 | 50 | 32 | 50 | 32 |
| 34CrMo4 | +QT** | 800 | 650 | 550 | 500 | 1000 | 900 | 800 | 750 | 11 | 9 | 12 | 10 | 14 | 12 | 15 | 13 | 35 | 40 | 25 | 45 | 27 |
| 42CrMo4 | +QT | 900 | 750 | 650 | 550 | 1100 | 1000 | 900 | 800 | 10 | 8 | 11 | 9 | 12 | 10 | 13 | 10 | 30 | 35 | 22 | 35 | 22 |

## Note:

I - Longitudinal sample, t-Transversal sample

*     - at +QT conditions pipes with outside diameter $\geq 100 \mathrm{~mm}$ and wall thickness $\leq 28 \mathrm{~mm}$ may be produced, for pipes with other dimensions +QT conditions are modeled on samples.
** - pipes are supplied at +AR conditions, +QT conditions are modeled on samples.
***- - pipes are supplied at +A conditions, +QT conditions are modeled on samples.
Cold rolled

| OD (mm) | Wall thickness, mm |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 3,6 | 4,0 | 4,5 | 5,0 | 5,6 | 6,3 | 7,1 | 8,0 | 8,8 | 10,0 | 11,0 | 12,5 | 14,2 | 16,0 |
| 33,7 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 35,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 38,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 40,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 42,4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 44,5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 48,3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 51,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 54,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 57,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 60,3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 63,5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 70,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 73,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 76,1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 82,2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

## Hot rolled

|  | Wall thickness |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 00 | 2,6 | 2,9 | 3,2 | 3,6 | 4,0 | 4,5 | 5,0 | 5,4 | 5,6 | 6,3 | 7,1 | 8,0 | 8,8 | 10,0 | 11,0 | 12,5 | 14,2 | 16,0 | 17,5 | 20,0 | 22,2 | 25,0 | 28,0 | 30,0 | 32,0 | 36,0 | 40,0 | 42,0 | 45,0 | 50,0 | 55,0 | 60,0 | 65,0 | 70 | 75,0 |
| 33,7 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 38,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 42,4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 48,3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 51 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 57 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 60,3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 63,5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 70 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 73,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 76,1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 82,5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 88,9 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 101,6 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 108,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 114,3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 121,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 127,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 133,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 139,7 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 141,3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 152,4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 159,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 168,3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 177,8 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 193,7 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 203,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 219,1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 229,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 244,5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 273,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 298,5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 323,9 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 355,6 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 368.0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 406,4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| $\begin{array}{\|l\|} \hline 419 \\ (426) \\ \hline \end{array}$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

## Dimensional tolerances

| Outside diameter, mm | Permissible deviation of Outside Diameter | Permissible deviation of Wall Thickness |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  | OD/WT < 0,025 | $0,025<0 \mathrm{D} / \mathrm{WT} \leq 0,05$ | OD/WT > 0,05 |
| $\leq 219,1$ | $\pm 1 \%$ or $0,5 \mathrm{~mm}$ - the greatest value | $\pm 12,5 \%$ or $\pm 0,4 \mathrm{~mm}$ - the greatest value |  |  |
| >219,1 | $\pm 1 \%$ | $\pm 20 \%$ | $\pm 15 \%$ | $\pm 12,5 \%$ |

## Lengths

Pipes are supplied with lengths according to standard requirements.
Any lengths different from the standard ones are subject to additional negotiations.

## Protection

Pipes are supplied:

- black and bare
- external varnished with black or clear lacquer
- oiled

Upon request pipes ends are protected with plastic caps.

## Marking

Pipes are supplied with marking according to standards and customer requests.
Marking is painted and/or hard stenciled on pipes ends. The same data, as well as additional information according to customer's request, are indicated on the bundle tags.

## Certification

Pipes are supplied with 3.1. inspection certificate, in conformity with EN 10204.

## EN 10294-1

Hollow bars for machining: Non alloy and alloy steels

Chemical composition

| Steel grade | Elements content, \% |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | C | Si | Mn | S | V | P | Cr | Ni | Mo | Cu | Al | Nb | Ti |
|  |  |  |  |  |  | Not more |  |  |  |  |  |  |  |
| E355 | $\leq 0.22$ | $\leq 0.5$ | $\leq 1.5$ | $\begin{aligned} & 0,015- \\ & 0,050 \end{aligned}$ | $\leq 0,10$ | 0,045 | 0.30 | 0,40 | 0,08 | 0,30 | 0,06 | 0,05 | 0,05 |
| 20MnV6 | 0,16-0,22 | 0,10-0,50 | 1,30-1,70 | $\begin{aligned} & 0,015- \\ & 0,050 \\ & \hline \end{aligned}$ | 0,08-0,15 | 0,045 | 0,30 | 0,40 | 0,08 | 0,30 | 0,06 | 0,07 | 0,05 |

Mechanical properties

| Steel grade | Delivery condition | Yield strength, $\mathrm{R}_{\mathrm{EH}} \mathrm{N} / \mathrm{mm}^{2}$ |  |  |  | Tensile strength Rm, $\mathrm{N} / \mathrm{mm} 2$ |  |  |  | ElongationA,\% | Impact test, KV, J |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Wall thickness Tn, mm |  |  |  | Wall thickness Tn , mm |  |  |  |  | Test temperature $-20^{\circ} \mathrm{C}$ |
|  |  | <16 | $16<T \mathrm{~T} \leq 25$ | $25<T n \leq 40$ | $40<T n \leq 50$ | <16 | $16<\operatorname{Tn} \leq 25$ | $25<T n \leq 40$ | $40<T n \leq 50$ |  |  |
|  |  | Not less than |  |  |  |  |  |  |  |  |  |
| E355 | +AR | 355 | 345 | 335 | 335 | 490 | 490 | 470 | 470 | 18 | - |
|  | $+\mathrm{N}$ | 355 | 345 | 335 | 335 | 490 | 490 | 470 | 470 | 20 | 27 |
| 20MnV6 | +AR | 470 | 460 | 430 | 430 | 650 | 620 | 600 | 550 | 17 | - |
|  | $+\mathrm{N}$ | 420 | 400 | 380 | 380 | 600 | 560 | 530 | 530 | 19 | 27 |
|  | +QT | 590 | 540 | 480 | 480 | 700 | 650 | 570 | 570 | 16 | 40 |



Cold rolled

| OD (mm) | Wall thickness, mm |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 3,6 | 4,0 | 4,5 | 5,0 | 5,6 | 6,3 | 7,1 | 8,0 | 8,8 | 10,0 | 11,0 | 12,5 | 14,2 | 16,0 |
| 33,7 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 35,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 38,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 40,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 42,4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 44,5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 48,3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 51,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 54,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 57,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 60,3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 63,5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 70,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 73,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 76,1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 82,5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

## Hot rolled

| OD (mm) |  | 10 | 11 | 12,5 | 14,2 | 16 | 17,5 | 20 | 22,2 | 25 | 28 | 30 | 32 | 36 | 38,0 | 40 | 45 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 82,5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 88,9 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 101,6 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 108 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 114,3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 127 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 133 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 139,7 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 152,4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 159 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 168,3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 177,8 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 193,7 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Note:
Order placement for pipe of intermediate dimensions not listed in the datasheet have to be previously agreed with the mill
Dimensional tolerances

| Outside diameter permissible deviation |  | Wall thickness permissible deviation |  |
| :--- | :--- | :--- | :--- |
| $O D \leq 75$ | $\pm 0,5 \mathrm{~mm}$ | $0 D \leq 180 \mathrm{~mm}, \mathrm{WT} \leq 15 \mathrm{~mm}$ | $\pm 12,5 \%$ or $\pm 0,4 \mathrm{~mm}$ - the greatest value |
| $75<0 \mathrm{~m} \leq 180$ | $\pm 0,75 \mathrm{~mm}$ | WT $>15$ | $\pm 10 \%$ |
| $0 D>180$ | $\pm 1 \%$ | $0 D>180 \mathrm{~mm}, \mathrm{WT} \leq 30 \mathrm{~mm}$ | $\pm 12,5 \%$ |

## Lengths

Pipes are supplied with lengths according to standard requirements.
Any lengths different from the standard ones are subject to additional negotiations.

## Protection

Pipes are supplied:

- black and bare
- external varnished with black or clear lacquer
- oiled

Upon request pipes ends are protected with plastic caps.

## Marking

Pipes are supplied with marking according to standards and customer requests.
Marking is painted and/or hard stenciled on pipe ends. The same data, as well as additional information according to customer's request, are indicated on the bundle tags.

## Certification

Pipes are supplied with 3.1. inspection certificate, in conformity with EN 10204.

## EN 10210-1, 2 Hollow sections for steel construction made of unalloyed and fine grain steels

## Chemical composition

| Steel grade | Elements content, \%, max. |  |  |  |  |  |  | Maximal carbon equivalent value CEV \% |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | C For nominal wall thickness, mm |  | Si | Mn | P | 5 | N | For nominal wall thickness, mm |  |  |  |
|  | $\leq 40$ | $>40$ |  |  |  |  |  | $\leq 16$ | $>16 \leq 40$ | $>40 \leq 65$ | $>65 \leq 120$ |
| S235)RH | 0,17 | 0,20 | - | 1,40 | 0,040 | 0,040 | 0,009 | 0,37 | 0,39 | 0,41 | 0,44 |
| S275j) H | 0,20 | 0,22 | - | 1,50 | 0,035 | 0,035 | 0,009 | 0,41 | 0,43 | 0,45 | 0,48 |
| S275,2 ${ }^{\text {H }}$ | 0,20 | 0,22 | - | 1,50 | 0,030 | 0,030 | - | 0,41 | 0,43 | 0,45 | 0,48 |
| S355JOH | 0,22 | 0,22 | 0,55 | 1,60 | 0,035 | 0,035 | 0,009 | 0,45 | 0,47 | 0,50 | 0,53 |
| S355]2H | 0,22 | 0,22 | 0,55 | 1,60 | 0,030 | 0,030 | - | 0,45 | 0,47 | 0,50 | 0,53 |
| S355K2H | 0,22 | 0,22 | 0,55 | 1,60 | 0,030 | 0,030 | - | 0,45 | 0,47 | 0,50 | 0,53 |


| Steel grade | Elements content, \% |  |  |  |  |  |  |  |  |  |  |  |  |  | Maximal carbon equivalent value CEV \% For nominal wall thichness, mm |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | C max | Si max | Mn | P max | S max | Nb max | V max | Al min | Ti max | $\begin{aligned} & \mathrm{Cr} \\ & \max \end{aligned}$ | $\begin{aligned} & \mathrm{Ni} \\ & \mathrm{max} \end{aligned}$ | $\begin{aligned} & \text { Mo } \\ & \max \end{aligned}$ | $\begin{aligned} & \mathrm{Cu} \\ & \max \end{aligned}$ | $\mathrm{N}_{\mathrm{max}}^{\mathrm{N}}$ |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | $\leq 16$ | > $16 \leq 65$ |
| S275NH | 0,20 | 0,40 | 0,50-1,40 | 0,035 | 0,030 | 0,050 | 0,08 | 0,020 | 0,03 | 0,30 | 0,30 | 0,10 | 0,35 | 0,015 | 0,40 | 0,40 |
| S355NH | 0,20 | 0,50 | 0,90-1,65 | 0,035 | 0,030 | 0,050 | 0,12 | 0,020 | 0,03 | 0,30 | 0,50 | 0,10 | 0,35 | 0,020 | 0,43 | 0,45 |

Mechanical properties

| Steel grade | Yield strength, $\mathrm{R}_{\mathrm{EH}} \mathrm{MPa}$ Not less |  |  |  | Tensile strength Rm, MPa |  | Elongation $\mathrm{A}, \%$ Not less |  |  | Impact test, KV, J Not less |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Nominal wall thickness, mm |  |  |  |  |  |  |  |  | Test temperature, ${ }^{\circ} \mathrm{C}$ |  |  |
|  | $\leq 16$ | $>16 \leq 40$ | $>40 \leq 63$ | $>63$ | $\leq 3$ | >3<100 | $\leq 40$ | $>40 \leq 63$ | >63 | -20 | 0 | +20 |
|  | Not less |  |  |  |  |  |  |  |  |  |  |  |
| S235)RH | 235 | 225 | 215 | 215 | 360-510 | 360-510 | 26 | 25 | 24 | - | - | 27 |
| S275) OH | 275 | 265 | 255 | 245 | 430-580 | 410-560 | 23 | 22 | 21 | - | 27 | - |
| S275)2 ${ }^{\text {H }}$ | 275 | 265 | 255 | 245 | 430-580 | 410-560 | 23 | 22 | 21 | 27 | - | - |
| S355JOH | 355 | 345 | 335 | 325 | 510-680 | 470-630 | 22 | 21 | 20 | - | 27 | - |
| S3555)2 | 355 | 345 | 335 | 325 | 510-680 | 470-630 | 22 | 21 | 20 | 27 | - | - |
| S355K2H | 355 | 345 | 335 | 325 | 510-680 | 470-630 | 22 | 21 | 20 | 40 | - | - |


| Steel grade | Yield strength, $\mathrm{R}_{\mathrm{EH}} \mathrm{MPa}$ Not less |  |  | Tensile strength Rm, MPa | $\begin{array}{\|l} \hline \text { Elongation A, \% } \\ \text { Not less } \end{array}$ |  | Impact test, KV,JNot less |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Nominal wall thickness, mm |  |  | Nominal wall thickness, $\leq 65 \mathrm{~mm}$ |  |  | Test temperature, ${ }^{\circ} \mathrm{C}$ |  |
|  | $\leq 16$ | $>16 \leq 40$ | $>40 \leq 65$ |  | longitudinal | transverse | -50 | -20 |
| S275NH | 275 | 265 | 255 | 370-510 | 24 | 22 | - | 40 |
| S355NH | 355 | 345 | 335 | 470-630 | 22 | 20 | - | 40 |



## Dimensions



## Dimensional tolerances

| Outside diameter permissible deviation | Wall thickness permissible deviation |
| :--- | :--- |
| $\pm 1 \%$ (but not less than $\pm 0.5 \mathrm{~mm}$ and not more than $\pm 10 \mathrm{~mm}$ ) | $-10 \%,+15 \%$ |

## Lengths

Pipes are supplied with lengths according to standard requirements.
Any lengths different from the standard ones are subject to additional negotiations.

## Protection

Pipes are supplied:

- black and bare
- external varnished with black or clear lacquer
- oiled

Upon request pipes ends are protected with plastic caps.

## Marking

Pipes are supplied with marking according to standard and customer request.
Marking is painted and/or hard stenciled on pipe ends. The same data, as well as additional information according to customer's request, are indicated on the bundle tags.

## Certification

Pipes are supplied with 3.1. inspection certificate, in conformity with EN 10204

## ASTM A 519

Seamless Carbon and Alloy Steel Mechanical Tubing

Chemical composition

| Steel grade | Elements content, \% |  |  |  |  |  |  |  |  | Si | Si | Cr |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :---: | :---: | :---: | :---: | :---: |
|  | C | Mn | P | Si |  |  |  |  |  |  |  |  |  |
| 1026 | $0.22-0.28$ | $0.60-0.90$ | $\leq 0.025 \%$ | $\leq 0.025 \%$ |  |  |  |  |  |  |  |  |  |
| 4130 | $0.28-0.33$ | $0.40-0.60$ | $\leq 0.025 \%$ | $\leq 0.025 \%$ | $0.15-0.35$ | - | $0.80-1.10$ | $0.15-0.25$ |  |  |  |  |  |
| 4140 | $0,38-0,43$ | $0,75-1,0$ | $\leq 0.025 \%$ | $\leq 0.025 \%$ | $0.15-0.35$ | - | $0,80-1,10$ | $0,15-0,25$ |  |  |  |  |  |

Typical Tensile Properties and Hardness

| Grade Designation | Delivery condition | Tensile strength |  | Yield strength |  | Elongation A, \% | Hardness, HRB |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | ksi | MPa | ksi | MPa |  |  |
|  |  | Not less |  |  |  |  |  |
| 1026 | HR | 55 | 379 | 35 | 241 | 25 | 60 |
|  | CW | 75 | 517 | 65 | 448 | 5 | 80 |
|  | SR | 70 | 483 | 55 | 379 | 8 | 75 |
|  | A | 53 | 365 | 30 | 207 | 25 | 57 |
|  | N | 55 | 379 | 36 | 248 | 22 | 60 |
| 4130 | HR | 90 | 621 | 70 | 483 | 20 | 89 |
|  | SR | 105 | 724 | 85 | 586 | 10 | 95 |
|  | A | 75 | 517 | 55 | 379 | 30 | 81 |
|  | N | 90 | 621 | 60 | 414 | 20 | 89 |
| 4140 | HR | 120 | 855 | 90 | 621 | 15 | 100 |
|  | SR | 120 | 855 | 100 | 689 | 10 | 100 |
|  | A | 80 | 552 | 60 | 414 | 25 | 85 |
|  | N | 120 | 855 | 90 | 621 | 20 | 100 |

HR- hot-rolled, CW- cold-worked, SR- stress relieved, A - annealed, N- normalized


Hot rolled

| Wall thickness |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| inch |  | 0,500 | 0,625 | 0,750 | 0,875 | 1,000 | 1,250 | 1,500 |
| OD (inch) | OD (mm) | 12,7 | 15,88 | 19,05 | 22,23 | 25,4 | 31,75 | 38,1 |
| 4,000 | 101,6 |  |  |  |  |  |  |  |
| 4,250 | 107,95 |  |  |  |  |  |  |  |
| 4,500 | 114,3 |  |  |  |  |  |  |  |
| 4,750 | 120,65 |  |  |  |  |  |  |  |
| 5,000 | 127 |  |  |  |  |  |  |  |
| 5,250 | 133,35 |  |  |  |  |  |  |  |
| 5,500 | 139,7 |  |  |  |  |  |  |  |
| 5,750 | 146,05 |  |  |  |  |  |  |  |
| 5,980 | 152,4 |  |  |  |  |  |  |  |
| 6,250 | 158,75 |  |  |  |  |  |  |  |
| 6,500 | 165,1 |  |  |  |  |  |  |  |
| 6,750 | 171,45 |  |  |  |  |  |  |  |
| 7,000 | 177,8 |  |  |  |  |  |  |  |
| 7,250 | 184,15 |  |  |  |  |  |  |  |
| 7,500 | 190,5 |  |  |  |  |  |  |  |

Note:
Order placement for pipes made of alloy steel and intermediate pipe dimensions not listed in the datasheet should be previously agreed with the mill

## Dimensional tolerances

| Outside diameter, inch $(\mathrm{mm})$ |  |  |
| :--- | :--- | :--- |
|  | Outside diameter permissible deviation, inch (mm) | less |
| Up to 2.999 (76.17) | $0.020(0.51)$ | $0.020(0.51)$ |
| $3.000-4.499(76.20-114.27)$ | $0.025(0.64)$ | $0.025(0.64)$ |
| $4.500-5.999(114.30-152.37)$ | $0.031(0.79)$ | $0.031(0.79)$ |
| $6.000-7.499(152.40-190.47)$ | $0.037(0.94)$ | $0.037(0.94)$ |
| $7.500-8.999(190.50-228.57)$ | $0.045(1.14)$ | $0.045(1.14)$ |
| $9.000-10.750(228.60-273.05)$ | $0.050(1.27)$ | $0.050(1.27)$ |


| Wall thickness as a percentage outside diameter | Wall thickness permissible deviation |  |  |
| :---: | :---: | :---: | :---: |
|  | OD < 2.999 (76.19) | 3.000 (76.20) < $00<5.999$ (152.37) | 6.00 (152.40) < $00<10.750$ (273.05) |
| Less than 15 | +/-12.5 \% | +/-10.0 \% | +/-10.0 \% |
| 15 and more | +/-10.0 \% | +/-7.5 \% | +/-10.0 \% |

## Lengths

Pipes are supplied with lengths according to standard requirements.
Any lengths different from the standard ones are subject to additional negotiations.

## Protection

Pipes are supplied:

- black and bare
- external varnished with black or clear lacquer
- oiled

Upon request pipes ends are protected with plastic caps.

## Marking

Pipes are supplied with marking according to standards and customer requests.
Marking is painted and/or hard stenciled on pipe ends. The same data, as well as additional information according to customer's request, are indicated on the bundle tags.

## Certification

Pipes are supplied with 3.1. inspection certificate, in conformity with EN 10204.

## GOST 23270-89

Seamless pipes for mechanical treatment
Chemical composition

| Steel Grade | Elements content, \% |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | C, \% | Si, \% | Mn, \% | Cr, \% not more than | S, P | Cu | Mo | Ni | Al |
| 10 | 0.07-0.14 | 0.17-0.37 | 0.35-0.65 | 0.15 |  |  |  |  |  |
| 20 | 0.17-0.24 | 0.17-0.37 | 0.35-0.65 | 0.25 |  |  |  |  |  |
| 35 | 0.32-0.40 | 0.17-0.37 | 0.50-0.80 | 0.25 |  |  |  |  |  |
| 45 | 0.42-0.50 | 0.17-0.37 | 0.50-0.80 | 0.25 |  |  |  |  |  |
| 10G2 (10「2) | 0.07-0.15 | 0.17-0.37 | 1.20-1.60 | - |  |  |  |  |  |
| 20 G (20г) | 0,17-0,24 | 0,17-0,37 | 0,70-1,00 | - |  |  |  |  |  |
| 2 H (20X) | 0.17-0.23 | 0.17-0.37 | 0.50-0.80 | 0.70-1.00 |  |  |  |  |  |
| 40H (40X) | 0.36-0.44 | 0.17-0.37 | 0.50-0.80 | 0.80-1.10 |  |  |  |  |  |
| 30HGSA (30XГCA) | 0,28-0,34 | 0,90-1,20 | 0,80-1,10 | 0,80-1,10 |  |  |  |  |  |
| 09G2S (0952C) | $\leq 0,12$ | 0,50-0,80 | 1,30-1,70 | $\leq 0,30$ |  |  |  |  |  |
| 32HA (32XA) | 0.32-0.35 | 0.17-0.37 | 0.55-0.85 | 1.00-1.10 | $\leq 0.025$ | $\leq 0.20$ |  | $\leq 0.20$ | $\geq 0.02$ |
| 38H2MUA (38X2MЮA) | 0.35-0.42 | 0.20-0.45 | 0.30-0.60 | 1.35-1.65 |  |  |  |  |  |
| 15HM (15XM) | 0,11-0,18 | 0,17-0,37 | 0,40-0,70 | 0,80-1,10 |  |  |  |  |  |
| 30HMA (30XMA) | 0,26-0,34 | 0,17-0,37 | 0,40-0,70 | 0,80-1,10 |  |  | 0,15-0,25 |  |  |
| 12HN2 (12XH2) | 0,09-0,16 | 0,17-0,37 | 0,30-0,60 | 0,60-0,90 |  |  |  | 1,50-1,90 |  |



## Mechanical properties

| Grade designation | Tensile strength, $\sigma_{\mathrm{t}^{\prime}} \mathrm{kgs} / \mathrm{mm}^{2}$ ( MPa ) | Yield strength, $\sigma_{r} \mathrm{kgs} / \mathrm{mm}^{2}(\mathrm{MPa})$ | Elongation, $\delta_{5}, \%$ | Brinell hardness (wall thickness $>10 \mathrm{~mm}$ ) |
| :---: | :---: | :---: | :---: | :---: |
|  | Not less than |  |  | Hardness number HB, not more than |
| 10 | 36 (353) | 22 (216) | 24 | 137 |
| 20 | 42 (412) | 25 (245) | 21 | 156 |
| 35 | 52 (510) | 30 (294) | 17 | 187 |
| 45 | 60 (588) | 33 (323) | 14 | 207 |
| 10G2 (10「2) | 48 (470) | 27 (265) | 21 | 197 |
| 20 G (20г) | 46 (450) | 28 (275) | 24 | 179 |
| 20 H (20x) | 44 (431) | 29(284) | 16 | 179 |
| 40H (40X) | 67 (657) | 36 (352) | 9 | 269 |
| 30HGSA (30XГCA) | 70 (686) | 41 (402) | 11 | 229 |
| 15HM (15XM) | 44 (431) | 23 (226) | 21 | 179 |
| 30HMA (30XMA) | 60 (588) | 40 (392) | 13 | 229 |
| 12HN2 (12XH2) | 55 (539) | 40 (392) | 14 | 207 |


| Grade designation | Tensile strength, $\sigma_{\varepsilon^{\prime}}$ MPa | Yield strength, $\sigma_{t} \mathrm{MPa}$ | Percent elongation,$\delta_{5}, \%$ | Impact test, KCU J/sm ${ }^{2}$ |  |  | Impact test, KCV, J/sm ${ }^{2}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Longitudinal direction |  |  |  |
|  |  |  |  | $t=20^{\circ} \mathrm{C}$ | $\mathrm{t}=-40^{\circ} \mathrm{C}$ | $\mathrm{t}=-70^{\circ} \mathrm{C}$ | $\mathrm{t}=-60^{\circ} \mathrm{C}$ |
|  | Not less than |  |  |  |  |  |  |
| 09G2S (09「2C) | 450 | 325 | 21 | 59 | 39 | 29 | 29 |


| Grade designation | Tensile strength, $\sigma B$, MPa | Yield strength, $\sigma$ T, MPa | Percent elongation, $\delta_{5}, \%$ | Necking, $\Psi$, \% | $\begin{aligned} & \text { Impact test, KV, J } \\ & \mathrm{t}=-20^{\circ} \mathrm{C} \end{aligned}$ | Hardness, HB |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Not less than |  |  |  |  |  |
| 32HA (32XA)* | 830 | 730 | 12 | 40 | 27 | 269-311 |

Note

*     - Mechanical properties after quenching and tempering. Quenched and tempered pipes with outside diameter $\geq 100 \mathrm{~mm}$ and wall thickness $\leq 28$ mm can be produced. Mechanical properties of pipes with other dimensions are defined on heat-treated samples.


## Mechanical properties on heat-treated samples

| Steel designation | Tensile strength, $\sigma \mathrm{\sigma B}, \mathrm{MPa}$ (kgs/mm²) | Percent elongation, $\delta_{5}, \%$ | Necking for wall thickness more than $5 \mathrm{~mm}, \Psi, \%$ | Impact toughness for wall thickness more than 12 $\mathrm{mm}, \mathrm{a}_{\mathrm{k}} \mathrm{kg} / \mathrm{sm}^{2}$ | Brinell hardness (imprint diameter), mm |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Not more than |  |  |  |  |
| 38H2MUA (38X2MЮA) | 980 (100) | 14 | 50 | 9 | 3,4-3,7 |

## Hot rolled




## Dimensional tolerances

| Outside diameter, mm | Permissible deviation of outside diameter |  |
| :--- | :--- | :--- |
|  | Enhanced accuracy | Usual accuracy |
| Less than 50 | $\pm 5 \mathrm{~mm}$ | $\pm 5 \mathrm{~mm}$ |
| $50-219$ | $\pm 0,8 \%$ | $\pm 1,0 \%$ |
| More than 219 | $\pm 1,0 \%$ | $\pm 1,25 \%$ |


| Outside diameter, mm | Wall thickness, mm | Permissible deviation for wall thickness |  |
| :--- | :--- | :--- | :--- |
|  |  | Enhanced accuracy | Usual accuracy |
| More than 219 | $15<\mathrm{S} \leq 30$ | $\pm 12,5 \%$ | $+12,5 /-15 \%$ |
|  | $\mathrm{~S}>30$ | $+10 /-12,5 \%$ | $\pm 12,5 \%$ |
|  | $\mathrm{~S} \leq 15$ | $\pm 10$ | $+10 /-12,5 \%$ |
|  | $15<\mathrm{S} \leq 30$ |  | $+12,5 /-15,0 \%$ |
|  | $\mathrm{~S}>30$ |  | $+12,5 \%$ |

## Lengths

Pipes are supplied with lengths according to standard requirements.
Any lengths different from the standard ones are subject to additional negotiations.

## Protection

Pipes are supplied:

- black and bare
- external varnished with black or clear lacquer
- oiled

Upon request pipes ends are protected with plastic caps.

## Marking

Pipes are supplied with marking according to standards and customer requests.
Marking is painted and/or hard stenciled on pipe ends. The same data, as well as additional information according to customer's request, are indicated on the bundle tags.

## Certification

Pipes are supplied with 3.1. inspection certificate, in conformity with EN 10204.

## GOST 8733-74, GOST 8734-75 <br> Seamless cold rolled steel tubes

## Chemical composition

| Steel Grade | Elements content, \% |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | C, \% | Si, \% | Mn, \% | $\mathrm{Cr}, \%$ not more than |
| 10 | 0.07-0.14 | 0.17-0.37 | 0.35-0.65 | 0.15 |
| 20 | 0.17-0.24 | 0.17-0.37 | 0.35-0.65 | 0.25 |
| 35 | 0.32-0.40 | 0.17-0.37 | 0.50-0.80 | 0.25 |
| 45 | 0.42-0.50 | 0.17-0.37 | 0.50-0.80 | 0.25 |
| $10 \mathrm{G2}$ (10Г2) | 0.07-0.15 | 0.17-0.37 | 1.20-1.60 | - |
| 20G (20г) | 0,17-0,24 | 0,17-0,37 | 0,70-1,00 | - |
| 20 H (20X) | 0.17-0.23 | 0.17-0.37 | 0.50-0.80 | 0.70-1.00 |
| 40H (40X) | 0.36-0.44 | 0.17-0.37 | 0.50-0.80 | 0.80-1.10 |
| 30HGSA (30XICA) | 0,28-0,34 | 0,90-1,20 | 0,80-1,10 | 0,80-1,10 |
| 09G2S (09「2C) | $\leq 0,12$ | 0,50-0,80 | 1,30-1,70 | $\leq 0,30$ |

## Mechanical properties

| Grade designation | Tensile strength, $\sigma_{8}$, kgs/ $\mathrm{mm}^{2}(\mathrm{MPa})$ | Yield strength, $\sigma_{\mathrm{T}}, \mathrm{kgs} /$ $\mathrm{mm}^{2}$ (MPa) | Elongation, $\delta_{5}, \%$ | Brinell hardness (wall thickness 10 mm ) |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Not less than |  |  | Imprint diameter, mm, not less than | Hardness number HB, not more than |
| 10 | 36 (353) | 22 (216) | 24 | 5,1 | 137 |
| 20 | 42 (412) | 25 (245) | 21 | 4,8 | 156 |
| 35 | 52 (510) | 30 (294) | 17 | 4,4 | 187 |
| 45 | 60 (588) | 33 (323) | 14 | 4,2 | 207 |
| 10G2 (10Г2) | 48 (470) | 27 (265) | 21 | 4,3 | 197 |
| 20 G (20г) | 46 (450) | 28 (275) | 24 | 4,5 | 179 |
| 2 HH (20X) | 44 (431) | 29(284) | 16 | 4,5 | 179 |
| 40H (40X) | 67 (657) | 36 (352) | 9 | 3,7 | 269 |
| 30HGSA (30XICA) | 70 (686) | 41 (402) | 11 | 4,0 | 229 |


| Grade designation | Tensile strength, $\sigma_{\mathrm{z}^{\prime}} \mathrm{MPa}$ | Yield strength, $\sigma_{\mathrm{r}}, \mathrm{MPa}$ | Percent elongation,$\delta_{5}, \%$ | Impact test, KCU J/sm ${ }^{2}$ |  |  | Impact test, KCV, //sm ${ }^{2}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Longitudinal direction |  |  |  |
|  |  |  |  | $\mathrm{t}=20^{\circ} \mathrm{C}$ | $\mathrm{t}=-40^{\circ} \mathrm{C}$ | $t=-70^{\circ} \mathrm{C}$ | $\mathrm{t}=-60^{\circ} \mathrm{C}$ |
|  | Not less than |  |  |  |  |  |  |
| 09G2S (09「2C) | 450 | 325 | 21 | 59 | 39 | 29 | 29 |



Cold rolled

| Outside | Wall thickness |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| diameter, mm | 3 | 3,5 | 4 | 4,5 | 5 | 5,5 | 6 | 6,5 | 7 | 7,5 | 8 | 8,5 | 9 | 9,5 | 10 | 11 | 12 | 12,5 | 13 | 14 | 15 | 16 |
| 32 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 34 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 36 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 38 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 40 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 42 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 45 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 48 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 50 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 51 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 53 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 54 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 56 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 57 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 63 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 65 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 68 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 70 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 73 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 75 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 76 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 80 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Note:
Order placement for pipe of intermediate dimensions not listed in the datasheet have to be previously agreed with the mill

## Dimensional tolerances

| Outside diameter, <br> mm | Outside diameter permissible deviation | Wall thickness | Wall thickness permissible deviation |
| :--- | :--- | :--- | :--- |
|  | Enhanced accuracy |  | Enhanced accuracy |
| $30-50$ | $\pm 0.4 \mathrm{~mm}$ | Up to 5 mm | $\pm 10 \%$ |
| $\geq 50$ | $\pm 0.8 \%$ | Above 5 mm | $\pm 8 \%$ |

## Lengths

Pipes are supplied with lengths according to standard requirements.
Any lengths different from the standard ones are subject to additional negotiations.

## Protection

Pipes are supplied:

- black and bare
- external varnished with black or clear lacquer
- oiled

Upon request pipes ends are protected with plastic caps.

## Marking

Pipes are supplied with marking according to standards and customer requests.
Marking is painted and/or hard stenciled on pipe ends. The same data, as well as additional information according to customer's request, are indicated on the bundle tags.

## Certification

Pipes are supplied with 3.1. inspection certificate, in conformity with EN 10204.

## EN 10305-1 COLD DRAWN SEAMLESS STEEL TUBES FOR HYDRAULIC CYLINDERS

Chemical composition

| Steel designation | Elements content, \% |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $C_{\text {max }}$ | Si max | Mn max | P max | 5 max | $V$ max | Al min |
| E355 | 0.22 | 0.55 | 1.60 | 0.025 | 0.025 |  | 0,02 |
| E460 | 0,16-0.22 | 0,10-0.55 | 0,30-1.70 | 0.025 | 0.025 | 0,08-0.15 | 0,01-0,06 |



Mechanical properties at $\mathrm{t}=20 \pm 2^{\circ} \mathrm{C}$

| Steel designation | Delivery condition | Yield strength, $\mathrm{R}_{\mathrm{EH}} \mathrm{N} / \mathrm{mm}^{2}$ | Tensile strength $\mathrm{Rm}, \mathrm{N} / \mathrm{mm}^{2}$ | Elongation A, \% | Impact test, KV, J |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | Test temperature, $-20^{\circ} \mathrm{C}$ Longitudinal direction |
|  |  | Not less than |  |  |  |
| E355 | +SR | 450 | 580 | 15 | 27 |
| E355 | +SR | 355 | 490-530 | 22 | 27 |
| E460 | +SR | 620 | 700 | 15 | 27 |
| E460 | +SR | 460 | 560-700 | 22 | 27 |


| Inside diameter mm | Wall thickness, mm |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 5 | 6 | 7,5 | 10 | 12,5 | 15 |
| 50 |  |  |  |  |  |  |
| 55 |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |
| 65 |  |  |  |  |  |  |
| 70 |  |  |  |  |  |  |
| 75 |  |  |  |  |  |  |
| 80 |  |  |  |  |  |  |
| 85 |  |  |  |  |  |  |
| 90 |  |  |  |  |  |  |
| 95 |  |  |  |  |  |  |
| 100 |  |  |  |  |  |  |
| 105 |  |  |  |  |  |  |
| 110 |  |  |  |  |  |  |
| 115 |  |  |  |  |  |  |
| 120 |  |  |  |  |  |  |
| 125 |  |  |  |  |  |  |
| 130 |  |  |  |  |  |  |
| 135 |  |  |  |  |  |  |
| 140 |  |  |  |  |  |  |
| 145 |  |  |  |  |  |  |
| 150 |  |  |  |  |  |  |

## Dimensional tolerances

| Inside diameter tolerance |  |  |  |  |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :---: | :---: | :---: |
| $-0,2 /-0,50$ | $-0,2 /-0,50$ | $-0,4 /-0,7$ | $-0,25 /-0,55$ | $0,3 /-0,7$ | $-0,5 /-1,0$ | $-0,5 /-0,9$ |  |  |  |

Pipes can be supplied with tolerances according to customer request.

## Length supplied

- random from 4.5 up to 12 meters
- fixed within the random length range


## Concentricity

The following concentricity values are guaranteed:

| OUTSIDE DIAMETER | CONCENTRICITY, NOT MORE THAN, \% |
| :--- | :--- |
| $\leq 125 \mathrm{~mm}$ | 5 |
| $>125 \mathrm{~mm}$ | 7 |

Concentricity is measured according to the formula:

## (WTmax - WTmin) <br> (WTmax + WTmin)

Where WTmax and WTmin are understood to be measured on the same tube cross-section.

## Ovality

Ovality is guaranteed within the diameter tolerances.

## Straightness

Local deviation from straight line max 1 mm per each meter length.
Total deviation from straightness:
max 3.5 mm for tubes with lengths of less than 6 m ; for tubes with lengths greater than 6 m , the tolerance will be increased by 0.5 mm for each 1 m over 6 m .

## Protection

Pipes are supplied:

- black and bare
- oiled internally and externally

Upon request pipes ends are protected with plastic caps

## Marking

Pipes are supplied with marking according to standards and customer requests.
Marking is painted and/or hard stenciled on pipe ends. The same data, as well as additional information according to customer's request, are indicated on the bundle tags.

## Certification

Pipes are supplied with 3.1. inspection certificate, in conformity with EN 10204.


## DIN 2391-1, 2 Seamless precision steel tubes

Chemical composition

| Steel designation | Elements content, \% |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | $C_{\text {max }}$ | Si max | Mn max | P max | 5 max |
| St 52 | 0.22 | 0.55 | 1.60 | 0.025 | 0.025 |

Mechanical properties at $\mathrm{t}=20 \pm 2^{\circ} \mathrm{C}$

| Steel designation | Delivery condition |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | BK |  | BKS |  |  | NBK |  |  |
|  | Tensile strength Rm, $\mathrm{N} / \mathrm{mm}^{2}$ | Elongation A, \% | Tensile strength Rm, $\mathrm{N} / \mathrm{mm}^{2}$ | $\begin{aligned} & \text { Yield strength, } \mathrm{R}_{\mathrm{EH}} \\ & \mathrm{~N} / \mathrm{mm}^{2} \end{aligned}$ | Elongation A, \% | Tensile strength Rm, N/mm ${ }^{2}$ | Upper yield strength, $\mathrm{R}_{\mathrm{EH}} \mathrm{N} / \mathrm{mm}^{2}$ | Percent elongation $A, \%$ |
|  | Not less |  | Not less |  |  | Not less |  |  |
| St 52 | 640 | 4 | 580 | 420 | 10 | 490-630 | 355 | 22 |


| Inside diameter, mm | Wall thickness, mm |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 5 | 6 | 7,5 | 10 | 12,5 | 15 |
| 50 |  |  |  |  |  |  |
| 55 |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |
| 65 |  |  |  |  |  |  |
| 70 |  |  |  |  |  |  |
| 75 |  |  |  |  |  |  |
| 80 |  |  |  |  |  |  |
| 85 |  |  |  |  |  |  |
| 90 |  |  |  |  |  |  |
| 95 |  |  |  |  |  |  |
| 100 |  |  |  |  |  |  |
| 105 |  |  |  |  |  |  |
| 110 |  |  |  |  |  |  |
| 115 |  |  |  |  |  |  |
| 120 |  |  |  |  |  |  |
| 125 |  |  |  |  |  |  |
| 130 |  |  |  |  |  |  |
| 135 |  |  |  |  |  |  |
| 140 |  |  |  |  |  |  |
| 145 |  |  |  |  |  |  |
| 150 |  |  |  |  |  |  |

Dimensional tolerances

| Inside diameter tolerance |  |  |  |  |  |  |  | $-0,4 /-0,7$ | $-0,25 /-0,55$ | $0,3 /-0,7$ | $-0,5 /-1,0$ | $-0,5 /-0,9$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| $-0,2 /-0,50$ | $-0,2 /-0,50$ |  |  |  |  |  |  |  |  |  |  |  |

Pipes can be supplied with tolerances according to customer request.

## Length supplied

- random from 4.5 up to 12 meters
- fixed within the random length range


## Concentricity

The following concentricity values are guaranteed:

| OUTSIDE DIAMETER | CONCENTRICITY, NOT MORE THAN, \% |
| :--- | :--- |
| $\leq 125 \mathrm{~mm}$ | 5 |
| $>125 \mathrm{~mm}$ | 7 |

[^0]Concentricity is measured according to the formula:

Where WTmax and WTmin are understood to be measured on the same tube cross-section.

## Ovality

Ovality is guaranteed within the diameter tolerances.

## Straightness

Local deviation from straight line max 1 mm per each meter length.
Total deviation from straightness:
max 3.5 mm for tubes with lengths of less than 6 m ; for tubes with lengths greater than 6 m , the tolerance will be increased by 0.5 mm for each 1 m over 6 m .

## Protection

Pipes are supplied:

- black and bare
- oiled internally and externally

Upon request pipes ends are protected with plastic caps.

## Marking

Pipes are supplied with marking according to standards and customer requests.
Marking is painted and/or hard stenciled on pipe ends. The same data, as well as additional information according to customer's request, are indicated on the bundle tags.

## Certification

Pipes are supplied with 3.1. inspection certificate, in conformity with EN 10204.

## BEARING TUBES

## Chemical composition

| 100Cr6 |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| C | Si | Mn | Cr | P | s | Mo | Cu | Al |
| 0.93- | 0.15- | 0.25- | 1.35 |  |  |  |  |  |
| 1.05 | 0.35 | 0.45 | 1.60 | 0.025 | 0.015 | 0.10 | 0.30 | 0.050 |
| Tolerances - $\mathrm{C}+/-0.03 \%, \mathrm{Si}+/-0.03 \%, \mathrm{Mn}+/-0.04 \%, \mathrm{P}, \mathrm{S}+0.005 \%, \mathrm{Cr}+/-0.05 \%, \mathrm{Mo}+/-0.03 \%, \mathrm{Al}+0.010 \%, \mathrm{Cu}+0.03 \%, \mathrm{O}-\mathrm{max} 0.0015 \%$. |  |  |  |  |  |  |  |  |

## Macro-inclusions

The content of macro-inclusions shall not exceed a length of 2.5 mm per $\mathrm{dm}^{2}$ as measured by the blue fracture test. The maximum length for a single inclusion shall not exceed 3 mm .

## Micro-inclusions

Heat check according to ISO 4967:1998 (E), Method A.
The micro-inclusion rating can be made on the sample of bar with a reduction ratio of minimum 1:10 or maximum 1:60 for continuously cast material. The micro-inclusion rating shall not exceed the limits specified below.

| Inclusion type | Thin | Heavy |  |
| :--- | :--- | :--- | :---: |
| A | 2.0 | 1.5 |  |
| B | 1.5 | 0.5 |  |
| C | 0.0 | 0.0 |  |
| D | 1.0 | 0.5 |  |
| DS | 1.5 |  |  |

## Microstructure

In accordance to SEP 1520

## Pearlite amount

$P A \leq 3.0$.

## Carbide size

2.1 to 2.3 .

## Carbide network

4.2 or 5.2 maximum respectively

## Carbide segregation

6.2 and 7.3 maximum respectively

## Hardness

Hot-rolled tubes:
170-210 HBS, according to ISO 6506-1:1999
Cold rolled tubes:
250-320 HBS, according to ISO 6506-1:1999
Decarburization:
Hot rolled tubes // Pilled external surface
Internal surface - max. 0,5 mm. External surface - 0 mm .
Hot rolled tubes // Not Pilled
Internal surface - max. 0,5 mm. External surface - 0,5 mm.
Cold rolled tubes // Internal surface - max. 0,3 mm External surface - max. 0,4 mm.
Hot rolled tubes size range:

| Outside diameter | Wall thickness, mm |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\begin{array}{\|l\|} \hline 8,0- \\ 9,0 \\ \hline \end{array}$ | $\begin{array}{\|l\|} \hline 9,1- \\ 10,0 \\ \hline \end{array}$ | $\begin{aligned} & 10,1- \\ & 11,0 \\ & \hline \end{aligned}$ | $\begin{array}{\|l\|l\|} \hline 11,1- \\ 13,0 \\ \hline \end{array}$ | $\begin{array}{\|l\|} \hline 13,1- \\ 15,0 \\ \hline \end{array}$ | $\begin{array}{\|l\|} \hline 15,1- \\ 17,0 \\ \hline \end{array}$ | $\begin{aligned} & 17,1- \\ & 19,0 \\ & \hline \end{aligned}$ | $\begin{array}{\|l\|} \hline 19,1- \\ 21,0 \\ \hline \end{array}$ | $\begin{aligned} & 21,1- \\ & 23,0 \\ & \hline \end{aligned}$ | $\begin{array}{r} 23,1- \\ 25,0 \\ \hline \end{array}$ | $\begin{aligned} & 25,1- \\ & 27,0 \\ & \hline \end{aligned}$ | $\begin{aligned} & 27,1- \\ & 29,0 \\ & \hline \end{aligned}$ | $\begin{aligned} & 29,1- \\ & 30,0 \end{aligned}$ | $\begin{aligned} & 30,1- \\ & 31,0 \end{aligned}$ | $\begin{aligned} & 31,1- \\ & 32,0 \end{aligned}$ | $\begin{aligned} & 32,1- \\ & 33,0 \end{aligned}$ | $\begin{aligned} & 33,1- \\ & 34,0 \end{aligned}$ | $\begin{aligned} & 34,1- \\ & 35,0 \end{aligned}$ | $\begin{aligned} & 35,1- \\ & 36,0 \end{aligned}$ | $\begin{aligned} & 36,1- \\ & 37,0 \end{aligned}$ | $\begin{aligned} & 37,1 \\ & 38,0 \end{aligned}$ |
| 80,1-90,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 90,1-100,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 100,1-110,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 110,1-120,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 120,1-130,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 130,1-140,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 140,1-150,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 150,1-160,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 160,1-170,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 170,1-183,0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

## Cold rolled tubes size range:

| Outside <br> diameter | Wall thickness, mm |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
|  | $4,5-5,0$ | $5,1-7,0$ |  | $9,1-11,0$ |  |  |
|  |  |  |  |  |  |  |
| $40,1-50$ |  |  |  |  |  |  |
| $50,1-60$ |  |  |  |  |  |  |
| $60,1-70$ |  |  |  |  |  |  |
| $70,1-81,2$ |  |  |  |  |  |  |

Note:
Pipes less than 36 mm outside diameter can be produced upon agreement with the mill

## Dimensional tolerances

Diameter
Hot rolled pilled tubes: $-0 /+0,2 \mathrm{~mm}$ Hot rolled unpilled tubes: -/+1\%
Cold rolled tubes: $-0 /+0,40 \mathrm{~mm}$

## Wall Thickness

Hot rolled tubes:

| Dimension / Wall thickness | Tolerance $(\mathrm{mm})$ |
| :--- | :--- |
| $0 D / W T<11$ | $-0 /+15 \%$ |
| $0 D / W T=11-12,5$ | $-0 /+20 \%$ |
| $0 D / W T>12,5$ | $-0 /+25 \%$ |

Cold rolled tubes: $-0 /+12 \%$ or to be agreed between customer and producer.

## Straightness

Any deviation from a straight line must not exceed 0.001 x the measured length.
The measured length must be minimum 1000 mm .

## Out-of-roundness

Maximum $80 \%$ of the OD tolerance range.

## Protection

Pipes are supplied:

- black and bare
- oiled internally and externally

Upon request pipes ends are protected with plastic caps.

## Marking

Pipes are supplied with marking according to standard and customer request.
Marking is paint and/or hard stenciled on the ends of pipes. The same data, as well as additional information per customer's request, is indicated on the bundle's tags.

## Certification

Pipes are supplied with 3.1. inspection certificate, in conformity with EN 10204.


## MANUFACTURING OF SEAMLESS PIPES



Billet incoming inspection


Billet weighing


Shell rolling at pilger mill


Heating of pipes

## MANUFACTURING OF SEAMLESS PIPES




Pipes cooling


Straightening of pipes

Stretch reducing


## FINISHING OF PLAIN END PIPES



Hydraulic pressure test
Painting of pipes


Bundling

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[^0]:    (WTmax - WTmin)
    (WTmax + WTmin)

